



# Increases in shame following binge eating among women: Laboratory and longitudinal findings

Heather A. Davis<sup>a,\*</sup>, Pamela K. Keel<sup>b</sup>, June P. Tangney<sup>c</sup>, Gregory T. Smith<sup>d</sup>

<sup>a</sup> Department of Psychology, Virginia Tech, United States

<sup>b</sup> Department of Psychology, Florida State University, United States

<sup>c</sup> Department of Psychology, George Mason University, United States

<sup>d</sup> Department of Psychology, University of Kentucky, United States

## ARTICLE INFO

### Keywords:

Shame  
Emotions  
Binge eating  
Bulimia nervosa

## ABSTRACT

This multi-method, two-study investigation tested the hypothesis that, controlling for guilt and negative affect, shame increases following binge eating. Support for this hypothesis constitutes the first step in testing the theory that shame mediates the link between binge eating and comorbid psychopathology. Study 1 employed a laboratory binge-eating paradigm in  $n = 51$  women [21 with bulimia nervosa, 30 controls]. Study 2 employed a naturalistic test of prospective relationships among binge eating, shame, guilt, and negative affect in  $n = 302$  college women over three months. In Study 1, women with bulimia nervosa reported increases in shame that were not explained by changes in guilt or negative affect, following laboratory binge eating, compared with controls. In Study 2, baseline binge eating predicted increased shame at follow-up independently of guilt and negative affect. Should shame prove to mediate the link between binge eating and comorbid disorders, interventions to reduce shame may be useful for those who binge.

## 1. Introduction

Binge eating is a serious eating disorder symptom characterized by the consumption of a large amount of food in a short period of time, accompanied by a loss of control (APA, 2013). Binge eating is common in multiple eating disorders including bulimia nervosa (BN), binge eating disorder (BED), and anorexia nervosa binge/purge type (AN-bp) (APA, 2013). Importantly, binge eating is associated with significant impairment (Trojanowski et al., 2019), health problems (Kessler et al., 2014), and psychiatric comorbidity, including depression, anxiety, post-traumatic stress, substance use problems, and suicidality (Serra et al., 2020).

Engagement in binge eating also predicts future psychopathology. Longitudinally, binge eating (or loss of control eating) precedes the development of depressive symptoms (Davis et al., 2019; Puccio et al., 2017), anxiety (Puccio et al., 2017), and substance use (Bulik et al., 2004; Stice & Shaw, 2003). Thus, binge eating serves as a risk factor for other types of dysfunction, and there is evidence for prospective bi-directionality among these problems (Puccio et al., 2016), supporting the need to identify treatment targets to break this cycle.

In prior work (see Davis et al., 2016, 2019), we have proposed that

binge eating triggers increases in the experience of shame, which, in turn, influences engagement in other forms of dysfunction. In the two studies described here, we tested the first part of this theory: that engagement in binge eating predicts increased levels of shame. We next review research that suggests the viability of this model broadly and our hypothesis tests for the current empirical study.

### 1.1. Shame as a risk factor for and consequence of psychopathology

Shame is part of a family of negatively-valenced “self-conscious emotions” that are evoked by self-reflection and self-evaluation (Tangney et al., 2007). Shame is thought to be the most dysfunctional of this set of emotions because it represents a negative evaluation of the global self (Lewis, 1971), while other such emotions, such as guilt, represent negative evaluations of a specific behavior or experience. The shame response is considered more painful than guilt or embarrassment because it is an overarching, negative attitude toward one’s permanent core self, rather than one’s changeable behavior. Research suggests that guilt is a more adaptive emotion because it may motivate one to engage in reparative action, while shame reinforces the person’s view of themselves as flawed and exacerbates the experience of a variety of

\* Corresponding author. 319 Williams Hall, Blacksburg, VA, 24061.

E-mail address: [heatherdavis@vt.edu](mailto:heatherdavis@vt.edu) (H.A. Davis).

maladaptive psychological symptoms (Kim et al., 2011; Tangney et al., 2007). Importantly, shame and guilt do co-occur, and both emotions can be felt in response to the same event (Tangney & Dearing, 2002). Given this shared variance and the differing implications of shame and guilt (Tangney et al., 2007), it is imperative that researchers measure both constructs and control for guilt when assessing shame (Dearing et al., 2005).

Individuals vary in their propensity to experience shame. A shame-prone person would be expected to feel shame as a consequence of a variety of potential behaviors and outcomes, which may include binge eating, nonsuicidal self-harm, unfavorable interpersonal interactions, and drinking (Tangney et al., 2007). Shame is associated with a range of psychiatric problems including BN (Blythin et al., 2020), mood (Kim et al., 2011), anxiety (Căndea & Szentagotai-Tătar, 2018), obsessive compulsive-related (Weingarden & Renshaw, 2015), and substance use disorders (Luoma et al., 2019) as well as self-harm behaviors (Sheehy et al., 2019).

There is extensive evidence for shame as a prospective risk factor for various forms of psychopathology, including eating pathology (Brockdorf et al., 2020), but less research on shame as an outcome or consequence of psychopathology, though, as noted above, theorists suspect shame is exacerbated by psychopathology (see Căndea & Szentagotai, 2013, for a review). One study demonstrated increases in shame two months after endorsement of bulimic psychopathology (Levinson et al., 2016), but it is unclear whether increases in shame follow binge eating in particular, or perhaps the combination of several bulimic symptoms.

A plausible process by which binge eating may increase risk for comorbid, transdiagnostic dysfunction (such as substance use, nonsuicidal self-harm, depression, and anxiety) through shame is as follows: for an individual with an eating disorder, the act of eating, accompanied by a loss of control, evokes increased feelings of shame due to the perceived inability to refrain from eating, control the amount consumed, and/or to prevent the potential consequences of excessive food consumption on weight or shape. The resulting increases in shame may then lead to increases in substance use, nonsuicidal self-harm, depression, and anxiety (Davis et al., 2016, 2019). In this model, shame is dissociated from guilt.

Alternatively, negative affect in general, rather than shame in particular, may contribute to comorbid symptoms, given that shame is represented in measures of broad negative affect, along with other attributes, such as guilt, anger, contempt, disgust, fear, and nervousness (Watson & Clark, 1984). This possibility is viable, because negative affect is implicated in the development of multiple types of psychopathology including disordered eating (Smyth et al., 2007), depression (Gulley et al., 2016), and substance use (Armeli et al., 2015). The evidence for the effect of binge eating on subsequent negative affect is mixed, with some studies observing declines in negative mood following binge eating (Ranzenhofer et al., 2013; Smyth et al., 2007), and others reporting increases in negative emotions following binge eating (see Haedt-Matt & Keel, 2011, for a metaanalytic review). Recent ecological momentary assessment (EMA) work indicated elevated negative mood on days in which loss of control eating occurred, both before and after the episode (Stevenson et al., 2018). Importantly, other recent EMA work may explain disparate findings regarding negative emotion following binge eating: one study suggested that timing of ratings proximal to binge eating matters. Berg et al. (2017) found that post-binge negative affect was higher than pre-binge negative affect across multiple, transdiagnostic samples of women with eating disorders when the pre-binge rating was *less* proximal to the binge eating episode and the post-binge rating was *more* proximal to the binge eating episode. To test the hypothesis that shame increases following binge eating, it is therefore crucial to test the relationship of binge eating to shame at equidistant times proximal to the binge eating episode.

## 1.2. The present studies

The current investigation sought to evaluate changes in shame, guilt,

and negative affect following binge eating using two study designs. Study 1 utilized a laboratory investigation of changes in shame after binge eating among women with BN compared with healthy control women without any eating disorder symptoms. Pathological eating behavior among individuals with BN can be modeled in the laboratory when specific instructions are provided (Mitchell et al., 1998; Sysko et al., 2018). Further, many individuals with BN endorse feeling as though their behavior in the laboratory mimics their binge eating behavior at home (Mitchell et al., 1998), suggesting laboratory episodes offer an acceptable analogue to binge eating. To our knowledge, no previous study has investigated the effect of laboratory binge eating on the experience of shame. Laboratory studies allow for a) real-time measurement of emotional experiences following binge eating; b) the measurement of food intake, which can facilitate understanding of whether the amount of food consumed mirrored that of an objective binge eating episode in terms of caloric intake; and, of course, c) minimizing the possibility that other factors differ between groups.

Study 2 utilized a prospective investigation of changes in shame predicted by binge eating in a nonclinical sample of college women. This second test allowed us to explore whether potential effects of binge eating on shame were a) present in a sample not selected for the presence of an eating disorder, b) maintained over a longer period of time, and c) reciprocal. By including both studies, we allowed for a multi-method test of our theory that shame is heightened following binge eating, both in the short-term, using a controlled, laboratory study, and in the long-term, using a naturalistic longitudinal study across three months.

