EATING YOUR FEELINGS: SEX DIFFERENCES IN STRESS-INDUCED EATING

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EATING YOUR FEELINGS: SEX DIFFERENCES IN

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Abstract: Stress-induced consumption of highly palatable food could be one potential pathway from stress to obesity. Despite a sex-independent correlation between BMI and subjective stress (Block, He, Zaslavsky, Ding, & Ayanian, 2009), it is unclear whether males engage in stress-induced eating to a similar extent as females (e.g. Grunberg & Straub, 1992; Zellner et al., 2007). The current study hypothesized that exposing male and female participants to sex-specific stressors would lead to similar levels of stress-induced consumption of highly palatable food between sexes. Using respiratory sinus arrhythmia (RSA) as a measure of stress, we effectively replicated the experimental sex-specific paradigm proposed by Stroud and colleagues (2002), in which males are theorized to demonstrate higher stress after an achievement stressor and females are expected to demonstrate higher stress after a social rejection stressor. Results demonstrated that males and females consumed a significant amount of highly palatable food after either the social rejection or the achievement condition than they did after the control condition. For female participants, food consumption was also associated with current menstrual cycle. However, self-reported pathological eating behavior did not play a significant role in the amount of highly palatable food consumed, and there were no sex differences in post-stressor taste preferences of highly palatable food (i.e. salty vs sweet).

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CHAPTER I

INTRODUCTION

Stress is a common reaction to situations in which one's environmental demands exceed their resources to cope with such demands. It also leads to several behavioral, psychological, and physiological changes; many of which have a negative impact on health (Dickereson & Kemeny, 2004; Duchesne et al., 2012; Kirschbaum et al., 1992). One such negative health impact of stress is overweight and obesity. Indeed, high subjective stress ratings are positively associated with BMI (Block, He, Zaslavsky, Ding, & Ayanian, 2009). This correlation is potentially very important, as the world-wide obesity epidemic shows no sign of slowing down and individuals in the modern world report feeling more stressed now than they did several years ago (Kelly, Wang, Chen, Reynolds & He, 2008; APA Press Release, 2007). Stress-induced eating of highly palatable unhealthy foods could be a potential pathway from stress to obesity. However, it is unclear whether males engage in stress-induced eating to a similar extent as what has been found among female samples (e.g. Grunberg & Straub, 1992; Zellner et al., 2007). Repairing this disconnect between the stress-obesity relationship (which is independent of sex) and the stress-eating relationship (which appears to be influenced by sex) could provide information that could lead to positive outcomes for individuals who are prone to stress-induced eating.

CHAPTER II

REVIEW OF LITERATURE

Sex Differences in the Experience of Stress

The stress-BMI association is independent of sex (Block et al., 2009); however, there is evidence that males and females experience stress differently. