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A daily diary study of emotion regulation as a moderator of negative affect-binge eating associations

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Abstract

Background: While negative affect (NA) typically increases risk for binge eating, the ultimate impact of NA may depend on a person's ability to regulate their emotions. In this daily, longitudinal study, we examined whether emotion regulation (ER) modified the strength of NA-dysregulated eating associations.

Methods: Women (N = 311) from the Michigan State University Twin Registry first reported dimensional binge eating symptoms and broad ER difficulties (e.g., limited emotional awareness, difficulty controlling emotional impulses). Participants then rated use of adaptive (cognitive reappraisal, social sharing, situation modification, acceptance) and maladaptive (rumination, expressive suppression, self-criticism) ER strategies, emotional eating (EE), objective binge eating (OBE), and NA once daily for 49 consecutive days.

Results: There were several main effects of ER on binge-eating pathology in both between-person (i.e., comparing women who differed on average) and within-person (i.e., examining fluctuations in variables day-to-day) analyses. Between-person, greater broad ER difficulties, greater maladaptive strategy use, and lower adaptive strategy use were all associated with greater binge-eating pathology. Within-person, greater maladaptive strategy use was associated with greater odds of OBE on that day and on the following day. However, neither broad emotion regulation difficulties nor use of specific strategies moderated associations between NA and dysregulated eating in between- or within-person analyses.

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Conclusions: While ER is independently associated with risk for dysregulated eating, it may not fully mitigate the impact of NA. Additional strategies (e.g., decreasing environmental stressors, increasing social support) may be needed to minimize NA and its impact on dysregulated eating.

Keywords

Binge eating; emotional eating; emotion regulation; negative affect; longitudinal; daily diary

Negative affect (NA) is a significant risk factor for dysregulated eating (Mason et al., 2018; Schaefer et al., 2020; Van Malderen et al., 2019; Wonderlich et al., 2022). Indeed, emotional eating (EE), or eating in response to NA, is a strong correlate and predictor of clinical binge eating (BE) (Ricca et al., 2009, 2012; Stice et al., 2002). Associations between NA and dysregulated eating are observed not only at the between-person level, but also in within-person studies that track changes in NA and BE/EE over time (Haedt-Matt & Keel, 2011; Mikhail, 2021). In other words, not only are people with higher average NA more likely to experience BE/EE, but day-to-day or hour-to-hour changes in NA may also amplify risk for BE/EE. While decreasing overall NA is important to prevent dysregulated eating, it is rarely possible to avoid NA altogether. Identifying other factors that can decrease the likelihood of BE/EE in response to NA may therefore be key to interrupting cycles of dysregulated eating in people experiencing eating disorders (EDs) such as bulimia nervosa (BN) and binge-eating disorder (BED).

Whether NA leads to BE/EE may depend in part on one's ability to regulate emotions. Emotion regulation (ER) refers to the ability to change the intensity/duration of an emotional response to cope adaptively (Gross, 2013). ER has been more narrowly operationalized two different ways in research: as a person's general (in)ability to recognize emotions and resist maladaptive emotion-driven impulses (i.e., broad ER difficulties), or as use of specific strategies that are typically more or less adaptive to manage emotions (i.e., ER strategy use) (Tull & Aldao, 2015). While broad ER difficulties and use of specific ER strategies are conceptually related, correlations between them are small-to-moderate (e.g., *r*s = .12–.36; Sörman et al., 2021; Westerlund & Santtila, 2018), suggesting they are distinct. Both broad ER difficulties and greater use of maladaptive ER strategies (e.g., rumination, self-criticism) are consistently associated with BE and EE in *between-person* studies (i.e., studies that compare individuals who differ in ER on average; Aldao et al., 2010; Brockmeyer et al., 2014; Kenny et al., 2017; Prefit et al., 2019; Whiteside et al., 2007). Associations between adaptive ER strategies (e.g., thinking differently about the situation, problem solving) and BE/EE are somewhat less consistent, but generally suggest higher adaptive strategy use is associated with *less* BE/EE at a between-person level (Aldao et al., 2010).

Notably, little research has examined associations between ER and BE/EE at a *within-person* level (i.e., how changes in ER are associated with risk for BE/EE in the same person over time). People may use different ER strategies depending on environmental factors (e.g., access to distractions or social support), internal resources (e.g., fatigue), and situational demands (e.g., social norms, situation-specific goals) (Colombo et al., 2020). Although some ER strategies are generally more adaptive than others, the adaptiveness of a strategy depends on context and the ability to flexibly use alternative strategies when appropriate

(e.g., distraction may be helpful for managing short-term distress, but less adaptive when it leads to long-term experiential avoidance) (Aldao, 2013). Within-person analyses can identify the situations and attendant ER strategies that may increase risk for BE/EE in a given moment (Parker et al., 2021).

