Counterregulatory eating behavior in multiple item test meals

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Abstract

Restrained eaters have been shown to disinhibit their eating when under stressful situations. However, the majority of laboratory studies that have demonstrated this effect utilized a single test food, typically ice cream. There is a lack of research investigating if this interaction is still evident when multiple foods are offered, and if so, the food choices that restrained and non-restrained eaters make when under stressful situations. The present study examined the impact of stress on food choices in individuals with varying degrees of restraint. Several classes of foods were offered (i.e., high fat/high sugar; low fat/high sugar; high fat/low sugar; low fat/low sugar). A total of 153 females were randomly assigned to either a stress or no-stress situation, and then both groups participated in a taste test. There was no significant difference in total amount of consumption between restrained and non-restrained eaters when under stress. However, further analyses found that restrained eaters under stress consumed more potato chips than those who were not under stress. Findings are discussed in terms of possible limitations of the stress-induced eating paradigm for restrained eaters.

Keywords: Dietary restraint; Eating disorders; Obesity; Stress

1. Introduction

Restrained eaters are individuals who constantly struggle to maintain control over their food intake and weight (Heatherton, Herman, Polivy, King, & McGree, 1988; Lowe, 1993). Not all dieters are
described as restrained eaters however; restrained eaters experience occasional lapses in restraint (Heatherton et al., 1988; Ward & Mann, 2000). Thus, restrained eaters may be trapped in a vicious cycle; chronic dieting results in overeating, and this overeating results in a further need for dieting (Herman & Polivy, 1975; Lowe, 1993).

A robust finding of research concerning stress induced eating is that restrained eaters demonstrate counterregulatory eating behaviors when anxious or stressed (Baucom & Aiken, 1981; Heatherton, Herman, & Polivy, 1991; Heatherton, Polivy, Herman, & Baumister, 1993; Herman & Polivy, 1975, 1980; Polivy & Herman, 1999; Ruderman & Christensen, 1983; Ruderman & Wilson, 1979; Tanofsky-Kraff, Wilfley, & Spurrell, 2000). In these studies, restrained eaters paradoxically consume more than non-restrained eaters when subjected to emotional stress. In contrast, other studies have demonstrated that non-restrained individuals consume less food when under stress (Schachter, Goldman, & Gordon, 1968; Stone & Brownell, 1994) than they would consume regularly. Many of these studies have used a similar methodology (i.e., the “taste-test” paradigm) to investigate the effects of stress on eating.

1.1. The laboratory “taste-test” paradigm

The taste test paradigm has been widely used to examine the eating behavior of restrained eaters. This paradigm was designed to disguise the true purpose of the experiment and unobtrusively determine how much food an individual will eat because eating is often reactive to observation. In this paradigm, the participant is exposed to a stressor and then is usually asked to taste and rate ice cream flavors, although the main variable of interest is caloric intake (Heatherton et al., 1991, 1993; Heatherton, Striepe, & Wittenberg, 1998; Lowe, 1994; Lowe, Whitlow, & Bellwoar, 1991; Polivy & Herman, 1991, 1999; Tanofsky-Kraff et al., 2000). The majority of these experiments find an interaction between stress and restraint in the amount of food consumed. This paradigm provides only a limited model for understanding stress-induced eating, however, because ice cream is generally the only type of food offered. Ice cream is high in both sugar and fat and needs to be consumed rather quickly in order to prevent melting. Also, in the natural environment, ice cream is only one of several types of foods available and may not be chosen when alternative foods (perhaps lower in sugar/fat) are accessible. This is an important consideration that may limit the external validity of the results from previous laboratory studies.

Only a limited number of laboratory studies have used foods other than ice cream to examine stress-induced eating. Ward & Mann (2000) used a variety of foods and found differences in amount of consumption between restrained and non-restrained eaters; however all foods were high in fat and sugar. Conversely, Oliver, Wardle, & Gibson (2000) used both low and high fat meal-type foods and did not find a restraint by stress interaction in amount of consumption. Levine and Marcus (1997) also used several food classes and did not find differences in the amount of consumption between bulimics and normal controls after a stress induction.

