Published in final edited form as:

Psychiatry Res. 2018 January ; 259: 210–215. doi:10.1016/j.psychres.2017.09.080.

Affect-based profiles of Bulimia Nervosa: The utility and validity of indicators assessed in the natural environment

Bethany C. Leraas^{a,*}, Kathryn E. Smith^{a,b}, Linsey M. Utzinger^c, Li Cao^a, Scott G. Engel^{a,b}, Ross D. Crosby^{a,b}, James E. Mitchell^{a,b}, and Stephen A. Wonderlich^{a,b}

^aNeuropsychiatric Research Institute, Fargo, ND, USA

^bDepartment of Psychiatry and Behavioral Science, University of North Dakota School of Medicine and Health Sciences, Fargo, ND, USA

^cDepartment of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Stanford, CA, USA

Abstract

Theoretical conceptualizations of bulimia nervosa (BN) emphasize the role of emotion dysregulation in the development and maintenance of symptoms, which has been supported by ecological momentary assessment studies. Given the importance of affective disturbances in BN, this study aimed to classify a sample of adult women with BN ($N=130$) based on primarily momentary affective indicators, including negative and positive affect, negative and positive affective lability, and depression. Participants completed baseline assessments followed by a two-week ecological momentary assessment protocol. Latent profile analysis revealed four groups: (1) a “stable normal” group characterized by low affective lability and intensity; (2) a “stable depressed” group characterized by low affective lability and higher affect intensity; (3) an “unstable normal” group characterized by higher affective lability but lower affect intensity; and (4) an “unstable depressed” group characterized by higher affective lability and intensity. The stable depressed group evidenced the highest levels of eating psychopathology, borderline personality traits, and childhood trauma history, while the stable normal group generally evidenced the lowest levels of psychopathology. The findings demonstrate significant heterogeneity in the topography of affect experienced by individuals with BN, and suggest that chronic, intense negative affect may be particularly important to address in treatment.

Keywords

eating disorders; bulimia nervosa; affect; depression; latent profile analysis; empirical classification

*Corresponding author: bleraas@cord.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

1. Introduction

Current empirical evidence suggests there is meaningful heterogeneity in affective functioning within BN. For instance, several classification studies have evaluated the dual-pathway model of BN, which posits that both high levels of overall dietary restraint and negative affect, as well as their possible combination, predispose individuals to binge eating (Stice, 2001). In support of this model, two distinct profiles have consistently emerged in BN classification studies: (1) a dietary group characterized by high dietary restraint and minimal NA, and (2) a dietary-negative affect (dietary-depressed) group characterized by high levels of both restraint and depressive symptoms, as well as greater symptom severity (Chen and Le Grange, 2007; Grilo et al., 2001; Stice and Agras, 1999; Stice et al., 2008; Stice and Fairburn, 2003). In addition, empirical classification studies have consistently identified under-regulated and over-regulated personality-based subtypes across and within EDs, with under-regulated subtypes characterized by greater ED psychopathology, negative affect, emotional reactivity, and impulsive behaviors (for a review see Wildes & Marcus, 2013). With respect to treatment implications, research also suggests that individuals with BN who evidence greater deficits in affective functioning evidence greater improvements in treatments that specifically target emotion regulation (Accurso et al., 2016). In addition to classification based studies which examine the role of affective variables for diagnostic subtyping, there is also accumulating evidence that affect is a significant factor in the onset and maintenance of bulimic symptoms (e.g., Lavender et al., 2015; Smyth et al., 2007; Stice, 2001). Several theoretical frameworks posit that binge eating behavior serve to escape from or regulate aversive affective states (e.g., affect regulation model: Hawkins & Clement, 1984; escape theory: Heatherton & Baumeister, 1991; integrative cognitive affective therapy [ICAT] theoretical model: Wonderlich et al., 2008). These models have been empirically supported by ecological momentary assessment (EMA) studies demonstrating that negative affect increases prior to and decreases following binge eating (e.g., Smyth et al., 2007), which suggests that negative affect contributes to the maintenance of binge eating via negative reinforcement processes.

While overall negative affect has been reliably implicated in bulimic psychopathology, studies have also indicated that the degree of momentary shifts in the valence and intensity of emotion (i.e., affective lability) is associated with binge eating (e.g., Anestis et al., 2010; Zander and De Young, 2014). These results highlight the importance of considering affect as a multidimensional construct that can be characterized in terms of valence, intensity, and variability, each of which may demonstrate distinctive relationships with bulimic and related psychopathology. However, many classification models of EDs have relied on measurements of affect that are based on retrospective reports and have been limited to one dimension of affect (e.g., intensity of depression, overall negative affect), which limits ecological validity and precludes consideration of meaningful heterogeneity in affect within EDs.

Notably, ecological momentary assessment has emerged as a particularly useful methodology to study affective processes in BN. Ecological momentary assessment allows for the measurement of current psychological states and behaviors in naturalistic environments, which decreases methodological problems of retrospective recall biases and increases the ecological validity of findings (Stone and Shiffman, 2002). Repeated

measurements also allow for the temporal sequencing of variables and assessment of variability in constructs (Smyth et al., 2001).

