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Low emotion differentiation: An affective correlate of binge eating?

Megan E. Mikhail[1], **Pamela K. Keel**[2], **S. Alexandra Burt**[1], **Michael Neale**[3], **Steven Boker**[4], **Kelly L. Klump**[1]

[1]Department of Psychology, Michigan State University, East Lansing, MI 48824-1116

[2]Department of Psychology, Florida State University, Tallahassee, FL 32306-4301

[3]Departments of Psychiatry, Human Genetics, and Psychology, Virginia Commonwealth University, Richmond, VA 23298

[4]Department of Psychology, University of Virginia, Charlottesville, VA 22904-4400

Abstract

Background: Low emotion differentiation (the tendency to experience vague affective states rather than discrete emotions) is associated with psychopathology marked by emotion regulation deficits and impulsive/maladaptive behavior. However, research examining associations between emotion differentiation and dysregulated eating is nascent and has yet to incorporate measures of clinically significant binge eating. Different measures of emotion differentiation have also been used, impeding cross-study comparisons. We therefore examined associations between several emotion differentiation measures and binge eating-related phenotypes across a spectrum of severity.

Methods: Women ($N = 482$) from the Michigan State University Twin Registry completed the Positive and Negative Affect Schedule (PANAS) daily for 45 consecutive days. Three measures of negative/positive emotion differentiation (NED/PED) were created using the intraclass correlation coefficient (ICC), average interitem correlation, and average daily variance between negative/positive emotion ratings on the PANAS. Associations between NED/PED measures and emotional eating (EE) and history of binge eating episodes (BEs) were then examined, controlling for affect intensity and BMI.

Results: Lower PED was associated with greater odds of BEs across the ICC and average interitem correlation measures, and more EE on the daily variance measure. Findings involving NED were less consistent; lower NED was associated with greater EE and greater odds of BEs using the daily variance measure only.

Conclusion: Low PED is associated with clinically significant binge eating, and some aspects of NED may also be relevant for binge eating-related phenotypes. Further research examining the constructs captured by different emotion differentiation measures and their relevance to binge eating is needed.

Keywords

binge eating; emotional eating; emotion differentiation; negative affect; positive affect

Emotion differentiation, a person's tendency to experience discrete emotions (e.g., angry, sad) as opposed to vague affective states (e.g., feeling "bad"), is associated with positive psychosocial functioning (Smidt & Suvak, 2015) and is reduced in several forms of psychopathology (e.g., depression; Demiralp et al., 2012). Negative (rather than positive) emotion differentiation has been most consistently linked to adaptive functioning (e.g., Barrett et al., 2001). Researchers have theorized that greater negative emotion differentiation (NED) is adaptive because it helps people tailor their responses to different kinds of affectively charged experiences (Smidt & Suvak, 2015). One example is emotion regulation strategy selection; while people with greater NED tend to use the same types of strategies as other people, they use these strategies more effectively (Kalokerinos et al., 2019), suggesting they may be better at picking the right strategy for a given situation. Though positive emotion differentiation (PED) has been less consistently linked to wellbeing, low PED is associated with behaviors that may feel good in the moment, but have negative long-term consequences (e.g., restriction and compensatory behaviors in anorexia nervosa; Selby et al., 2014). While the mechanisms underlying these associations are not yet clear, temporary positive feelings derived from some risky/maladaptive behaviors (e.g., relief from purging) may be less distinct from other forms of positive affect (e.g., pride at doing well in school) for people with low PED, increasing the likelihood of using maladaptive behaviors to feel better.

Both NED and PED have potential relevance for binge eating and eating disorders (e.g., bulimia nervosa, binge eating disorder) characterized by difficulty regulating negative emotions (e.g., Monell et al., 2018) and behaviors that are temporarily pleasurable, but ultimately detrimental (i.e., over-consumption of palatable food). However, only two studies have examined associations between emotion differentiation and binge eating-related symptoms, each with methodological limitations. Dixon-Gordon and colleagues (2004) found that lower PED was associated with greater binge eating urges in undergraduates with elevated borderline personality traits; however, this study only used one item to assess binge eating urges over a single day of data collection. In the second study, lower NED predicted higher caloric intake in a laboratory setting (Jones & Herr, 2018). However, this study used ratings of how participants *thought* they would feel in different scenarios to calculate NED rather than affect ratings in daily life. While these studies represent an important start to examining associations between emotion differentiation and dysregulated eating, neither incorporated measures of clinically significant binge eating or collected emotion ratings longitudinally over an extended period.