## 2. Study 1

In Study 1, we sought to examine momentary changes in shame after binge eating in a controlled laboratory environment. First, as a test of the internal validity of the laboratory binge eating paradigm, we hypothesized that women with BN would report greater subjective eating disorder distress in the form of cognitive (i.e., preoccupation with weight/shape) and behavioral (i.e., urge to vomit) symptoms, after consuming the test meal, compared with controls. This test would replicate prior research indicating these effects for women with BN following a single, ad lib test meal (Kissileff et al., 1986; Mitchell et al., 1998).

Our core hypothesis was that women with BN would report greater increases in shame, controlling for guilt, following test meal consumption compared to controls. We also tested whether women with BN would report greater increases in negative affect following test meal consumption compared to controls. If they did, we would test the effect of test meal consumption on shame controlling for negative affect. Previous research on this latter comparison has produced mixed results (Ranzenhofer et al., 2013; Smyth et al., 2007).

### 2.1. Method

Participants completed questionnaires before and after consuming a test meal in which they were instructed to binge.

#### 2.1.1. Participants

Women ( $N = 51$ ) were recruited from a large, public university in the southeastern United States ( $N = 35$ ) and the surrounding community ( $N = 16$ ) to fill two groups: women with DSM-5 criteria for BN or OSFED BN (of low frequency)<sup>1</sup> ( $N = 21$ ) and healthy controls ( $N = 30$ ). Participant

<sup>1</sup> Of the 21 participants in the BN group, four participants endorsed fewer than 12 episodes of binge eating in the past 12 weeks (range: 6–11 episodes), thus meeting criteria for OSFED BN (of low frequency). Results did not differ when these four participants were excluded from analyses, so these participants were retained in the study. The term “BN group” refers to all 21 participants who met criteria for BN or OSFED BN.

eligibility criteria were modeled after previous laboratory studies of eating behavior including women with BN (Keel et al., 2018). Telephone screens were conducted to verify eligibility. Participants were assessed using the SCID-5 screening questions (First, 2014) for psychological disorders, to rule out current comorbid psychological diagnoses, which allowed for the understanding of relationships between shame and binge eating that were not confounded by the presence of current symptoms of other shame-related disorders (e.g. mood, anxiety, and substance use disorders). Questions concerning binge eating and compensatory behaviors were assessed using the Eating Disorder Examination (EDE; Cooper & Fairburn, 1987), to confirm diagnostic group. Additional inclusion criteria for all participants were age between 18 and 25 years and body mass index (BMI) between 18.5 and 26.5 kg/m<sup>2</sup>, based on self-report and verified with objective measure<sup>2</sup> at the in-person study visit (see “Procedures” subsection).

Participants were excluded from the study if they endorsed current medical conditions or medication use that could influence appetite, weight, or ability to safely participate, current pregnancy, or lactation (to control for variations in appetite due to pregnancy or breastfeeding). Prospective participants with BN were excluded if they a) were in or seeking treatment due to the potential for the ad lib test meal, and associated feelings and urges, to interfere with treatment progress or b) had a lifetime history of AN (to control for the presence of a history of AN on responses to binge eating). For non-eating disorder controls, self-reported lifetime history of eating disorder symptoms, dietary restriction for weight loss or maintenance within the past 8 weeks, and exercise for more than 45 min more than four times per week were exclusion criteria. To ensure accurate diagnostic classification, women with BN were required to endorse consuming at least 1000 kcal during objective binge eating (OBE) episodes accompanied by a perceived loss of control. Calories consumed during OBE were calculated using nutritional information available on the internet.

### 2.1.2. Measures

In this section, we report the measures used in Study 1. Additional measures to be reported elsewhere included additional demographic information, the Test of Self-Conscious Affect-4, Alcohol Use Disorders Identification Test, State-Trait Anxiety Inventory, Eating and Thinness Expectancies scales, Drug History Questionnaire, Clinical Impairment Assessment, Body Shape Questionnaire, UPPS-P, Maryland Trait and State Depression scale, and questions about cigarette smoking frequency and quantity.

**BMI.** Height (in centimeters) and weight (in kilograms) were measured at the study visit and BMI was calculated using the following formula: kg/m<sup>2</sup>.

**Food consumption.** Food provided during the ad lib test meal was weighed before and after the test meal using a standard food scale. Total intake was calculated in grams consumed by taking the difference of the two values and then converting to calories using the gram to calorie ratio of the specific food.

**Eating Disorder Symptoms.** The Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 2008) was used to assess frequency and severity of eating disorder symptoms. This 28-item self-report measure asks participants to rate, on a Likert scale anchored from 0 to 6, the frequency/severity of their disordered eating behaviors and thoughts. The measure consists of four subscales: Restraint, Eating Concern, Weight Concern, and Shape Concern. The EDE-Q has demonstrated good reliability and convergent validity with

the EDE (Fairburn & Cooper, 1993; Mond et al., 2006). Participants completed the EDE-Q before consuming the test meal. Internal consistency for the four subscales was good to excellent: Restraint,  $\alpha = 0.87$ ; Eating Concern  $\alpha = 0.88$ ; Weight Concern  $\alpha = 0.89$ ; and Shape Concern,  $\alpha = 0.96$ .

**Shame and Guilt.** We used the State Shame and Guilt Scale (SSGS; Marschall et al., 1994) to assess experiences of shame and guilt before and after test meal consumption. The SSGS is a 15-item self-report scale of in-the-moment feelings of shame, guilt, and pride experiences. Only the shame and guilt subscales were used for this study. Though shame and guilt correlate highly, it is shame independent of guilt that is most harmful (Tangney et al., 2007), so it is important to assess both emotions when evaluating shame. The SSGS asks participants to respond to how they currently feel on a Likert scale anchored at 1 (not feeling this way at all) to 5 (feeling this way very strongly). A sample shame item is, “I want to sink into the floor and disappear”. A sample guilt item is, “I feel tension about something I have done”. The SSGS has demonstrated high levels of internal consistency ( $\alpha = 0.82 - 0.89$  for each subscale), predictive validity, and convergent validity (Tangney & Dearing, 2002). Internal consistency for the shame ( $\alpha = 0.83$  at baseline,  $\alpha = 0.91$  at follow-up) and guilt ( $\alpha = 0.84$  at baseline,  $\alpha = 0.94$  at follow-up) subscales was good to excellent.

**Negative affect.** Participants were asked to complete ratings before and after test meal consumption on a 100 mm Visual Analogue Scale (VAS), anchored from “Not at all/No” to “Extreme/Extremely.” Ratings included sad, anxious, tense, and angry. These items were highly correlated ( $\alpha = 0.84$ ) and combined to form a negative affect variable. VAS scales have been shown to be more sensitive to changes over time compared to Likert-type scale responses (Hasson & Arnetz, 2005). This approach has been used in previous investigations examining changes in VAS scores over a similar time frame (Mabe et al., 2014; Keel et al., 2018).

**Eating disorder distress.** VAS scales were also used to measure the following experiences: hungry, full, preoccupation with weight, preoccupation with shape, and urge to vomit. Preoccupation with weight and preoccupation with shape ( $\alpha = 0.95$ ) were combined to form a composite preoccupation with weight/shape variable, representing cognitive eating disorder distress (Keel et al., 2018; Mabe et al., 2014). Urge to vomit represented behavioral eating disorder distress.

### 2.1.3. Procedures

The study was approved by the Institutional Review Board (IRB) at the University of Kentucky (IRB protocol #43524, Title: Emotions and Eating). The research was conducted with human participants who voluntarily participated after providing written informed consent to the research team, per the approved IRB protocol. All ethical guidelines in the treatment of study participants and in conducting and analyzing the retrieved data were followed. Procedures included one study visit that lasted up to 2 h.

Participants were provided a 200 kcal standardized breakfast (1 cup of store-bought yogurt with pre-measured granola) before the study visit, to consume on the morning of their study visit between 9am and 9:30am. They were instructed to eat nothing else until their study visit at 2pm, consistent with procedures of other ad lib test meal studies (Keel et al., 2018; Kazak, 2018)ed consent and prior to beginning the study visit, participants’ eligibility was verified via a brief interview, to ensure they followed study visit instructions. Participants eligible to continue then had their height and weight measured and provided a urine sample for a pregnancy test. Following this, participants were provided with an electronic questionnaire packet on an iPad which included baseline measures listed above.