1.1 The Present Study

Taken together, several theoretical models (e.g., affect regulation model, escape theory, ICAT, dual-pathway model) suggest that affective functioning is central to the etiology and maintenance of bulimic psychopathology, and extant evidence has indicated variability in negative affectivity with BN is associated with meaningful differences in clinically relevant domains. However, little research has examined the differential relevance of various affective metrics in EDs, and particularly within BN. Using indicators drawn from momentary assessments to define profiles within BN allows for the assessment of multiple dimensions of affect (i.e., valence, intensity, lability), which provides a more nuanced characterization of the differential significance of various affective processes among individuals with BN. Much of the previous EMA based examination of affective processes in BN has focused on valence of affect and intensity of affect. As noted previously, increasing negative affect intensity and decreasing positive affect intensity appear to trigger bulimic behavior. In the present study, we examined the idea that affective lability may contribute to subtyping models of BN – an idea that has not been previously tested. If, in fact, affective lability helps to identify a unique subgroup of bulimic individuals, it could aid in both our theoretical understanding of BN psychopathology and in the development of additional clinical interventions in the realm of affective responding.

While we have previously published studies assessing momentary relationships between affect and bulimic behaviors from our data (e.g., Lavender et al., 2016; Smyth et al., 2007), as well as two prior latent profile analysis studies (i.e., Utzinger et al., 2016; Wonderlich et al., 2007), no study has explored a classification model utilizing ecological momentary assessment-based indicators to define latent profiles. Therefore, the present study sought to identify BN latent profiles based predominately on momentary assessments of affect (i.e., negative and positive affect intensity and lability). Second, we evaluated the external validity of these profiles by assessing differences in clinically relevant variables, including the severity of ED psychopathology (i.e., EDE global, binge and purge frequency), borderline personality features, childhood trauma history, and co-occurring psychopathology (i.e., major depression, anxiety/PTSD, and substance dependence disorders).

2. Method

2.1 Participants

The present study included 130 women who met criteria for BN based on the Diagnostic and Statistical Manual of Mental Disorders (*DSM-IV*; APA, 1994) criteria. The majority of participants were single or never married (64.1%), Caucasian (96.9%), and reported having at least some college experience (81.2%). More information on sample demographics can be found in Smyth et al (2007).

2.2 Measures

2.2.1. The Structured Clinical Interview for *DSM-IV* Axis I Disorders, Patient Edition (SCID-I/P)—The SCID-I/P is a widely used semi-structured diagnostic interview that assesses symptomatology for mental disorders in the *DSM-IV*. The SCID-I/P has demonstrated sound psychometric properties (First and Gibbon, 2004) and was used in the present study to assess BN and other co-occurring Axis I diagnoses. The present study specifically assessed major depression, substance dependence, and anxiety/PTSD diagnoses. Interrater reliability of diagnoses was adequate, as the kappa coefficient for BN diagnoses based upon 25 randomly selected cases was 1.00.

2.2.2. Eating Disorders Examination (EDE; Fairburn and Cooper, 1993)—The EDE is a semi-structured interview that measures various dimensions of eating disorder symptomatology, including behavioral frequencies, restraint, and eating, weight, and shape concerns. In the present study, the EDE global score was used as a measure of overall eating disorder psychopathology. There is well-documented support for the reliability and validity of this instrument (Berg et al., 2012; Fairburn and Cooper, 1993). In the current sample the intraclass correlation coefficients (ICC; Shrout & Fleiss, 1979),¹ which represent the extent to which different interviewers agreed on ratings (i.e., interrater reliability), were based on 25 cases; ICC values ranged from 0.65 (restraint subscale) to over 0.98 on the weight concern, shape concern, and eating concerns subscales.

2.2.3. Childhood Trauma Questionnaire (CTQ; Bernstein and Fink, 1998)—The CTQ is a 28-item self-report assessment that is used to identify individuals with a history of child abuse and/or neglect, in which respondents indicate the frequency of experiences on a Likert scale ranging from “never true” to “very often true.” The CTQ is comprised of five subscales (i.e., emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect) and a total score that ranges from 25 to 125. The CTQ has previously demonstrated adequate internal consistency and concurrent validity (Bernstein et al., 2003; Spinhoven et al., 2014).²

2.2.4. Revised Diagnostic Interview for Borderlines (DIB-R; Zanarini et al., 1989)—The DIB-R is a semi-structured interview that assesses features of borderline personality disorder, including disturbances in affect, cognition, impulse action patterns, and interpersonal relationships. The DIB-R has evidenced good reliability, sensitivity, specificity, and validity in previous clinical samples (Zanarini et al., 1989; Zanarini et al., 2002). The current study included participants’ DIB-R total score as an external validator, for which the intraclass correlation coefficient (based on 25 randomly selected cases) was 0.98.

2.2.5. Beck Depression Inventory-II (BDI-II; Beck et al., 1996)—The BDI-II is a 21-item self-report measure that assesses the severity of depressive symptoms. Scores range from 0 to 63, with higher values reflecting a greater severity of depressive symptoms. A score of 0 to 13 is considered minimal depression; 14 to 19, mild depression; 20 to 28,

¹The ICC (I,1) consistency model was used, as each participant was assessed by a different set of randomly selected raters.

