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Motives for eating tasty foods associated with binge-eating. Results from a student and a weight-loss seeking population*

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Abstract

The aim of this study was to use the Palatable Eating Motives Scale (PEMS) to determine if and what motives for eating tasty foods (e.g., junk food, fast food, and desserts) are associated with binge-eating in two diverse populations. BMI and scores on the PEMS, Yale Food Addiction Scale (YFAS), and Binge-eating Scale (BES) were obtained from 247 undergraduates at the University of Alabama at Birmingham (UAB) and 249 weight-loss seeking patients at the UAB EatRight program. Regression analyses revealed that eating tasty foods to forget worries and problems and help alleviate negative feelings (i.e., the 4-item Coping motive) was associated with binge-eating independently of any variance in BES scores due to sex, age, ethnicity, BMI, other PEMS motives, and YFAS scores in both students ($R^2 = .57$) and patients ($R^2 = .55$). Coping also was associated with higher BMI in students ($p < 0.01$), and in patients despite their truncated BMI range ($p < 0.05$). Among students, the motives Conformity and Reward Enhancement were also independently associated with binge-eating. For this younger sample with a greater range of BES scores, eating for these motives, but not for Social ones, may indicate early maladaptive eating habits that could later develop into disorders characterized by binge-eating if predisposing factors are present. Thus, identifying one's tasty food motive or motives can potentially be used to thwart the development of BED and obesity, especially if the motive is Coping. Identifying one's PEMS motives should also help personalize conventional treatments for binge-eating and obesity toward improved outcomes.

Keywords

Emotions; Obesity; Motivation; Stress; BED; Palatable food

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Introduction

Binge-eating disorder (BED) is a stable and aberrant pattern of eating where unusually large amounts of food are consumed, in a discrete period of time, with a sense of loss of control over how much or what is eaten and that is accompanied by intense embarrassment, disgust, or shame, and distress. It is now an officially codified eating disorder (American Psychiatric Association, 2013; Pope et al., 2006). Yet BED, and other binge-eating conditions including subthreshold BED and bulimia nervosa are still lacking treatments with lasting efficacy and for many individuals, current treatments are not even initially effective (Halmi, 2013; Wilson, Grilo, & Vitousek, 2007; Wonderlich, de Zwaan, Mitchell, Peterson, & Crow, 2003). Moreover, the lifetime duration of these disorders, particularly of BED, are chronic (American Psychiatric Association, 2013; Pope et al., 2006). Acknowledging the truth behind the axiom that prevention is the best treatment, one method of preventing disorders characterized by binge-eating is to identify cognitive and behavioral factors associated with binge-eating. In line with this belief, we recently developed a questionnaire that identifies one's motives for consuming highly palatable foods or drinks. The impetus behind developing this scale, the Palatable Eating Motives Scale or PEMS (Burgess, Turan, Lokken, Morse, & Boggiano, 2014), was the belief that not all obese individuals eat highly tasty foods for the same reason. Ultimately, knowing one's specific motive for eating these palatable foods, which likely contributes to an individual's overweight status since they are eaten for reasons other than a metabolic deficit, may yield better treatments. We recently reported that one motive in particular, that of Coping (one of the four PEMS motives reflecting a tendency to eat palatable foods to deal with problems, worries, or negative moods), was associated with higher BMI in a sample of undergraduate students (Burgess et al., 2014).

The PEMS instructions define "tasty foods or drinks" as desserts, junk food, fast foods, fried foods, sweetened beverages, or other salty snacks. These types of foods are salient to BED. They are preferred and craved during binges, are more likely to be consumed for reasons other than hunger, their high palatability would render them more difficult to limit or to control, and their greater caloric value would contribute to the distress, shame, and guilt that is characteristic of BED and other binge-eating conditions (Boggiano, Turan, Maldonado, Oswald, & Shuman, 2013; Dalton, Blundell, & Finlayson, 2013; Davis et al., 2008, 2009; Drewnowski, 1998; Gendall, Sullivan, Joyce, Carter, & Bulik, 1997; Hill & Peters, 1998; Kales, 1990; Thomas, Doshi, Crosby, & Lowe, 2011; White & Grilo, 2005; Witt & Lowe, 2014; Yanovski, 2003). The PEMS differs from other eating-related cognitive and behavioral measures in that it probes why one eats palatable foods (i.e., eating as a means to meet a certain end) rather than assessing addictive-like behavior with food (Gearhardt, Corbin, & Brownell, 2009) or the extent to which various emotions and cues trigger food intake (Arnow, Kenardy, & Agras, 1995; van Strien, Frijters, Bergers, & Defares, 1986). It also focuses exclusively on palatable food intake and not on the consumption of all foods in general (Steptoe, Pollard, & Wardle, 1995). Individuals are not always aware of the motives behind their behavior and being aware of their motives is often the first step in changing behavior (Bandura, 1977; Cardi, Clarke, & Treasure, 2013). The PEMS is a tool that brings awareness to both the person being tested and the tester regarding the person's motives

