

Understanding the relationship between negative emotional eating and binge eating: The moderating effects of acting with awareness and non-reactive mindfulness

Wesley R. Barnhart  | Abby L. Braden  | Lauren A. Dial 

Department of Psychology, Bowling Green State University, Bowling Green, Ohio, USA

Correspondence

Wesley R. Barnhart, Department of Psychology, Bowling Green State University, Psychology Building 223, 822 East Merry Avenue, Bowling Green, OH 43403, USA.
Email: wrbarnh@bgsu.edu

Abstract

Objectives: Negative emotional eating and binge eating are positively related, occur in diverse populations, and may be driven by similar mechanisms. Mindfulness facets such as acting with awareness, describe, non-judgement, non-reactive, and observe may moderate the relationship between these maladaptive eating phenotypes.

Method: A cross-sectional study assessed emotional eating-depression (Emotional Eating Scale-Revised, depression subscale), trait mindfulness facets (Five Facet Mindfulness Questionnaire-Short Form), and binge eating severity (Binge Eating Scale) in adults ($N = 258$).

Results: Emotional eating-depression was less strongly associated with binge eating severity in participants with higher acting with awareness mindfulness. Emotional eating-depression was more strongly associated with binge eating severity in participants with higher non-reactive mindfulness.

Conclusions: Acting with awareness and non-reactive mindfulness may be important treatment targets in concurrent presentations of emotional eating-depression and binge eating.

KEYWORDS

acting with awareness mindfulness, binge eating, emotional eating, mindfulness, negative emotional eating, non-reactive mindfulness

1 | INTRODUCTION

Binge eating (BE) is a serious eating disorder symptom that includes the consumption of an unusually large amount of food over a short period of time with feelings of loss of control during the eating episode (American Psychiatric Association [APA], 2013). BE presents across the full spectrum of eating pathology (APA, 2013) and is positively associated with weight gain and obesity, hypertension, type 2 diabetes, and heart disease (Bankier et al., 2004; Bulik et al., 2002; Hasler et al., 2004; Telch et al., 1988). Thus, BE is a significant public health concern (Austin, 2012), yet mechanisms remain poorly understood. Research is needed to develop our understanding of factors related to BE to support prevention and treatment efforts. One such factor is emotional eating.

Emotional eating, or the urge to eat in response to emotions outside of physiological need (i.e., hunger; Arnow et al., 1995), is related to BE. That said, emotional eating and BE are unique constructs in a number of ways (APA, 2013; Arnow et al., 1995). First, emotional antecedents are not required for BE (APA, 2013), nor is the consumption of an unusually large amount of food required for emotional eating (Arnow et al., 1995). Indeed, emotional eating can include snacking, eating a regular meal, or overeating (Arnow et al., 1995) while BE is marked by the consumption of an unusually large amount of food (APA, 2013). Second, the latency with which these eating behaviors occur differ, with emotional eating occurring over a more diffuse state (Arnow et al., 1995) while BE occurs over a defined short period of time (APA, 2013). Finally, emotional eating differs from BE in that emotional eating does not share the hallmark feature of loss of control during an eating episode (APA, 2013). In addition to these functional differences, emotional eating is a more common and less severe eating phenotype than BE (Lindeman & Stark, 2001; Vannucci et al., 2013), and some research has shown that emotional eating prospectively predicts BE (Stice et al., 2002). Thus, it is important to understand under what circumstances and for whom emotional eating and BE overlap.

These differences aside, emotional eating and BE share negative health consequences including weight gain and obesity (Fairburn et al., 1998; Hudson et al., 2007; Koenders & van Strien, 2011; Raman et al., 2013; Udo & Grilo, 2018); thus, factors associated with decreased emotional eating and BE may prove especially useful in advancing prevention and treatment efforts. However, it is important to first consider the valence of emotional eating. More specifically, emotional eating can be conceptualized as negative and positive emotional eating (Arnow et al., 1995; Nolan et al., 2010), which can be further defined as an urge to eat in response to negative (e.g., sadness) and positive (e.g., happiness) emotions, respectively, in the absence of hunger. While positive emotional eating may be positively associated with BE (Barnhart et al., 2020; Sultson et al., 2017), negative emotional eating has the strongest evidence base in relation to BE (e.g., Barnhart et al., 2021; Braden et al., 2018).

Negative emotional eating is positively associated with BE. Early research shows that increased negative emotional eating may be uniquely tied to populations that exhibit BE such as people with binge eating disorder (Eldredge & Agras, 1996), demonstrating the potential positive relationship between negative emotional eating and BE. These data have been replicated in a body of research (Agras & Telch, 1998; Telch & Agras, 1996a; Telch & Argus, 1996b) pointing to a robust, positive relationship between negative emotional eating and BE, and more contemporary research replicates this effect in clinical (e.g., Gianini et al., 2013; van Strien et al., 2005) and non-clinical (e.g., Barnhart et al., 2020; Sultson et al., 2017) populations. Given the wealth of evidence supporting the positive relationship between negative emotional eating and BE, some research has endeavored to understand factors that may mitigate the effects of negative emotional eating and BE. One such factor that has emerged in the literature is mindfulness.

Mindfulness can be conceptualized as attention to the present moment without judgment (Kabat-Zinn, 1990), including acceptance and openness to experiences in the present moment (Bishop et al., 2004). Research on mindfulness highlights the importance of “reperceiving” (Shapiro et al., 2006), the process whereby an individual distances themselves from their thoughts, feelings, and emotions experienced in daily life. Indeed, mindfulness has been positioned as a self-regulatory process—or the process by which one is aware of or yields attention to the development and maintenance of psychological/behavioral functioning—and has shown effectiveness in improving

well-being (Brown & Ryan, 2003). Furthermore, mindfulness may prove especially useful in regulating emotions (Chambers et al., 2009; Roemer et al., 2015), specifically negative emotions. Because negative emotional eating and BE may be driven by maladaptive affect regulation (Arnou et al., 1995; Heartherton & Baumeister, 1991; Pine, 1985; Polivy & Herman, 1993), mindfulness may therefore be a promising factor underlying negative emotional eating and BE symptom reduction.