Intuitively, the impact of ER is likely to be greatest when NA is high at both between- and within-person levels – i.e., ER may matter more for people generally high in NA, and ER may also be more impactful in moments/days when NA is particularly high. Despite a strong theoretical basis, only one study has tested this hypothesis. Svaldi et al. (2019) found that rumination or a composite measure tapping adaptive ER (e.g., tolerating NA, viewing the situation differently) failed to moderate the association between NA and BE in participants with BED. However, this study did not clearly distinguish between specific ER strategies, like distraction, and broad ER difficulties, such as intolerance of NA. Additionally, analyses did not distinguish between- versus within-person effects, and some items did not clearly distinguish adaptive from maladaptive ER (e.g., general attempts to modify emotions were classified as adaptive). Finally, only objective binge eating episodes (OBEs) were examined, and not other forms of dysregulated eating (EE, subjective binge eating [SBE]) that may be more common (Vannucci et al., 2013), are associated with distress/impairment (Forney et al., 2014; Vannucci et al., 2013), and predict future OBEs (Stice et al., 2002). Further research is therefore needed to better understand when and how ER may impact NA-dysregulated eating associations.

In this daily, longitudinal study, we examined whether ER moderated associations between NA and dysregulated eating in a large, population-based sample of women who completed assessments once per day for 49 consecutive days. An extended daily diary design was ideal for capturing BE behaviors that occur less frequently in non-clinical samples and could be missed using shorter, more intensive designs (e.g., ecological momentary assessment [EMA]). Because population-based participants are less likely to experience BE or high NA multiple times per day, administering assessments once per day allowed us to capture relevant behaviors while minimizing participant burden. Multiple measures of dysregulated eating were included to assess similarities/differences across levels of BE severity (i.e., between EE and OBEs).

Methods

Participants

Analyses included 311 female twins ages 15–29 (mean = 22.09, *SD* = 3.21) from the ongoing *Twin Study of Exogenous Hormone Exposure and Risk for Binge Eating*, a 49-day study of hormones and behavior conducted with women from the Michigan State University Twin Registry (MSUTR; Burt & Klump, 2013, 2019; Klump & Burt, 2006). Participants completing the study between November 2018 (when ER measures were added) and October 2020 (when preliminary analyses were conducted) were included.

Participants were recruited through mailings based on birth records (45.3%), flyers (21.4%), social media (18.8%), community events (8.4%), and word-of-mouth (6.2%). Because the parent study focuses on combined oral contraceptives (COC) and BE, eligibility criteria

included: 1) member of a female same-sex twin pair (as documented on birth certificates); 2) at least one twin taking COCs (participants not taking COCs (n = 54, 17.7%) required to have regular menstruation); 3) no pregnancy/lactation in the past 6 months; and 4) no history of genetic/medical conditions known to influence hormones/appetite/weight. Race/ethnicity was assessed via questionnaire based on US Census categories and NIH reporting requirements. Participants identified as white (88.4%), Black/African American (4.2%), Asian/Asian American (1.9%), and multiracial (5.5%), and 4.5% identified as Latina. The mean participant BMI was 24.70 (SD = 5.49, range = 17.04–58.12).

Participants completed daily questionnaires after 5 p.m. and as close to bedtime as possible each day for 49 days. Questionnaires were completed online (99.3%) or via Scantrons. The median completion time was between 11 PM-12 AM, and most surveys (76.4%) were completed after 9 PM. Surveys expired at 4 AM the following morning. Staff called participants 1x/week to confirm protocol adherence and answer questions. Participants received full study compensation if they completed ≥30 daily questionnaires and had ≤4 consecutive missing questionnaires. Additional assessments were completed at the beginning (“intake assessment”), mid-point (~day 23; “intermediate assessment”), and end (after day 49; “final assessment”) of data collection. Dropout was rare (0.5%), and compliance was excellent (89% of daily assessments completed on average).

Measures

Non-Daily Measures

Broad ER difficulties.: Broad ER difficulties were assessed using the 36-item Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004) during the intermediate assessment. Subscales on the DERS assess non-acceptance of emotions (e.g., “when I’m upset, I feel guilty for feeling that way”), difficulties engaging in goal-directed behavior (e.g., “when I’m upset, I have difficulty getting work done”), impulse control difficulties (e.g., “when I’m upset, I become out of control”), limited emotional awareness (e.g., “I am attentive to my feelings” [reverse scored]), limited emotional clarity (e.g., “I have no idea how I am feeling”), and limited access to ER strategies (e.g., “when I’m upset, it takes me a long time to feel better”). Scores on the DERS are significantly correlated with behaviors driven by emotion dysregulation, including non-suicidal self-injury (Gratz & Roemer, 2004), BE (Weinbach et al., 2018; Whiteside et al., 2007), and EE (Gianini et al., 2013). To avoid an excessive number of tests, primary analyses focused on the DERS total score. However, results for individual subscales were similar (see Table S2). Internal consistency for the total score is excellent (α = .95 in the current sample).