behind consuming highly palatable foods or drinks. This knowledge should help individuals at risk for binge-eating conditions or already suffering from them. It should also aid clinicians by allowing them to better tailor cognitive-behavioral and other treatment approaches toward improved outcomes.

Therefore, the current study was designed to test the hypothesis that the PEMS could be used to demonstrate motivation-based associations not only with higher BMI in regression models, but also with greater severity of binge-eating. It is important to note that obesity and binge-eating, while highly correlated, are theoretically distinct constructs. Weight or BMI status is not a criterion for BED. The behavior of binge-eating can occur in non-obese individuals with other eating disorders such as anorexia nervosa and bulimia nervosa. The key difference between BED and these other eating disorders is that the binge-eating occurs in the absence of any compensatory behaviors (American Psychiatric Association, 2013). Obesity and binge-eating are independently heritable as implicated in human (Bulik, Sullivan, & Kendler, 2003) and animal studies (Boggiano et al., 2007). Obese binge-eating individuals also display greater psychopathology, personality disturbance, impulsivity, reward sensitivity, and overall decreased quality of life than do non-binge-eating obese individuals (American Psychiatric Association, 2013; Bulik et al., 2003; Schag, Schönleber, Teufel, Zipfel, & Giel, 2013). Therefore it was important to test whether motives for eating tasty foods were associated with binge-eating independently of BMI. Hence BMI was controlled in all the analyses of this study.

An additional aim of the study was to determine if PEMS motives associated with binge-eating differ according to the type of population tested. For this reason we chose to study two groups. One was a sample of 247 undergraduate students. This represented a normative sample of young adults but also a group with an average age just younger than the typical age of onset for BED which is approximately 25 years of age (Hudson, Hiripi, Pope, & Kessler, 2007). We also studied a group of 249 older weight-loss seeking individuals. This represented a clinical sample and one in which a greater portion of the individuals would be expected to suffer from BED given the high comorbidity between BED and obesity (Grucza, Przybeck, & Cloninger, 2007; Hudson et al., 2007; Yanovski, Nelson, Dubbert, & Spitzer, 1993).

Materials and methods

Participants and procedures

Undergraduate student sample—A total of $N = 247$ students at the University of Alabama at Birmingham (UAB) were recruited through the Introductory Psychology course subject pool. They participated either for required research credits or extra credit. Additional students were recruited through flyers and were compensated with a \$10 Visa card. Of the pool of 247 students, $N = 150$ came into the lab to complete a demographics survey, then had their height and weight measured for a body mass index (BMI). They then completed the Palatable Eating Motives Scale (PEMS), the Yale Food Addiction Scale (YFAS), and the Binge-eating Scale (BES). The other $N = 97$ students were tested in a classroom. They self-reported height and weight which we later calculated into a BMI. They completed a demographic sheet, the PEMS and the BES but not the YFAS due to time constraints. We

conducted regression analyses with and without BMI in the model to test its effect on any PEMS motives associated with binge-eating. Only the N = 150 students that completed the YFAS were used in regression models that included the YFAS as an independent correlate of binge-eating.

EatRight patients—A total of N = 249 patients enrolled in the EatRight program of the University of Alabama at Birmingham were tested. They enrolled with the goal of losing weight, many because of weight-related medical complications, and to learn healthier eating habits. They represented a weight-loss seeking population. As with the group of N = 150 students, the EatRight patients had their height and weight measured by clinic staff to calculate BMI then provided demographic information and completed the PEMS, BES, and YFAS questionnaires. This took place during their initial visit to the program, prior to the weight-loss intervention. This study used informed consent from all patients and was approved through two separate protocols by the UAB Internal Review Board.