Importantly, other research has found that binge eating is associated with alexithymia (defined as difficulty identifying and describing emotions; e.g., Wheeler et al., 2005). While alexithymia shares some conceptual similarities with emotion differentiation, associations between these constructs are small ($r = -.01$–.12; Boden et al., 2013). One potential reason is that a person could be certain that they feel "good" or "bad" (and thus scores low on alexithymia) even if they lack awareness of the nuances of their emotions (e.g., experience both sadness and frustration as "feeling bad"). Thus, emotion differentiation represents a unique aspect of emotion experience that is not fully captured by alexithymia.

To address gaps in the literature, the primary aim of this study was to examine how NED and PED relate to well-validated measures of binge eating and emotional eating (i.e., eating in response to negative emotions) using an intensive, longitudinal study design. Affect and emotional eating ratings were collected over 45 consecutive days in a large, population-based sample of women and binge eating was assessed via clinical interview. It was hypothesized that women who experience greater emotional eating or have a history of clinically significant binge eating would experience greater difficulty differentiating among both negative and positive emotions.

A secondary aim was to examine how alternate methods of calculating emotion differentiation impact associations. At least two methods have been used in past research, including the intraclass correlation coefficient (ICC) (e.g., Dixon-Gordon et al., 2014) and average interitem correlation (e.g., Demiralp et al., 2012). Very little research has compared different ways of operationalizing emotion differentiation to determine whether they relate to outcomes similarly, impeding comparisons across studies. Different measures of emotion differentiation (see Methods) were therefore analyzed in this study to examine whether alternative operationalizations of this construct show different associations with dysregulated eating.

Methods

Participants

Analyses included 482 women (ages 15–25; mean = 17.86, *SD* = 1.82) from the *Twin Study of Hormones and Behavior Across the Menstrual Cycle* (TSHBMC; Klump et al., 2013) who were recruited from the Michigan State University Twin Registry (MSUTR; Burt & Klump, 2013, 2019; Klump & Burt, 2006). Because the TSHBMC study focused on ovarian hormones, there were several eligibility criteria: 1) female sex; 2) menstruation every 22–32 days for the past 6 months; 3) no hormonal contraceptive use in the past 3 months; 4) no psychotropic or steroid medications in the past 4 weeks; 5) no pregnancy or lactation in the past 6 months; and 6) no history of genetic/medical conditions known to influence hormones or appetite/weight. Seven participants (1.4%; full TSHBMC *N* = 489) who completed less than 23 days' worth of affect ratings were excluded from the present analyses due to concerns that fewer ratings might be insufficient to accurately calculate NED and PED. However, results were unchanged if these participants were included.

The final sample was representative of the recruitment region with regard to race/ethnicity (Klump et al., 2013). Most participants identified as White (81.5%), followed by Black or African American (12.4%), more than one race (4.6%), Asian American (1%), and American Indian or Alaska Native (0.4%). One participant (0.2%) did not identify her race. Across races, 9.1% of participants identified as Latina.

Procedure

As described by Klump et al. (2013), participants provided daily ratings of emotions and emotional eating for 45 consecutive days. Participants had their BMI measured at three in-person assessments and completed a clinical interview at the end of the study. Dropout (3%)

and missing data (≤ 6%) were minimal (Klump et al., 2013). On average, participants provided 41.59 days' worth of negative/positive emotion ratings and 41.53 days' worth of emotional eating ratings (range = 23–45 days for all variables); participants who provided data on fewer than 45 days either discontinued participation in the study prematurely or failed to complete all scales on certain days.

Measures

Emotion Differentiation—Three emotion differentiation variables were created using daily ratings of negative emotions (distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid) and positive emotions (interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, active) from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Emotions were rated from 1 (very slightly or not at all) to 5 (extremely).

The general rationale underlying all emotion differentiation variables is that if a person always reports experiencing one emotion at the same intensity as another over an extended period of time, or if increases in one emotion are always accompanied by increases in another, the person may not experience these emotions as functionally distinct. Explained another way, if two emotions are always experienced at the same intensity or correlate perfectly across time, then they fail to provide unique information – i.e., they do not allow an individual to distinguish between affectively nuanced experiences.

The different emotion differentiation variables were calculated as follows:

Intraclass correlation coefficient (ICC).: The average intraclass correlation coefficient with absolute agreement (Shrout & Fleiss, 1979) was calculated for negative/positive emotion ratings separately across days for each participant. This form of the ICC is represented by the equation $\frac{MS(B) - MS(W)}{MS(B) + (MS(C) - (MS(W))/n}$ where MS(B) represents the proportion of variance due to differences in overall affect intensity from one day to the next, MS(C) represents the proportion of variance due to systematic differences in the intensity of different emotions across time, and MS(W) represents residual variance due to non-systematic differences in the intensity of different emotions on the same day. Because the ICC computation requires that all emotions are rated on each day, days on which only some emotions were rated were excluded from the calculation. This method of operationalizing emotion differentiation has been used in past studies of disordered eating (Dixon-Gordon et al., 2014; Jones & Herr, 2018; Selby et al., 2014) and other impulsive behaviors (e.g., substance use; Kashdan et al., 2010). Similar to past studies, ICC values were Fisher r-to-z transformed to induce a normal distribution and subtracted from 1 so that higher scores would indicate greater emotion differentiation.

People who distinguish more between emotions on a single day (e.g., feel more embarrassed than irritated) or experience specific emotions as more intense than others across time (e.g., *generally* feel more embarrassed than irritated) will have greater emotion differentiation on the ICC measure. Conversely, people whose overall affect intensity varies more from day to day (e.g., feel terrible one day, but fine the next) will have lower emotion differentiation on this measure. Note that this dependence on variability in overall affect across days distinguishes the ICC from the other measures described below.

Average interitem correlation.: The average interitem correlation across all pairs of negative/positive emotions was calculated separately for each participant. Conceptually, the average interitem correlation is based on the idea that emotions that covary little across time are more likely to be experienced as distinct. This method has been used in past studies of depression (Demiralp et al., 2012) and borderline personality disorder (Zaki et al., 2013). Pearson correlations were calculated for each pair of negative or positive emotions (e.g., hostility and shame, hostility and fear, etc.), then averaged across emotions. The correlation between any given pair of emotions (e.g., nervous and ashamed) included data from all days on which both emotions in the pair were rated. Consistent with past studies, average correlations were Fisher r-to-z transformed and subtracted from 1 so that higher scores would indicate greater emotion differentiation. If there was no variability in a participant's ratings of an emotion, correlations with that emotion were excluded from the final calculation because it is not possible to calculate a correlation with a constant. One participant (0.2%) only had variability in a single negative emotion, and so was excluded from analyses of NED calculated using this method.

Average daily variance.: Finally, the variances of each participant's negative emotion ratings and positive emotion ratings were calculated on each day, then averaged separately across days. All days on which at least two emotions were rated were included in the calculation. This method was newly developed to create a measure that captured differences in the intensity of different emotions on the same day but was not weighted by variability in affect *across* days (as is true for the ICC). Higher scores on this measure indicate more variability between individual emotion ratings, and thus greater emotion differentiation. Unlike the ICC and average interitem correlation, the average daily variance *only* captures differences in the absolute levels at which emotions are experienced on the same day, omitting how emotions differ across days.

Dysregulated Eating

Emotional Eating.: Emotional eating was assessed with the Emotional Eating scale from the Dutch Eating Behavior Questionnaire (DEBQ; van Strien et al., 1986) modified with permission to refer to that day. The emotional eating scale correlates strongly with measures of binge eating (e.g., the Bulimia scale of the Eating Disorders Inventory; van Strien, 1996) and palatable food consumption in laboratory settings (van Strien, 2000), and differentiates between women with and without binge eating disorder after controlling for weight status (Schulz & Laessle, 2010). Internal consistency is excellent (average α = .90 in the current study; Klump et al., 2014). An overall measure of emotional eating was created by averaging the daily ratings for each participant over the study to allow for comparisons with person-level emotion differentiation variables.

Binge Eating.: History of binge eating episodes (BEs, representing current or past clinically significant binge eating) was assessed using the Eating Disorders Module from the Structured Clinical Interview for DSM-IV Axis 1 Disorders (SCID; First et al., 1996) with additional probes tailored to a community sample. There was good interrater reliability for presence of BEs (kappa = .82; Klump et al., 2014).

Twenty-nine women (6.0%) reported BEs, including 21 (72.4%) with current BEs. To maximize power with a community sample, this includes both participants with threshold objective binge eating episodes (*n* = 15; ≥ 1000 calories consumed, behavioral (e.g., not being able to stop eating) and psychological (e.g., feeling depressed, guilty, or disgusted with oneself after eating) indicators of severe loss of control) as well as those who may have consumed fewer calories (i.e., 600–999 calories) or reported less severe loss of control during BEs (i.e., endorsed some, but not all, behavioral indicators of loss of control along with psychological indicators). This approach is consistent with evidence that loss of control over eating is clinically significant, even if the amount of food consumed falls short of “objectively large” thresholds (i.e., ≥ 1000 calories) (Forney et al., 2014). History of BEs was identified using a dichotomous indicator (0 = no BEs; 1 = current or past BEs). Seven participants (1.5%) were missing BE data on the SCID and were excluded from analyses involving this measure.

Covariates

BMI.: BMI (kilograms/meters^2) was averaged across the three in-person assessments and included as a covariate to determine whether emotion differentiation was associated with dysregulated eating independent of weight status. BMI was calculated from height and weight measured using a wall-mounted ruler and digital scale, respectively.