BE.: The BE subscale of the Minnesota Eating Behavior Survey[1] (MEBS; von Ranson et al., 2005) administered at intake was used to examine between-person differences in dimensional BE pathology (i.e., thoughts, urges, and behaviors related to BE, such as fear

[1]The Minnesota Eating Behavior Survey (MEBS; previously known as the Minnesota Eating Disorder Inventory [M-EDI]) was adapted and reproduced by special permission of Psychological Assessment Resources, 16204 North Florida Avenue, Lutz, Florida 33549, from the Eating Disorder Inventory (collectively, EDI and EDI-2) by Garner, Olmstead, Polivy, Copyright 1983 by Psychological Assessment Resources. Further reproduction of the MEBS is prohibited without prior permission from Psychological Assessment Resources.

of losing control over eating). The MEBS total score (α = .88 in the current study) and BE subscale (α = .66) show adequate internal consistency; note that the lower BE scale internal consistency is likely due to less frequent item endorsement in a non-clinical sample. The MEBS total score and BE subscale successfully discriminate between individuals with and without BN (von Ranson et al., 2005).

Daily Measures

Disordered eating.: *EE* was assessed using the Dutch Eating Behavior Questionnaire (DEBQ; van Strien et al., 1986) EE subscale modified with permission to refer to that day. DEBQ EE is strongly correlated with OBEs (Ricca et al., 2009, 2012), loss of control over eating (Goossens et al., 2009), and palatable food consumption (van Strien, 2000), and prospectively predicts development of more severe dysregulated eating (Stice et al., 2002). Internal consistency of the daily DEBQ EE subscale is excellent (between-person α = .95; within-person α = .85).

OBEs were assessed by asking participants how many times they binge ate that day. Because multiple OBEs on the same day were rare (0.5% of days), OBEs were dichotomized as 0 = no OBEs, 1 = ≥1 OBEs that day. To ensure participants provided valid reports of OBEs, they were given a detailed definition of OBEs at intake (i.e., eating a large amount of food in a short period of time, accompanied by loss of control) and quizzed on their understanding with four case examples at intake and intermediate assessments (see Klump et al., 2014). Participants could refer to a written definition of OBEs when completing daily questionnaires. These steps increase accuracy of self-reported OBEs (Celio et al., 2004) and are consistent with past research (Klump et al., 2014; Mikhail et al., 2021).

Daily ER strategy use.: Daily ER strategy use was assessed using a protocol adapted from Mikhail and Kring (2019) that is similar to other ER daily dairy studies (e.g., Kalokerinos et al., 2017; Kneeland et al., 2020; Ortner et al., 2021). Participants were first asked to recall when they experienced the most NA that day, then reported the extent to which they used several ER strategies at that time from 1 (not at all) to 5 (very much). Adaptive ER strategies included situation modification (“change an aspect of the situation”), cognitive reappraisal (“think about the situation differently”), acceptance (“accept how you were feeling”), and social sharing (“talk about how you were feeling with someone else”), while maladaptive strategies included expressive suppression (“keep yourself from expressing your emotions outwardly”), self-criticism (“criticize yourself for feeling the way you did”), and rumination (“continue to focus on how you felt and why you felt that way even after the situation ended”). An additional item assessing distraction was not included in the current analyses because distraction does not group neatly with adaptive or maladaptive ER strategies (Mikhail & Kring, 2019). Distraction averaged across days also showed the weakest association with the DERS total score of any strategy (r = .03, p = .563), further suggesting it is neither clearly adaptive nor maladaptive. Internal consistency for ER scales was adequate at a between-person level (adaptive α = .78; maladaptive α = .76). Internal consistency was lower within-person (adaptive α = .43; maladaptive α = .35), but this was expected because only one ER strategy might be used in any given situation, leading to weaker within-person correlations even when strategies are similarly adaptive/maladaptive.

To confirm that ER strategies grouped empirically as adaptive/maladaptive in the manner predicted by theory, we conducted an exploratory factor analysis with orthogonal varimax rotation at the between-person level (see Table S1). Two primary factors emerged with eigenvalues >1. Acceptance, social sharing, situation modification, and cognitive reappraisal all had loadings ≥ .40 on the first factor and ≤ .22 on the second factor. Conversely, rumination, expressive suppression, and self-criticism all had factor loadings ≥ .50 on the second factor and ≤ .20 on the first factor. Thus, the factor analysis supported categorization of strategies into adaptive and maladaptive groupings. The correlation between adaptive and maladaptive scales was moderate (r = .29; 8% of variance shared), suggesting they are related but distinct. To assess convergent validity, mean adaptive and maladaptive ER strategy scores were correlated with the DERS total score. Correlations were significant for maladaptive (r = .43, p < .001) and adaptive (r = −.19, p = .001) strategies, but low enough to indicate that ER strategy use is distinct from broad ER difficulties.

NA.: Daily NA was assessed using the negative emotion items from the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988). Internal consistency was good (between-person α = .93; within-person α = .73).