Indeed, mindfulness has been associated with decreased symptom severity in people who engage in negative emotional eating (Alberts et al., 2010; Daubenmier et al., 2011) and BE (Baer et al., 2005; Kristeller & Hallett, 1999). A recent meta-analysis demonstrated that across the full spectrum of eating pathology, mindfulness appears to be especially useful in symptom reduction of negative emotional eating and BE (Sala et al., 2020). In treatment contexts, mindfulness meditation interventions such as mindfulness training was associated with decreased negative emotional eating and BE across diverse overweight/obese and clinical eating disorder populations (Katterman et al., 2014). However, all of these studies either examined negative emotional eating and BE in isolation or, if combined, examined separate reductions as a consequence of mindfulness training. To our understanding, no research to date has examined if the *relationship* between negative emotional eating and BE may vary based on (henceforth discussed as moderators) mindfulness.

Given that negative emotional eating and BE may both be driven by maladaptive affect regulation (Arnou et al., 1995; Heartherton & Baumeister, 1991; Pine, 1985; Polivy & Herman, 1993), and that mindfulness is associated with maladaptive affect regulation (Chambers et al., 2009; Roemer et al., 2015), mindfulness may moderate the relationship between these eating phenotypes. For example, the maladaptive affect regulation theory of BE (Polivy & Herman, 1993) holds that BE is elicited as a reaction to the experience of negative emotions, with the emotional state improving as a consequence of BE (but see Haedt-Matt & Keel, 2011). However, other theories of BE exist with unique mechanisms (Heartherton & Baumeister, 1991; Pine, 1985). For example, escape theory (Heartherton & Baumeister, 1991) holds that BE is elicited as a way to escape the negative emotional experience altogether, whereas emotional arousal theory (Pine, 1985) holds that BE is elicited in response to emotionally arousing experiences and events in one's environment as a way to return emotional arousal to baseline. Though mechanisms may differ, each of these theories underscore maladaptive affect regulation as a primary driving factor of BE. This overlaps with mechanisms of negative emotional eating in which the urge to eat is triggered by negative emotional antecedents, irrespective of physiological hunger, to regulate the aversive emotional experience (Arnou et al., 1995). Thus, across both phenotypes, eating is proposed to be elicited in response to negative emotions as a way to regulate these negative emotions. This common ground between negative emotional eating and BE, that both can be elicited in response to negative emotions, both elicited as a way to regulate the aversive emotional experience, and that both may be internally driven processes points to the potential for mindfulness to moderate the relationship between these maladaptive eating phenotypes.

Indeed, mindfulness has emerged as an important moderator variable in the eating pathology literature. For example, recent data with a nonclinical population demonstrated that higher mindfulness weakened the positive relationship between eating disorder cognitions and eating disorder behaviors (Masuda et al., 2018). Previous research with a non-clinical population showed that among participants with lower levels of depressive symptoms, higher mindfulness was associated with less negative emotional eating (Pidgeon et al., 2012). Furthermore, recent clinical data (i.e., people with cystic fibrosis) demonstrated that relationships between negative emotional eating and body mass index (BMI) were weakened by both mindfulness and mindful eating behavior (Egan et al., 2020). However, across these studies, mindfulness was operationalized more broadly as opposed to considering trait mindfulness facets such as acting with awareness, describe, non-judgment, non-reactive, and observe. Given that research has identified differential relationships between trait mindfulness facets and a host of psychological variables (Hanley & Garland, 2017), trait mindfulness facets may differentially moderate the relationship between negative emotional eating and BE.

Acting with awareness, describe, non-judgment, non-reactive, and observe are known trait mindfulness facets that map onto individual characteristic tendencies relevant to a range of mental health problems (Carpenter

et al., 2019), including negative emotional eating and BE (Frayn & Knäuper, 2016; Katterman et al., 2014; O'Reilly et al., 2014). For instance, people endorsing acting with awareness may show a weaker relationship between negative emotional eating and BE given this mindfulness facet places active attentional intervention to thoughts, feelings, and emotions in the moment (Baer et al., 2006), which may mitigate negative emotional antecedents proposed to drive these maladaptive eating phenotypes (Arnow et al., 1995; Heartherton & Baumeister, 1991; Pine, 1985; Polivy & Herman, 1993). In this case, it is possible that acting with awareness may demonstrate a protective effect on the relationship between negative emotional eating and BE.

Alternatively, people endorsing non-reactive mindfulness, or letting thoughts, feelings, and emotions come and go *without* attentional intervention (Baer et al., 2006), may also experience a weaker relationship between negative emotional eating and BE given this mindfulness facet may simply mute reactions to negative emotions. Thus, *urges* to eat in response to negative emotions, which appear to be important antecedents to negative emotional eating and BE, may be muted when one engages in non-reactive mindfulness. Similarly, people endorsing non-judgement mindfulness, or acceptance of internal thought processes without critical evaluation (Baer et al., 2006), may also experience a weaker relationship between negative emotional eating and BE because this mindfulness facet mitigates negative internal thought processes such as shame and guilt that are particularly relevant to negative emotional eating (Wong & Qian, 2016) and BE (Sanfter et al., 1995).

Finally, people endorsing describe and observe mindfulness, in which mindful attention is paid to noticing one's internal and external experiences (observe), as well as labeling these experiences through language (describe) (Baer et al., 2006), may similarly impact negative emotional eating and BE, but their moderating roles on the relationship between these maladaptive eating phenotypes is less clear. More specifically, describe and observe facets of mindfulness may be more related to external processes (e.g., noticing/labeling physical sensations in one's environment) as compared to the internal mindfulness processes (e.g., acting with awareness; Baer et al., 2006). This distinction between internal and external processes is important given some theoretical models of negative emotional eating and BE hinge on regulating aversive *internal* experiences (i.e., negative emotions, Arnow et al., 1995; Heartherton & Baumeister, 1991; Pine, 1985; Polivy & Herman, 1993). Taken together, while some mindfulness facets may bear closer resemblance to mechanisms of negative emotional eating and BE (e.g., acting with awareness, non-reactive, and non-judgement) compared to others (e.g., describe and observe), no research to date has explored the moderating effects of mindfulness facets on the relationship between these maladaptive eating phenotypes, and thus the present study addressed an important gap in the literature.