Based on prior laboratory studies establishing increased food intake in those who binge eat compared to controls (Raymond et al., 2007), the

<sup>2</sup> Eligibility was determined based on participants’ self-reported height and weight at the time of the phone screen. Upon objective measurement of height and weight, it was determined that four participants (two in the control group and two in the BN group) had BMIs over 26.5. Results of the study did not differ when those with higher BMIs were excluded from analyses, so these participants were retained in the study.

ad lib test meal<sup>3</sup> included three foods. Participants were asked about their food preferences on the eligibility telephone screen: participants with BN were asked to report three store-bought foods they typically consumed during binge eating episodes, and participants in the control group were asked to report three store-bought foods they enjoyed eating for snacks. During the ad lib test meal, each participant was provided with the three foods they requested on the telephone screen, allowing for each participant to receive a personalized assortment of foods for their test meal, as in previous research (Raymond et al., 2007). Common examples of food requested by participants were pretzels, Oreo cookies, ice cream, cereal with milk, and sandwich bread with peanut butter and jelly. Because we sought to simulate loss-of-control binge eating, enough food was provided to allow for that outcome: 2000 calories of each food item was placed into a bowl or plate and served at an individual place-setting (Wolfe et al., 2002), for a total of 6000 calories of food provided for each participant at the ad lib test meal. Participants were also provided an 8-ounce bottle of water with the ad lib test meal. No other beverages were served.

Participants were presented with the test meal and instructions were provided verbally: "Let yourself go and eat as much as you can," to replicate prior methods (Kissileff et al., 1986) that have predicted increased food consumption among individuals with BN compared to controls (Sysko et al., 2018). Participants were then left alone in the room with the food.

Immediately upon finishing the test meal, participants completed an electronic follow-up questionnaire packet and were guided through a relaxation exercise by the principal investigator. Given the possibility of increases in shame and/or negative affect (Haedt-Matt & Keel, 2011; Keel et al., 2018), the relaxation exercise aimed to return participants to a relaxed and neutral mood before they left the laboratory.

Participants were then debriefed on the purpose of the research, provided compensation in cash (\$30) for community-recruited participants or electronic verification of credit for university-recruited participants, and provided a list for local mental health resources at the university (for students) and in the community.

#### 2.1.4. Data analytic method

Data were analyzed using SPSS v.24. Descriptive statistics were used to characterize the BN and control groups on demographic and clinical variables. Independent samples t-tests were used to compare groups on demographics, test meal consumption, and scores on the EDE-Q. Mean frequencies were calculated for eating disorder behaviors among participants in the BN group. Mixed design, repeated measures analysis of covariance (ANCOVAs) were used to assess the effect of group (BN or control) as a between-subjects variable on within-subject changes following test meal consumption. In each of these analyses, age was entered as a covariate because participants in the BN group were significantly older than controls on average. For analyses including shame, guilt was entered as a covariate to control for overlap between the two constructs (Tangney & Dearing, 2002) as is standard in shame assessment (Tangney et al., 2007). All covariates were centered (Schneider et al., 2015). Effect sizes (Cohen's *d*) were calculated for each result; per Cohen (1992), *d* = 0.20 represents a small effect size, *d* = 0.50 represents a medium effect size, and *d* = 0.80 represents a large effect size.

## 2.2. Study 1 results

**Descriptive Data and Comparisons.** Participants in the BN and control groups did not differ significantly on self-reported race or ethnicity,

household income, religion or BMI (all *ps* > .05). Participants in the BN group were significantly older than control participants [*t*(*df*) = −3.79 (49), *p* < .001; a mean difference of 1.28 years]. Mean (SD) age of participants was 19.41 (1.55) years. Participants self-identified as 72.5% White/European American, 9.8% Black/African American, 7.8% Hispanic, 7.8% Asian/Pacific Islander, and 2% biracial. Table 1 presents comparisons between the BN and control groups on clinical variables assessed at baseline. Participants in the BN group scored significantly higher on all EDE-Q measures of eating pathology, consumed significantly more calories during the test meal, and spent more time eating, compared to non-eating disorder controls. Though participants in the control and BN groups did not differ on their hunger level prior to consuming the test meal, participants in the BN group endorsed greater fullness ratings immediately after eating, compared with controls.

**Test Meal Response.** To assess the effects of test meal consumption, comparisons were made between the BN and control conditions pre- and post-meal (see Table 2) on scores of eating disorder distress (preoccupation with weight/shape and urge to vomit), shame, and negative affect, as described next.

**Eating Disorder Distress.** We first tested changes in cognitive and behavioral symptoms of eating disorder-specific distress following the test meal. Regarding cognitive symptoms, there was a large main effect of group on preoccupation with weight/shape (*d* = 1.96, 95% CI: 1.25, 2.61). As expected, the BN group reported significantly greater preoccupation with weight/shape compared with controls. The main effect of time was not significant, indicating that across groups, preoccupation with weight/shape remained stable over time. However, a significant and moderate time by group interaction was observed (*d* = 0.73, 95% CI: 0.13, 1.28), indicating a differential effect of test meal consumption on change in preoccupation with weight/shape from pre-meal to post-meal depending on group membership. As illustrated in the top panel of Fig. 1, participants in the BN group endorsed significantly greater increases in preoccupation with weight/shape immediately following the test meal than participants in the control group [*M*(*SD*) preoccupation with weight/shape score change = 10.38[22.06] versus −3.17[7.59]].

Regarding behavioral symptoms of eating disorder distress, there was a significant and large main effect of group on urge to vomit (*d* = 0.97, 95% CI: 0.36, 1.54): the BN group reported significantly greater

**Table 1**  
Study 1 comparison of groups' demographic and clinical characteristics.

Measure	Mean (SD)		T (1, 49)	d
	Control (N = 30)	BN (N = 21)		
Age, years	18.80 (1.00)	20.29 (1.79)	3.79**	1.03
BMI	22.17 (2.29)	23.24 (2.15)	1.68	0.48
Test Meal Consumption, kcal	554.06 (235.60)	1276.35 (629.22)	5.67**	1.52
Time spent eating test meal, in minutes	13.84 (7.69)	19.42 (8.44)	2.29*	0.69
VAS Hunger, pre-meal	58.03 (19.80)	60.05 (23.78)	0.33	0.09
VAS Fullness, post-meal	59.13 (33.76)	79.43 (23.51)	2.37*	0.70
EDE-Q Restraint	0.21 (0.55)	2.83 (1.18)	10.68**	2.85
EDE-Q Eating Concern	0.15 (0.31)	2.70 (1.26)	10.72**	2.78
EDE-Q Weight Concern	0.65 (0.66)	3.61 (1.34)	10.41**	2.80
EDE-Q Shape Concern	1.02 (0.91)	4.30 (1.28)	10.71**	2.95
Binge/month	–	8.81 (12.51)	–	–
Self-induced vomiting/month	–	5.50 (14.28)	–	–
Driven exercise/month	–	9.52 (8.58)	–	–
Fasting/month	–	8.25 (5.63)	–	–

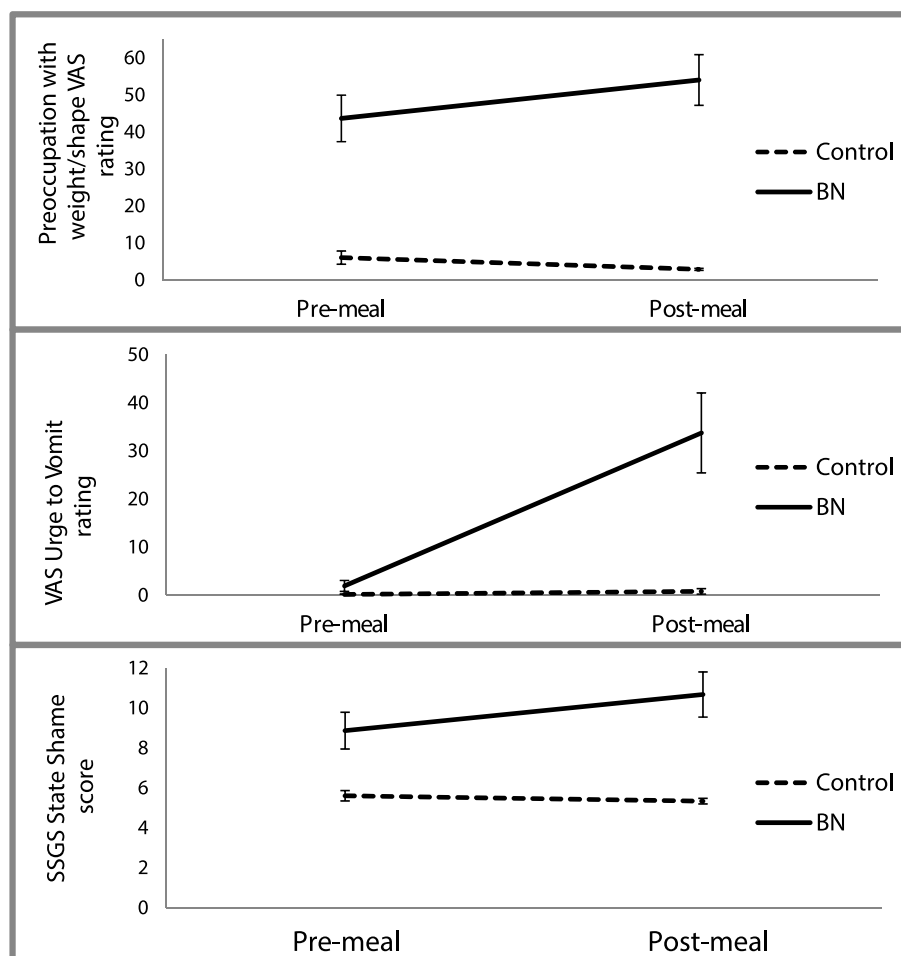
Note. *N* = 51. Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); VAS, Visual Analogue Scale; EDE-Q, Eating Disorder Examination- Questionnaire. Mean (SD) values for eating disorder behaviors indicate average number of episodes in the past month. \**p* < .05, \*\**p* < .001.