Questionnaires

Palatable Eating Motives Scale (PEMS)—The PEMS is a recently developed questionnaire that has good internal reliability and good convergent, incremental, and discriminant validity with existing measures of aberrant food intake and sensitivity to reward or punishment (Burgess et al., 2014). The PEMS is comprised of 19 Likert-like frequency response items that factor into four motives for eating tasty foods or drinks: Coping, Reward Enhancement, Conformity, and Social motives. Responses on each item are scored from 1 (“Almost Never/Never”) to 5 (“Almost Always/Always”). All of the motives are composed of 5 items (or questions) except Coping which is composed of 4 items. Example questions are: “How often do you eat these tasty foods to forget about your problems? (Coping), “... because it’s exciting” (Reward Enhancement), “...to fit in with a group you like” (Conformity), and “...to celebrate a special occasion with friends” (Social). The possible score range for each motive is therefore 5–25, with the exception of Coping, which has a possible score range of 4–20. Motive scores can be weighted equally by multiplying the Coping sum by 1.25 if using the sum of responses, or by obtaining the mean of the Likert-like response values rather than the sum of the responses. A PEMS total score is obtained by summing across all 19 item responses so can range from 19 to 95 or by summing the means of each motive. The PEMS total score reflects the frequency with which tasty foods are consumed for non-metabolic reasons (e.g., individuals who generally eat tasty foods to stave off hunger would obtain a very low PEMS total score). The complete scale and items that comprise each motive are available in Burgess et al. (2014). The use of the term “tasty foods or drinks” and examples of such foods were adapted from the YFAS (Gearhardt et al., 2009). The PEMS instructions contain examples of what is meant by tasty foods and drinks (e.g., fast foods, desserts, junk food, fried foods, salty snacks, and sugary drinks).

Yale Food Addiction Scale (YFAS)—The YFAS is a 27-item scale based on DSM-IV-TR criteria for substance dependence. It yields both a “symptom” and a “clinical diagnostic” score. In this study we used only the symptom score which can range from 0 to 7 and is based on responses to items probing food tolerance, withdrawal, and continued intake despite consequences. Scores on the YFAS correlate highly with binge-eating and it

has been proposed that the YFAS may be diagnosing more severe forms of BED (Burmeister, Hinman, Koball, Hoffmann, & Carels, 2013; Davis, 2013; Davis et al., 2011; Gearhardt et al., 2012; Gearhardt, White, & Potenza, 2011).

Binge-eating Scale (BES)—Binge-eating severity was the main dependent variable of this study. Binge-eating severity was determined using scores on the BES (Gormally, Black, Daston, & Rardin, 1982). The BES is a 16-item scale that yields a total sum score ranging from 0 to 46. Scores from 0 to 16.9 conventionally indicate very mild or no binge-eating, 18–26.9 indicate moderate binge-eating, and scores ≥ 27 indicate severe binge-eating (Gormally et al., 1982). The BES has good test–retest reliability and has been used in over 100 published studies to identify or diagnose BED (Celio et al., 2004; Greeno et al., 1995), to discern non-binge obesity from binge-eating obesity (Dalton et al., 2013), and to screen for BED in bariatric surgery candidates (Grupski et al., 2013).

Body mass index (BMI)

BMI was calculated with the formula kg/m^2 . In-lab or in-clinic weight and height were measured with a scale and stadiometer, respectively. The participants were measured barefoot and in a private room. For BMI derived through self-report we simply calculated the BMI of reported height and weight.

Statistical analyses

ANOVA was used to compare differences between sample ages, BMI, and questionnaire scores. Chi square was used to test the distribution of sex and ethnicity between samples, respectively. Sex, age, and ethnicity were controlled for most of the analyses performed as these have been shown to influence eating habits for reasons other than those we are measuring (Asarian & Geary, 2013; Freedman, 2011; Larson, Neumark-Sztainer, Laska, & Story, 2011; Monneuse, Bellisle, & Louis-Sylvestre, 1991). Sex, age, and ethnicity were covaried in a MANOVA comparing PEMS scores between the two populations. We used PEMS motive scores that were standardized to account for an unequal number of items in the Coping vs. other motives by obtaining the mean Likert responses for each motive, per participant, and then obtaining a mean of these values for each population (Table 1). Correlations between BES, YFAS, and PEMS motive scores were conducted with two-tailed partial correlations using Pearson's r , controlling for BMI and demographic variables (Table 2). Separate correlations were conducted between BES scores and BMI (not shown). Separate multivariate linear regression analyses tested for variance in BES scores and in BMI that could be independently associated with YFAS and PEMS motives scores while controlling for demographic variables (and BMI when BES scores was the dependent variable) in the student (Table 3) and EatRight sample (Table 4). Possible interactions between PEMS motives with demographic variables were tested with separate ANOVAs using BES scores as the dependent variable, with PEMS motives, sex, ethnicity, age, and BMI as covariates. Finally, binge-eating groups for each sample were created for descriptive purposes using conventional BES cutoff scores. This generated a “non-binge” group (scores ≤ 17), and a “moderate/severe binge” group (scores ≥ 18). The original moderate and severe groups were combined due to the low number of participants with scores in the severe range (see Table 1). Binary logistic regressions were then used to determine what PEMS motives