Recently, researchers have begun to examine the external validity of stress and eating in more naturalistic studies by analyzing real life stressors and self-reported daily consumption. Several of these more naturalistic studies have not found an interaction between restraint and stress in amount of food consumed (Ball, Lee, & Brown, 1999; Conner, Fitter, & Fletcher, 1999); thus the restraint by eating interaction may be an artifact of the taste-test methodology.
The present study was designed to extend the typical methodology of stress-induced eating studies by including several snack-type foods, while remaining a well-controlled laboratory study. Based on previous research, it was hypothesized that restrained eaters would consume more food, regardless of food class, when under a stressful condition than when not under stress. It was also hypothesized that restrained eaters under stress would consume more calorie dense, highly palatable foods (e.g., Oreo cookies, M&M candies, potato chips) than foods lower in energy (e.g., carrots, grapes, pretzels); however in the no-stress condition, restrained eaters would consume more low fat foods. Finally, it was also predicted that there would be no differences in food choice among non-restrained eaters in either the stress or no-stress conditions.

Previous research has documented a hyperphagic effect when a variety of foods are presented (see Raynor & Epstein, 2001 for a review). The aim of the present study was not to compare single and multi-item test meals; the present study only used a multiple item food paradigm. The purpose was: (1) to test the limits of the single food item paradigm to investigate if the restraint by stress interaction is still evident when multiple food types are offered, and (2) to examine the restraint x stress interaction in proportion of calories consumed of each food type.

2. Method

2.1. Participants

A total of 169 female undergraduate college students signed up for the experiment. Exclusion criteria included: current diagnosis of eating disorder, having eaten within 3 h of participation, allergies to the foods being utilized, and awareness of the study protocol. This screening resulted in a subset of 153 students who took part in the experiment. A total of 86 (56.2%) and 67 (43.0%) were randomized to the no-stress and stress condition, respectively.

2.2. Measures

2.2.1. Screening questionnaire

Participants answered questions to the exclusion criteria previously mentioned. They were also asked to rate how hungry they were on a 4-point Likert scale and how much they enjoy eating each of the foods under investigation on a scale of 1–100.

2.2.2. Restraint scale (RS; Herman & Polivy, 1980)

The RS appears to measure the consequences of chronic unsuccessful dieting such as disinhibited eating and weight fluctuations (Gorman & Allison, 1995; Heatherton et al., 1988; Lowe, 1993). This scale consists of ten questions yielding a total possible score of 35. Participants were classified as restrained eaters according to the customary cutoff of ≥16 (Heatherton et al., 1991, 1993; Polivy & Herman, 1991; Ward & Mann, 2000). Secondary analyses were conducted classifying participants as restrained or non-restrained eaters using a median split (Polivy, Heatherton, & Herman, 1988; Polivy, Herman, & Howard, 1988), which yielded a median of 12;
participants that scored $\geq 13$ were categorized as restrained eaters. Results using the recommended cutoff and the median split were almost identical, so only the results using the customary cutoff are presented.

2.2.3. State self-esteem scale (SSES; Heatherton & Polivy, 1991)

The SSES is a 20-item scale, which contains three correlated factors (performance, social, and appearance) pertaining to self-esteem. Each item is scored on a 5-point scale with higher scores indicating higher self-esteem. The SSES has been shown to be sensitive to rapid changes in self-esteem that result after laboratory manipulations (Heatherton & Polivy, 1991).

2.2.4. Subjective units of distress (SUDS)

Participants were asked, “On a scale of 0–100, in which 0 is the least and 100 is the most, how stressed do you feel right now at this moment?”

2.2.5. Taste rating forms

For each type of food, participants were required to rate various aspects of each food (enjoyment, salty, sweet, etc.) on a scale from 1 to 10.

2.3. Procedure

Participants were told that the purpose of the experiment was to investigate how intellectual functioning affects taste perception. They were led to believe that they would be completing a variety of questionnaires, engaging in a cognitive task which measures intellectual functioning, and then tasting and rating certain foods.

Participants completed the screening form and eligible participants were then randomized to a condition. They were asked to rate their subjective level of distress (SUDS) and complete several questionnaires. Participants were then given their “intellectual task.”

2.3.1. Stress induction

Participants in the no-stress condition read a short story and were instructed to circle all of the letter “e’s” that they find (Tanofsky-Kraff et al., 2000). Based on previous studies, participants in the stressful condition were given a list of 17 anagrams (mostly unsolvable) and were told that it was a task of intellectual ability (Eldredge, Wilson, & Whaley, 1990; Polivy & Herman, 1999). Participants were instructed to unscramble each word to form a common English word. They were told that the average person finishes in about 15 min and that grammar school children can solve the puzzles. Upon task completion, participants were asked their SUDS and to complete the SSES in order to assess changes in stress. They then had their height and weight taken with their shoes off using a Detecto scale. Finally, participants were instructed to engage in the taste test (see below).