<sup>3</sup> Foods presented at each personalized test meal ranged from those typical of a meal (e.g., cereal with milk, sandwich bread with peanut butter and jelly) to those typical of a snack (e.g. cookies, pretzels), as in previous research of laboratory binge eating (Sysko et al., 2018).

**Table 2**

Study 1 subjective responses to the laboratory binge eating meal.

Variable	Control Mean (SD) (N = 30)	BN Mean (SD) (N = 21)	Group F	Time F	Time X Age F	Time X Guilt F	Group X Time F	df
Preoccupation with weight/shape								
Pre	6.00 (9.82)	43.62 (28.81)	46.04***	2.57	0.15	–	6.42*	1, 48
Post	2.83 (7.05)	54.00 (31.41)						
Urge to vomit								
Pre	0.13 (0.57)	1.90 (5.21)	11.40***	22.46***	4.58*	–	10.11**	1, 48
Post	0.77 (3.15)	33.71 (38.10)						
Shame								
Pre	5.60 (1.43)	8.86 (4.22)	14.69***	3.47	0.30	0.90	4.47*	1, 47
Post	5.33 (0.76)	10.67 (5.16)						
Negative Affect								
Pre	5.89 (6.93)	16.17 (14.27)	13.95***	0.20	4.25*	–	1.02	1, 48
Post	1.75 (3.84)	19.52 (18.92)						

Note.  $N = 51$ . \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .**Fig. 1.** Top Panel: Study 1. Mean (±SE) preoccupation with weight/shape from pre-meal to post-meal.  $N = 51$ .Middle Panel: Study 1. Mean (±SE) urge to vomit from pre-meal to post-meal.  $N = 51$ .Bottom Panel: Study 1. Mean (±SE) shame from pre-meal to post-meal.  $N = 51$ .



urge to vomit across time, compared with controls. The main effect of time on urge to vomit was significant, indicating urge to vomit increased across groups over time ( $d = 1.37$ , 95% CI: 0.72, 1.95). There was a significant and large time by group interaction ( $d = 0.92$ , 95% CI: 0.31, 1.48) such that the effect of test meal consumption on change in urge to vomit was different for participants in each group. As illustrated in the middle panel of Fig. 1, participants in the BN group reported a significantly greater increase in urge to vomit rating immediately following the test meal than participants in the control group ( $M[SD]$  urge to vomit rating = 31.81[37.07] versus 0.63[2.67]). The ad lib test meal replicated important aspects of the experience of binge eating for BN participants.

**Shame.** There was a significant and large main effect of group on shame controlling for guilt ( $d = 1.12$ , 95% CI: 0.49, 1.69). The effect was also present not controlling for guilt. Specifically, the BN group reported significantly higher shame compared with controls. The main effect of time was not significant, indicating across groups, shame level remained stable over time, controlling for guilt. A significant time by group interaction was observed for shame, indicating that there was a moderately large differential effect of test meal consumption on change in shame from pre-meal to post-meal depending on group membership ( $d = 0.62$ , 95% CI: 0, 1.17). As illustrated in the bottom panel of Fig. 1, participants in the BN group endorsed significantly greater increases in shame following the test meal than participants in the control group, who reported a slight decrease in shame following the test meal ( $M[SD]$  shame score change = 1.81[4.20] versus  $-0.31[1.28]$ ).

**Negative affect.** There was a significant and large main effect of group on negative affect ( $d = 1.08$ , 95% CI: 0.46, 1.64). Specifically, the BN group reported significantly greater negative affect compared with controls. The main effect of time on negative affect was not significant, indicating that collapsing across groups, negative affect remained stable over time. The interaction of group by time on negative affect was not significant, indicating change in negative affect level following the test meal was not different according to group.

### 2.3. Study 1 discussion

The key study hypothesis of Study 1 was supported: shame increased following a laboratory test meal, in which instructions to binge were provided, for women with BN compared with control women. This effect was not present for negative affect, suggesting that increases in shame following binge eating are not an artifact of increases in negative affect. Results of Study 1 also provide further support for the use of laboratory analogue binge eating designs in eating disorder research: In contrast to healthy control women, women with BN reported experiencing increases in both cognitive (preoccupation with weight and shape) and behavioral (urge to vomit) eating disorder symptoms after the laboratory test meal in which they were instructed to binge.

It is striking that increases in shame following binge eating were greater for the BN group compared with controls, even after controlling for guilt, indicating that the resulting increases in shame were a) potentially due to binge eating, and b) uncomplicated by overlap with guilt. The finding that shame was more strongly associated with BN than was guilt overlaps with other research indicating a stronger association between shame and psychopathology, rather than guilt and psychopathology (Kim et al., 2011; Tangney et al., 2007).

Although prior work has established both cross-sectional and longitudinal associations between shame and bulimic symptoms (Goss & Allan, 2009; Levinson et al., 2016; Sanftner et al., 1995), this is the first documentation of increases in shame following laboratory binge eating in a clinical sample of young women with BN. The findings of this study are consistent with, though not proof of, the theory that binge eating in the context of BN causes increases in the experience of shame, a harmful emotion that heightens risk for the experience of multiple forms of psychopathology beyond just disordered eating (Tangney et al., 2007). Increases in shame among women with BN could be observed after just

one occasion of binge eating in a laboratory setting. This finding suggests the possibility that binge eating in one's natural environment, engaged in repetitively over time, may impact overall shame levels even more dramatically.

#### 2.3.1. Study 1 strengths and limitations

Study 1 had several strengths. First, the laboratory design allowed us to test state levels of shame and other emotions and eating disorder symptoms directly before and immediately after a laboratory binge eating task among women with BN. Second, we controlled for guilt when examining changes in shame. Given the common co-occurrence and high conceptual overlap between shame and guilt, it is essential that researchers control for guilt when examining shame (Tangney & Dearing, 2002). In a recent systematic review of shame in eating disorders, few studies controlled for guilt when measuring shame (Blythin et al., 2020), making it difficult to ascertain relationships between BN, shame, and guilt. Third, we used measures with strong psychometric properties and well-established study methods to examine laboratory binge eating.

Limitations to Study 1 include the following. First, although the study design allowed for an experience that closely mirrored that of a binge eating episode and analogue designs of binge eating using these methods have been shown to be rigorous and reproducible (Sysko et al., 2018), the experience was nonetheless a laboratory approximation of a binge-eating episode. We cannot know from this study if participants' emotional responses following binge eating would have differed if they were assessed after binge eating in their natural environment. Second, despite efforts to match participants on age, participants in the control and BN groups differed significantly by age. Though participants were recruited using stringent eligibility criteria and through similar methods, women with BN in this sample tended to be older on average than controls. It is noteworthy that a) the mean age difference was only 1.28 years and b) the results regarding increases in shame and cognitive and behavioral measures of disordered eating following the test meal did not differ even when controlling for age.<sup>4</sup> Third, because we could only enroll non-treatment seeking women with BN, the sample of women with BN was recruited largely from the community and was of mixed severity: some participants endorsed below-threshold binge eating frequency (i.e. OSFED BN) while others endorsed daily binge eating and purging. Thus, it is possible that results may differ with a sample of women with higher rates of binge eating and purging. Fourth, we only included participants in the BN group who did not meet criteria for any comorbid psychiatric diagnosis. Because the focus of the study was to investigate shame following binge eating, and shame is heightened across psychiatric disorders, we considered it important to control for the possibility that elevations in shame following test meal consumption could be attributed to other forms of distress the participant may be experiencing. Nonetheless, BN is associated with significant psychiatric comorbidity (Appolinario et al., 2022), thus our sample represents a unique subset of individuals with BN. Future research should investigate if our results extend to samples of BN with known psychiatric comorbidity. Fifth, participants in the study were required to have a BMI between 18.5 and 26.5. Future research should investigate whether these results extend to participants of higher and lower weights. Sixth, the design did not include a control group of women with BN who did not engage in the laboratory binge eating episode, thus precluding a direct inference that binge eating, versus any food intake or the simple passage of time, was the cause of increased shame for women with BN. Seventh, there are likely other candidate mechanisms for the proposed comorbidity model that were not tested in Study 1, which was not an exhaustive test of all possible risk processes.

<sup>4</sup> Results were not changed when the youngest controls were excluded from analyses to allow for age-matched groups.