²Internal consistency was not able to be calculated for the CTQ due to the lack of availability of individual items.

moderate depression; and 29 to 63, severe depression. The reliability and validity of this measure have been well-established (e.g., Beck et al., 1988); in the current study, Cronbach's alpha was 0.90.

2.2.6. Daily ED behaviors—During the ecological momentary assessment protocol participants were instructed to record whether they engaged in binge eating, self-induced vomiting, laxative misuse, or diuretic misuse either immediately after such behaviors or at the next signaled recording. Participants were provided with standard definitions of binge episodes (“an amount of food that you consider excessive, or an amount of food that other people would consider excessive, with an associated loss of control or the feeling of being compelled to eat”), including examples of what would be considered an objectively large amount of food. In the present study, self-induced vomiting, laxative misuse, and diuretic misuse were combined to form a single purging variable. The total number of binge and purge episodes recorded during the ecological momentary assessment protocol was calculated separately for each participant, and each were included in the present analysis as an external validator.

2.2.7. Momentary affect—The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) is a self-report measure of positive and negative emotional states that was used to assess momentary positive and negative affect in the present study. Selected items from the PANAS were included in the ecological momentary assessment protocol at signal-contingent, event-contingent, and interval-contingent recordings. Momentary negative affect was comprised of 11 items (i.e., *afraid, lonely, irritable, ashamed, angry, disgusted, nervous, dissatisfied with self, jittery, sad, and angry with self*), while momentary positive affect was comprised of 13 items (i.e., *happy, alert, proud, cheerful, enthusiastic, confident, concentrating, energetic, calm, strong, determined, attentive, relaxed*). At each recording, participants were prompted to rate the extent to which they currently felt these emotions on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). Mean negative and positive affect subscale scores were calculated over the duration of the ecological momentary assessment protocol, and each were used as indicators in the present study. Cronbach's alpha coefficients for the positive and negative affect subscales were 0.91 and 0.92, respectively.

2.3. Procedure

The sample in the present study was drawn from a larger project for which the data collection protocol has been previously published (see Smyth et al., 2007 for further details). Eligible participants first completed structured clinical interviews and self-report measures, after which they completed a two-week ecological momentary assessment data collection period, during which they provided interval-contingent (i.e., ratings completed at pre-determined intervals), event-contingent (i.e., ratings following the occurrence of identified disordered eating behaviors), and signal-contingent (i.e., ratings completed at six semi-random signals each day) recordings of affect. The University of North Dakota and MeritCare Health System Institutional Review Boards approved the protocol.

2.4. Statistical Analyses

Individuals who provided on validators ($n=128$) were classified into unobserved (i.e., latent) categorical groups using latent profile analysis, which is an extension of latent class analysis for categorical, ordinal, or continuous “indicator” variables based on the principal of conditional independence (i.e., within each identified class, indicator variables should be uncorrelated; Vermunt and Magidson, 2005). Mean negative affect, mean positive affect, negative affect mean squared successive difference statistic (MSSD), positive affect MSSD, and BDI-II values served as affective indicators in the current study. Mean negative and positive affect were obtained by averaging all momentary negative and positive affect ratings individually by participant.

Momentary affect ratings were also used to calculate affective lability, which was operationalized as the MSSD. The MSSD is a measure of point-to-point variability in a time series, and represents individual’s average variability in affect over time (Witte et al., 2005; Woyshtville et al., 1999). In the present study, the negative and positive affect MSSD values were calculated separately based on negative and positive affect ratings, respectively. Negative and positive affect MSSD were calculated as the squared difference in ecological momentary assessment negative and positive affect ratings (respectively) across successive time points in relation to the distance between the measured time points. Thus, negative and positive affect MSSD are indices of average instability in negative and positive affect (Jahng et al., 2008).

Latent Gold version 5.0 was used to compare 1- to 8-class models, and the identification of the best fitting model was made based on the Consistent Akaike Information Criterion (Bozdogan, 1987) and the Bayesian Information Criterion (Schwarz, 1978) fit indices. Class membership assignments were based on posterior Bayesian probabilities, and the assumption of conditional independence was evaluated by examining bivariate residuals. To compare the latent profiles, a series of one-way analyses of variance (ANOVAs) were used to compare classes on affective indicator variables, which were first examined to confirm normal distributions. Post hoc comparisons between groups were based upon Bonferroni corrections. To assess the external validity of the latent profiles, an ANOVA was used to compare the profiles on co-occurring diagnoses (i.e., major depression, substance dependence, anxiety/PTSD), CTQ total scores, DIB total scores, EDE global scores, and the frequencies of binge and purge episodes. Pairwise differences between groups were based upon Bonferroni corrected post hoc comparisons. Only participants who provided complete data on these indicators were included in latent profile analysis models ($N=130$), of which 128 participants had complete data for external validation analyses ($n=128$).