1.1 | The present study

The present study used overlapping theories of negative emotional eating and BE (Arnow et al., 1995; Heartherton & Baumeister, 1991; Pine, 1985; Polivy & Herman, 1993) to examine trait mindfulness facets as moderators of the relationship between emotional eating in response to depression (i.e., emotional eating-depression) and BE. Within the broad range of negative emotions that can trigger emotional eating, specific types of negative emotions exist such as eating in response to depression, anger/anxiety, and boredom (Arnow et al., 1995; Koball et al., 2012). Indeed, the initial conceptualization of emotional eating as measured by the Emotional Eating Scale was designed to tap into specific negative emotions that may be related to the urge to eat (Arnow et al., 1995), and specific negative emotions may be uniquely related eating behavior (Macht, 2008). Because emotional eating in response to depression, as opposed to anger/anxiety, boredom, and positive emotional eating, was most strongly related to higher disordered eating (Braden et al., 2018), the present study focused on emotional eating-depression.

Furthermore, given that internal facets of mindfulness may overlap with maladaptive affect regulation theories of negative emotional eating and BE, exploratory hypotheses proposed that emotional eating-depression would be less strongly associated with BE severity when internal facets of mindfulness (e.g., acting with awareness,

non-reactive, and non-judgement mindfulness) were high. It was also hypothesized that more external facets of mindfulness (e.g., describe and observe mindfulness), in which an emphasis is placed on noticing and labelling experiences and sensations in one's environment, would not moderate the relationship between these maladaptive eating phenotypes.

2 | METHODS

2.1 | Participants

Participants ($N = 258$), recruited through Amazon Mechanical Turk (MTurk; participant database on Amazon.com), completed a cross-sectional study on eating behaviors, childhood experiences, and health. Inclusion criteria were that participants be adults (≥ 18 years), U.S. residents, and fluent in the English language. At the start, 638 participants were recruited, and from these, 380 were excluded. Participants were excluded due to not providing consent (0.3% of the initial sample), reporting the presence of a medical condition impacting appetite or weight (e.g., diabetes, cancer; 14.6%), current pregnancy or breast-feeding (11.1%), or current (8%) or past diagnosis of Anorexia Nervosa or Bulimia Nervosa (10%). Participants with Anorexia Nervosa or Bulimia Nervosa were excluded because the parent study (Braden et al., 2020) sought to inform treatment of adults with emotional eating who do not have these eating disorders. To assist in data quality, attention checks were implemented to help correct for random participant responding. To this end, participants were also excluded if their response patterns indicated random responding (i.e., failed to correctly answer at least two out of three attention check items; 15.5%).

2.2 | Measures

2.2.1 | Demographics

Participants self-reported age, gender, education level, race/ethnicity, relationship and employment status, and current income. Data were also collected on participants' parents, including their marital status and level of education, but these data were not analyzed in the present study.

2.2.2 | Anthropometry

BMI (kg/m^2) was assessed with participants' self-reported height in feet and weight in pounds.

2.2.3 | Emotional Eating Scale-Revised, depression subscale

The urge to eat in response to negative emotions, specifically depression-related emotions (e.g., sadness, loneliness, and guilt), was assessed using the depression subscale of the Emotional Eating Scale-Revised (EES-R; Koball et al., 2012). The EES-R depression subscale consists of nine items measuring eating in response to depressed feelings (e.g., sadness, loneliness, and guilt). Items are measured on a 5-point Likert scale ranging from 1 ("no desire to eat") to 5 ("an overwhelming desire to eat"). Since its inception, examining specific subscales, not overall scores, has been the recommended research practice given validity and reliability of the EES-R were based on subscale scores (Koball et al., 2012). Furthermore, eating in response to

depression has received the strongest support as a positive correlate in the eating and weight disorders literature (Braden et al., 2018); thus, we focused on eating in response to depression, termed emotional eating-depression, for the present analyses. Higher scores were indicative of increased endorsement of emotional eating-depression. Previous research demonstrates good psychometric properties (i.e., validity and reliability) with the EES-R (Koball et al., 2012). In the present study, internal consistency was high ($\alpha = .94$; $\omega = .94$).

2.2.4 | Five Facet Mindfulness Questionnaire-Short Form

The Five Facet Mindfulness Questionnaire-Short Form (FFMQ-SF; Bohlmeijer, ten Klooster, et al., 2011) assesses five trait facets of mindfulness which include: (1) acting with awareness, (2) description of experiences, (3) non-judgment of inner thoughts, (4) non-reactive to inner negative emotions and thoughts, and (5) observation of internal and external environments. The FFMQ-SF contains 24 items divided into five subscales that range from four to five items. All items are measured on a 5-point Likert scale ranging from 1 ("never or very rarely true") to 5 ("very often or always true"). Higher scores were indicative of increased endorsement of the mindfulness facets. Previous research demonstrates good psychometric properties (i.e., good internal consistency and construct validity) with the FFMQ-SF (Bohlmeijer, Fledderus, et al., 2011). In the present study, internal consistency was high for the acting with awareness ($\alpha = .90$; $\omega = .90$), describe ($\alpha = .76$; $\omega = .75$), non-judgment ($\alpha = .86$; $\omega = .86$), non-reactive ($\alpha = .83$; $\omega = .84$), and observe ($\alpha = .81$; $\omega = .81$) subscales.

2.2.5 | Binge Eating Scale

The Binge Eating Scale (BES; Gormally et al., 1982) is a 16-item self-report measure assessing behavioral, emotional, and cognitive aspects of BE. Items include three or four statements that range in severity about various aspects of BE. For example, statements may range from, "I don't feel any guilt or self-hate after I overeat," to "Almost all the time I experience strong guilt or self-hate after I overeat." Higher BES scores were indicative of increased endorsement of severe BE. Previous research demonstrates good psychometric properties in clinical and non-clinical samples (Duarte et al., 2015; Gormally et al., 1982), with near 100% discriminant validity (96.7% discrimination) in detecting clinical cases of BE from non-clinical (Duarte et al., 2015). In the present study, internal consistency was high ($\alpha = .93$; $\omega = .93$).