### 3. Study 2

It is unclear from the results of Study 1 whether increases in the temporal association between binge eating and shame (1) persists across time, (2) are experienced by women not selected for BN diagnosis, and (3) involve a reciprocal process. We sought to address this limitation in Study 2 using a longitudinal design in college women measuring binge eating, shame, guilt, and negative affect across three months. Binge eating is particularly prevalent among college women, compared to men (Serra et al., 2020). College students who endorse binge eating are 6.6 times more likely to endorse a comorbid mental health problem (Serra et al., 2020), indicating transdiagnostic risk factors may potentially be at play in explaining clinical overlap. Thus, a sample of undergraduate women was appropriate for this study. We hypothesized that endorsement of binge eating at baseline would predict greater shame three months later. Because of prior work showing prospective prediction from shame to binge eating (Levinson et al., 2016), we sought to replicate that time-lagged prediction as well. We included negative affect as a control.

#### 3.1. Method

Participants completed questionnaires online via a secure website at baseline and at 3-month follow-up.

##### 3.1.1. Participants

Our sample consisted of 302 college women from a large, public university in the southeastern U.S. Data were collected at two time points across three months [retention at follow-up,  $N = 260$  (86%)]. Participants were between the ages of 18 and 25 years (mean (SD) age = 18.45 (0.88) years). At baseline, participants self-identified as White (71.9%), Black (15.6%), Biracial (5.3%), Hispanic (3.6%), Asian (2.3%), and American Indian (0.3%).

##### 3.1.2. Measures

We report the measures used in Study 2. Additional measures to be reported elsewhere included additional demographic information, the Test of Self-Conscious Affect-4, Alcohol Use Disorders Identification Test, State-Trait Anxiety Inventory, Eating and Thinness Expectancies scales, Drug History Questionnaire, Clinical Impairment Assessment, Body Shape Questionnaire, UPPS-P, Center for Epidemiological Studies-Depression scale, Risky Behavior Scale, and questions about cigarette smoking frequency and quantity.

**Body Mass Index.** Participants self-reported height and weight. BMI was calculated by dividing weight, in kilograms, by height, in meters squared. Good agreement has been found between online, self-reported height and weight and direct anthropometric measurements (Davies et al., 2020).

**Binge eating.** The EDE-Q, described above in Study 1, was used to assess binge eating over the past 28 days. We defined binge eating as objective binge eating with loss of control (APA, 2013). Scoring was dichotomous; to be scored positively for binge eating, participants needed to positively endorse 1) objective over-eating episodes (e.g. “how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)?”) and 2) loss of control during objective over-eating episodes (“On how many of these times did you have a sense of having lost control over your eating (at the time you were eating)?”).

**Shame and Guilt.** The State Shame and Guilt Scale (SSGS), described above in Study 1, was used to assess shame and guilt. In this study, internal consistency for the shame ( $\alpha = 0.82$  at baseline,  $\alpha = 0.83$  at follow-up) and guilt ( $\alpha = 0.87$  at baseline,  $\alpha = 0.91$  at follow-up) subscales was good to excellent. Although used as a state measure, the SSGS has good test-retest reliability (Tangney & Dearing, 2002), and both the shame and guilt subscales correlate with other measures of shame and guilt, demonstrating its convergent validity (Fedewa et al., 2005;

Tilghman-Osborne et al., 2008).

**Negative Affect.** The Positive and Negative Affect Schedule (PANAS), Negative Affect Scale (Watson et al., 1988) was used to measure broad, trait-level negative affect. The “ashamed” and “guilty” items were omitted to allow for the measurement of negative affect independent of shame and guilt. Participants were asked to rate how they feel on average on a Likert scale anchored at “very slightly” and “extremely”. The mean of the 10 items was taken to obtain a score ranging from 1 to 5. The PANAS has impressive reliability and validity (Crawford & Henry, 2004). In this study, internal consistency estimates of reliability were good ( $\alpha = 0.85$  at baseline,  $\alpha = 0.89$  at follow-up).

##### 3.1.3. Procedure

The study was approved by the IRB at the University of Kentucky (IRB protocol #44670 “A Longitudinal Study of Emotions and Eating”). The research was conducted with human participants who voluntarily participated after providing written informed consent to the research team, per the approved IRB protocol. All ethical guidelines in the treatment of study participants and in conducting and analyzing the retrieved data were followed. Participants were recruited from an online database that allows students to receive course credit for taking part in research. Informed consent was obtained electronically before the secure online survey began. Participants were informed the research consisted of two parts.

##### 3.1.4. Data analysis

Data were analyzed using SPSS v.24. In advance of statistical tests of our model, descriptive statistics for key variables and bivariate correlations between variables were calculated. At each time point, participants with and without follow-up data did not differ on any study variables, so we inferred that data were missing at random. We therefore used the expectation maximization (EM) procedure to impute missing values, a procedure shown to more accurately approximate population data than traditional, alternative methods, such as case deletion or mean substitution (Enders, 2006; Little & Rubin, 1989). As a result, we were able to make full use of the entire sample of  $N = 302$ . Primary analyses were as follows: First, we conducted a hierarchical linear regression testing whether endorsement of binge eating at baseline predicted increases in shame at follow-up, controlling for baseline shame, guilt, and negative affect. Next, we conducted a binomial logistic regression analysis testing whether shame at baseline predicted endorsement of binge eating at follow-up, controlling for baseline binge eating, guilt, and negative affect.

### 3.2. Results of Study 2

**Descriptive Data.** Table 3 presents demographics, frequencies of engagement in binge eating, and means and standard deviations for shame, guilt, and negative affect at baseline and follow-up among all participants, as well as correlations between study variables. As the table shows, each variable at baseline positively correlated with itself at follow-up. As expected, variables with conceptual overlap (e.g. shame, guilt, negative affect) were positively correlated at each time point. Binge eating was positively correlated with shame and negative affect at each time point.

**Prediction of Shame.** Baseline shame and guilt were entered into the first step of the model, followed by baseline endorsement of binge eating and negative affect. Follow-up shame was entered as the outcome variable. Results are shown in the top panel of Table 4. In support of our hypothesis, baseline binge eating prospectively predicted increased shame level at follow-up, beyond baseline shame and guilt. We note the non-hypothesized finding that baseline negative affect also predicted heightened shame at follow-up, controlling for baseline shame, guilt, and binge eating.

**Prediction of Binge Eating.** Baseline binge eating was entered into the first step of the logistic regression model, followed by baseline levels of

**Table 3**

Top panel: Study 2 participant demographic and clinical characteristics Bottom panel: Study 2 correlations among key study variables.

Variable	Baseline (N = 302)				Follow-up (N = 260)		
	M (SD)				M (SD)		
BMI	23.66 (4.51)				23.84 (4.53)		
Shame	8.16 (3.87)				7.88 (3.80)		
Guilt	9.34 (4.98)				8.61 (4.59)		
Negative affect	17.50 (5.91)				17.11 (6.42)		
	N (%)				N (%)		
Endorsed Binge Eating	88 (29.1)				64 (21.2%)		

	Binge 1	Shame 1	Guilt 1	NA 1	Binge 2	Shame 2	Guilt 2
Shame 1	.15**	–	–	–	–	–	–
Guilt 1	.13*	.67***	–	–	–	–	–
NA 1	.28***	.56***	.47***	–	–	–	–
Binge 2	.52***	.20***	.07	.22***	–	–	–
Shame 2	.21***	.42***	.25***	.35***	.27***	–	–
Guilt 2	.19***	.17**	.24***	.22***	.24***	.68***	–
NA 2	.17**	.36***	.27***	.57***	.28***	.55***	.35***

Note. N = 302. BMI = Body Mass Index. NA = Negative Affect. 1 = Baseline, 2 = Follow-up.

\*p < .05, \*\*p < .01, \*\*\*p < .001.

**Table 4**

Top panel: Study 2 hierarchical linear regression predicting shame at follow-up Bottom panel: Study 2 binary logistic regression predicting endorsement of binge eating at follow-up.