Data Analyses

Between-Person Analyses—Between-person analyses examined whether individual differences in ER moderated associations between mean NA and dysregulated eating. Four measures of dysregulated eating were examined: MEBS BE, mean EE, total days with OBEs, and odds of *any* OBEs during the study. Daily measures were averaged across the study for analyses. Age was covaried given the wide age range and correlations between age and broad ER difficulties (r = −.17, p = .004) and maladaptive ER (r = −.17, p = .002). Other potential covariates (i.e., body mass index) were not included because correlations with predictors were small and non-significant (rs = −.01 to −.10; ps >.10). MEBS BE and average EE were log transformed due to positive skew, and all continuous variables were z-scored to increase interpretability over raw Likert scores.

Multilevel models (MLMs) with a family-level random intercept were used to control for clustering of participants within families. Logistic MLMs were used to predict odds of any OBEs and negative binomial MLMs (which fit better based on AIC/BIC than other models for overdispersed data, such as zero-inflated Poisson) were used to predict total days with OBEs. Models were fit using maximum likelihood estimation (MLE), which provides unbiased estimates with missing data (Black et al., 2011). We first predicted each dysregulated eating outcome from broad ER difficulties on the DERS, mean NA, and the NA × DERS interaction. We then predicted each outcome from mean use of maladaptive and adaptive ER strategies, mean NA, and all two-way interactions between NA and ER strategies.

Within-Person Analyses—Within-person analyses examined how fluctuations in adaptive and maladaptive ER were associated with within-person fluctuations in dysregulated eating, and whether daily ER strategy use moderated daily NA-dysregulated eating associations. Measures administered once (i.e., DERS, MEBS BE) or aggregated

across days (i.e., total days with OBEs) could not be examined because they did not vary within person. Analyses therefore focused on daily ER strategy use, with daily EE and daily odds of OBE as outcomes. All continuous daily predictors and outcomes were standardized within-person (i.e., subtracted from a person's mean and divided by their own standard deviation) as recommended for within-person MLMs (Rabe-Hesketh & Skrondal, 2012). Analyses of EE used MLE estimation, random intercepts at the family and participant levels, random slopes at the participant level, and an AR(1) residual structure, which produces less bias than other methods of accounting for autocorrelation in some cases (Achen, 2000). Analyses of OBEs used a simpler model with a random intercept at the participant level only and no random slopes due difficulties estimating more complex random effects. Autocorrelation was less of a concern for OBEs because it was unlikely OBEs would occur on two consecutive days in our non-clinical sample. We controlled for day of participation due to a small decrease in EE across time ($r = -.11$, $p < .001$).

Daily EE and OBE were predicted from daily maladaptive and adaptive ER, daily NA, and all two-way interactions between NA and ER. Because it was not possible to establish temporal precedence between variables on the same day (e.g., whether NA preceded or followed EE/OBE), we also examined whether NA, adaptive/maladaptive ER, and their interaction prospectively predicted EE or odds of OBE on the next day.

Results

Descriptive Statistics

Participants reported the full possible range of MEBS BE symptoms (mean = 1.39, *SD* = 1.53, range = 0–7), with a similar mean to published norms for adolescent/young adult women (von Ranson et al., 2005) (see Table 1). Overall, 9.0% of participants scored above the MEBS total score clinical cutoff, suggesting significant disordered eating. Almost 1/3 of participants (31.8%) reported OBE at least once during the study. Though this proportion may seem relatively high for a non-clinical sample, it is similar to the rate of OBEs in a previous longitudinal 45-day population-based study from our group (Klump et al., 2014; Mikhail et al., 2021), and could also reflect increased BE during COVID-19 (Klump et al., in press). With respect to ER, DERS total scores were similar to published norms for women in the community (Gratz & Roemer, 2004) (mean = 75.82, *SD* = 21.49, range = 36–155). There was also a wide range of NA, with a similar mean to other community samples (Watson & Clark, 1999) (mean = 15.42, *SD* = 4.11, range = 10.39–42.37).

Between-Person Analyses

Broad ER Difficulties (DERS)—Contrary to hypotheses, there were no significant interactions between broad ER difficulties and NA (all *p*s >.10), indicating that broad ER difficulties did not impact the strength of NA-dysregulated eating associations. However, the main effect of broad ER difficulties was significantly associated with greater MEBS BE (β = .18, $p = .004$, 95% CI [.06, .31]), odds of any OBEs (OR = 1.61, $p = .020$, 95% CI [1.08, 2.40]), and total days with OBEs (IRR = 1.59, $p = .017$, 95% CI [1.09, 2.33]) even after accounting for NA (see Table 3). Notably, the main effect of broad ER difficulties was a stronger predictor than the main effect of NA for these three phenotypes, and the main effect

of NA was non-significant after accounting for ER difficulties. Interestingly, EE showed a different pattern. Though the DERS was significantly associated with EE at a bivariate level using Pearson correlations (r = .28, p <.001; see Table 2), the main effect of the DERS was non-significant after controlling for NA in the MLM (p = .370).