were associated with the more problematic “moderate/severe binge” group classification. All tests used alpha set at 0.05 for significance or a lower, Bonferroni-corrected alpha, when conducting multiple comparisons.

Results

Self-report vs. objective BMI in the student samples

The mean BMI of the students who self-reported height and weight was not statistically different from those who had their BMI measured in the lab (24.9 vs. 26.3, respectively, $p = 1.0$, ns). We therefore combined the two student pools in all analyses except those testing YFAS scores as an independent variable (since only the 150 students with objective BMIs completed the YFAS). Besides the non-significant difference in mean BMIs, confidence in combining the student groups was increased by the finding that regression analyses results were not changed if BMI was included or omitted from any of the models (shown in Tables 3 and 4). For example, in the student sample, while BMI was significantly associated with binge-eating scores in addition to YFAS and PEMS scores (Table 3), omitting BMI from the regression did not alter the power of YFAS and PEMS scores to be significantly associated with binge-eating.

Demographic, BMI, and questionnaire scores characterizing the student vs. the EatRight participants

As shown in Table 1, EatRight patients were older than the students and had a higher female-to-male ratio than did the student sample. However, the EatRight sample had a more equal representation of White and African American participants than did the student sample. As a group, the EatRight patients were, as expected, significantly heavier than the students, with a mean BMI in the obesity range (39 kg/m²). Nevertheless, the student sample BMI mean was in the overweight range (26 kg/m²), reflecting the 69.2% U.S. prevalence of overweight among adults (CDC, 2013).

As also shown in Table 1, the EatRight sample scored numerically higher on all the eating scales but significantly higher on the YFAS, standardized PEMS total score, and the standardized Coping and Conformity motives of the PEMS. EatRight patients also had significantly greater BES scores with a larger percentage of the patients scoring in the “moderate” and “severe binge” categories compared to the student population (Table 1).

Relationship between PEMS, YFAS, and BES scores

As shown in Table 2, binge-eating scores, represented by BES scores, were most strongly associated with YFAS symptom scores but also with the PEMS total score and with most but not all of the PEMS motives scores, most notably with Coping and Reward Enhancement motives.

PEMS motives associated with binge-eating in the student sample

Among the students, regression analysis revealed that the PEMS motives: Coping, Enhancement, and Conformity, were independently associated with higher binge-eating scores (Table 3). The model included any variance contributed by BMI, sex, age, ethnicity,

and shared variance between the PEMS motives. As expected, YFAS scores were independently associated with binge-eating scores but, importantly, the three PEMS motives emerged as significant correlates whether or not YFAS scores were included in the model. In this student sample, being female and having a higher BMI were also significantly and independently associated with increasing binge-eating scores, but did not significantly interact with BES or the PEMS motives.

PEMS motives associated with binge-eating in the EatRight sample

As in the student sample, YFAS scores were significant independent correlates of binge-eating scores in the EatRight sample (Table 4). However, multiple regression analysis revealed that among the four PEMS motives, only Coping was significantly and uniquely associated with binge-eating scores, and this was true whether or not YFAS scores were included in the model (Table 4). In this group of more homogenous BMIs and mostly female participants (80%), neither BMI nor sex was associated with binge-eating scores.