3. Results

3.1. Profile Identification

The results of the latent profile analysis indicated a four-profile solution; descriptive statistics for indicator variables across these profiles are shown in Table 1. While the fit indices for the three-profile model were lower, this model violated the assumption of conditional independence; thus the four-profile model was selected based on the next lowest

Bayesian Information Criterion and Consistent Akaike Information Criterion values due to high pair-wise residuals between x and y . The four profiles were defined based on relative levels of affect intensity and lability, which included (1) a “stable normal” group characterized by low affective lability and lower overall depression scores and momentary negative affect ($n=48$; 36.9%), (2) a “stable depressed” group characterized by low affective lability and higher depression scores and momentary negative affect ($n=41$; 31.5%), (3) an “unstable normal” characterized by higher affective lability but lower depression scores and momentary negative affect ($n=24$; 18.5%), and (4) an “unstable depressed” group characterized by higher affective lability, depression, and momentary negative affect ($n=17$; 13.1%).

Figure 1 depicts relative levels of indicator variables across the four profiles. ANOVA results (Table 2) indicated groups differed significantly in mean negative affect ($F[3,126]=83.18$, $p<0.001$), mean positive affect ($F[3,126]=11.59$, $p<0.001$), negative affect MSSD ($F[3,126]=70.41$, $p<0.001$), positive affect MSSD ($F[3,126]=111.89$, $p<0.001$), and BDI-II scores ($F[3,126]=17.97$, $p<0.001$). Post-hoc analyses with Bonferroni corrections demonstrated that the stable and unstable depressed groups had higher BDI-II scores than the stable and unstable normal groups. Similarly, the stable and unstable depressed groups evidenced significantly higher overall negative affect than the stable normal and unstable normal groups, and the unstable normal group also had higher negative affect than the stable normal group. With respect to positive affect, the stable and unstable normal groups had higher overall positive affect than the stable depressed group.

In regards to affective lability, post-hoc analyses indicated that the stable normal group had lower negative affect lability than all other groups, whereas the unstable depressed group had higher negative affect lability than all other groups. For positive affect lability, the unstable normal and depressed groups evidenced higher lability than the stable normal and depressed groups, and the unstable depressed group also evidenced higher lability than the unstable normal group.

3.2. Profile Validation

As shown in Table 3, there were significant group differences in EDE global scores, ($F[3,124]=6.07$, $p=.001$), with a medium to large effect size, such that the stable depressed and unstable depressed groups evidenced significantly higher scores compared to the stable normal group. There was a significant overall effect of group for binge episode frequency ($F[3,126]=2.97$, $p=0.034$), with a small to medium effect size. However, after adjusting for multiple comparisons, posthoc analyses revealed no statistically significant pairwise differences, though inspection of subtype means suggest a trend of more frequent binge episodes among the stable and unstable depressed groups. There was not a significant effect of group for purging episodes ($F[3,126]=2.50$, $p=0.062$).

Significant group differences in DIB-R scores were observed ($F[3,124]=3.35$, $p=0.021$), with a medium effect size, in that the stable depressed group demonstrated significantly higher levels of borderline personality features compared to the stable normal group. Differences in CTQ also emerged ($F[3,124]=3.84$, $p=0.011$), with a medium effect size, in that the stable depressed group reported a greater level of childhood trauma than the unstable normal

group. With respect to co-occurring diagnoses, there was not a significant association between group and the frequency of co-occurring major depressive disorder ($\chi^2 [3]=4.77$, $p=0.189$), anxiety/PTSD ($\chi^2 [3]=7.01$, $p=0.072$) or substance dependence diagnoses ($\chi^2 [3]=3.89$, $p=0.273$).

4. Discussion

The present study examined a classification of BN based on affective domains, particularly those assessed at the momentary level. Latent profile analysis results indicated a four-profile solution based on negative and positive affective intensity and lability: (1) a stable normal group characterized by lower levels of affective lability, overall negative affect, and depression, and higher levels of overall positive affect; (2) a stable depressed group characterized by lower levels of lability and higher overall negative affect and depression; (3) an unstable normal group characterized by higher lability and overall positive affect, and lower overall negative affect and depression; and (4) an unstable depressed characterized by higher lability, overall negative affect, and depression. The relative differences in BDI scores also reflect clinically significant variation in depression, as the stable and unstable depressed groups reported greater depression levels (i.e., within the moderate range) compared to the stable normal group (minimal range) and the unstable normal groups (mild range) based on established BDI cutoffs. While these results are in line with previous latent class and latent profile analysis studies that have demonstrated that negative affect or depression distinguishes subgroups of individuals with BN, the present study adds to the available literature by enhancing ecological validity of the assessment of affective domains, as well as by elucidating the dimensions of affect (i.e., valence, intensity, lability) that appear most relevant to symptom severity.

The validity of these profiles was supported by significant group differences in ED psychopathology, borderline personality features, and childhood trauma history. The highest levels of global ED psychopathology were observed in the stable and unstable depressed groups. Individuals in these groups also reported relatively more frequent binge episodes, though further replication of these results is necessary given that posthoc comparisons were not statistically significant. However, the overall pattern of results in the present study suggests that affective intensity seems to be more potently linked to BN psychopathology than affective lability. The two groups with high levels of affective lability (i.e., unstable depressed and normal) did not significantly differ on any validity test when compared to their comparison group with comparable levels of affective intensity (i.e., stable depressed and normal). Thus, the present findings provide initial support for the idea that valence and intensity of affect are more relevant to subtype classification of BN than affective lability. Thus, while some studies suggest that affective lability has significant influence beyond affect intensity in the prediction of bulimic symptoms (e.g., Anestis et al, 2010), the present findings suggest that when attempting to classify subgroups of bulimic individuals, affective intensity may be a more potent indicator.