2.3 | Procedure

The present study was approved by the university's Institutional Review Board before data collection and advertised on MTurk's TurkPrime extension. Participants gave electronic informed consent and then completed the survey. Completion of the present study was approximately 30 minutes in total. In closing the survey, participants were debriefed and given contact information to address study-related questions or concerns. Participants were compensated \$1.25 for their participation.

Previous research documents the potential for MTurk samples to yield diverse, quality data (Casler et al., 2013); however, crowdsourcing data collection methods introduce threats to data quality due to random responding or poor participant motivation. To help prevent threats to data quality, three attention checks were integrated into the survey (e.g., "When you are done reading this question, choose 'about half the time' as your answer.") to help correct random participant responding.

2.4 | Analytic plan

Data were screened to ensure values for study variables were within minimum and maximum expected ranges. Data were also screened to detect the presence of possible outliers and missing data. Next, multiple regression assumptions were examined which included assumptions of additivity, homoscedasticity, linearity, and normality, followed by calculation of descriptive statistics to determine means, standard deviations, minimum and maximum values, range, kurtosis and skewness, and bivariate correlations for primary study variables: emotional eating-depression, mindfulness facets (acting with awareness, describe, non-judgment, non-reactive, and observe), and BE.

Because we were interested in mindfulness facets as moderators of the relationship between emotional eating-depression and BE, five moderation (Model 1) analyses were calculated in the PROCESS macro for SPSS, version 25, according to methods outlined by Hayes (2018). Conducting five separate moderation analyses allowed for distinction of effects across each mindfulness facet, as well as how the specific mindfulness facet interacted with emotional eating-depression in relation to BE variance as determined by conditional moderation effects and examination of the Johnson–Neyman significance region. Furthermore, because exploratory hypotheses outlined potential differences in moderation effects across mindfulness facets, five separate models were tested. Each moderation analysis was bootstrapped with 5000 replications to calculate standard errors and 95% confidence intervals. In each model, BE was included as the dependent variable. After inspection of scatterplots, it was determined that these data were slightly heteroscedastic. To correct for this, heteroscedasticity consistent standard error estimates (HC3 estimator) were included in each model (Hayes & Cai, 2007). All five moderation analyses included BMI (mean centered) and gender (0 = males, 1 = females) as covariates. BMI and gender were included as covariates given each variable is associated with eating pathology, including emotional eating-depression and BE (Hays et al., 2002; Lazarevich et al., 2016; McCuen-Wurst et al., 2018; Nguyen-Rodriguez et al., 2009; Savage & Birch, 2010; Striegel-Moore et al., 2009). In controlling for these potential confounds, we were able to map the relationships between emotional eating-depression and mindfulness facets in relation to BE with increased accuracy and precision.

3 | RESULTS

3.1 | Preliminary results

Of the 258 participants, some were excluded due to concerns about data quality. For example, two participants (0.78%) reported implausible age values and an additional 20 participants (7.75%) reported weight and height values that yielded extreme BMI values. To support data quality, extreme BMI values were deduced in consideration of World Health Organization (1995) values in which low values such as a BMI of 17 indicate extreme thinness and increased potential for an extraneous health condition that could potentially impact data quality (e.g., Anorexia Nervosa not self-reported). Other height and weight values self-reported were screened and excluded due to implausibility (e.g., weight of 3 pounds). Because BMI was used as a covariate in all moderation analyses, extreme BMI data were not included in these analyses. An additional 18 participants (6.98%) were not included in moderation analyses due to missing data on more than one item of the FFMQ (1.55%; four participants evenly distributed across all five subscales) and BES (5.42%; 14 participants). Pairwise deletion was used to retain participant data that included missing variables but eliminate those from primary analyses that used missing data. The final resulting sample was 218, which was used to calculate descriptive and bivariate correlations for primary study variables and all moderation analyses. Participants ($N = 258$) were split across gender, males ($n = 127$) and females ($n = 130$), with only one participant listing their gender as “Other.” Moreover, participants were, on average, 36.5 (11) years of age, Caucasian (65%), overweight (BMI = 26.9 [7.1]), married (45%), employed full-time

TABLE 1 Descriptive statistics and bivariate correlations across primary study variables

	Mean	SD	Min.	Max.	Range	Kurtosis (SE)	Skew (SE)	1.	2.	3.	4.	5.	6.
1. EE-D	2.37	1.07	1.00	4.67	3.67	-1.11 (.30)	.31 (.15)	-					
2. AA	3.42	1.07	1.00	5.00	4.00	-.80 (.30)	.11 (.15)	-.55**	-				
3. DS	3.42	0.84	1.00	5.00	4.00	-.36 (.30)	-.28 (.15)	-.21**	.43**	-			
4. NJ	3.06	1.03	1.00	5.00	4.00	-1.00 (.30)	-.12 (.15)	-.46**	.68**	.34**	-		
5. NR	3.26	0.88	1.00	5.00	4.00	-.13 (.30)	.04 (.15)	.07	-.03	.40**	.02	-	
6. OB	3.61	0.88	1.00	5.00	4.00	-.11 (.30)	-.55 (.15)	.14*	-.06	.24**	-.11	.36**	-
7. BES	10.82	9.32	0.00	36.00	36.00	-.81 (.32)	.57 (.16)	.60**	-.53**	-.27**	-.45**	-.04	.07

Note: $N = 218$.

Abbreviations: AA, acting with awareness; BES, binge eating severity; DS, describe; EE-D, emotional eating-depression; Max., maximum; Min., minimum; NJ, non-judgment; NR, non-reactive; SD, standard deviation; SE, standard error; OB, observe.

* $p < .05$.

** $p < .01$.

(76%), and earning an annual income approximately between \$20,000–\$50,000 (see parent study, Braden et al., 2020, for more information).