PEMS motives associated with moderate-to-severe binge-eating classification

As stated above, the “moderate” and “severe” conventional BES classifications were combined into one “moderate/severe” group (BES scores ≥ 18) since in both samples very few participants were in the “severe” BES classification (see Table 1). The groups were created merely for descriptive purposes, to obtain some idea of the associations PEMS could have with clinically defined binge-eating. Among the EatRight sample, logistic regression with the binary binge-eating variable as the dependent variable and sex, age, ethnicity, BMI, and the four PEMS motives as independent variables, revealed that Coping was independently associated with a “moderate/severe” binge-eating classification (odds ratio = 1.22, $p < 0.001$). Among the student sample, three PEMS motives: Enhancement (odds ratio = 1.19, $p < 0.01$), Conformity (odds ratio = 1.27, $p < 0.01$), and Coping (odds ratio = 1.22, $p < 0.001$), were independently associated with a “moderate/severe” binge classification.

PEMS motives associated with BMI in both the student and EatRight samples

When BMI was entered as the dependent variable, regression analyses controlling for all PEMS motives and demographic variables revealed that greater Coping scores were significantly associated with greater BMI in both the student ($\beta = 0.20$, $t = 2.88$, $p < 0.01$) and the EatRight population ($\beta = 0.15$, $t = 1.93$, $p < 0.05$).

Discussion

The goal of this study was to determine if PEMS motives were associated with binge-eating severity as measured by the BES. If so, we wished to identify what particular motives to eat tasty foods correlated with higher binge-eating scores and determine if these differed among the two populations studied, a college student sample and an overall older weight-loss seeking sample. Possible PEMS motives for eating tasty foods are Coping, Reward Enhancement, Conformity, and Social. These are also the same motives for drinking alcohol that were obtained with the Drinking Motives Questionnaire – Revised (DMQ-R), a scale from which the PEMS was adapted (Burgess et al., 2014; Cooper, 1994; Cooper, Russell, Skinner, & Windle, 1992). The main finding of this study was that consuming tasty food or

drinks for Coping motives was significantly associated with increasing binge scores in both the student and the patient populations. Importantly, Coping scores were uniquely and significantly associated with binge scores independent of the effects of age, sex, ethnicity, BMI, YFAS scores, and other motives for eating tasty foods. The Coping motive is very brief. It is composed of only 4 questions related to the frequency with which one eats tasty foods or drinks to: (1) forget worries, (2) help when feeling depressed or nervous, (3) cheer up when in a bad mood, and (4) forget about problems (Burgess et al., 2014).

We previously reported that the Coping motive was independently associated with BMI in a smaller sample of undergraduate students with objectively-measured BMIs (Burgess et al., 2014). Although the focus of the current study was on binge-eating, we report here for the first time that Coping is also significantly associated with greater BMI in this larger sample of students, and among EatRight patients despite their much narrower range of (overweight and obese) BMIs. Hence, Coping appears to be associated with more problem outcomes, i.e., binge-eating and increasing BMI. Similarly, in alcohol-use studies, it is the Coping motive, over other motives, that is associated with greater alcohol intake and consequences from drinking (Cooper, 1994; Gmel, Labhart, Fallu, & Kuntsche, 2012; Kuntsche, Stewart, & Cooper, 2008; Németh, Kuntsche, Urbán, Farkas, & Demetrovics, 2011).

In the student analysis, older age was also associated with BMI. However, when considering that the Coping motive correlated with both greater BMI and binge-eating severity in this young adult population, it suggests that the Coping scores on the PEMS might be used to assess risk of developing BED in those that do not yet meet criteria for BED. Longitudinal studies are needed to determine if increasing Coping scores do indeed predict BED at a later time point. In support of this possibility, we recently found that greater eating restraint, weight-concern, and loss of control, as measured by the Eating Disorders Examination-Questionnaire, were significantly predicted by Coping scores obtained 2 years earlier in college students (unpublished data). Additional longitudinal studies validating this preliminary finding are important because the typical age of onset for BED is during the mid-20s when many individuals are at the end of their college years (American Psychiatric Association, 2013; Hudson et al., 2007). Indeed, as shown in Table 1, some of the undergraduates in the present study were already scoring in the moderate (13%) and severe (3%) categories of binge-eating according to conventional BES classifications. However, they had not (yet) approached the higher percent of EatRight patients who scored in the moderate binge-eating category (32% vs. 13% of students), and in the severe binge-eating category (12% vs. 3% of students). Therefore, higher scores on the 4-item Coping motive could identify those younger adults most at-risk for BED and obesity. More importantly, and unlike standard diagnostic binge-eating scales, high scores on the Coping motive can readily suggest a rational method of preventing binge-eating: by arresting the habit of eating tasty food as a means of solving or dealing with one's problems, worries, or negative moods. For those already diagnosed with BED, high scores on the Coping motive would suggest modifying treatment approaches to specifically address healthier methods of dealing with problems and worries than by ingesting highly palatable foods.