Affect Intensity.: If emotion differentiation was correlated with affect intensity (i.e., how strongly positive/negative someone feels), then associations between emotion differentiation and dysregulated eating could be confounded by associations between affect intensity and dysregulated eating. To examine this possibility, overall levels of negative and positive affect intensity were calculated by averaging the daily total negative/positive affect ratings for each participant over the study and included as covariates.

Age.: Associations between age and emotion differentiation were minimal (see Table 2), and thus age was not included as a covariate. We examined whether age *moderated* associations between emotion differentiation and dysregulated eating. There were no significant moderation effects (i.e., all *p*s >.10; see Tables S4 and S5 in Supplemental Material), suggesting similar associations across adolescent and young adult participants.

Statistical Analyses

We examined Pearson correlations between NED and PED and emotional eating/BE status to provide initial indications of associations without covariates. Mixed linear models (MLMs) that accounted for nesting of participants within twin pairs were then conducted for NED and PED separately, with emotional eating or BE status as the outcome. MLMs first included BMI as the only covariate (results for models without BMI were similar; see Tables S1–S3 in Supplemental Material). Positive and negative affect intensity were then added to examine whether NED and PED were associated with dysregulated eating independent of affect intensity. Results of the MLMs are presented as standardized regression coefficients (for emotional eating) and odds ratios (for BE status).

Results

Descriptive Statistics

Descriptive statistics are presented in Table 1. A wide range of emotional eating was represented (average emotional eating score range = 1–4.02 out of a possible range of 1–5), indicating good variability in dysregulated eating symptoms. Participants also varied considerably on indices of emotion differentiation. Participants' untransformed average interitem correlations ranged from −.05 to .63 for negative emotions, and from −.01 to .69 for positive emotions. Similar variability was observed for the average daily variance (range = .004–3.29 for negative emotions and .04–3.26 for positive emotions; possible range = 0–4.44) and untransformed ICC values (range = −.15–.91 for negative emotions and −.04–.95 for positive emotions; an ICC of 1 indicates perfect agreement and thus no differentiation). While some researchers discard negative ICC values, we retained them because these values can be valid when variability within groups (i.e., between different emotions on the same day) is much greater than variability between groups (i.e., in overall affect levels across days) (Kenny et al., 2002). Results were unchanged if these participants (n = 6; 1.2%) were excluded.

Pearson Correlations

Pearson correlations are presented in Table 2. Measures of NED and PED calculated using the same method (e.g., both calculated using ICCs) were moderately correlated with each other (rs = .23–.41, ps <.001), suggesting that NED and PED represented related but distinguishable constructs. With respect to correlations between different measures of emotion differentiation, NED/PED calculated using the ICC were highly correlated with NED/PED calculated using the average interitem correlation (rs >.80), but these measures were more weakly (or even negatively) correlated with NED/PED calculated using the average daily variance (rs = −.14 to .26). This suggests that the average daily variance taps a different aspect of emotion differentiation than the ICC/average interitem correlation.

As expected, PED measured using the ICC was negatively correlated with BE status (r = −.11, p = .015). NED measured using the ICC was negatively correlated with emotional eating (r = −.17, p <.001) and BE status (r = −.14, p = .002). A similar pattern was observed for NED measured using the average interitem correlation (emotional eating: r = −.09, p = .044; BE status: r = −.11, p = .013). Contrary to expectations, however, NED measured using the average daily variance was *positively* correlated with emotional eating (r = .28, p <.001). This measure of NED also showed a different relationship with negative affect intensity (i.e., a positive correlation, as opposed to negative correlations for the ICC/average interitem correlation; see Table 2). Thus, inconsistent associations between NED measures and emotional eating could be due in part to confounding by negative affect intensity (especially as negative affect intensity was also significantly correlated with emotional eating; r = .46, p <.001). MLMs controlling for affect intensity examined this possibility directly (see below).

MLMs

NED.—When controlling for BMI alone, *lower* NED measured using the ICC (OR = .54, $p = .009$) and average interitem correlation (OR = .65, $p = .036$) were associated with greater odds of BEs (see Table 3). Lower NED measured using the ICC was also associated with more emotional eating ($\beta = -.13$, $p = .002$). In contrast (but consistent with Pearson correlations), *higher* NED measured using the average daily variance was associated with greater emotional eating ($\beta = .25$, $p < .001$); however, it was not significantly related to BEs.

When positive and negative affect intensity were added to the models, associations between NED measured using the ICC or average interitem correlation and dysregulated eating were no longer significant (though there remained a trend-level association for the ICC measure between lower NED and greater odds of BEs; see Table 3). However, *lower* NED measured using the average daily variance was now associated with more emotional eating ($\beta = -.31$, $p < .001$) and greater odds of BEs (OR = .39, $p = .020$). In other words, the unique variance associated with NED measured using the average daily variance (independent of negative and positive affect intensity) was *negatively* related to dysregulated eating. This was likely obscured in previous models by the strong, positive correlation between this measure of NED and negative affect intensity (importantly, however, indices of multicollinearity were within acceptable limits – i.e., VIF < 4 for all predictors; O'Brien, 2007).

PED.—As shown in Table 4, when controlling for BMI alone, the only significant association was between lower PED measured using the ICC and greater odds of BEs (OR = .58, $p = .030$). After controlling for positive and negative affect intensity, this association remained significant (OR = .52, $p = .008$), and was joined by a similar association between lower PED measured using the average interitem correlation and greater odds of BEs (OR = .64, $p = .045$). While PED measured using the average daily variance was not significantly related to BEs, the association was in the expected direction (OR = .67, $p = .139$), and lower PED on this measure was associated with greater emotional eating ($\beta = -.15$, $p < .001$).

In summary, after controlling for potential confounds (i.e., BMI, affect intensity), lower PED was associated with greater odds of BEs across two measures (ICC and average interitem correlation) and greater emotional eating on the third (average daily variance). Lower NED measured using the average daily variance was also associated with greater odds of BEs and greater emotional eating. Note that the overall pattern of findings was unchanged if NED and PED were included together in the same model (see Table 5), except that the association between PED measured using the average interitem correlation and BEs was only present at a trend level (OR = .67, $p = .088$).

Discussion

Few studies have examined associations between emotion differentiation and binge eating-related phenotypes, and this study is the first to use data collected over several weeks in daily life, multiple well-validated measures of dysregulated eating across different levels of severity, and a large, population-based sample. This is also one of few studies for any phenotype to directly compare different operationalizations of emotion differentiation. Overall, results support associations between lower emotion differentiation and increased risk for dysregulated eating. Specifically, lower PED was related to greater odds of BEs after controlling for affect intensity across two measures of emotion differentiation used in past research, and lower NED was related to dysregulated eating on a third measure.

The observed associations between lower PED and greater odds of BEs are consistent with previous research linking binge eating urges in daily life to low PED (Dixon-Gordon et al., 2014). While speculative, it may be that individuals with low PED more readily substitute the pleasure or relief associated with palatable food intake for other sources of (perhaps less easily accessible) positive affect. In other words, for a person with low PED, the positive feelings associated with eating palatable foods may feel more similar to those associated with seeing a close friend or being praised by one’s supervisor, increasing the likelihood of eating to feel good. If the relationship between lower PED and binge eating is primarily driven by hedonic processes (i.e., desire for positive affect), this may help explain why low PED was less consistently associated with eating in response to negative emotions (i.e., emotional eating). Importantly, while binge eating is often associated with negative affect, disruptions in reward processes have also been implicated (e.g., Avena & Bocarsly, 2012; Ma et al., in press).

Lower NED was less consistently linked to dysregulated eating – significant associations were only observed with the average daily variance. While these associations could be spurious, consistent results across emotional eating and binge eating suggest a meaningful effect. The average daily variance most directly taps differences in the experience of different emotions on the same day, rather than covariances or consistent differences in the intensity of specific emotions across days. Low NED on this measure might therefore represent a tendency to experience multiple negative emotions simultaneously (i.e., to feel angry, sad, and scared rather than just angry) more than an inability to conceptually distinguish between emotions (which may be better captured by the other NED measures that assess consistent patterns of relationships between specific emotions over time). An association between dysregulated eating and lower NED on the daily variance measure – but not other NED measures – could therefore suggest that a person is more likely to experience binge eating if they tend to experience mixed negative emotions, even when those emotions are conceptually distinct. This could reflect the fact that it is easier to generate an adaptive, situation-appropriate response to one or two intense negative emotions than to multiple negative emotions experienced at a more moderate level, which may be more likely to lead to binge eating or other self-soothing behaviors. PED measured using the average daily variance may be less strongly associated with dysregulated eating because situations that evoke positive emotions are less likely to call for a specific change in behavior or use of emotion regulation strategies (e.g., Gross et al., 2006), rendering the “mixed signal” of multiple positive emotions less problematic.

Differences in associations across emotion differentiation measures highlight the fact that measures are not necessarily interchangeable. While use of multiple emotion differentiation measures can help identify the aspects of this construct that are most relevant to a phenotype, the current measures are all indirect, which introduces some uncertainty about what is being captured by each. Factor analytic techniques or more explicit emotion differentiation measures, such as questionnaires or laboratory paradigms that assess “justnoticeable differences" between stimuli with different emotional charges (e.g., Norton et al., 2009), could help establish convergent validity for existing measures.