ER Strategy Use—As with broad ER difficulties, all interactions between ER strategy use and NA were non-significant (ps >.10). The main effects of adaptive and maladaptive ER strategy use were significantly associated with total days with OBEs, but not other dysregulated eating phenotypes (see Table 3). Greater mean maladaptive ER (IRR = 1.59, p = .019, 95% CI [1.08, 2.34]) and lower mean adaptive ER (IRR = .68, p = .044, 95% CI [.47, .99]) were independently associated with more days with OBEs. Though associations with other dysregulated eating phenotypes were non-significant, they were in the same direction (i.e., more maladaptive/lower adaptive ER associated with more dysregulated eating) for both MEBS BE and odds of any OBEs. Nevertheless, effect sizes were smaller than for the DERS, suggesting that specific ER strategies might be less strongly associated with BE than broader ER difficulties. Results were similar when adaptive and maladaptive strategies were examined in separate models (see Table S3), suggesting smaller effects were not due to more variables in the models.

Within-Person Analyses

Consistent with between-person analyses, all within-person interactions between ER strategy use and NA were non-significant (ps >.10; see Table 4). However, the main effect of within-person maladaptive strategy use was significantly associated with odds of OBE (OR = 1.20, p = .001, 95% CI [1.08, 1.34]), indicating that participants were more likely to experience OBEs on days when they used more maladaptive ER strategies than typical for them. The main effect of daily NA was also significantly associated with odds of OBE and EE. Finally, the main effect of maladaptive ER strategy use (but not NA) significantly predicted odds of OBE on the next day (OR = 1.14, p = .028, 95% CI [1.01, 1.28]), suggesting a lingering impact of maladaptive ER.

Post-Hoc Analyses

Because the lack of NA-ER interactions was contrary to hypotheses, we examined whether associations might be stronger in participants with OBEs. We focused on within-person associations for participants with OBEs given the smaller sample size that precluded between-person analyses. Associations were generally very similar to the full sample, except that both daily maladaptive and adaptive strategy use were significantly associated with daily EE (abet with small effect sizes; see Table S4).

We also wondered whether associations differed pre/post COVID-19, as 46% of individuals participated after the first US COVID-19 case. Within-person associations did not differ across COVID-19 (see Table S6). However, between-person, the NA × DERS and NA × maladaptive ER interactions did differ across COVID-19 for EE only (see Table S5). Pre-COVID, but not post-COVID, the NA-EE association was stronger for participants who scored higher on the DERS or had greater mean maladaptive ER use. NA may have led more easily to EE post-COVID even for participants generally skilled at ER due to increased

stress and decreased access to supports. EE itself may have also become a way of regulating emotions for some during the pandemic.

Discussion

While NA is an established risk factor for dysregulated eating (Haedt-Matt & Keel, 2011; Mikhail, 2021), less is known about factors that may buffer against the impact of NA. Negative emotions are not always avoidable, and it is important to identify resiliency factors that may prevent dysregulated eating even when NA is high. ER has been posited as one such moderating factor, but very little research has tested this empirically. In the current study, we significantly expanded on prior research by analyzing multiple forms of dysregulated eating and measures of ER within a large, population-based sample. We found that some forms of ER difficulties were associated with greater dysregulated eating at both between- and within-person levels even after controlling for NA. However, contrary to hypotheses, ER did not modify NA-dysregulated eating associations. Improving ER may therefore decrease BE risk in general, but other interventions that target NA directly may be needed to dampen its effects on dysregulated eating.

While unexpected, our findings were consistent across multiple measures of ER and dysregulated eating, as well as with the one other study that has directly examined moderation of NA-dysregulated eating associations by ER (Svaldi et al., 2019). Nevertheless, more nuanced relationships may exist between ER, NA, and BE/EE. Stronger moderation of between-person NA-EE associations by ER pre-COVID-19 suggests ER may be more effective at reducing the impact of NA when there are fewer contextual stressors. Some forms of ER may also be more effective when used immediately after NA starts to rise. For example, cognitive reappraisal is most effective before NA becomes intense (Sheppes & Gross, 2011). Because we only administered questionnaires once per day, we were unable to examine these more fine-grained temporal dynamics, but this is important to investigate further. Alternatively, ER may be less effective for individuals with long-standing BE, for whom dysregulated eating may become a conditioned response to NA. Because BE often persists over many years even in community samples (Pope et al., 2006), research should further investigate how associations between NA, ER, and BE/EE change over time.

Though ER did not directly modify the impact of NA on BE/EE, strong associations between ER and BE even after controlling for NA indicate that perceptions of and responses to emotions have important implications for BE risk. Indeed, the main effects of ER variables were often more strongly associated with BE than was NA. EE showed a slightly different pattern of effects and was more strongly associated with NA than ER, perhaps because it is by definition tightly linked to the experience of negative emotions. Interestingly, associations between ER and dysregulated eating were most consistent for broad ER difficulties and maladaptive strategy use, rather than adaptive strategy use. This finding is consistent with a past meta-analysis suggesting maladaptive responses to emotions may be more tightly linked to disordered eating than a lack of adaptive ER strategies (Aldao et al., 2010). One possible reason is that maladaptive ER can further amplify NA, potentially leading to a vicious cycle of escalating NA and risk for BE that can stretch into the next day (Brockman et al., 2017). Indeed, we observed that maladaptive strategy use

predicted significantly higher NA on the next day after accounting for autocorrelation (β = .04, p <.001), which may partially explain why maladaptive strategy use was a significant predictor of next-day OBE. It is also possible that maladaptive ER may make NA feel more intolerable, prompting additional efforts (such as dysregulated eating) to eradicate unwanted feelings.