The question of what the Coping motive is actually measuring is an important one and the subject of a manuscript under preparation. However, we previously found that Coping was

the only PEMS motive correlated with Gray's construct of behavioral inhibition as measured by the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (Burgess et al., 2014; Gray, 1981). Behavioral inhibition is characteristic of anxiety (Gray, 1983). We also recently found Coping scores to correlate with some, but not all sources of stress reactivity (unpublished data). Coping is also the most stable of the motives and is correlated with surprisingly few emotion-triggered urges to eat (i.e., it is not "emotional-eating"), and high Coping scores correlate with some but not all eating disorder traits (unpublished data). Theoretically, in the absence of more adaptive ways of dealing with their anxiety, negative emotions, and unpleasant situations, individuals who score higher on Coping may be using tasty foods to temporarily help regulate these negative states. This is analogous to individuals who have been found to drink alcohol for Coping motives. Paradoxically, drinking to alleviate problems causes more problems than does drinking for any other motive (Cooper, 1994; Gmel et al., 2012; Kuntsche et al., 2008; Németh et al., 2011).

Although the Coping motive emerged as the motive most strongly linked to problem eating and weight gain, it is important to point out that some of the students and overweight patients who were assessed did not obtain the highest scores on the Coping motive but instead, on other PEMS motives. Some ate tasty foods and drinks mainly to experience the pleasure of consuming these items (i.e., scored highest on the Reward Enhancement motive), or to make social gatherings more fun (i.e., scored highest on the Social motive), or simply to fit in with their peers (i.e., scored highest on the Conformity motive). Hence, individual differences in motives ought to still be considered when shaping prevention or treatment plans with the PEMS. Clearly in obese binge-eating, the Coping motive would be suspected to be the main motive, but the fact that some EatRight patients in our study scored higher on other motives is evidence that not all individuals develop obesity via the same eating-motive route. The PEMS could be used as a tool by clinicians to assess patients' motives for eating certain types of food. Based on this assessment clinicians can better construct a tailored therapy or treatment plan.

Could the same be said of binge-eating? Are there various eating-motive routes to binge-eating? The question is raised by the fact that while we found Coping to be the only motive associated with binge-eating in the EatRight sample, two other motives: Reward Enhancement and Conformity, were independently associated with binge-eating in the student sample. This may indicate that we use food for different reasons at different points of our lives. Interestingly, eating tasty foods for Social motives was not independently associated with binge-eating, just as drinking alcohol for Social motives is not associated with alcohol-related problems in the U.S. (Cooper, 1994; Gmel et al., 2012; Kuntsche et al., 2008; Németh et al., 2011). Given the greater variance in BES scores among the student population, and their younger mean age, the independent association between Reward Enhancement and Conformity motives and higher BES scores may reflect an association with binge or binge-like eating that has not yet reached a level of consequence as they have for the EatRight patients who, being older and seeking help for their overweight status, have struggled with food for a longer period of time. Nonetheless, eating tasty foods to enhance reward or conform to others may indicate a psychologically unhealthy use of these foods compared to eating them for social reasons. Simply because these motives were not associated with binge-eating in the patient population does not rule out the possibility that an

early habit or tendency to eat tasty foods mainly for their reward value or to conform, will not facilitate the development of binge-eating especially if genetic or other known predisposing factors (e.g., negative affect, stress, or restrictive dieting; American Psychiatric Association, 2013) are present. Future longitudinal tests are needed to bear out this possibility. A similar explanation could explain why the student sample scored significantly lower on the YFAS, a measure of experiencing tasty food much like a substance of abuse, than did the EatRight sample. For the latter, the consequences of eating tasty foods (an important component of the YFAS) have obviously already emerged as they are seeking treatment for their eating and weight problems.