Before closing, some limitations of this study should be noted. Although the PANAS is a widely used emotion measure, it primarily focuses on high arousal emotions (e.g., scared, excited); thus, results may differ if low arousal emotions (e.g., bored, calm) are included in emotion differentiation measures. While this community sample showed ample variability in emotion differentiation and dysregulated eating, it is unclear whether results would fully generalize to clinical populations. Future research could extend this study by examining associations between emotion differentiation and binge eating frequency in people with eating disorders. There was also low representation of women from some racial/ethnic groups (i.e., Asian American and Native American women) due to the demographic composition of the recruitment region. Relatedly, all participants were female adolescents or young adults. Additional research is needed to examine whether results generalize across gender and developmental stage.

It is possible that differences across emotional eating and BE status in this study could reflect the inclusion of participants who met DSM criteria for past (but not current) binge eating in the BE group. However, most participants with BEs had current BEs, and associations with emotion differentiation were not consistently stronger for emotional eating versus binge eating.

Finally, our ability to examine daily/prospective associations between emotion differentiation and dysregulated eating was limited due to the nature of our data (e.g., emotions were only rated once per day; emotion differentiation was not actively manipulated). Only the average daily variance could be calculated for a particular day, as multiple ratings of each emotion were needed to calculate the ICC and average interitem correlation. However, we conducted post hoc analyses to examine whether within-person fluctuations in the average daily variance were associated with fluctuations in emotional eating. We did not find significant same day or next day associations when controlling for affect intensity (*p*s >.10; see Table S6 in Supplemental Material). We did not examine associations across a longer delay due to evidence that emotion experience is most strongly related to dysregulated eating on the same day (Haedt-Matt et al., 2014). These findings preliminarily suggest that general tendencies toward low or high emotion differentiation may matter more for dysregulated eating than within-person fluctuations from day to day. Future research could build on this work by using more intensive experience sampling or experimental/intervention-based designs to further examine whether changes in emotion differentiation prospectively predict changes in dysregulated eating.

Cognitive-behavioral therapy and other treatments for binge eating-related disorders (e.g., dialectical behavior therapy (Telch et al., 2001), integrative cognitive-affective therapy (Wonderlich et al., 2014)) emphasize emotion identification as a critical skill. While additional research is needed, the current study provides evidence that facets of both positive and negative emotion differentiation are relevant for dysregulated eating, and supports the potential clinical utility of teaching individuals with binge eating to identify and differentiate between emotions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Descriptive statistics

Variable	Mean	*SD*	Range
NED-ICC	.30	.28	−.54–1.15
PED-ICC	.13	.31	−.84–1.04
NED-AC	.80	.11	.26–1.05
PED-AC	.72	.14	.15–1.01
NED-VAR	.53	.41	.004–3.29
PED-VAR	.78	.40	.04–3.26
DEBQ Emotional Eating	1.31	.40	1–4.02
Negative affect intensity	15.12	3.91	10.04–32.09
Positive affect intensity	22.89	6.32	10.39–39.90
BMI	23.71	5.47	15.30–47.59

Note: Values represent final variables after all transformations were applied. NED-ICC = negative emotion differentiation calculated using the intraclass correlation coefficient; PED-ICC = positive emotion differentiation calculated using the intraclass correlation coefficient; NED-AC = negative emotion differentiation calculated using the average interitem correlation; PED-AC = positive emotion differentiation calculated using the average interitem correlation; NED-VAR = negative emotion differentiation calculated using the average daily variance of emotion ratings; PED-VAR = positive emotion differentiation calculated using the average daily variance of emotion ratings; DEBQ Emotional Eating = average Dutch Eating Behavior Questionnaire Emotional Eating subscale score; BMI = body mass index.

Table 2.

Pearson correlations between emotion differentiation variables, affect intensity, dysregulated eating, and BMI

	1	2	3	4	5	6	7	8	9	10	11	12
1. NED-ICC	—											
2. PED-ICC	.31***	—										
3. NED-AC	.83***	.24***	—									
4. PED-AC	.23***	.89***	.23***	—								
5. NED-VAR	−.14**	.02	−.08	.11*	—							
6. PED-VAR	−.01	.26***	.05	.19***	.41***	—						
7. Negative affect	−.31***	−.02	−.23***	.11*	.82***†	.26***	—					
8. Positive affect	−.06	−.12**	−.02	−.10*	.17***	.31***	.26***	—				
9. Emotional eating	−.17***	−.08	−.09*	−.01	.28***	−.03	.46***	.11*	—			
10. Binge eating	−.14**	−.11*	−.11*	−.06	.05	−.05	.17***	−.05	.21***	—		
11. BMI	−.06	−.09*	−.06	−.07	−.04	−.002	−.04	−.08	.01	.10*	—	
12. Age	.002	−.02	.01	−.04	−.06	−.03	−.11*	−.06	−.03	.09	.20***	—