2.3.2. Taste test

Participants were brought into a room with bowls of preweighed food (using an Acculab Electronic Balance Scale with 0.1 g precision) and a pitcher of water. Several foods (i.e., M &M candies and Oreo cookies; grapes; potato chips; pretzels and baby carrots) were chosen to
encompass a variety of food categories (i.e., high fat/high sugar; low fat/high sugar; high fat/low sugar; low fat/low sugar, respectively). Large bowls were used so that participants would be unaware of how much they consumed. Snack foods were used because when stressed, snacks may be preferred over meals (Lowe & Fisher, 1983; Oliver et al., 2000).

Participants were instructed to taste and rate each food. After turning in their taste rating forms, participants were told that their questionnaires must be scored before they could leave. They were also told that the food could not be used with other participants due to sanitary concerns and were invited to eat as much as they wanted. After 10 min, the experimenter returned to the room and debriefed the participant.

3. Results

3.1. Descriptive differences between groups

The mean age of participants was 19.3 ± 3.0 years (range=17–44). They averaged a height of 163.3 ± 7.4 cm; a weight of 64.0 ± 11.7 kg; and a BMI of 24.0 ± 4.6 kg/m². Forty-six (30.1%) were considered overweight (BMI ≥ 25.0). A total of 106 (69.3%) were Caucasian; 14 (9.2%) were African American; 10 (6.5%) were Asian; 8 (5.2%) were Hispanic; and 15 (9.8%) did not indicate their race. When using the customary cutoff (≥ 16), 99 and 54 participants were defined as non-restrained and restrained eaters, respectively. A one-way analysis of variance (ANOVA) revealed no significant differences between the conditions in age, weight, or BMI.

3.2. Premanipulation measures

ANOVA revealed that the two conditions did not differ in level of depression. However, despite randomization the groups were significantly different in their restraint score. Participants in the stress condition had significantly higher restraint scores than those in the no-stress condition (M = 14.7 ± 6.6 vs. 11.6 ± 6.3, p < 0.01).

3.3. Differences in hunger and food preferences between groups

One-way ANOVAs revealed no significant differences in hunger level between the no-stress (M = 1.3 ± 0.8) and stress conditions (M = 1.3 ± 0.8, p = 0.8) or between restrained (M = 1.2 ± 0.9) and non-restrained eaters (M = 1.4 ± 0.7, p = 0.23). Most participants reported being at least moderately hungry.

In addition to being hungry, participants reported that they typically enjoy eating all of the foods presented. The average rating for each food was above 50 (see Table 1) as measured on a Likert scale of 0–100. The stress and no-stress groups did not differ in the pre-manipulation enjoyment rating of M&M candies, grapes, and pretzels. However, participants in the stress condition reported enjoying carrots more than participants in the no-stress condition whereas participants in the no-stress condition reported enjoying Oreos and chips more than participants in the stress condition (see Table 1). A similar analysis demonstrated that there were no significant differences by restraint status in enjoyment of eating any of the six food choices.
3.4. Manipulation check

A one-way ANOVA revealed no significant baseline differences in SSES or SUDS between the stress and no-stress conditions. However, at time 2 participants in the stress condition reported significantly lower SSES and higher SUDS than those in the no-stress condition (see Table 2).

A pairwise comparison $t$-test pairing each subscale of the SSES and SUDS scores across time revealed that the level of stress remained fairly constant across time for

