



Binge eating, but not dietary restraint, moderates the association between unhealthy food marketing exposure and sugary food consumption



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ABSTRACT

Restrained eaters, those who exercise dietary restraint and often experience dietary lapses, may be particularly susceptible to food marketing. Findings are mixed as to whether restrained eaters consume more food after exposure to unhealthy food marketing, and little is known about whether food marketing may have more impact on those who exercise successful dietary restraint as compared with those who experience dietary lapses, such as binge eating. In the current study, participants were 38 young women, ages 18–22 years old. Both dietary restraint and binge eating were measured by the Eating Disorder Examination-Questionnaire. Participants viewed both unhealthy food commercials and non-food commercials two separate times in the laboratory, and ad libitum candy intake was subsequently measured. Results indicated that participants who endorsed binge eating ate significantly more candy than those who did not endorse binge eating after they viewed unhealthy food commercials $F(1, 35) = 20.49, p < .001, \eta^2 = 0.37$, but not after viewing non-food commercials. No significant differences in candy eaten emerged when comparing those who endorsed dietary restraint as compared to those who did not, regardless of commercial type. Findings demonstrate the importance of specific operational definitions of restrained eating to consider the differences between those who report binge eating, and those who do not. They also suggest that individuals who engage in binge eating may be particularly susceptible to overeating in response to unhealthy food marketing, marking a possible area for intervention.

1. Introduction

Over the last decade, an increasing body of research has reported the high prevalence and highly effective nature of food marketing. There is evidence to suggest that children as young as age four prefer the taste of a food that comes in a McDonald's package as compared to food wrapped in an identical, but unbranded package (Robinson, Borzekowski, Matheson, & Kraemer, 2007). Researchers have posited that food marketing may be particularly salient for young women, who are often targeted through the use of emotional appeals and stereotyping to influence purchasing (Barletta, 2006; Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). Additionally, exposure to pictures and videos of food has been associated with subsequent increases in dietary intake and craving, similar to exposure to real food (Boswell & Kober, 2016). Despite the association between food marketing and dietary intake, it is unclear whether individuals who engage in disordered eating patterns may be more susceptible to the influence of food marketing than others.

According to Fairburn's transdiagnostic model, many eating disorders are perpetuated through an overemphasis on the importance of shape and weight that manifests through a pattern of dietary restraint (i.e., strict dietary rules and intent to diet), dietary restriction (i.e., a reduction in the amount of food eaten), and temporary acts of abandoning restraint, which may result in binge eating (Fairburn, Cooper, &

Shafraan, 2003). Although often less severe in nature, there is evidence that both dietary restraint and binge eating occur commonly in community samples (Mond, Hay, Rodgers, & Owen, 2006), but very little is known about the impact of binge eating on response to food marketing. However, there has been limited research into how food marketing impacts so-called “restrained eaters,” individuals who attempt to exercise cognitive control over eating, often through dieting, instead of relying on physiological cues to direct hunger, often attempting to maintain diets without success (Polivy et al., 1979).

After exposure to unhealthy food marketing, some studies have found positive trend level associations between restrained eating and greater consumption of both healthy and unhealthy foods (Harris, Bargh, & Brownell, 2009), while others have found that restrained eaters tend to refuse all foods after watching unhealthy advertisements (Dovey, Torab, Yen, Boyland, & Halford, 2017). However, past food marketing research has investigated eating behaviors without using clinically significant measures of eating disorder psychopathology. Therefore, it is difficult to ascertain how these findings may translate to individuals with symptoms of eating disorders. Indeed, one potential explanation for discrepancies in the literature lies in the inconsistent definition of restrained eating among non-clinical measures. Classic measures of restrained eating, such as the Restraint Scale, tend to identify individuals who attempt to maintain a diet but fail to do so (Polivy et al., 1979). Although this may capture individuals who binge

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eat, the measure does not specifically ask about binge eating. Other measures, such as the Three Factor Eating Questionnaire (TFEQ), tend to be more consistent with clinical definitions of dietary restraint by distinguishing between those who are successful at maintaining a diet and those who are not successful (Stunkard & Messick, 1985). However, the TFEQ describes unsuccessful dieting as disinhibition, and asks about “eating binges” but does not capture clinical definitions of binge eating, which include both eating a large amount and experiencing a loss of control over eating (American Psychiatric Association, 2013). Additionally, neither measure focuses on assessment of dietary restriction.

Despite inconsistencies in measurement, there is evidence to suggest that the success with which a diet is maintained may have implications for responsiveness to food cues. In one of the only studies to date to distinguish between restrained eating that is successful versus unsuccessful, Brunstrom, Yates, and Witcomb (2004) found that young adult females who successfully maintained their diets (i.e., were high on the Restraint subscale of the Three-Factor Eating Questionnaire) displayed increased salivary response to a pre-lunch presentation of a slice of pizza. However, individuals who did not successfully maintain their diets, but instead had a tendency to overeat (i.e., were high on the Disinhibition subscale), did not display this response. Although participants were not given the opportunity to eat the pizza and instead had a pre-portioned amount of a sandwich given to them for lunch, this study indicates that response to food cues in young women may differ based on whether successful or unsuccessful dietary restraint is endorsed, and that individuals who overeat may be less reactive to food cues (Brunstrom et al., 2004). However, it is unclear whether this association translates when food marketing is presented as a food cue, or whether these associations would persist if more clinically relevant measures were used to capture dietary restraint and binge eating.

The aim of the current study was to examine the relation between food marketing and food consumption in a community sample of young women and to assess whether this relation differed by dietary restraint and binge eating behaviors. We hypothesized that, similar to Brunstrom et al. (2004), dietary restraint, but not binge eating, would moderate food consumption in the lab following exposure to unhealthy food marketing, such that participants who endorsed more dietary restraint would consume more as compared with those who endorsed less dietary restraint, and but there would be no moderating impact of binge eating on the association between food marketing and food consumption.

2. Method

2.1. Participants

Participants included were 38 females ranging in age from 18 to 22 years old (mean age = 18.84, $SD = 1.03$) with a mean BMI of 23.53 ($SD = 6.24$). The majority of participants identified as White/Caucasian (~60%) and the next largest group identified as Asian (~30%). Approximately 13% of participants identified as Hispanic. Data for this study were originally collected as part of a larger study assessing eating and sleep patterns of college students. The current study recruited young adult females due to the high levels of eating disorders among women (Hudson, Hiripi, Pope, & Kessler, 2007) and because many of the most commonly used measures of eating disorders have not been normed and validated on males (Berg, Peterson, Frazier, & Crow, 2012). In total, there were 574 female participants in the larger study, which assessed global levels of eating disorder concerns. Participants who scored either high (75th percentile and above) or low (25th percentile and below) on global scale of the Eating Disorder Examination-Questionnaire were then invited to complete the current study ($n = 267$), in order to capture individuals with a wide range of both high and low levels of a variety of eating disorder concerns. Of the 44 participants who agreed to complete the study, three participants were eliminated due to not completing the lab-based food task, and three were removed as outliers as they consumed an amount of food that was

greater than two standard deviations above mean. This brought the total number of participants to 38.

2.2. Procedure

This study utilized a two-condition within-subjects design, such that participants were tested in the laboratory two times, approximately one week apart. During one session, they were shown five advertisements for unhealthy foods and during the other session, they were shown five advertisements for non-food items. The order of presentation of the food or non-food advertisements was counterbalanced across participants. Commercials that appeared frequently on women's programming were selected for this study from a sample of 20 total commercials (10 food and 10 non-food) pretested on appeal and emotion using an online sample of women between the ages of 18–25. Food commercials included advertisements for products ranging from fast food to candy. Non-food commercials advertised products such as those relating to items such as beauty and cars. The top five most appealing commercials were chosen in both the food and the non-food categories.

After watching the commercials, participants were instructed to complete a written response about the persuasive tactics used in the commercials and completed several laboratory tasks pertinent to a secondary study. Next, participants were given an ad libitum food task where they were presented with a divided bowl of M&M and Skittles candy (one on either side) and left in the room alone for 2 min while the examiner retrieved a survey. The examiner was also instructed to take a handful of candy before leaving the room and to record the exact amount of candy taken once out of view of the participant. The experimenter then returned and removed the bowl of candy from the room so that it could be weighed. Bowls of candy were weighed before and after the food task to determine the amount of candy taken by the participant (each piece of candy weighed 1 g), accounting for the amount of candy that the examiner first took. Finally, after completing surveys, height and weight were measured using a scale and stadiometer.

2.3. Measures

2.3.1. Demographics

Demographics, including age, were assessed via self-report questionnaire.

2.3.2. Body Mass Index

Height was collected during the first visit to the lab. Weight was collected during both the first and second visits to the lab, after the collection of height. Weight was measured to the nearest 0.1 kilogram (kg) and height was measured to the nearest 0.1 cm. BMI was calculated using the standard formula of kg/m^2 . For the purposes of the current study, Time 1 BMI was used to descriptively evaluate participants.

2.3.3. Disordered eating

The Eating Disorder Examination-Questionnaire (EDE-Q; (Fairburn & Beglin, 1994), a 28-item measure, was used to assess the psychopathology of eating disorders. The EDE-Q is the self-report version of the Eating Disorder Examination (EDE), a semi-structured interview used to diagnose eating disorders. For the purposes of the current study, the EDE-Q Restraint subscale score, which includes items that measure both attempts to restrict food intake as well as actual caloric restriction, was used to measure dietary restraint, and item 15 of the EDE-Q “...on how many days have such episodes of overeating occurred, i.e., you have eaten an unusually large amount of food and have a sense of loss of control at the time?” was used to measure binge eating. The sample was separated in two different ways – 1) high (75th percentile or greater) in dietary restraint or low (less than 25th percentile) in dietary restraint according to published norms (Luce, Crowther, & Pole, 2008); and 2) presence or absence of at least one episode of binge eating – and

analyses were conducted separately for each classification, consistent with previous research (Brunstrom et al., 2004).

2.3.4. Hunger

To ensure that participants were not hungry prior to beginning the experiment, hunger was assessed by adding an additional item to the standard Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988). Consistent with previous research, participants indicated their level of hunger on a scale from 1 (very slightly or not at all) to 5 (extremely) (Harris et al., 2009). This score was then checked before the experiment began to ensure that participants were not hungry (i.e., that they rated hunger as less than 4 on the 1–5 scale) before beginning the task, otherwise they were given a granola bar.

2.4. Statistical analyses

IBM SPSS Statistics, Version 25 was used to conduct all analyses (IBM Corp., Armonk, N.Y., USA). All data were first examined for missing values. Only three participants had missing data due not successfully completing the candy task due to researcher error. These participants were excluded. The data were then examined for skewness and outliers (Fidell & Tabachnick, 2003). The dependent variable was positively skewed, therefore outliers who ate less than -2 or more than +2 SD of the mean amount of candy during the food task were eliminated (n = 3). After eliminating outliers, a Kolmogorov-Smirnov test was then conducted and revealed that the dependent variable did not violate the assumption of normal distribution (p = .200). t-Tests and chi-square analyses were used to determine differences in demographic variables between high versus low restraint groups and binge versus no binge groups. Next, a repeated measures analysis of variance (ANOVA) was used to assess the impact of commercial type (food or non-food) on the amount of candy eaten during the food task. Binge eating status (yes or no) and dietary restraint (high or low) were entered into the model as moderators. Prior to adjusting for multiple comparisons, group comparisons revealed that BMI was higher in individuals who endorsed more binge eating and those who were higher in dietary restraint (see Table 1), therefore BMI was included as a covariate in all subsequent analyses. With regards to hunger, only two participants out of 38 rated their hunger at a four or higher, and after being offered and eating a granola bar, both participants rated hunger levels in the acceptable range (i.e., lower than four on a five-point scale). Adding hunger levels as a covariate in the models did not change the results; therefore, the following analyses represent the most parsimonious models with

hunger levels not included.

3. Results

Analyses indicated no differences in demographic characteristics when the sample was split into high versus low dietary restraint or when it was split into presence or absence of binge eating (see Table 1). As can be seen in Table 1, participants who endorsed binge eating were also significantly higher in dietary restraint (i.e., in the 80th percentile) than those who did not endorse binge eating. Additionally, approximately 70% of individuals who were high in dietary restraint and 40% of those who were low in dietary restraint also endorsed at least one binge eating episode.

With regard to hypothesis testing, a repeated measures ANOVA revealed that, accounting for BMI, there was no main effect of commercial type (food or non-food) on the amount of candy eaten during the food task (p = .108; η² = 0.07). Additionally, level of dietary restraint did not moderate this finding (p = .181; η² = 0.05); however, there was a significant interaction between commercial type and endorsement of binge eating, F(1, 35) = 20.49, p < .001, η² = 0.37 (see Fig. 1). Post-hoc t-tests revealed that participants who endorsed binge eating ate more candy after watching food commercials (m = 28.29 g; SD = 14.21) than those who did not endorse binge eating (m = 17.94 g; SD = 11.96), t(36) = -2.40, p = .022, but there was no significant difference in the amount of candy eaten after viewing non-food commercials (p = .111). Given that there was a significant correlation between dietary restraint and binge eating (r = 0.42, p = .004), and that dietary restraint scores were also significantly higher in individuals who endorsed binge eating as compared with those who did not (see Table 1), mean EDE-Q Restraint subscale scores were also added to the binge eating model as a covariate. These analyses revealed that, although attenuated, binge eating continued to significantly moderate the relation between commercial type and amount of candy eaten accounting for levels of dietary restraint (p = .001; η² = 0.29).

4. Discussion

Exposure to food cues, like food marketing, is associated with increased food consumption. Restrained eating has been posited as a factor that may be associated with reactivity to food cues. However, most studies do not distinguish between successful dietary restraint and unsuccessful dietary restraint that may result in overeating, nor do they

Table 1 Participant characteristics by two classifications of disordered eating concerns.

	High restraint (n = 17)	Low restraint (n = 21)	Binge (n = 20)	No binge (n = 18)	Total (n = 38)
Age, m (SD)	19.00 (1.17)	18.71 (0.90)	19.00 (1.07)	18.67 (0.97)	18.84 (1.03)
BMI, m (SD)	26.07 (7.87)	21.48 (3.53)	25.23 (7.52)	21.65 (3.78)	23.53 (6.24)
Race, n (%)					
White	13 (76)	10 (48)	14 (70)	9 (50)	23 (60)
Asian	1 (6)	10 (48)	4 (20)	7 (39)	11 (29)
Black	1 (6)	0 (0)	1 (5)	0 (0)	1 (3)
Other	2 (12)	1(4)	1 (5)	2 (11)	3 (8)
Ethnicity, n (%)					
Hispanic	3 (18)	2 (10)	1 (5)	4 (22)	5 (13)
Non-Hispanic	14 (82)	19 (90)	19 (95)	14 (78)	33 (87)
Year in school, n (%)					
First	9 (53)	15(71)	11 (52)	10 (63)	24 (63)
Second	7 (41)	3 (14)	7 (33)	3 (19)	10 (27)
Third	0 (0)	2 (10)	2 (10)	2 (12)	2 (5)
Fourth	1 (6)	1 (5)	1 (5)	1 (6)	2 (5)
EDE-Q Restraint, m (SD)	3.57 (1.02)	0.37 (0.57)*	2.60 (1.74)	0.92 (1.44)*	1.81 (1.80)
EDE-Q Binge, m (SD)	4.82 (5.43)	1.05 (1.94)*	5.20 (4.73)	0.00 (0.00)*	2.74 (4.29)

EDE-Q = Eating Disorder Examination-Questionnaire; EDE-Q Restraint = EDE-Q Restraint subscale score; EDE-Q Binge – Item 15 of EDE-Q assessing number of binge eating episodes.

* One-way analysis of variance (ANOVA) significant at p < .006, reflecting Bonferroni adjustment for multiple comparisons.

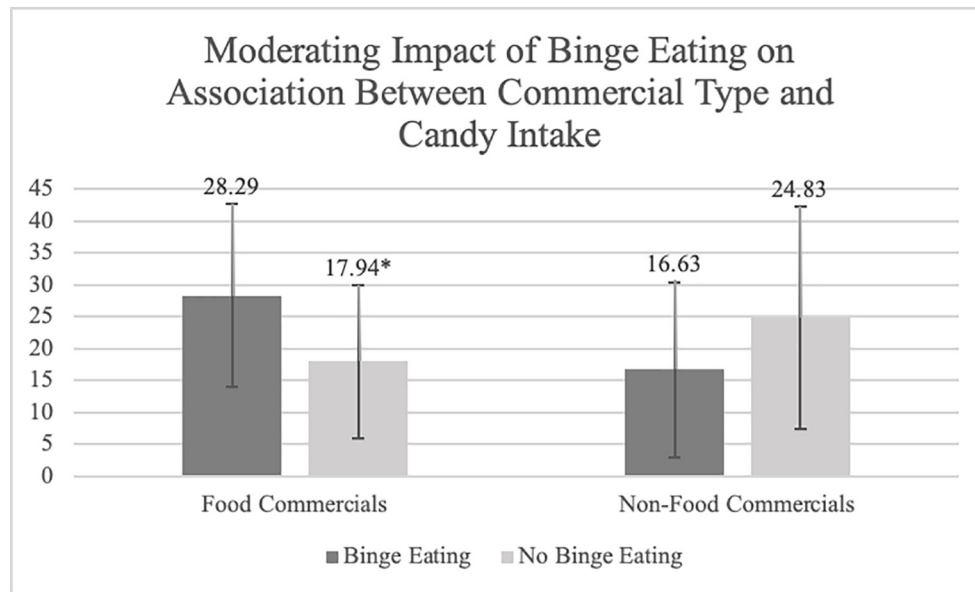


Fig. 1. Amount of candy eaten after watching food commercials as compared with amount of candy eaten after watching non-food commercials, by binge eating status

considered eating disorder symptoms such as binge eating. Therefore, the current study examined whether dietary restraint or binge eating moderated the association between exposure to unhealthy food marketing and subsequent food consumption. Contrary to our hypothesis, dietary restraint did not moderate the association between exposure to food marketing and subsequent food consumption. However, young women who endorsed binge eating ate more after viewing food commercials than those who did not endorse binge eating, but there was no difference in the two groups after viewing non-food commercials.