This study had several strengths, including a large, population-based sample, multiple measures of dysregulated eating at different levels of severity, and a longitudinal study design spanning 49 days with a high rate of daily diary completion. Nevertheless, some limitations should be noted. As stated above, dysregulated eating, NA, and ER were only assessed once per day, making it difficult to determine whether ER and NA preceded or followed EE/OBEs. Daily diary designs may also introduce somewhat greater recall bias than EMA. While findings regarding NA-dysregulated eating associations have been highly consistent across daily dairy and EMA studies (e.g., Barker et al., 2006; Haedt-Matt et al., 2014; Mason et al., 2016), future research (potentially in clinical samples) should use more intensive monitoring to help further elucidate relationships between NA, ER, and BE/EE on shorter time scales. Relatedly, although our method of assessing ER was typical for daily diary studies, it may have been cognitively taxing for some participants to recall a specific instance of NA and clearly distinguish between ER strategies at that time.

Analyses focused on a non-clinical sample, and it is unclear whether findings would fully generalize to individuals with threshold EDs. However, using a population-based sample allowed us to examine participants across the full spectrum of BE pathology and ER difficulties, which prevents statistical concerns related to range restriction in clinical samples (Sackett & Yang, 2000).

This study only included young adult women and adolescents who met several exclusion criteria (e.g., regular menstruation). Relatedly, our sample was predominantly white and socioeconomically advantaged. Additional research in more diverse populations, including older women and men, is needed.

Nevertheless, the current study provides initial evidence of the potential limitations of relying on ER alone to interrupt NA-dysregulated eating associations. If results are replicated in future research, other approaches that directly target NA (e.g., decreasing environmental stressors, increasing social support) or individuals' ability to resist emotion-driven impulses (e.g., "urge surfing") may be needed to reduce dysregulated eating.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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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.

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Public Significance:

Negative affect (NA; e.g., sadness, guilt) increases dysregulated eating risk. Because NA is sometimes unavoidable, we examined whether emotion regulation (ER; i.e., how a person responds to their emotions) might impact whether NA leads to dysregulated eating. Although more effective ER was associated with less dysregulated eating overall, ER did not impact the association between NA and dysregulated eating. Other approaches may therefore be needed to mitigate NA-dysregulated eating associations.

Table 1.

Descriptive statistics for participant demographics and symptoms (N = 311)

Participant Characteristics	Mean (SD) or % of Sample (N)	Range
Age	22.09 (3.21)	15–29
Racial identity		
White	275 (88.4%)	—
Black/African American	13 (4.2%)	—
Asian/Asian American	6 (1.9%)	—
More than one race	17 (5.5%)	—
Latina ethnicity	14 (4.5%)	—
Combined parental income		
<$20,000	8 (2.6%)	—
$20,000-$40,000	13 (4.2%)	—
$40,000-$60,000	33 (10.6%)	—
$60,000-$100,000	82 (26.4%)	—
>$100,000	167 (53.7%)	—
Unknown	8 (2.6%)	
Body mass index (BMI)	24.70 (5.49)	17.04–58.12

Symptom Measures	Mean (SD) or % of Sample (N)	Sample Range	Possible Range
MEBS total score	6.84 (5.56)	0–23	0–30
MEBS binge eating	1.39 (1.53)	0–7	0–7
Mean DEBQ emotional eating	1.33 (.40)	1–3.58	1–5
Any OBEs during the study	99 (31.8%)	—	—
Number of days with OBEs (if OBEs present)	5.19 (6.55)	1–45	1–49
DERS total score	75.82 (21.49)	36–155	36–180
Mean adaptive strategy use	2.35 (.55)	1.08–4.27	1–5
Mean maladaptive strategy use	2.27 (.62)	1.04–4.87	1–5
Mean NA	15.42 (4.11)	10.39–42.37	10–50

Note: MEBS = Minnesota Eating Behavior Survey; DEBQ = Dutch Eating Behavior Questionnaire; OBE = objective binge eating episode; DERS = Difficulties in Emotion Regulation Scale; NA = negative affect on the Positive and Negative Affect Schedule.

Table 2.