The finding that the stable and unstable depressed groups exhibited higher levels of ED psychopathology compared to other groups also suggests that the presence of depression in BN may be an exacerbating factor in the severity of ED symptoms, which is consistent with

findings that the dietary-negative affect subtype of BN is associated with greater symptom severity (Chen and Le Grange, 2007; Grilo et al., 2001; Stice and Agras, 1999; Stice et al., 2008; Stice and Fairburn, 2003). These findings also may have prognostic relevance, given that previous research found that the dietary-negative affect BN subgroup evidences poorer treatment response (Stice et al., 2008), and that higher levels of depression are related to poorer treatment outcome in EDs (Vall and Wade, 2015). However, future research is needed to assess the predictive validity of the profiles identified in the present study.

The stable depressed group also reported higher levels of borderline personality features compared to the stable normal group. This finding was somewhat unexpected, as previous literature suggests that affective instability is associated with borderline personality disorder (Koeningsberg et al., 2002; Trull et al., 2008). One tentative explanation is that these results are a function of measurement; that is, the DIB-R affect subscale may be a stronger indicator of affect intensity, which has been suggested in previous research (Tragesser et al., 2010). Thus, it is likely that those with chronic, intense negative affect would evidence higher total scores on this measure. Nevertheless, the DIB-R means for both the stable depressed ($M=6.12$) and unstable depressed ($M=5.35$) groups were relatively higher than the other groups. Thus, the presence of intense negative affect, regardless of lability, may be associated with a higher degree of borderline personality symptomatology as measured by the DIB-R.

In addition, the stable depressed group evidenced the highest degree of childhood trauma history. Taken together with the finding that the stable depressed group also had the highest level of borderline personality traits, these results could in part reflect associations between childhood trauma history and borderline personality traits, which has been demonstrated in previous classifications of BN (Utzinger et al., 2016).

There are several limitations to note. Given that the majority of participants were Caucasian females, the results may not be generalizable to other demographic groups. The sample size is somewhat smaller than other latent profile analyses, which indicates a need for further replication. Moreover, the smaller size of the unstable depressed group may have limited the statistical power to detect differences between this group and others. In addition, there were not significant differences in external validators between the stable and unstable depressed groups or between the stable and unstable normal groups; thus, it is therefore unclear the extent to which affect lability impacts symptoms, and it appears that affect intensity is more relevant with respect to the external validators in the present study. However, there may be validators that were not assessed in the present study that could further differentiate the profiles, including personality dimensions and emotion regulation difficulties; thus, future studies are needed to address such domains across these groups.

Despite these limitations, the present study offers a unique classification of BN based on affective profiles. To our knowledge, this is the first latent profile analysis to use primarily ecological momentary assessment based indicators to define affective profiles and examine their associations with clinically relevant variables. Findings demonstrated heterogeneity in the topography of affect among those with BN, including significant differences in valence, intensity, and variability. Furthermore, these variations provide valid distinctions on several

psychopathology or developmental factors. However, the present findings did not reveal support for classification of BN based on affective lability.

Additionally, results suggest that the presence of depression, or high levels of other types of negative affect (e.g., anxiety), in BN may be particularly important to address in treatment, and several emotion-focused treatments have been developed in EDs (Berg & Wonderlich, 2013). In line with previous research in BN (Accurso et al., 2016), tailoring treatments for these groups with emotion-focused interventions may be particularly important to both reduce negative affect and improve the overall prognosis for such individuals. Taken together, the present findings support both the validity and utility of subtyping BN based on affective profiles and suggest that the intensity of negative affect, particularly when it is relatively stable in a potentially useful clinical target, and further demonstrate the importance of considering the symptom heterogeneity both between EDs and within diagnoses.

Acknowledgments

Funding: This research was supported by National Institute of Mental Health Grants R01 MH059674, and T32 MH082761.