<table>
<thead>
<tr>
<th>Food</th>
<th>RE ($n=54$)</th>
<th>NRE ($n=99$)</th>
<th>$p$</th>
<th>Stress condition ($n=86$)</th>
<th>No stress condition ($n=67$)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oreo cookies</td>
<td>71.0±22.4</td>
<td>65.9±28.9</td>
<td>0.26</td>
<td>61.9±28.2</td>
<td>72.2±24.9</td>
<td>0.02*</td>
</tr>
<tr>
<td>Carrots</td>
<td>68.9±26.9</td>
<td>62.4±27.3</td>
<td>0.16</td>
<td>71.5±27.2</td>
<td>59.5±26.2</td>
<td>0.01*</td>
</tr>
<tr>
<td>M&amp;M candies</td>
<td>72.2±22.6</td>
<td>67.3±25.7</td>
<td>0.25</td>
<td>65.7±25.0</td>
<td>71.6±24.3</td>
<td>0.14</td>
</tr>
<tr>
<td>Grapes</td>
<td>79.1±20.3</td>
<td>80.1±20.5</td>
<td>0.79</td>
<td>80.3±19.4</td>
<td>79.3±21.2</td>
<td>0.77</td>
</tr>
<tr>
<td>Pretzels</td>
<td>68.9±25.9</td>
<td>63.8±29.9</td>
<td>0.29</td>
<td>65.7±30.2</td>
<td>65.5±27.4</td>
<td>0.97</td>
</tr>
<tr>
<td>Potato chips</td>
<td>57.5±26.8</td>
<td>63.9±25.6</td>
<td>0.15</td>
<td>56.3±29.8</td>
<td>65.8±22.1</td>
<td>0.03*</td>
</tr>
</tbody>
</table>

RE=restrained eater; NRE=non-restrained eater.
Numbers represent average enjoyment ratings of consuming each specific food (0=I do not enjoy eating this food; 100=this is one of my favorite foods to eat).
participants in the no-stress condition, but significantly increased from time 1 to time 2 in the stress condition. Thus, the manipulation appeared to be effective at inducing stress (see Table 2).

3.5. Amount of consumption

A 2 (Restraint) × 2 (Condition) multivariate analysis of covariance (MANCOVA) was used to determine the amount of total calories consumed as well as the proportion of calories consumed for each specific food item. BMI was controlled because it has been shown to affect eating behavior and food choice (Mela, 2001; Saelens & Epstein, 1996). On average, participants consumed 283.71 ± 261.36 calories. There was a main effect for restraint; restrained eaters consumed a higher proportion of grapes in their total caloric intake than non-restrained eaters \( (M=21.00 \pm 18.50 \text{ vs. } 14.41 \pm 11.48; p<0.01, \text{ respectively}) \). Additionally, there was an interaction in the proportion of calories consumed of chips; restrained eaters in the stress condition consumed a greater proportion of their total caloric intake from potato chips than restrained eaters in the no-stress condition \( (M=15.40 \pm 14.37 \text{ vs. } 8.50 \pm 10.13) \), while non-restrained eaters in the no-stress condition consumed a greater proportion of chips than those in the stress condition \( (M=11.29 \pm 9.82 \text{ vs. } 14.32 \pm 13.13, p<0.05, \text{ respectively}) \). Thus, contrary to prediction, restrained eaters in the stressful condition did not consume more total calories when under stress. However, restrained eaters in the stressful condition consumed a greater proportion of potato chips compared to those in the no-stress condition.

Given that not all participants in the stress condition responded to the manipulation a secondary analysis was conducted, which quantified changes in SUDS levels. Similar to previous research (Roemmich, Wright, & Epstein, 2002), participants were classified as “low-responders” or “high-responders” based on a median split of 0 on change in SUDS scores. A total of 76 participants were defined as “low-responders” (SUDS change of <0), and 73 were defined as “high-responders” (SUDS change ≥1). A 2 (Restraint) × 2 (Stress Responder) MANCOVA was used to determine the amount of total calories consumed as well as the proportion of calories consumed for each specific food, while controlling for BMI. Results showed no significant main effects or interaction for total calories consumed. However, similar to the results previously mentioned, restrained eaters consumed a greater proportion of grapes than did non-restrained eaters \( (M=21.29 \pm 18.54 \text{ vs. } 14.25 \pm 11.48, p<0.05, \text{ respectively}) \), while non-restrained eaters consumed a greater proportion of pretzels than did restrained eaters \( (M=12.38 \pm 10.91 \text{ vs. } 8.72 \pm 7.18, p<0.01, \text{ respectively}) \). Additionally, low-responders consumed a greater proportion of M&M candies than did high-responders \( (M=17.92 \pm 15.96 \text{ vs. } 13.20 \pm 10.54, p<0.05, \text{ respectively}) \). Finally, there was an interaction in the proportion of caloric consumption in chips; restrained eaters who were high stress responders consumed a greater proportion of their total caloric intake from chips than restrained eaters who were low-responders \( (M=15.69 \pm 14.55 \text{ vs. } 7.75 \pm 9.51) \), whereas non-restrained eaters who were low stress responsive consumed a greater proportion of chips \( (M=14.92 \pm 13.91) \) than those who were high responders \( (M=10.62 \pm 8.60, p<0.01) \). Thus, contrary to prediction, restrained eaters under stress did not consume more total calories than those not under stress. However, restrained eaters high in stress consumed a greater proportion of potato chips than those low in stress.
4. Discussion