Variable	<i>B</i>	<i>S.E.</i>	$\beta$	<i>t</i>	95% CI		<i>F</i>	<i>R</i> <sup>2</sup>	$\Delta R^2$
					Lower	Upper			
Block 1									
Shame 1	.46	.07	.46	6.48***	.32	.59	32.27***	.18	.18
Guilt 1	−.05	.06	−.06	−.85	−.15	.06			
Block 2									
Shame 1	.38	.07	.38	5.08***	.23	.52	20.27***	.21	.04
Guilt 1	−.07	.05	−.09	−1.34	−.18	.03			
Negative Affect 1	.10	.04	.16	2.40*	.02	.18			
Binge 1	1.00	.45	.12	2.22*	.11	1.89			
Variable	<i>B</i>	<i>S.E.</i>	Wald	OR	95% CI		<i>X</i> <sup>2</sup>		
					Lower	Upper			
Block 1									
Binge 1	2.50	.31	66.31	12.15***	6.66	22.16	75.76***		
Block 2									
Binge 1	2.49	.33	58.11	12.09***	6.37	22.96	87.49***		
Guilt 1	−.11	.05	5.23	.90*	.82	.99			
Negative Affect 1	.02	.03	.50	1.02	.96	1.09			
Shame 1	.16	.06	8.51	1.18**	1.06	1.31			

Note. N = 302.1 = Baseline. \*p < .05, \*\*p < .01, \*\*\*p < .001.

shame, guilt, and negative affect. Follow-up binge eating was entered as the outcome variable. Results are shown in the bottom panel of Table 4. As expected, baseline shame prospectively predicted positive endorsement of binge eating at follow-up, beyond prediction from baseline binge eating. Specifically, for every one-unit increase in shame at baseline, the likelihood of binge eating endorsement at follow-up, controlling for all other predictors, increased by 18%. Baseline guilt prospectively predicted negative endorsement of binge eating at follow-up, beyond prediction from baseline binge eating. Specifically, for every one-unit increase in guilt at baseline, the likelihood of binge eating at follow-up, controlling for all other predictors, decreased by 10%. When baseline shame was removed from the predictive model, baseline guilt was not a significant predictor of binge eating at follow-up. Baseline negative affect did not significantly predict binge eating at follow-up.

### 3.3. Discussion study 2

Findings from Study 2 support the presence of a longitudinal,

reciprocal relationship between shame and binge eating among college women, controlling for both guilt and negative affect.<sup>5</sup> These results extend the findings of Study 1 in two important ways. First, Study 2 demonstrated that increases in shame predicted by binge eating can be shown across three months, suggesting a prolonged effect of generalized shame level following binge eating. Second, Study 2 demonstrated binge eating predicts greater shame in college women not selected for the presence of an eating disorder. This contributes further evidence that binge eating is linked to distress in both clinical eating disorders and community-based samples (DeJong et al., 2013). This study provides further support for bringing attention to the full spectrum of binge

<sup>5</sup> Effects of the model were present when individuals with clinical levels of eating pathology (i.e. EDE global score above 2.8; Mond et al., 2015) were excluded from analyses, indicating that significant relationships between variables were not a function of including individuals with diagnosable eating disorders.



eating severity and its potential impact on the harmful, maladaptive emotion of shame.

Existing research has shown a longitudinal relationship between broad bulimic psychopathology (which includes binge eating and compensatory behaviors) and subsequent increases in shame in college students (Levinson et al., 2016). Study 2 extended the findings of Levinson et al. (2016) by demonstrating that shame is predicted by, and predicts, binge eating in particular, and not just overall levels of bulimic psychopathology or eating pathology (Brockdorf et al., 2020), and that associations are independent of guilt and negative affect. This distinction is important because it is consistent with the possibility that binge eating is perhaps a more precise facilitator of future increases in shame.

Notably, increases in guilt were predictive of less binge eating across time, controlling for shame. When we did not control for shame, guilt was no longer a significant predictor of binge eating, suggesting that only the part of guilt that does not overlap with shame is significant in the prediction of less binge eating. This finding differs from Levinson et al. (2016) but is consistent with the conceptual distinction between shame and guilt. One who experiences guilt uncomplicated by shame (Tangney et al., 2007) after binge eating is likely to feel remorse or regret about the specific behavior (Miceli & Castelfranchi, 2018), rather than about their core self. One can address and resolve one's guilt about binge eating by seeking to behave differently in the future (Miceli & Castelfranchi, 2018; Tangney & Dearing, 2002), which is adaptive and may lead to decreases in the binge eating over time. In this way, guilt may even demonstrate a protective effect (Sanftner et al., 1995).

Study 2's longitudinal demonstration of effects observed in the Study 1 laboratory study help build a case for further examining consequences of this process. It is striking that the pattern of increased shame following binge eating, as observed in Study 1, is also present in Study 2, in non-selected individuals followed in their natural environment across 3 months. Replication of results across methods supports the value of testing the second part of the model for transdiagnostic risk emanating from the effect of binge eating on shame.

### 3.3.1. Study 2 strengths and limitations

The use of a prospective, longitudinal design in a large sample with high retention represent strengths of Study 2. These features permitted us to demonstrate shame was a prospective risk factor for increased binge eating while controlling for both guilt and negative affect. Findings support the viability of a comorbidity theory focused on shame.

Unlike Study 1, Study 2 focused on college women which limits generalizability of findings. Although Study 2 was designed to be an extension of Study 1, the three-month time frame does not permit us to draw conclusions regarding persistence over longer time frames. Future studies may choose to extend this work over longer longitudinal periods (e.g., six months, one year, or more) to better capture periods over which incidence of comorbid disorders could be measured.

The use of the SSGS, a state-based measure of shame and guilt, is a potential limitation due to its emphasis on assessment of in-the-moment feelings of shame and guilt, as opposed to trait shame or measures of shame over the past several days or weeks. However, despite its sensitivity to momentary changes in shame, the SSGS has also demonstrated high levels of test-retest reliability across prolonged time frames (Tangney & Dearing, 2002), converges with other measures of trait shame and guilt (Fedewa et al., 2005; Tilghman-Osborne et al., 2008), and provides consistency across studies because it was used in Study 1 as well. Future studies may (1) use validated measures of trait shame and (2) control for trait shame in analyses to investigate the impact of shame proneness on state shame following binge eating.

## 4. Overall discussion

Taken together, the present findings provide laboratory and longitudinal field support for both immediate and ongoing increases in shame following binge eating. Researchers have proposed shame as an outcome

of ongoing psychopathology (Căndea & Szentagotai, 2013); the current empirical findings are consistent with this hypothesis.

These results may have important implications for comorbidity in eating disorders: if shame, a transdiagnostic risk factor for depression, anxiety, substance use, and self-harm (Kim et al., 2011; Tangney et al., 2007), increases as a result of binge eating, does shame mediate the effect of binge eating on other maladaptive behaviors? These laboratory and longitudinal findings may be a first step toward the validation of a comorbidity risk model that emphasizes shame as a mechanism underlying the relationship between binge eating and other types of psychopathology (Davis et al., 2019). Future laboratory work may investigate urges to engage in maladaptive behaviors and endorsement of comorbid symptoms in the minutes and hours following ad lib test meal consumption, mediated by increases in shame. Future laboratory work may also investigate changes in shame following test meal consumption under other experimental conditions, such as when participants are not instructed to binge, or following a negative affect induction. Future EMA studies should study the progression of shame following binge eating, to test whether shame appears to decrease with more assessment points, similar that of broad negative affect (Berg et al., 2018), or increase further over time. Future longitudinal investigations should include additional assessment points, longer follow up duration, and measures of comorbid disorders to determine if shame serves as a mediator of the established prospective impact of binge eating on transdiagnostic dysfunction (including anxiety, depression and substance misuse; Bulik et al., 2004; Puccio et al., 2016; Puccio et al., 2017; Stice et al., 2004; Stice & Shaw, 2003). If shame mediates the relationship between binge eating and other forms of psychopathology, it would indicate that binge eating (1) is even more pernicious than previously acknowledged, and (2) should be more of a focus of researchers studying the risk process of other types of psychopathology.

It is important to note that our samples consisted of young adult women who were mostly white (~72%). Binge eating is present across racial, ethnic, gender, and age groups (Hudson et al., 2007; Udo & Grilo, 2018). Therefore, it will be important for future investigations to examine shame following binge eating in individuals of diverse backgrounds and identities. Future work should also test the current model in clinical samples of individuals meeting criteria for other eating disorders that include binge eating, such as AN-bp and BED. Finally, it is possible that other types of disinhibited eating (e.g. loss of control eating or subjective binge eating) may precede elevated feelings of shame. Future studies should examine this possibility in groups without objective binge eating, such as purging disorder or anorexia nervosa, restricting type.

Results of the current study have important clinical implications. Given its pervasive nature and extensive reach across several domains of psychological dysfunction, the experience of generalized shame may be a useful intervention target (Căndea & Szentagotai, 2013). Targeted intervention to treat shame precisely and promptly may be warranted in women with bulimic-spectrum eating disorders and college women who binge eat. Indeed, compassion-focused therapy (Goss & Allan, 2010) leads to reductions in shame level, and early reductions in shame are associated with decreases in eating disorder symptoms (Kelly et al., 2014). Some women presenting to treatment for concerns regarding binge eating, whether as part of BN, OSFED BN, or outside of a formal diagnosis, may benefit from a focus on shame as a primary treatment target. Specifically, patients experiencing shame following binge eating may find interventions such as cognitive restructuring (a component of enhanced Cognitive Behavioral Therapy for eating disorders; Fairburn, 2008) useful to help challenge and ultimately modify shame-related cognitive distortions. As noted, shame predicts transdiagnostic behaviors and symptoms (Căndea & Szentagotai, 2013) that are comorbid with BN. If interventions to treat shame resulting from binge eating are implemented, engagement in other behaviors and the experience of other symptoms (e.g. substance use, self-harm, anxiety, depression) may be reduced.