References

- Accurso EC, Wonderlich SA, Crosby RD, Smith TL, Klein MH, Mitchell JE, ... Peterson CB. Predictors and moderators of treatment outcome in a randomized clinical trial for adults with symptoms of bulimia nervosa. *J Consult Clin Psychol*. 2016; 84(2):178–184. [PubMed: 26689304]
- American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. 4. Author; Washington DC: 1994.
- Anestis MD, Selby EA, Crosby RD, Wonderlich SA, Engel SG, Joiner TE. A comparison of retrospective self-report versus ecological momentary assessment measures of affective lability in the examination of its relationship with bulimic symptomatology. *Behav Res Therapy*. 2010; 48(7): 607–613.
- Beck, AT., Steer, RA., Brown, GK. *Manual for the Beck Depression Inventory-II*. Psychological Corporation; Texas: 1996.
- Beck AT, Steer RA, Carbin MG. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clin Psychol Rev*. 1988; 8(1):77–100.
- Berg KC, Crosby RD, Cao L, Peterson CB, Engel SG, Mitchell JE, Wonderlich SA. Facets of negative affect prior to and following binge-only, purge-only, and binge/purge events in women with bulimia nervosa. *J Abnorm Psycho*. 2013; 122(1):111–118.
- Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: A systematic momentary assessment review of the literature. *Int J Eat Disord*. 2012; 45(3):428–438. [PubMed: 21744375]
- Berg KC, Wonderlich SA. Emerging psychological treatments in the field of eating disorders. *Curr Psychiatry Rep*. 2013; 15(11):407. [PubMed: 24163060]
- Bernstein, DP., Fink, L. *Childhood Trauma Questionnaire: A Retrospective Self-Report: Manual*. The Psychological Corporation; Texas: 1998.
- Bozdogan H. Model selection and Akaike's information criterion (AKAIKE INFORMATION CRITERION): the general theory and its analytical extensions. *Psychometrika*. 1987; 52(3):345–370.
- Caslini M, Bartoli F, Crocamo C, Dakanalis A, Clerici M, Carrà G. Disentangling the association between child abuse and eating disorders: a systematic momentary assessment review and meta-analysis. *Psychosom Med*. 2016; 78(1):79–90. [PubMed: 26461853]

- Chen LP, Murad MH, Paras ML, Colbenson KM, Sattler AL, Goranson EN, et al. Sexual abuse and lifetime diagnosis of psychiatric disorders: systematic momentary assessment review and meta-analysis. *Mayo Clin Proc.* 2010; 85(7):618–629. [PubMed: 20458101]
- Claes L, Vandereycken W, Luyten P, Soenens B, Pieters G, Vertommen H. Personality prototypes in eating disorders based on the big five model. *J Pers Disord.* 2006; 20(4):401–416. [PubMed: 16901262]
- Duncan AE, Neuman RJ, Kramer J, Kuperman S, Hesselbrock V, Reich T, Bucholz KK. Are there subgroups of bulimia nervosa based on comorbid psychiatric disorders? *Int J Eat Disord.* 2005; 37(1):19–25. [PubMed: 15690461]
- Engel SG, Boseck JJ, Crosby RD, Wonderlich SA, Mitchell JE, Smyth J, et al. The relationship of momentary anger and impulsivity to bulimic behavior. *Behav Res Therapy.* 2007; 45:437–447.
- Fairburn, CG., Cooper, Z. The Eating Disorder Examination. In: Fairburn, CGGT., editor. *Binge Eating: Nature, Assessment and Treatment.* 12. Guilford Press; New York: 1993. p. 317–360.
- First, MB., Gibbon, M. The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) and the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II). In: Hilsenroth, MJ.Segal, DL., Hersen, M., editors. *Comprehensive Handbook of Psychological Assessment, Volume 2, Personality Assessment.* John Wiley & Sons; New York: 2004.
- Grilo CM, Masheb RM, Berman RM. Subtyping women with bulimia nervosa along dietary and negative affect dimensions: A replication in a treatment-seeking sample. *Eat Weight Disord.* 2001; 6:53–58. [PubMed: 11300547]
- Haedt-Matt A, Keel PK. Revisiting the affect regulation model of binge eating: A meta-analysis of studies using ecological momentary assessment. *Psychol Bull.* 2011; 137(4):660–681. [PubMed: 21574678]
- Jahng S, Wood PK, Trull TJ. Analysis of affective instability in ecological momentary assessment: Indices using successive difference and group comparison via multilevel modeling. *Psychol Methods.* 2008; 13(4):354. [PubMed: 19071999]
- Keel PK, Crosby RD, Hildebrandt TB, Haedt-Matt AA, Gravener JA. Evaluating new severity dimensions in the DSM-5 for bulimic syndromes using mixture modeling. *J Int Eat Disord.* 2013; 46(2):108–118.
- Koenigsberg HW, Harvey PD, Mitropoulou V, Schmeidler J, New AS, Goodman M, et al. Characterizing affective instability in borderline personality disorder. *Am J Psychiatry.* 2002; 159(5):784–788. [PubMed: 11986132]
- Lavender JM, Utzinger LM, Cao L, Wonderlich SA, Engel SG, Mitchell JE, Crosby RD. Reciprocal associations between negative affect, binge eating, and purging in the natural environment in women with bulimia nervosa. *J Abnorm Psycho.* 2016; 125(3):381.
- Lavender JM, Wonderlich SA, Engel SG, Gordon KH, Kaye WH, Mitchell JE. Dimensions of emotion dysregulation in anorexia nervosa and bulimia nervosa: A conceptual review of the empirical literature. *Clin Psycho Rev.* 2015; 40:111–122.
- Lovibond PF, Lovibond SH. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Therapy.* 1995; 33(3):335–343.
- O'Brien KM, Vincent NK. Psychiatric comorbidity in anorexia and bulimia nervosa: nature, prevalence, and causal relationships. *Clin Psychol Rev.* 2003; 23(1):57–74. [PubMed: 12559994]
- Simons JS, Carey KB. Risk and vulnerability for marijuana use problems: the role of affect dysregulation. *Psychol Addict Beav Behav.* 2002; 16(1):72–75.
- Simons JS, Carey KB, Gaher RM. Liability and Impulsivity Synergistically Increase Risk for Alcohol-Related Problems. *Am J Drug Alcohol Abuse.* 2004; 30(3):685–694. [PubMed: 15540500]
- Smyth J, Wonderlich S, Crosby R, Miltenberger R, Mitchell J, Rorty M. The use of ecological momentary assessment approaches in eating disorder research. *Int J Eat Disord.* 2001; 30(1):83–95. [PubMed: 11439412]
- Smyth JM, Wonderlich SA, Heron KE, Sliwinski MJ, Crosby RD, Mitchell JE, Engel SG. Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. *J Consult Clin Psychol.* 2007; 75(4):629–638. [PubMed: 17663616]