The main aim of this study was to investigate whether the effect of stress induced eating is evident when a variety of foods are offered, and if so which types of foods restrained eaters seek out when stressed. Results showed no differences in total amount of calories consumed in the stress or no-stress condition. This is inconsistent with previous literature indicating that restrained eaters consume more food in stressful situations compared to nonstressful situations (Baucom & Aiken, 1981; Heatherton et al., 1991, 1993; Herman & Polivy, 1975, 1980; Polivy & Herman, 1999; Ruderman & Christensen, 1983; Ruderman & Wilson, 1979; Tanofsky-Kraff et al., 2000).

A commonality found in many stress and eating investigations is the sole use of ice-cream consumption as the dependent variable. This study is part of a growing list of studies suggesting that the original taste-test paradigm may not be generalizable to foods other than ice cream. For example, some studies have found that individuals in general consume more sweet foods when under stress than when not under stress (Epel, Lapidus, McEwen, & Brownell, 2001; Grunberg & Straub, 1992; Oliver & Wardle, 1999).

Several researchers have begun to expand the taste-test paradigm to include foods other than ice-cream. Findings from these studies are inconclusive with some that showed a significant restraint by stress interaction (Ward & Mann, 2000), while others did not (Epel et al., 2001). Although these studies attempted to increase the external validity of the taste-test paradigm they did not utilize certain food categories (e.g., fruits and vegetables) which are probably regularly consumed by restrained eaters.

Several more naturalistic studies have begun to question the robust finding of laboratory ice cream studies. For example, one study found women with high stress were not significantly more likely to engage in disordered eating than those with low stress (Ball et al., 1999). Also, in another study, although daily hassles was shown to be positively correlated to number of snacks consumed, restraint status did not moderate the relationship between stress and snacks (Conner et al., 1999). Thus, it would be more appropriate to conclude that restrained eaters may consume more ice cream when under stress than when not under stress.

The present study attempted to simulate more naturalistic eating by including a variety of food classes, while remaining a well-controlled laboratory investigation. When several food classes were available, restrained eaters did not increase their eating when stressed. This extension in methodology may pose a limit to the “taste test” paradigm.

When investigating specific food choices, results showed that in general, restrained eaters consumed a greater proportion of calories from grapes. Further, restrained eaters under stress consumed a larger proportion of their total caloric intake from potato chips than those who were not under stress. This is interesting because potato chips were actually rated the lowest on enjoyment by restrained eaters, yet when under stress they consumed more chips. Thus, when under stress, restrained eaters chose to eat more of a highly palatable, energy dense food.

The relationship between stress and general disinhibited eating may not have been detected due to one of several limitations. First, participants in the no-stress condition entered the study with a moderate level of stress. Perhaps their real life stressors were more intense than the stress induction (in the stress condition) and were similarly manifested in eating behavior. However, there were still no differences in consumption, even when a median split was used, which
examined all individuals who demonstrated an increase in stress. Similarly, despite random assignment, participants in the stress condition had significantly higher restraint scores than participants in the no-stress condition. Perhaps the two conditions were different in other characteristics as well. However, again, similar results emerged when using a median split on change in stress rating.

Additionally, although the use of proportion of total calories consumed by each individual food is a logical method for food comparison, this methodology can be problematic. For example, the percentage of calories consumed for Oreo cookies trumped all other foods; 1 g of Oreos is 4.85 calories, whereas 1 g of grapes is 0.44 calories. Thus, perhaps some participants consumed one Oreo and several grapes, but in caloric content it appears as though they consumed more Oreos. However, this same argument could be used if investigating total calories for each food consumed or amount of grams eaten.

In conclusion, this study found that although total caloric intake was not affected by either restraint or stress, restrained eaters under stress consumed a larger proportion of their total caloric intake from a food that is high in salt and fat (i.e., potato chips). It is unclear why consumption of the other high energy, high palatable foods was not affected by the stressor. Future research is needed to determine whether these findings are due to the study methodology, the specific types of foods offered, or if the general effect of stress induced eating actually disappears with greater food options. Continued research is necessary to determine the generalizability of the taste-test paradigm.

References