Note: NED-ICC = negative emotion differentiation calculated using the intraclass correlation coefficient; PED-ICC = positive emotion differentiation calculated using the intraclass correlation coefficient; NED-AC = negative emotion differentiation calculated using the average interitem correlation; PED-AC = positive emotion differentiation calculated using the average interitem correlation; NED-VAR = negative emotion differentiation calculated using the average daily variance of emotion ratings; PED-VAR = positive emotion differentiation calculated using the average daily variance of emotion ratings; negative and positive affect = average intensity of negative or positive affect across the study; emotional eating = average Dutch Eating Behavior Questionnaire Emotional Eating subscale score; binge eating = presence of clinically significant binge eating; BMI = body mass index.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

† Note that the high correlation between NED-VAR and negative affect intensity likely reflects the fact that most participants had low to moderate negative affect intensity (as would be expected for a population-based sample), so that individuals who had greater variability in negative emotion ratings (e.g., rated some emotions “1” and other emotions “5”) also tended to have higher negative affect intensity than individuals who had lower variability in negative emotion ratings (e.g., may have rated all negative emotions a “1”).

Table 3.

Associations between dysregulated eating and negative emotion differentiation

Method 1 – Intraclass Correlation Coefficient

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	.0001	.05	.998	−.10, .10	.03	.02	<.001 ***	.01, .09
NED	−.13	.04	.002 **	−.22, −.05	.54	.13	.009 **	.34, .86
BMI	.01	.05	.775	−.08, .11	1.43	.29	.079	.96, 2.14

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.985	−.09, .09	.03	.02	<.001 ***	.01, .08
NED	−.02	.04	.665	−.10, .06	.64	.15	.051	.41, 1.002
Negative affect	.44	.04	<.001 ***	.35, .53	2.10	.46	.001 **	1.37, 3.24
Positive affect	−.02	.04	.689	−.10, .07	.54	.15	.022 *	.32, .91
BMI	.03	.04	.479	−.05, .12	1.44	.28	.061	.98, 2.10

Method 2 – Average Interitem Correlation

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	.0004	.05	.994	−.10, .10	.03	.02	<.001 ***	.01, .09
NED	−.06	.04	.205	−.14, .03	.65	.13	.036 *	.43, .97
BMI	.02	.05	.697	−.08, .12	1.46	.30	.070	.97, 2.20

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.002	.04	.969	−.09, .09	.03	.02	<.001 ***	.01, .09
NED	.03	.04	.519	−.05, .11	.77	.15	.184	.52, 1.13
Negative affect	.45	.04	<.001 ***	.37, .54	2.16	.47	<.001 ***	1.41, 3.32
Positive affect	−.02	.04	.639	−.10, .06	.57	.15	.032 *	.34, .95
BMI	.03	.04	.438	−.05, .12	1.47	.29	.049 *	1.002, 2.15

Method 3 – Average Daily Variance

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.05	.985	−.10, .10	.03	.02	<.001 ***	.01, .09
NED	.25	.04	<.001 ***	.17, .34	1.27	.26	.258	.84, 1.91

Method 1 – Intraclass Correlation Coefficient								
	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
BMI	.03	.05	.546	−.06, .12	1.52	.32	.046 *	1.01, 2.29
	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**B**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.990	−.09, .08	.03	.02	<.001 ***	.01, .08
NED	−.31	.07	<.001 ***	−.45, −.17	.39	.16	.020 *	.18, .86
Negative affect	.71	.07	<.001 ***	.57, .85	4.52	1.61	<.001 ***	2.25, 9.09
Positive affect	−.03	.04	.442	−.11, .05	.48	.14	.012 *	.28, .85
BMI	.03	.04	.497	−.05, .11	1.46	.28	.051	1.00, 2.14

Note: Models controlling for BMI only are presented first, followed by models controlling for BMI and positive/negative affect intensity. NED = negative emotion differentiation; DEBQ Emotional Eating = average Dutch Eating Behavior Questionnaire Emotional Eating subscale score; BE = clinically significant binge eating episode; BMI = body mass index.

* p <.05,

** p <.01,

*** p <.001.

Table 4.

Associations between dysregulated eating and positive emotion differentiation

Method 1 – Intraclass Correlation Coefficient

	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.0001	.05	.998	−.10, .10	.02	.02	<.001 ***	.01, .08
PED	−.06	.04	.166	−.15, .03	.58	.15	.030 *	.35, .95
BMI	.02	.05	.740	−.08, .11	1.46	.32	.079	.96, 2.24

	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.984	−.09, .09	.02	.01	<.001 ***	.01, .08
PED	−.07	.04	.109	−.15, .01	.52	.13	.008 **	.32, .84
Negative affect	.45	.04	<.001 ***	.36, .53	2.53	.59	<.001 ***	1.60, 3.99
Positive affect	−.03	.04	.550	−.11, .06	.48	.13	.009 **	.28, .83
BMI	.03	.04	.559	−.06, .11	1.45	.29	.060	.98, 2.14