- Stice E. A prospective test of the dual pathway model of bulimic pathology: Mediating effects of dieting and negative affect. *J Abnorm Psychol.* 2001; 110(1):124–135. [PubMed: 11261386]
- Stice E, Agras WS. Subtyping bulimic women along dietary restraint and negative affect dimensions. *J Consult Clin Psychol.* 1999; 67(4):460–469. [PubMed: 10450616]
- Stice E, Bohon C, Marti CN, Fischer K. Subtyping women with bulimia nervosa along dietary and negative affect dimensions: Further evidence of reliability and validity. *J Consult Clin Psychol.* 2008; 76(6):1022–1033. [PubMed: 19045970]
- Stice E, Fairburn CG. Dietary and dietary-depressive subtypes of bulimia nervosa show differential symptom presentation, social impairment, comorbidity, and course of illness. *J Consult Clin Psychol.* 2003; 71(6):1090–1094. [PubMed: 14622085]
- Stice E, Marti CN, Durant S. Risk factors for onset of eating disorders: Evidence of multiple risk pathways from an 8-year prospective study. *Behav Res Therapy.* 2011; 49(10):622–627.
- Stone AA, Shiffman S. Capturing momentary, self-report data: A proposal for reporting guidelines. *Ann Behav Med.* 2002; 24(3):236–243. [PubMed: 12173681]
- Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. *Psychol Bull.* 1979; 86(2):420–428. [PubMed: 18839484]
- Swartz G. Estimating the dimension of a model. *Ann Stat.* 1978; 6(2):461–464.
- Tragesser SL, Solhan M, Brown WC, Tomko RL, Bagge C, Trull TJ. Longitudinal associations in borderline personality disorder features: Diagnostic Interview for Borderlines Revised (DIB-R) scores over time. *J Pers Disord.* 2010; 24(3):377. [PubMed: 20545501]
- Trull TJ, Solhan MB, Tragesser SL, Jahng S, Wood PK, Piasecki TM, Watson D. Affective instability: measuring a core feature of borderline personality disorder with ecological momentary assessment. *J Abnorm Psychol.* 2008; 117(3):647–661. [PubMed: 18729616]
- Utzinger LM, Haukebo JE, Simonich H, Wonderlich SA, Cao L, Lavender JM, Mitchell JE, Engel SG, Crosby RD. A latent profile analysis of childhood trauma in women with bulimia nervosa: associations with borderline personality disorder psychopathology. *Int J Eat Disord.* 2016; 49(7): 689–694. [PubMed: 27038436]
- Vall E, Wade TD. Predictors of treatment outcome in individuals with eating disorders: A systematic review and meta-analysis. *Int J Eat Disord.* 2015; 48(7): 946–971. [PubMed: 26171853]
- Vermunt, JK., Magidson, J. Technical Guide for latent Gold Choice 4.0: basic and advanced. Statistical Innovations Inc; Massachusetts: 2005.
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol.* 1988; 54(6):1063–1070. [PubMed: 3397865]
- Westen D, Harnden-Fischer J. Personality profiles in eating disorders: Rethinking the distinction between axis I and axis II. *Am J Psychiatry.* 2001; 158(4):547–562. [PubMed: 11282688]
- Wildes JE, Marcus MD. Alternative methods of classifying eating disorders: Models incorporating comorbid psychopathology and associated features. *Clin Psychol Rev.* 2013; 33(3):383–394. [PubMed: 23416343]
- Wildes JE, Marcus MD, Crosby RD, Ringham RM, Dapelo MM, Gaskill JA, Forbush KT. The clinical utility of personality subtypes in patients with anorexia nervosa. *J Consult Clin Psychol.* 2011; 79(5):665. [PubMed: 21767000]
- Witte TK, Fitzpatrick KK, Joiner TE, Schmidt NB. Variability in suicidal ideation: A better predictor for past attempt than intensity and duration of ideation? *J Affect Disord.* 2005; 88(2):131–136. [PubMed: 16054227]
- Wonderlich SA, Crosby RD, Joiner T, Peterson CB, Bardone-Cone A, Klein M, et al. Personality subtyping and bulimia nervosa: Psychopathological and genetic correlates. *Psychol Med.* 2005; 35(5):649–657.
- Wonderlich SA, Crosby RD, Engel SG, Mitchell JE, Smyth J, Miltenberger R. Personality-based clusters in bulimia nervosa: Differences in clinical variables and ecological momentary assessment. *J Pers Disord.* 2007; 21(3):340–357. [PubMed: 17536944]