The impact of shame appears to be beyond merely increasing risk for

binge eating, and may also be a harmful consequence of engagement in binge eating, for women with BN and college women who binge eat. Clinicians and researchers alike are urged to consider shame in their conceptualizations of binge eating and comorbid forms of dysfunction.

## Author contributions

Conceptualization: H. Davis, G. Smith, P. Keel, J. Tangney; Methodology: H. Davis, G. Smith, P. Keel, J. Tangney; Funding Acquisition: H. Davis and G. Smith; Investigation: H. Davis and G. Smith; Data Curation: H. Davis; Formal Analysis: H. Davis; Writing – Original Draft Preparation: H. Davis; Writing – Review & Editing: G. Smith, P. Keel; Project Administration: H. Davis.

## Funding information

This work was supported by grants from the National Institute of Mental Health (F31 MH114551 & T32 MH082761). The funder had no role in study design, in the data collection, analysis and interpretation of data, in the writing of the report, or in the decision to submit the article for publication.

Data have not been published elsewhere.

## Ethical statement

The studies described in this report were approved by the Institutional Review Board (IRB) at the University of Kentucky (Study 1: IRB protocol #43524, Title: Emotions and Eating; Study 2: IRB protocol #44670 “A Longitudinal Study of Emotions and Eating”). The research was conducted with human participants who voluntarily participated after providing written informed consent to the research team, per the approved IRB protocols. All ethical guidelines in the treatment of study participants and in conducting and analyzing the retrieved data were followed.

Data and analyses are available upon request to the corresponding author.

## Declaration of competing interest

The authors have no conflicts of interest to disclose.

## Data availability

Data will be made available on request.

## References

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
- Appolinario, J. C., Sichieri, R., Lopes, C. S., Moraes, C. E., da Veiga, G. V., Freitas, S., ... Hay, P. (2022). Correlates and impact of DSM-5 binge eating disorder, bulimia nervosa and recurrent binge eating: A representative population survey in a middle-income country. *Social Psychiatry and Psychiatric Epidemiology*, 1–13.
- Armeli, S., Sullivan, T. P., & Tennen, H. (2015). Drinking to cope motivation as a prospective predictor of negative affect. *Journal of Studies on Alcohol and Drugs*, 76(4), 578–584. <https://doi.org/10.15288/jsad.2015.76.578>
- Blythin, S. P., Nicholson, H. L., Macintyre, V. G., Dickson, J. M., Fox, J. R., & Taylor, P. J. (2020). Experiences of shame and guilt in anorexia and bulimia nervosa: A systematic review. *Psychology and Psychotherapy: Theory, Research and Practice*, 93(1), 134–159. <https://doi.org/10.1111/papt.12198>
- Brockdorf, A. N., Tomaso, C. C., & Keel, P. K. (2020). Sensitivity to punishment and eating pathology among undergraduate women: The mediating role of shame. *Eating Behaviors*, 36, Article 101362. <https://doi.org/10.1016/j.eatbeh.2019.101362>
- Bulik, C. M., Klump, K. L., Thornton, L., Kaplan, A. S., Devlin, B., Fichter, M. M., Halmi, K. A., Strober, M., Woodside, D. B., Crow, S., Mitchell, J. E., Rotondo, A., Mauri, M., Cassano, G. B., Keel, P. K., Berrettini, W. H., & Kaye, W. H. (2004). Alcohol use disorder comorbidity in eating disorders: A multicenter study. *The Journal of Clinical Psychiatry*, 65(7), 1000–1006. <https://doi.org/10.4088/jcp.v65n0718>
- Căndea, D., & Szentagotai, A. (2013). Shame and psychopathology: From research to clinical practice. *Journal of Cognitive and Behavioral Psychotherapies*, 13(1), 101–113.
- Căndea, D. M., & Szentagotai-Tătar, A. (2018). Shame-proneness, guilt-proneness and anxiety symptoms: A meta-analysis. *Journal of Anxiety Disorders*, 58, 78–106. <https://doi.org/10.1016/j.janxdis.2018.07.005>
- Cooper, Z., & Fairburn, C. (1987). The eating disorder examination: A semi-structured interview for the assessment of the specific psychopathology of eating disorders. *International Journal of Eating Disorders*, 6(1), 1–8.
- Crawford, J. R., & Henry, J. D. (2004). The Positive and Negative Affect Schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, 43(3), 245–265. <https://doi.org/10.1348/0144665031752934>
- Davies, A., Wellard-Cole, L., Rangan, A., & Allman-Farinelli, M. (2020). Validity of self-reported weight and height for BMI classification: A cross-sectional study among young adults. *Nutrition*, 71, Article 110622. <https://doi.org/10.1016/j.nut.2019.110622>
- Davis, H. A., Ortiz, A. M. L., D'Agostino, A. R., & Smith, G. T. (2016). A two-stage risk model for bulimic behavior. In N. Morton (Ed.), *Eating disorders: Prevalence, risk factors, and treatment options* (pp. 97–120). Nova Science Publishers.
- Davis, H. A., Ortiz, A. M. L., & Smith, G. T. (2019). Transactions between early binge eating and personality predict transdiagnostic risk. *European Eating Disorders Review*, 27(6), 614–627. <https://doi.org/10.1002/erv.2682>
- Dearing, R. L., Stuewig, J., & Tangney, J. P. (2005). On the importance of distinguishing shame from guilt: Relations to problematic alcohol and drug use. *Addictive Behaviors*, 30(7), 1392–1404. <https://doi.org/10.1016/j.addbeh.2005.02.002>
- DeJong, H., Oldershaw, A., Sternheim, L., Samarawickrema, N., Kenyon, M. D., Broadbent, H., ... Schmidt, U. (2013). Quality of life in anorexia nervosa, bulimia nervosa and eating disorder not-otherwise-specified. *Journal of Eating Disorders*, 1(1), 43. <https://doi.org/10.1186/2050-2974-1-43>
- Enders, C. K. (2006). Analyzing structural equation models with missing data. *Structural Equation Modeling: A second course*, 2, 493–519 (IAP Information Age Publishing).
- Fairburn, C. G., & Beglin, S. J. (2008). Eating disorder examination questionnaire (EDE-Q 6.0). In C. G. Fairburn (Ed.), *Cognitive behavior therapy and eating disorders* (pp. 309–313). New York: Guilford Press.
- First, M. B. (2014). Structured clinical interview for the DSM (SCID). *The Encyclopedia of Clinical Psychology*, 1–6. <https://doi.org/10.1002/9781118625392.wbcp351>
- Goss, K., & Allan, S. (2009). Shame, pride and eating disorders. *Clinical Psychology & Psychotherapy: An International Journal of Theory & Practice*, 16(4), 303–316. <https://doi.org/10.1002/cpp.627>
- Goss, K., & Allan, S. (2010). Compassion focused therapy for eating disorders. *International Journal of Cognitive Therapy*, 3(2), 141–158. <https://doi.org/10.1521/ijct.2010.3.2.141>
- Gulley, L. D., Hankin, B. L., & Young, J. F. (2016). Risk for depression and anxiety in youth: The interaction between negative affectivity, effortful control, and stressors. *Journal of Abnormal Child Psychology*, 44(2), 207–218. <https://doi.org/10.1007/s10802-015-9997-7>
- Haedt-Matt, A. A., & Keel, P. K. (2011). Revisiting the affect regulation model of binge eating: A meta-analysis of studies using ecological momentary assessment. *Psychological Bulletin*, 137(4), 660–681. <https://doi.org/10.1037/a0023660>
- Hasson, D., & Arnetz, B. B. (2005). Validation and findings comparing VAS vs. Likert scales for psychosocial measurements. *The International Electronic Journal of Health Education*, 8, 178–192. Retrieved from: <http://files.eric.ed.gov/fulltext/EJ794094.pdf>
- Hudson, J. I., Hiripi, E., Pope, H. G., Jr., & Kessler, R. C. (2007). The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biological Psychiatry*, 61(3), 348–358. <https://doi.org/10.1016/j.biopsych.2006.03.040>
- Kazak, A. E. (2018). Editorial: Journal article reporting standards. *American Psychologist*, 73(1), 1–2. <https://doi.org/10.1037/amp0000263>
- Keel, P. K., Haedt-Matt, A. A., Hildebrandt, B., Bodell, L. P., Wolfe, B. E., & Jimerson, D. C. (2018). Satiation deficits and binge eating: Probing differences between bulimia nervosa and purging disorder using an ad lib test meal. *Appetite*, 127, 119–125. <https://doi.org/10.1016/j.appet.2018.04.009>
- Kelly, A. C., Carter, J. C., & Borairi, S. (2014). Are improvements in shame and self-compassion early in eating disorders treatment associated with better patient outcomes? *International Journal of Eating Disorders*, 47(1), 54–64. <https://doi.org/10.1002/eat.22196>
- Kessler, R. C., Shahly, V., Hudson, J. I., Supina, D., Berglund, P. A., Chiu, W. T., ... Xavier, M. (2014). A comparative analysis of role attainment and impairment in binge-eating disorder and bulimia nervosa: Results from the WHO world mental health surveys. *Epidemiology and Psychiatric Sciences*, 23(1), 27–41. <https://doi.org/10.1017/S2045796013000516>
- Kim, S., Thibodeau, R., & Jorgensen, R. S. (2011). Shame, guilt, and depressive symptoms: A meta-analytic review. *Psychological Bulletin*, 137(1), 68–96. <https://doi.org/10.1037/a0021466>
- Kissileff, H. R., Walsh, B. T., Kral, J. G., & Cassidy, S. M. (1986). Laboratory studies of eating behavior in women with bulimia. *Physiology & Behavior*, 38(4), 563–570. [https://doi.org/10.1016/0031-9384\(86\)90426-9](https://doi.org/10.1016/0031-9384(86)90426-9)
- Levinson, C. A., Byrne, M., & Rodebaugh, T. L. (2016). Shame and guilt as shared vulnerability factors: Shame, but not guilt, prospectively predicts both social anxiety and bulimic symptoms. *Eating Behaviors*, 22, 188–193. <https://doi.org/10.1016/j.eatbeh.2016.06.016>
- Lewis, H. B. (1971). Shame and guilt in neurosis. *The Psychoanalytic Review*, 58(3), 419–438.
- Little, R. J., & Rubin, D. B. (1989). The analysis of social science data with missing values. *Sociological Methods & Research*, 18(2–3), 292–326.