Method 2 – Average Interitem Correlation

	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.0001	.05	.999	−.10, .10	.02	.02	<.001 ***	.01, .09
PED	.003	.04	.937	−.08, .09	.76	.17	.237	.49, 1.19
BMI	.02	.05	.649	−.08, .12	1.50	.33	.063	.98, 2.29

	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.984	−.09, .09	.03	.01	<.001 ***	.01, .08
PED	−.05	.04	.228	−.13, .03	.64	.14	.045 *	.41, .99
Negative affect	.45	.04	<.001 ***	.37, .54	2.57	.61	<.001 ***	1.62, 4.08
Positive affect	−.02	.04	.576	−.11, .06	.51	.14	.014 *	.30, .87
BMI	.03	.04	.509	−.06, .11	1.50	.30	.041 *	1.02, 2.23

Method 3 – Average Daily Variance

	DEBQ Emotional Eating				**Presence of BEs**			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.0001	.05	.999	−.10, .10	.03	.02	<.001 ***	.01, .09
PED	−.02	.04	.659	−.11, .07	.82	.20	.425	.50, 1.33

Method 1 – Intraclass Correlation Coefficient

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
BMI	.02	.05	.646	−.08, .12	1.49	.31	.053	.99, 2.23

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.986	−.09, .08	.03	.02	<.001 ***	.01, .09
PED	−.15	.04	<.001 ***	−.23, −.07	.67	.18	.139	.40, 1.14
Negative affect	.48	.04	<.001 ***	.39, .56	2.40	.51	<.001 ***	1.59, 3.63
Positive affect	.02	.04	.593	−.06, .11	.63	.16	.078	.38, 1.05
BMI	.04	.04	.385	−.05, .12	1.47	.27	.036 *	1.02, 2.12

Note: Models controlling for BMI only are presented first, followed by models controlling for BMI and positive/negative affect intensity. PED = positive emotion differentiation; DEBQ Emotional Eating = average Dutch Eating Behavior Questionnaire Emotional Eating subscale score; BE = clinically significant binge eating episode; BMI = body mass index.

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Table 5.

Associations between dysregulated eating and emotion differentiation measures, with negative and positive emotion differentiation included in the same model

Method 1 – Intraclass Correlation Coefficient

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.984	−.09, .09	.03	.01	<.001 ***	.01, .08
NED	.003	.04	.947	−.08, .09	.76	.18	.243	.47, 1.21
PED	−.07	.04	.123	−.15, .02	.57	.14	.026 *	.35, .94
Negative affect	.45	.04	<.001 ***	.36, .54	2.35	.55	<.001 ***	1.48, 3.73
Positive affect	−.03	.04	.548	−.11, .06	.48	.13	.009 **	.28, .84
BMI	.03	.04	.557	−.06, .11	1.42	.28	.073	.97, 2.08

Method 2 – Average Interitem Correlation

	DEBQ Emotional Eating				Presence of BEs			
Variable	**β**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.002	.04	.966	−.09, .09	.03	.02	<.001 ***	.01, .08
NED	.04	.04	.313	−.04, .13	.85	.18	.456	.56, 1.30
PED	−.06	.04	.149	−.14, .02	.67	.16	.088	.43, 1.06
Negative affect	.47	.04	<.001 ***	.38, .55	2.43	.59	<.001 ***	1.51, 3.91
Positive affect	−.03	.04	.498	−.11, .06	.52	.14	.018 *	.30, .89
BMI	.03	.04	.481	−.05, .12	1.48	.29	.047 *	1.005, 2.19

Method 3 – Average Daily Variance

	DEBQ Emotional Eating				Presence of BEs			
Variable	**B**	**SE**	***p***	**95% CI**	**OR**	**SE**	***p***	**95% CI**
Intercept	−.001	.04	.990	−.08, .08	.03	.02	<.001 ***	.01, .09
NED	−.25	.08	.001 **	−.40, −.10	.40	.19	.048 *	.16, .99
PED	−.10	.05	.032 *	−.19, −.01	.95	.30	.875	.51, 1.76
Negative affect	.68	.07	<.001 ***	.54, .83	4.42	1.68	<.001 ***	2.10, 9.31
Positive affect	−.003	.04	.937	−.09, .08	.50	.16	.030 *	.26, .93
BMI	.03	.04	.440	−.05, .11	1.46	.28	.050	1.00, 2.14

Note: NED = negative emotion differentiation; PED = positive emotion differentiation; DEBQ Emotional Eating = average Dutch Eating Behavior Questionnaire Emotional Eating subscale score; BE = clinically significant binge eating episode; BMI = body mass index.

* $p<.05$,

** $p<.01$,

*** $p<.001$.