- Woyshville MJ, Lackamp JM, Eisengart JA, Gilliland JAM. On the meaning and measurement of affective instability: Clues from chaos theory. *Biol Psychiatry*. 1999; 45(3):261–269. [PubMed: 10023499]
- Yu J, Selby EA. The interaction between affective lability and interpersonal problems in binge eating. *J Soc Clin Psychol*. 2013; 32(5):465–481.
- Zander ME, De Young KP. Individual differences in negative affect and weekly variability in binge eating frequency. *Int J Eat Disord*. 2014; 47(3):296–301. [PubMed: 24222630]
- Zanarini MC, Frankenburg FR, Vujanovic AA. Inter-rater and test-retest reliability of the revised diagnostic interview for borderlines. *J Pers Disord*. 2002; 16(3):270–276. [PubMed: 12136682]
- Zanarini MC, Gunderson JG, Frankenburg FR, Chauncey DL. The Revised Diagnostic Interview for Borderlines: discriminating BPD from other axis II disorders. *J Pers Disord*. 1989; 3(1):10–18.

Highlights

- Affective disturbances appear to be salient in bulimia nervosa (BN).
- Within eating disorder diagnoses there is significant heterogeneity in symptoms.
- This study examined a classification model of BN using momentary affect indicators.
- Results revealed four profiles that differed in affect intensity and lability.
- Profiles were differentially associated with clinically relevant validators.

Figure 1.

Affective indicators across four-profile LPA solution. NA= Negative Affect; PA=Positive Affect; MSSD=Mean Square Successive Difference; BDI=Beck Depression Inventory.

Table 1

Fit Indices for 1- to 8-Class Latent Profile Analysis Models

Number of classes	Number of parameters	LL	BIC	cAIC
1	10	-2724.71	5498.11	5508.11
2	21	-2618.11	5338.44	5359.43
3	32	-2574.11	5303.99	5335.99
4	43	-2552.28	5313.85	5356.85
5	54	-2536.38	5335.61	5389.61
6	65	-2520.85	5358.1	5423.1
7	76	-2506.96	5383.86	5459.86
8	87	-2493.78	5411.04	5498.04

Note. LL = Log-likelihood; BIC = Bayesian Information Criterion; cAIC = Consistent Akaike Information Criterion. Bolded text indicate the best fitting model. Examination of the 3-class model bivariate residuals violated the assumption of conditional independence.

Table 2

Descriptive statistics for indicators across subtypes

	Stable normal ¹ (<i>n</i> =48)		Stable depressed ² (<i>n</i> =41)		Unstable normal ³ (<i>n</i> =24)		Unstable depressed ⁴ (<i>n</i> =17)		Partial η^2	Post-hoc analyses
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
BDI-II	13.15	7.98	24.78	10.07	15.29	7.64	25.18	7.63	.30	1,3<2,4
NA	17.16	3.29	32.05	6.38	21.34	3.87	30.73	5.35	.66	1<3<2,4
PA	38.09	10.36	28.98	6.46	37.41	4.46	34.33	4.53	.22	2<1,3
NA MSSD	20.20	9.88	48.80	20.99	56.14	19.79	117.31	29.53	.73	1<2,3<4
PA MSSD	35.72	15.86	39.41	15.53	96.56	30.82	120.01	49.70	.63	1,2<3<4

Note. NA= Negative affect; PA=Positive affect; MSSD=Mean squared successive difference; BDI-II= Beck Depression Inventory-II.

Table 3

External validators across subtypes

	Stable normal ¹ (n=47)		Stable depressed ² (n=41)		Unstable normal ³ (n=23)		Unstable depressed ⁴ (n=17)		Partial η^2	Post-hoc analyses
	M	SD	M	SD	M	SD	M	SD		
EDE global	2.86	0.15	3.68	0.17	3.09	0.22	3.79	0.26	.13	1<2,4
DIB-R	4.13	0.45	6.12	0.48	4.52	0.64	5.35	0.75	.08	1<2
CTQ	42.15	2.8	53.02	2.99	39.26	4.00	51.35	4.65	.09	3<2
Binge episodes	6.17	5.75	9.27	6.60	6.96	5.37	10.65	8.94	.07	n.s.
Purging episodes	8.50	6.88	12.85	11.29	11.38	9.00	14.76	11.77	.06	n.s.
Co-occurring diagnosis	n	%	n	%	n	%	n	%	Phi	χ^2 (df)
Anxiety/PTSD	23	48.9	27	65.9	8	43.8	11	64.7	.23	7.01 (3)
Major Depression	16	47.1	28	68.3	13	68.4	10	71.4		13.74(3)
Substance Dependence	4	8.5	9	22	5	21.7	2	11.8	.17	3.89 (3)

Note. EDE=Eating Disorder Examination; DIB-R=Diagnostic Interview for Borderlines—Revised; CTQ=Childhood Trauma Questionnaire; PTSD=Posttraumatic Stress Disorder; n.s.=nonsignificant. Posthoc comparisons were made based on Bonferroni corrected alpha values.