- Luoma, J. B., Chwyl, C., & Kaplan, J. (2019). Substance use and shame: A systematic and meta-analytic review. *Clinical Psychology Review*, 70, 1–12. <https://doi.org/10.1016/j.cpr.2019.03.002>
- Mabe, A. G., Forney, K. J., & Keel, P. K. (2014). Do you “like” my photo? Facebook use maintains eating disorder risk. *International Journal of Eating Disorders*, 47(5), 516–523. <https://doi.org/10.1002/eat.22254>
- Marschall, D., Sanftner, J., & Tangney, J. P. (1994). *The state shame and guilt scale*. Fairfax, VA: George Mason University.
- Miceli, M., & Castelfranchi, C. (2018). Reconsidering the differences between shame and guilt. *Europe's Journal of Psychology*, 14(3), 710–733. <https://doi.org/10.5964/ejop.v14i3.1564>
- Mitchell, J. E., Crow, S., Peterson, C. B., Wonderlich, S., & Crosby, R. D. (1998). Feeding laboratory studies in patients with eating disorders: A review. *International Journal of Eating Disorders*, 24(2), 115–124. [https://doi.org/10.1002/\(SICI\)1098-108X\(199809\)24:2<115::AID-EAT1>3.0.CO;2-H](https://doi.org/10.1002/(SICI)1098-108X(199809)24:2<115::AID-EAT1>3.0.CO;2-H)
- Puccio, F., Fuller-Tyszkiewicz, M., Ong, D., & Krug, I. (2016). A systematic review and meta-analysis on the longitudinal relationship between eating pathology and depression. *International Journal of Eating Disorders*, 49(5), 439–454. <https://doi.org/10.1002/eat.22506>
- Puccio, F., Fuller-Tyszkiewicz, M., Youssef, G., Mitchell, S., Byrne, M., Allen, N., & Krug, I. (2017). Longitudinal bi-directional effects of disordered eating, depression and anxiety. *European Eating Disorders Review*, 25(5), 351–358. <https://doi.org/10.1002/erv.2525>
- Ranzenhofer, L. M., Hannallah, L., Field, S. E., Shomaker, L. B., Stephens, M., Sbrocco, T., ... Tanofsky-Kraff, M. (2013). Pre-meal affective state and laboratory test meal intake in adolescent girls with loss of control eating. *Appetite*, 68, 30–37. <https://doi.org/10.1016/j.appet.2013.03.018>
- Raymond, N. C., Bartholome, L. T., Lee, S. S., Peterson, R. E., & Raatz, S. K. (2007). A comparison of energy intake and food selection during laboratory binge eating episodes in obese women with and without a binge eating disorder diagnosis. *International Journal of Eating Disorders*, 40(1), 67–71. <https://doi.org/10.1002/eat.20312>
- Sanftner, J. L., Barlow, D. H., Marschall, D. E., & Tangney, J. P. (1995). The relation of shame and guilt to eating disorder symptomatology. *Journal of Social and Clinical Psychology*, 14(4), 315–324. <https://doi.org/10.1521/jscp.1995.14.4.315>
- Schneider, B. A., Avivi-Reich, M., & Mozuraitis, M. (2015). A cautionary note on the use of the Analysis of Covariance (ANCOVA) in classification designs with and without within-subject factors. *Frontiers in Psychology*, 6, 474. <https://doi.org/10.3389/fpsyg.2015.00474>
- Serra, R., Kiekens, G., Vanderlinden, J., Vrieze, E., Auerbach, R. P., Benjet, C., ... Tarsitani, L. (2020). Binge eating and purging in first-year college students: Prevalence, psychiatric comorbidity, and academic performance. *International Journal of Eating Disorders*, 53(3), 339–348. <https://doi.org/10.1002/eat.23211>
- Sheehy, K., Noureen, A., Khaliq, A., Dhingra, K., Husain, N., Pontin, E. E., ... Taylor, P. J. (2019). An examination of the relationship between shame, guilt and self-harm: A systematic review and meta-analysis. *Clinical Psychology Review*, 73, Article 101779. <https://doi.org/10.1016/j.cpr.2019.101779>
- Smyth, J. M., Wonderlich, S. A., Heron, K. E., Sliwinski, M. J., Crosby, R. D., Mitchell, J. E., & Engel, S. G. (2007). Daily and momentary mood and stress are associated with binge eating and vomiting in bulimia nervosa patients in the natural environment. *Journal of Consulting and Clinical Psychology*, 75(4), 629–638. <https://doi.org/10.1037/0022-006X.75.4.629>
- Stevenson, B. L., Dvorak, R. D., Wonderlich, S. A., Crosby, R. D., & Gordon, K. H. (2018). Emotions before and after loss of control eating. *Eating Disorders: The Journal of Treatment and Prevention*, 26(6), 505–522. <https://doi.org/10.1080/10640266.2018.1453634>
- Stice, E., Burton, E. M., & Shaw, H. (2004). Prospective relations between bulimic pathology, depression, and substance abuse: Unpacking comorbidity in adolescent girls. *Journal of Consulting and Clinical Psychology*, 72(1), 62–71. <https://doi.org/10.1037/0022-006X.72.1.62>
- Stice, E., & Shaw, H. (2003). Prospective relations of body image, eating, and affective disturbances to smoking onset in adolescent girls: How Virginia slims. *Journal of Consulting and Clinical Psychology*, 71(1), 129–135. <https://doi.org/10.1037/0022-006X.71.1.129>
- Sysko, R., Steinglass, J., Schebendach, J., Mayer, L. E., & Walsh, B. T. (2018). Rigor and reproducibility via laboratory studies of eating behavior: A focused update and conceptual review. *International Journal of Eating Disorders*, 51(7), 608–616. <https://doi.org/10.1002/eat.22900>
- Tangney, J. P., & Dearing, R. L. (2002). *Shame and guilt*. New York, NY, US: Guilford Press.
- Tangney, J. P., Stuewig, J., & Mashek, D. J. (2007). Moral emotions and moral behavior. *Annual Review of Psychology*, 58, 345–372. <https://doi.org/10.1146/annurev.psych.56.091103.070145>
- Trojanowski, P. J., Adams, L. M., & Fischer, S. (2019). Understanding profiles of student binge drinking and eating: The importance of motives. *Addictive Behaviors*, 96, 148–155. <https://doi.org/10.1016/j.addbeh.2019.04.025>
- Udo, T., & Grilo, C. M. (2018). Prevalence and correlates of DSM-5-defined eating disorders in a nationally representative sample of US adults. *Biological Psychiatry*, 84(5), 345–354. <https://doi.org/10.1016/j.biopsych.2018.03.014>
- Watson, D., & Clark, L. A. (1984). Negative affectivity: The disposition to experience aversive emotional states. *Psychological Bulletin*, 96(3), 465–490. <https://doi.org/10.1037/0033-2909.96.3.465>
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063.
- Weingarden, H., & Renshaw, K. D. (2015). Shame in the obsessive compulsive related disorders: A conceptual review. *Journal of Affective Disorders*, 171, 74–84. <https://doi.org/10.1016/j.jad.2014.09.010>
- Wolfe, B. E., Metzger, E. D., & Jimerson, D. C. (2002). Serotonin and satiety in bulimia nervosa. *Biological Psychiatry*, 51, 12S.