Correlations between measures of dysregulated eating, emotion regulation, and negative affect

Between-Person Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. MEBS binge eating	—													
2. OBE	**.31**	—												
3. EE	**.35**	**.20**	—											
4. NA	**.26**	**.17**	**.57**	—										
5. DERS	**.25**	.10	**.28**	**.45**	—									
6. Maladaptive	**.20**	**.13**	**.31**	**.52**	**.43**	—								
7. Adaptive	−.02	−.04	**.18**	**.18**	**-.19**	**.29**	—							
8. Suppress	**.18**	**.13**	**.13**	**.23**	**.18**	**.79**	**.22**	—						
9. Criticize	.10	.11	**.34**	**.54**	**.52**	**.84**	**.18**	**.44**	—					
10. Ruminate	**.21**	.09	**.32**	**.53**	**.39**	**.85**	**.32**	**.45**	**.67**	—				
11. Social share	.005	−.02	**.16**	**.22**	**-.17**	**.13**	**.73**	−.06	**.12**	**.29**	—			
12. Reappraise	−.07	−.02	**.27**	**.20**	−.08	**.37**	**.84**	**.27**	**.34**	**.30**	**.49**	—		
13. Change	−.04	−.04	**.22**	**.17**	−.07	**.31**	**.82**	**.27**	**.26**	**.24**	**.39**	**.83**	—	
14. Accept	.05	−.05	−.05	.008	**-.24**	**.13**	**.74**	**.23**	−.11	**.17**	**.40**	**.38**	**.44**	—

Within-Person Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1. Daily OBE	—											
2. EE	**.06**	—										
3. NA	**.02**	**.18**	—									
4. Maladaptive	**.02**	**.05**	**.22**	—								
5. Adaptive	−.0003	**.04**	**.11**	**.10**	—							
6. Suppress	.009	−.02	−.009	**.66**	−.008	—						
7. Criticize	**.02**	**.07**	**.17**	**.62**	**.06**	**.12**	—					
8. Ruminate	.01	**.06**	**.30**	**.65**	**.19**	**.07**	**.26**	—				
9. Social share	−.002	**.05**	**.21**	**.06**	**.64**	**-.15**	**.05**	**.26**	—			
10. Reappraise	.009	**.02**	−.003	**.15**	**.58**	**.12**	**.14**	**.06**	**.12**	—		
11. Change	.006	**.02**	**.03**	**.09**	**.56**	**.05**	**.09**	**.06**	**.11**	**.28**	—	

Within-Person Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
12. Accept	−.008	.01	−.009	.01	**.58**	**.04**	**-.08**	**.07**	**.17**	**.15**	**.11**	—

Note: MEBS binge eating = the binge eating subscale of the Minnesota Eating Behavior Survey; OBE = objective binge eating; daily OBE = whether a person experienced objective binge eating on a given day; EE = emotional eating subscale of the Dutch Eating Behavior Questionnaire (DEBQ); NA = negative affect on the Positive and Negative Affect Schedule (PANAS); DERS = Difficulties in Emotion Regulation Scale total score; maladaptive = use of maladaptive emotion regulation strategies (rumination, self-criticism of emotions, and expressive suppression); adaptive = use of adaptive emotion regulation strategies (cognitive reappraisal, situation modification, acceptance of emotions, and social sharing); suppress = expressive suppression; criticize = self-criticism of emotions; reappraise = cognitive reappraisal; change = situation modification; accept = acceptance of emotions. Daily variables were averaged across the 49 days of the study for between-person correlations. Correlations significant at $p < .05$ are bolded.

Table 3.

Between-person associations between emotion regulation, negative affect, and dysregulated eating

DERS total score					Mean Emotion Regulation Strategy Use				
Mean Emotional Eating									
	β	**SE**	***p***	**95% CI**		**β**	**SE**	***p***	**95% CI**
Intercept	−.06	.05	.269	−.16, .04	Intercept	−.08	.05	.133	−.18, .02
NA	.43	.06	**<.001**	.32, .54	NA	.39	.06	**<.001**	.26, .52
DERS	.05	.05	.370	−.06, .15	Mean maladaptive	.04	.06	.434	−.07, .15
NA × DERS	.03	.03	.400	−.04, .09	Mean adaptive	.09	.05	.057	−.003, .19
Age	−.02	.05	.652	−.11, .07	NA × mean maladaptive	.05	.04	.145	−.02, .12
					NA × mean adaptive	.06	.04	.141	−.02, .14
					Age	−.008	.05	.852	−.10, .08
MEBS Binge Eating									
	β	**SE**	***p***	**95% CI**		**β**	**SE**	***p***	**95% CI**
Intercept	.06	.06	.350	−.07, .19	Intercept	.06	.07	.384	−.07, .19
NA	.09	.07	.181	−.04, .23	NA	.16	.08	.050	.0003, .31
DERS	.18	.06	**.004**	.06, .31	Mean maladaptive	.10	.07	.154	−.04, .23
NA × DERS	−.004	.04	.918	−.08, .07	Mean adaptive	−.10	.06	.117	−.21, .02
Age	−.008	.06	.886	−.12, .11	NA × mean maladaptive	−.001	.04	.978	−.09, .08
					NA × mean adaptive	−.07	.05	.190	−.17, .03
					Age	−.001	.06	.982	−.11, .11
Odds of Any OBEs									
	OR	**SE**	***p***	**95% CI**		**OR**	**SE**	***p***	**95% CI**
Intercept	.33	.08	**<.001**	.20, .54	Intercept	.30	.08	**<.001**	.18, .50
NA	1.32	.29	.212	.85, 2.04	NA	1.24	.32	.398	.75, 2.05
DERS	1.61	.33	**.020**	1.08, 2.40	Mean maladaptive	1.31	.29	.208	.86, 2.01
NA × DERS	.83	.10	.132	.65, 1.06	Mean adaptive	.86	.17	.456	.59, 1.27
Age	1.31	.27	.179	.88, 1.95	NA × mean maladaptive	.91	.13	.502	.68, 1.20
					NA × mean adaptive	1.29	.22	.142	.92, 1.82
					Age	1.29	.25	.197	.88, 1.90
Number of Days with OBEs									