Regression assumptions, including additivity, homoscedasticity, linearity, and normality were examined and scatterplots generated. Collinearity diagnostics revealed that each variable had a tolerance greater than .20, showing that each variable has a unique contribution on BE variance, and variance inflation factors that did not exceed 5 (all less than 3; Belsley et al., 1980). Descriptive statistics including means, standard deviations, minimum and maximum values, range, kurtosis and skewness, and bivariate correlations are presented in Table 1.

Significant correlations were observed across study variables (see Table 1). A significant positive correlation was observed between emotional eating-depression and BE ($r = .60$). Of note, the correlation between emotional eating-depression and BE was also previously calculated and reported in a recently published study that used the current data set (Barnhart et al., 2020). Across mindfulness facets, significant negative correlations were observed with emotional eating-depression and BE (Table 1).

3.2 | Mindfulness facets as moderators

3.2.1 | Model 1: Acting with awareness mindfulness

When examining BE, the overall model assessing acting with awareness mindfulness was significant ($R^2 = .50$, $p < .001$; Table 2). The interaction between emotional eating-depression and acting with awareness mindfulness on BE was significant ($b = -.92$, $p = .03$), which accounted for a significant proportion of the variance in BE severity, $\Delta R^2 = .01$, $\Delta F(1, 212) = 4.86$, $p = .03$. Conditional moderation was observed such that higher emotional eating-depression was associated with higher BE severity when acting with awareness mindfulness was 1SD below average ($b = 4.62$, $p < .001$), average ($b = 3.65$, $p < .001$), and 1SD above average ($b = 2.68$, $p = .001$; Figure 1). However, the strength of the relationship between emotional eating-depression and BE severity, although still positive and significant at each level of the moderator, varied based on the level of acting with awareness mindfulness. For example, emotional eating-depression was less strongly associated with BE severity when acting with awareness mindfulness was high (+1SD above average) compared to low (-1SD below average). Thus, exploratory hypotheses were supported. See Figure 1. Examination of the Johnson–Neyman significance region revealed that at all values of acting with awareness, significant conditional effects of

TABLE 2 Mindfulness facets as moderators of the relationship between emotional eating-depression and binge eating severity

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	LLCI	ULCI
Model 1: AA						
EE-D	3.65	0.58	6.30	<.001***	2.51	4.80
AA	-2.91	0.51	-5.68	<.001***	-3.92	-1.90
EE-D × AA	-.92	0.42	-2.21	.03*	-1.74	-.10
CV: BMI	.30	0.06	5.21	<.001***	.18	.41
CV: Gender	1.06	0.97	1.09	.27	-.83	2.97
CME						
-1 SD	4.62	0.65	7.13	<.001***	3.34	5.90
Average AA	3.65	0.58	6.30	<.001***	2.51	4.80
+1SD	2.68	0.80	3.36	.001***	1.11	4.30
Model 2: DS						
EE-D	5.06	.51	9.84	<.001***	4.05	6.08
DS	-1.88	.62	-3.04	.003**	-3.11	-.66
EE-D × DS	-.33	.62	-.53	.59	-1.54	.89
CV: BMI	.27	.06	4.46	<.001***	.15	.39
CV: Gender	.50	1.02	.49	.62	-1.51	2.50
Model 3: NJ						
EE-D	4.36	.56	7.80	<.001***	3.26	5.46
NJ	-2.35	.58	-4.04	<.001***	-3.50	-1.20
EE-D × NJ	-.62	.47	-1.32	.19	-1.53	.30
CV: BMI	.27	.06	4.24	<.001***	.15	.40
CV: Gender	.89	.98	.90	.37	-1.05	2.83
Model 4: NR						
EE-D	5.20	.50	10.31	<.001**	4.20	6.20
NR	-.74	.53	-1.39	.17	-1.80	.31
EE-D × NR	1.50	.46	3.21	.002**	.57	2.37
CV: BMI	.27	.06	4.60	<.001***	.16	.39
CV: Gender	.43	1.01	.42	.67	-1.56	2.41
CME						
-1 SD	3.92	.69	5.69	<.001***	2.56	5.28
Average NR	5.19	.50	10.31	<.001***	4.20	6.20
+1SD	6.50	.59	10.94	<.001***	5.30	7.63
Model 5: OB						
EE-D	5.37	.54	10.03	<.001***	4.31	6.42
OB	-.08	.57	-.14	.89	-1.21	1.04
EE-D × OB	.17	.54	.31	.76	-.89	1.23

(Continues)

TABLE 2 (Continued)

	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	LLCI	ULCI
CV: BMI	.27	.06	4.27	<.001***	.15	.40
CV: Gender	.51	1.04	.49	.62	-1.54	2.57

Note: Model 1: AA, $R^2 = .50$. Model 2: DS, $R^2 = .44$. Model 3: NJ, $R^2 = .47$. Model 4: NR, $R^2 = .44$. Model 5: OB, $R^2 = .41$. $N = 218$. Covariates included in all moderation analyses: BMI and Gender.

Abbreviations: AA, acting with awareness; BMI, body mass index; CME, conditional moderation effects; CV, covariate; DS, describe; EE-D, emotional eating-depression; LLCI, lower level confidence interval; NJ, non-judgment; NR, non-reactive; OB, observe; SE, standard error; ULCI, upper level confidence interval.

* $p < .05$.

** $p < .005$.

*** $p < .001$.

emotional eating-depression on BE severity were observed in the direction of effects displayed in Figure 1. Conditional moderation was significant with the inclusion of BMI ($b = .30$, $p < .001$) and gender ($b = 1.06$, $p = .27$) covariates.

3.2.2 | Model 2: Describe mindfulness

When examining BE, the overall model assessing describe mindfulness was significant ($R^2 = .44$, $p < .001$; Table 2). However, describe mindfulness did not moderate the association between emotional eating-depression and BE ($b = -.33$, $p = .59$).