The present study has shortcomings that should be addressed in future studies using the PEMS. For one, our results were based on self-report of binge symptoms and PEMS motives and hence subject to the known biases of self-reporting such as social desirability and response bias. However, it is important to point out that even when we controlled for the other PEMS motive scores and YFAS scores (also from self-report surveys), we still obtained a significant effect of Coping to correlate with binge-eating scores, and this effect was also consistent as it emerged in two very different samples. Another limitation is that because the patients were treatment-seeking, results with the EatRight sample may not generalize to the general overweight population. Hence, assessment of same-aged adults in the community would be valuable. However, a strength in studying the EatRight sample was that it was composed of nearly as many African American as non-Hispanic White patients and there was no difference in PEMS motive associations with binge-eating that were due to ethnicity. Another limitation is that we did not conduct clinical interviews to confirm BED among those with high BES scores. Administration of the PEMS in longitudinal studies using diagnosed bulimia nervosa and/or BED patients will test the reliability of our present findings with the Coping motive, and shed light on whether other PEMS motives, ones besides Coping, are significant predictors of binge-eating in weight-loss seeking patients. Still, it is interesting to note that 3% of our student sample, and 12% of the EatRight weight-loss seeking sample obtained scores indicative of “severe bingeing”. These numbers approximate the estimated prevalence of BED in the general adult population (Hudson et al., 2007) and in weight-loss seeking populations (Dalle Grave, Calugi, Petroni, Di Domizio, & Marchesini, 2010; Hudson et al., 2007; Vamado et al., 1997). When we grouped participants into “none” and “moderate/severe” binge groups based on BES cut-offs for purely descriptive purposes, we found that scores on the PEMS motives were significantly higher in those classified as “moderate/severe” vs. “non-binge”. This suggests that the PEMS motive scores will also be significantly higher in individuals that are formally diagnosed with BED but this must be investigated.

A fortuitous strength of the study was our decision to include the YFAS. We did so because while YFAS scores are known to correlate highly with binge-eating (Burmeister et al., 2013; Davis, 2013; Davis et al., 2011; Gearhardt et al., 2012), they also correlated with the PEMS motives scores in a previous study (Burgess et al., 2014). This begged the question, “Are the PEMS motives adding any information beyond YFAS scores in their association with binge-eating?” The answer is “yes” as evidenced by the regression results shown in Tables 3 and 4. Although including YFAS scores increased the variance in binge-eating that could be accounted for by the variables entered in the models, YFAS scores did not remove the

unique contribution of PEMS motive associations with binge-eating in either of the populations tested. Hence the PEMS and YFAS seem to be tapping into two different constructs of binge-eating behavior. The YFAS assesses the presence of addictive- or dependence-like behavior and consequences with eating tasty foods (Gearhardt et al., 2009), while the PEMS probes reasons for eating these foods in the first place which is information that is more readily clinically useful.

In sum, we previously showed that the PEMS, specifically the Coping motive, was associated with higher BMI (Burgess et al., 2014). Here we report that PEMS motives are also associated with severity of binge-eating. A third piece of valuable information that can be gathered through use of the PEMS is identification of one's main motive behind eating tasty foods. Once identified, this information can be used to personalize cognitive-behavioral, dialectical behavior, and other therapies, thus improving recovery rates for those with BED or subthreshold BED. In those individuals still in the vulnerable stages of developing a binge-eating disorder, knowing one's motive style, particularly if it is to "Cope" with eating tasty foods, may help prevent the development of binge-eating altogether. In weight-loss treatment facilities, those who are obese and also suffering from BED can be expected to have a Coping motive style. However, it bears repeating that we believe it is very important to consider the presence of an alternate dominant motive since not all obese patients in this study with high binge-eating scores endorsed Coping items as their main motive to eat tasty foods. Knowing what a salient role tasty foods play in binge-eating, it is certainly worth identifying the PEMS motive that characterizes individuals being treated for binge-eating and obesity.

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Table 1

Demographics, BMI, and mean scores on the Palatable Eating Motives Scale (PEMS), Yale Food Addiction Scale (YFAS), and Binge-eating Scale (BES) for the students and patient samples.