Our findings demonstrate that individuals with binge eating may be more susceptible to environmental food cues than those who do not binge eat, which may have important implications for treatment. This differs from both our hypotheses as well as the findings of Brunstrom et al. (2004), who found that individuals who overate were less reactive to food cues than those who did not. However, there are several differences between the current study and that of Brunstrom et al. (2004), including measurement differences, the assessment of general disinhibited eating versus binge eating, the type of food cue presented, and the way that food cue reactivity was measured. Similar to Brunstrom et al. (2004), the current study also found that more frequent binge eating episodes were significantly correlated with higher levels of dietary restraint, which is consistent with well-established theoretical models of disordered eating (Fairburn et al., 2003). This lends support to the hypothesis that although binge eating may be related to dietary restraint, the two are independent constructs, as even those who were low in restraint endorsed some amount of binge eating on average. Indeed, we found that even when both dietary restraint and binge eating were considered in a model together, only binge eating was a significant moderator of the relation between exposure to unhealthy food marketing and subsequent food consumption, lending support to the idea that binge eating, and not restraint, may be most linked to susceptibility to food marketing.

Our findings may also help to explain the mixed literature in the area of restrained eating and food marketing. For example, research finding that restrained eating is associated with greater food intake following food marketing exposure (i.e., Harris et al., 2009) has measured restrained eating as attempts to maintain a diet without success. In contrast, research finding that restrained eaters consume less food following food marketing exposure have measured restrained eating as successful dietary restraint (Dovey et al., 2017). The results of the current study demonstrate that it may be disinhibited eating, such as

that seen from our binge eaters, that drives overeating in response to food marketing.

4.1. Strengths and limitations

Strengths of the study include the use of well-established measures of disordered eating, the consideration of both dietary restraint and binge eating, and the within-subjects design of this study, which minimized variability between groups and allowed for more precise accounting for individual differences. However, the use of a single item from the EDE-Q to measure binge eating represents a limitation of this study, as it may have impacted the reliability of the findings. Other limitations of the study include small sample size, which decreased the statistical power to detect small effects. Additionally, we only included participants who scored either below the 25th or above the 75th percentile on the EDE-Q, which insured that we accounted for individuals with a wide range of eating disorder concerns; however, this also limited our variability, which may be seen as a limitation in light of our small sample. Given that this study included mostly white women, it is also difficult to generalize the findings to men and ethnic minorities, for whom disordered eating may look different than it does for White women (Rodgers, Berry, & Franko, 2018). Therefore, the findings should be replicated with larger, more diverse samples. Finally, although this study assessed the impact of unhealthy food commercials on subsequent food intake, it is unclear what the response would have been if healthy food commercials had also been presented as a third condition.

Future studies should examine the mechanisms underlying the association between binge eating and susceptibility to food marketing. This association appears to go beyond levels of dietary restraint, so future research is needed to investigate the role of loss of control eating as well as temptation and desire for food. Furthermore, research is needed to investigate whether other types of commercials, such as those focusing on physical appearance or weight loss, may also affect individuals with binge eating differently. This includes future research investigating the impact of healthy food commercials on individuals with and without binge eating. Although television remains an important medium for marketing, future studies should also investigate the impact of advertisements on social media, given its “always on” nature. Finally, more research is needed to examine the impact of food marketing in clinical populations where there are more individuals with

a variety of disordered eating behaviors, not just binge eating.

5. Conclusion

This study augments the current literature by providing evidence that individuals who endorse binge eating, above and beyond their levels of dietary restraint, may be more impacted by unhealthy food marketing than those who do not endorse binge eating. Understanding the impact of unhealthy food marketing in populations with disordered eating is important for designing both effective treatment as well as public health interventions to reduce the negative effects of food marketing.

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CRedit authorship contribution statement

Amy H. Egbert: Conceptualization, Investigation, Formal analysis, Writing - original draft, Funding acquisition. **Laura Nicholson:** Investigation, Project administration, Data curation, Writing - review & editing. **Anna Sroka:** Investigation, Visualization. **Rebecca Siltan:** Conceptualization, Supervision, Resources. **Amy M. Bohnert:** Conceptualization, Supervision, Resources, Writing - original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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