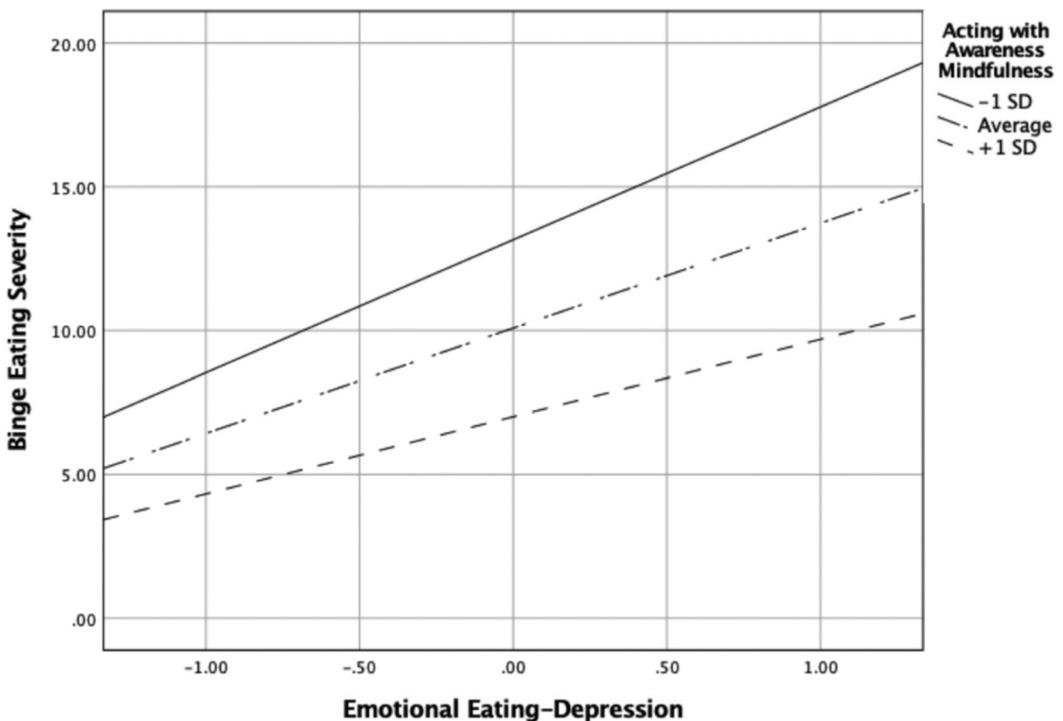


FIGURE 1 Moderation of emotional eating-depression and binge eating severity by acting with awareness mindfulness

3.2.3 | Model 3: Non-judgment mindfulness

When examining BE, the overall model assessing non-judgment mindfulness was significant ($R^2=.47$, $p < .001$; Table 2). However, non-judgment mindfulness did not moderate the association between emotional eating-depression and BE ($b = -.62$, $p = .19$).

3.2.4 | Model 4: Non-reactive mindfulness

When examining BE, the overall model assessing non-reactive mindfulness was significant ($R^2=.44$, $p < .001$; Table 2). The interaction between emotional eating-depression and non-reactive mindfulness on BE was significant ($b = 1.50$, $p = .002$), which accounted for a significant proportion of the variance in BE severity, $\Delta R^2=.02$, $\Delta F(1, 212) = 10.28$, $p = .002$. Conditional moderation was observed such that higher emotional eating-depression was associated with higher BE severity when non-reactive mindfulness was 1 SD below average ($b = 3.92$, $p < .001$), average ($b = 5.19$, $p < .001$), and 1 SD above average ($b = 6.50$, $p < .001$). However, like acting with awareness mindfulness, the strength of the relationship between emotional eating-depression and BE severity varied based on the level of the moderator. Unlike acting with awareness mindfulness, emotional eating-depression was more strongly associated with BE severity when non-reactive mindfulness was high (+1 SD above average) compared to low (-1 SD below average). Thus, exploratory hypotheses were not supported. See Figure 2. Examination of the Johnson-Neyman significance region further revealed that at slightly over -2 SDs, non-reactive mindfulness no longer significantly moderated the relationship between emotional eating-depression and BE ($b = 2.21$, $p = .05$), and lower scores beyond this value were non-significant. Thus, emotional eating-depression was no longer significantly related to BE severity at extremely low levels of non-reactive mindfulness. At the low and upper values of non-reactive mindfulness, relationships with emotional eating-depression and BE remained significant. More specifically, low (-1 SD; $b = 3.92$, $p < .001$), average ($b = 5.19$, $p < .001$), high (+1 SD; $b = 6.50$, $p < .001$), and extremely high (approximately +2 SDs; $b = 7.74$, $p < .001$) non-reactive mindfulness significantly moderated relationships between emotional eating-depression and BE severity, and it appears that emotional eating-depression was more strongly associated with BE severity at higher levels of non-reactive mindfulness. Conditional moderation was significant with the inclusion of BMI ($b = .27$, $p < .001$) and gender ($b = .43$, $p = .67$) covariates.

3.2.5 | Model 5: Observe mindfulness

When examining BE, the overall model assessing observe mindfulness was significant ($R^2=.41$, $p < .001$; Table 2). However, observe mindfulness did not moderate the association between emotional eating-depression and BE ($b = .17$, $p = .76$).