	Undergraduate students (N = 247)	EatRight patients (N = 241)	p<
Age			
Mean age (SD)	20.6 (4.6)	48.3 (13.6)	0.001
Age range	18–60	15–80 ^a	
Sex			
Female	62%	80%	0.001
Male	38%	20%	
Ethnicity			
African American	29%	44%	0.001
Non-Hispanic White	53%	49%	
Asian	10%	6%	
Other [#]		8%	1%
BMI			
Mean (SD)	25.7 (6.2)	38.9 (8.9)	0.001
Range	17–51 ^b	23–69 ^c	
BES			
Score	10.29 (7.3)	16.4 (8.5)	0.01 *
Non-binging (17)	84%	56%	0.001
Moderate binging (18–26)	13%	32%	0.001
Severe binging (27)	3%	12%	0.001
PEMS ^d			
PEMS total	7.29 (2.0)	8.30 (2.7)	0.01 *
PEMS Coping	1.75 (0.8)	2.32 (1.1)	0.001 *
PEMS Enhancement	1.90 (0.8)	2.12 (0.9)	ns *
PEMS Conformity	1.38 (0.4)	1.49 (0.6)	0.01 *
PEMS Social	2.25 (0.8)	2.34 (0.9)	ns *
YFAS			
Symptom score ^e	1.9 (1.3)	3.1 (1.7)	0.001 *

^aThe sample included one 15 and two 17 year-olds.

^bThere was no difference in the mean self-reported vs. objective BMI group of students (24.9 ± 0.6 vs. 26.2 ± 05 , respectively, ns).

^cThree individuals had a BMI of 23–24 and were in EatRight to learn healthier eating habits due to a predisposition for obesity-related medical conditions.

^dValues are means and SD using standardized scores (the mean rather than the sum of Likert response values for items comprising the motive) due to an unequal number of items comprising the Coping motive. PEMS total is the sum of these four motive means.

^eYFAS scores for students were from N = 150 with objective BMI (see Materials and Methods).

[#]The ethnicity “Other” included Hispanic, Native American, multi-ethnic, or those marking “other” or choosing not to disclose.

*
p values represent differences between samples while controlling for sex, age, and ethnicity.

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Table 2

Partial correlation coefficients of Binge-eating Scale (BES) scores with Yale Food Addiction Scale (YFAS) symptom scores, PEMS total, and individual PEMS motives for the student and patient samples.^{a,b}

Dependent variable:	BES scores	
	Student sample	EatRight sample
PEMS total	0.52 ***	0.52 ***
PEMS Coping	0.47 ***	0.51 ***
PEMS Enhancement	0.46 ***	0.40 ***
PEMS Conformity	0.28 ***	0.30
PEMS Social	0.24	0.32 ***
YFAS	0.58 ***	0.65 ***

^aCorrelations while controlling for age, sex, ethnicity, and BMI.

^bAll analyses use alpha <0.008 for significance to correct for multiple comparisons hence only

p 0.001 values are denoted as significant.

Table 3

Student sample linear regression model of PEMS motives without and with Yale Food Addiction Scale (YFAS) scores in the model with binge-eating severity (BES scores)^a as the dependent variable.

Dependent variable:	BES scores			
	Without YFAS in model		With YFAS in model	
	β	t	$p<$	t
Independent variables				
Sex	-0.22	-4.14	.001	-2.97
BMI	0.24	4.37	.001	2.97
YFAS	-	-	-	5.69
PEMS motives				
Coping	0.27	4.65	.001	2.91
Enhancement	0.26	4.55	.001	3.08
Conformity	0.22	3.80	.001	2.08
Social	-0.05	-0.81	ns	-0.84
Model $R^2=$	0.43			0.57

^a Ethnicity (dummy coded for African American; White, Asian, and other) and age were included in the model but not shown; they were not significantly associated with BES scores. The results were the same when we used z-score standardization instead of the means for the PEMS motives.

EatRight patient linear regression model of PEMS motives without and with Yale Food Addiction Scale (YFAS) in the models with binge-eating severity (BES scores)^a as the dependent variable.

Table 4

Dependent variable:	BES scores			
	Without YFAS in model		With YFAS in model	
	β	t	β	t
Independent variables				
Sex	-0.04	-0.73	ns	-0.27
BMI	0.09	1.55	ns	0.75
YFAS	-	-	-	9.23
PEMS motives				
Coping	0.41	6.21	.001	2.78
Enhancement	0.13	1.82	ns ^b	1.27
Conformity	0.10	1.40	ns	1.16
Social	0.06	0.85	ns	1.44
Model R ² =	0.37			0.55

^a Ethnicity (dummy coded for African American, White, Asian, and other) and age were included in the model but not shown: they were not significantly associated with BES scores.

^b $p < 0.07$. The results were the same when we used z-score standardization instead of the means for the PEMS motives.