	IRR	SE	*p*	95% CI		IRR	SE	*p*	95% CI
Intercept	.51	.16	**.034**	.28, .95	Intercept	.53	.18	.055	.27, 1.01
NA	1.21	.26	.370	.80, 1.85	NA	1.25	.31	.371	.77, 2.02
DERS	1.59	.31	**.017**	1.09, 2.33	Mean maladaptive	1.59	.31	**.019**	1.08, 2.34
NA × DERS	.91	.12	.441	.71, 1.16	Mean adaptive	.68	.13	**.044**	.47, .99
Age	1.12	.21	.566	.77, 1.62	NA × mean maladaptive	.88	.12	.350	.67, 1.15
					NA × mean adaptive	1.24	.21	.206	.89, 1.72
					Age	1.10	.20	.613	.77, 1.56

Note: Outcomes are the Minnesota Eating Behavior Survey (MEBS) binge-eating subscale (log transformed), mean emotional eating on the Dutch Eating Behavior Questionnaire across the 49 days of the study (log transformed), odds of reporting objective binge eating (OBEs) on any day of the study, and number of days reporting OBEs during the study. NA = average negative affect on the Positive and Negative Affect Schedule across the study; DERS = total score on the Difficulties in Emotion Regulation Scale; mean maladaptive = average use of maladaptive emotion regulation strategies (rumination, self-criticism of emotions, and expressive suppression) across the study; mean adaptive = average use of adaptive emotion regulation strategies (cognitive reappraisal, situation modification, acceptance of emotions, and social sharing) across the study; OR = odds ratio; IRR = incidence-rate ratio. Effects significant at $p < .05$ are bolded.

Table 4.

Within-person associations between daily emotion regulation, negative affect, and dysregulated eating

Emotional Eating					Odds of OBE				
	β	**SE**	***p***	**95% CI**		**OR**	**SE**	***p***	**95% CI**
Same Day Analyses									
Intercept	.39	.02	**<.001**	.35, .43	Intercept	.005	.001	**<.001**	.003, .009
NA	.13	.01	**<.001**	.11, .15	NA	1.11	.06	**.048**	1.001, 1.24
Daily maladaptive	.02	.01	.100	−.003, .04	Daily maladaptive	1.20	.07	**.001**	1.08, 1.34
Daily adaptive	.02	.009	.063	−.001, .04	Daily adaptive	.96	.05	.518	.87, 1.08
NA × daily maladaptive	.0005	.01	.963	−.02, .02	NA × daily maladaptive	.94	.05	.192	.85, 1.03
NA × daily adaptive	.001	.01	.911	−.02, .02	NA × daily adaptive	1.01	.05	.789	.92, 1.11
Study day	−.02	.0007	**<.001**	−.02, −.01	Study day	.98	.004	**<.001**	.98, .99
Time-Lagged Analyses									
Intercept	.28	.02	**<.001**	.24, .32	Intercept	.005	.002	**<.001**	.003 .009
Prior day NA	−.005	.009	.544	−.02, .01	Prior day NA	1.08	.06	.202	.96, 1.21
Prior day maladaptive	.008	.009	.380	−.01, .03	Prior day maladaptive	1.14	.07	**.028**	1.01, 1.28
Prior day adaptive	.005	.009	.580	−.01, .02	Prior day adaptive	1.02	.06	.701	.91, 1.14
Prior day NA × maladaptive	.0003	.008	.974	−.02, .02	Prior day NA × maladaptive	.98	.05	.737	.89, 1.09
Prior day NA × adaptive	−.006	.008	.437	−.02, .01	Prior day NA × adaptive	1.001	.05	.990	.91, 1.11
Study day	−.01	.0007	**<.001**	−.01, −.01	Study day	.98	.004	**<.001**	.97, .99

Note: Outcomes are within-person standardized emotional eating on the Dutch Eating Behavior Questionnaire and odds of objective binge-eating (OBE) on a given day of the study. NA = daily, within-person standardized negative affect measured using the Positive and Negative Affect Schedule; daily maladaptive = within-person standardized use of maladaptive emotion regulation strategies (rumination, self-criticism of emotions, and expressive suppression) on a given day; daily adaptive = within-person standardized use of adaptive emotion regulation strategies (cognitive reappraisal, situation modification, acceptance of emotions, and social sharing) on a given day; study day = day of participation in the study. Effects significant at $p < .05$ are bolded.