4 | DISCUSSION

Binge eating is a serious, transdiagnostic eating disorder symptom (APA, 2013) positively associated with poor health outcomes (Bankier et al., 2004; Bulik et al., 2002; Hasler et al., 2004; Telch et al., 1988). Results echo previous research with diverse populations (Agras & Telch, 1998; Eldredge & Agras, 1996; Gianini et al., 2013; Sultson et al., 2017; Telch & Agras, 1996a; Telch & Argus, 1996b; van Strien et al., 2005) and point to a strong, positive correlation between emotional eating-depression and BE (Barnhart et al., 2020). The present study builds on this positive relationship by exploring whether acting with awareness, describe, non-judgment, non-reactive, and observe mindfulness facets moderate the relationship between emotional eating-depression and BE. More

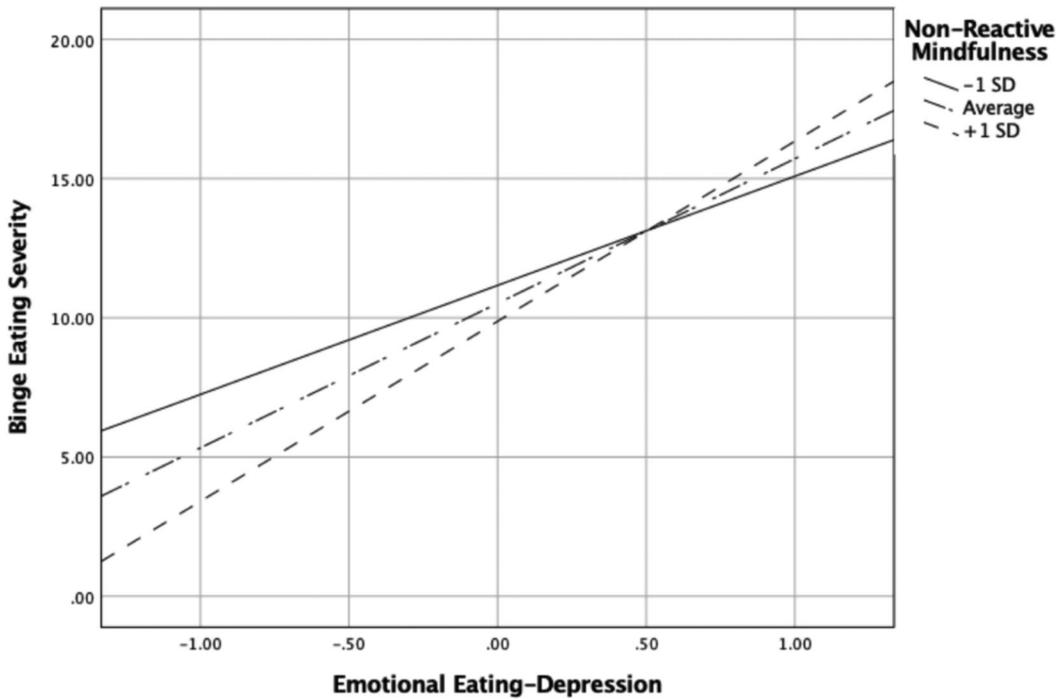


FIGURE 2 Moderation of emotional eating-depression and binge eating severity by non-reactive mindfulness

specifically, exploratory hypotheses proposed that more internal facets of mindfulness (e.g., acting with awareness, non-reactive, and non-judgement mindfulness) would moderate the relationship between negative emotional and BE such that emotional eating-depression would be less strongly associated with BE when internal facets of mindfulness were high. Furthermore, exploratory hypotheses proposed that external facets of mindfulness (e.g., describe and observe mindfulness) would not moderate the relationship between emotional eating-depression and BE.

We found partial evidence for the exploratory hypotheses, namely with acting with awareness mindfulness. At high and low levels of emotional eating-depression, the lowest levels of BE severity were observed when acting with awareness mindfulness was high. In other words, findings suggest that emotional eating-depression was less strongly associated with BE severity when acting with awareness mindfulness was high. These data overlap with intervention research suggesting that eating with awareness mindfulness-based interventions are more effective at impacting eating behavior and weight loss than more general mindfulness-based interventions (see Katterman et al., 2014, for a review). Relatedly, longitudinal investigations of associations between trait mindfulness facets and eating pathology in clinical eating disorder presentations demonstrated that lower acting with awareness mindfulness prospectively predicted higher drive for thinness and bulimic symptoms, with the latter effect complementing the present findings (Sala et al., 2019). Furthermore, these data are in line with previous research documenting a negative relationship between acting with awareness mindfulness and negative emotional eating in people who are overweight with diabetes (Levin et al., 2014; Ouwens et al., 2015; Tak et al., 2015). More recent research demonstrated that acting with awareness mindfulness fully mediated the relationship between depressive symptomatology and negative emotional eating in the general population, possibly leading to decreased emotional eating (Höppener et al., 2019). The protective effect of acting with awareness mindfulness on the association between emotional eating-depression and BE should be considered in light of the contrasting effects of non-reactive mindfulness.

Acting with awareness mindfulness refers to behavior that is characterized by purposeful, active attention to one's internal thoughts, feelings, and emotions in the moment (Baer et al., 2006). In contrast, non-reactive mindfulness refers to letting internal thoughts, feelings, and emotions come and go without active attentional intervention (Baer et al., 2006). Results of the present study showed that high levels of emotional eating-depression were more strongly associated with BE severity when non-reactive mindfulness was higher, not lower. Taken together, data suggest that emotional eating-depression may be more strongly associated with BE severity in people with high levels of non-reactive awareness mindfulness. Furthermore, people who experience infrequent emotional eating-depression may benefit from practicing non-reactive mindfulness, as it may be associated with lower BE severity. However, people who struggle with more frequent emotional eating-depression may benefit from practicing more active mindfulness strategies as these may be associated with lower BE severity. Findings with non-reactive mindfulness were not supported by exploratory hypotheses; nonetheless, several possibilities may shed light on these unexpected outcomes.

One possibility reconsiders the function of non-reactive mindfulness on emotional eating-depression and BE. More specifically, non-reactive mindfulness may serve a deleterious effect in the context of emotional eating-depression and BE because the key pieces of this facet of mindfulness, to ignore or let go of thoughts, feelings, and emotions may mimic maladaptive affect regulation mechanisms such as ignoring or suppressing thoughts and feelings, namely negative emotions. Thus, emotional eating-depression may be more strongly associated with BE severity at higher levels of non-reactive mindfulness. These data add an important nuance to the literature that suggest that non-reactive mindfulness is beneficial for diverse presentations of psychopathology (Hedman et al., 2017; Hicks et al., 2018), and findings from the present study should be interpreted with caution. Another possibility for this unexpected outcome considers the eating behaviors (i.e., emotional eating-depression and BE) themselves. More specifically, the act of engaging in emotional eating-depression and BE may be tools to avoid getting lost in thoughts, feelings, and emotions, and thus the role of non-reactive mindfulness on the relationship between these maladaptive eating phenotypes becomes less clear. What is more clear were data on describe and observe mindfulness.

We found no evidence that describe and observe mindfulness moderate the relationship between emotional eating-depression and BE. Several reasons could help explain these findings. First, it is again important to consider differences across mindfulness facets in the context of theory of emotional eating-depression and BE. Maladaptive affect regulation theory posits that eating behaviors such as emotional eating-depression and BE are elicited in response to the experience of *internal* negative emotions (Polivy & Herman, 1993). Thus, these regulation mechanisms (i.e., emotional eating-depression and BE) are elicited to escape or avoid (Heartherton & Baumeister, 1991) or to return the *internal* negative emotional state to baseline (Pine, 1985). To this end, more externally-based mindfulness practices such as describe and observe may be mechanistically unrelated to the driving factors of emotional eating-depression and BE. An important layer to these data is reflected in the emotional eating literature that suggests that positive emotional eating and emotional eating-depression may be driven by different mechanisms, with emotional eating-depression driven by internal mechanisms and positive emotional eating driven by external mechanisms (e.g., food reward; Macht, 1999), but mechanisms of positive emotional eating still remain largely unknown. Future research should experimentally manipulate internal and external mindfulness to discern their casual role on the full spectrum of emotional eating and BE.

What is less clear are the null effects of non-judgment mindfulness on the relationship between emotional eating-depression and BE, a finding that runs contrary to exploratory hypotheses. The present study adds an important layer to research on the positive association between shame and guilt and emotional eating-depression and BE (Sanfter et al., 1995; Wong & Qian, 2016); however, non-judgment mindfulness appears to be unrelated to the relationship between emotional eating-depression and BE. Importantly, results from the present study showed that higher non-judgment mindfulness was significantly associated with lower BE severity and emotional eating-depression. Thus, while non-judgment mindfulness may bear specific relevance to symptom reduction of emotional eating-depression and BE separately, it appears that this facet of mindfulness is unrelated to the *relationship*

between these maladaptive eating phenotypes. It could be the case that non-judgement mindfulness within the context of mindful eating behavior, as opposed to broad non-judgement mindfulness, may interact with the relationship between emotional eating-depression and BE, illustrating a novel area for future research. Importantly, mindful eating behavior has emerged as a moderator of relationships between emotional eating-depression and BMI (Egan et al., 2020) such that mindful eating behavior weakened the link between emotional eating-depression and BMI. Because emotional eating-depression and BE follow a similar positive trend, and because BMI and BE are intimately, positively linked (see McCuen-Wurst et al., 2018, for a review), similar effects may unfold with mindful eating behavior, as opposed to more general mindfulness facets such as non-judgement, on the relationship between these maladaptive eating phenotypes. Use of larger, more heterogeneous sampling to determine the effects of trait mindfulness facets, as well as mindful eating behavior, on emotional eating-depression and BE could provide confirmatory conclusions useful to researchers and clinicians alike. Coupled with this idea for future research exist several other areas, as well as several limitations to consider when interpreting results from the present study.

4.1 | Limitations and future directions

First, the cross-sectional nature of the present study prevents attributions of causality across study variables. Experimental research should manipulate mindfulness facets to discern the casual role of internal- versus external-based mindfulness on negative and positive emotional eating and BE. Second, our sample did not include clinical presentations of BE as evidenced in clinical eating disorder populations. Future research should integrate these research findings into exploratory and confirmatory studies with overweight/obese and clinical eating disorder populations to distinguish potential constraints on generality (Simonds et al., 2017). Third, while the present study did use online crowdsourcing methods that assisted in collecting diverse populations, our sample was still mostly WEIRD: White, Educated, Industrialized, Rich, and Democratic (Henrich et al., 2010). Future research should explore how such relationships between emotional eating-depression, mindfulness, and BE present in non-WEIRD populations. Fourth, use of BMI as a covariate was done to control for the potential impact of overweight status on emotional eating-depression and BE, a positive effect well-established in the literature (e.g., Hays et al., 2002; Lazarevich et al., 2016; McCuen-Wurst et al., 2018; Savage & Birch, 2010). However, BMI as measured by self-reported height and weight is an imperfect assessment of overweight status, and future research would be well-positioned to use more exhaustive measures of overweight status (e.g., in-person weight assessment, waist circumference, distinguishing muscularity from fat tissue, etc.) to calculate BMI. Fifth and finally, the present study explicitly sampled from the depression subscale of the EES-R to run parallel with research supporting the link between negative, depressed emotional states on eating pathology including BE (Braden et al., 2018). Other emotional eating types—though lacking support with existing theoretical models of emotional eating-depression and BE—could be associated with BE and illustrate a unique pathway by which mindfulness influences outcomes.

5 | CONCLUSIONS

Taken together, the present study demonstrated that acting with awareness and non-reactive mindfulness moderate the relationship between emotional eating-depression and BE. Emotional eating-depression was less strongly associated with BE severity in participants with higher acting with awareness mindfulness. Alternatively, emotional eating-depression was more strongly associated with BE severity in participants with higher non-reactive mindfulness. More external facets of mindfulness were not associated with the relationship between emotional eating-depression and BE, which may overlap with theory holding that these eating phenotypes may be driven by internal mechanisms (e.g., maladaptive affect regulation). Furthermore, non-judgement mindfulness was not associated

with the relationship between emotional eating-depression and BE. These data suggest that active attentional intervention to one's internal thoughts, feelings, and emotions in the moment may be associated with lower BE severity among people with concurrent emotional eating-depression styles. Emphasizing research and clinical practice around acting with awareness of internally guided mindfulness processes such as recognizing and attending to the experience of negative emotions in the moment may be of mutual benefit to populations exhibiting emotional eating-depression and BE.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Wesley R. Barnhart  <http://orcid.org/0000-0002-9809-5225>

Abby L. Braden  <http://orcid.org/0000-0002-7412-8854>

Lauren A. Dial  <http://orcid.org/0000-0003-4022-1572>

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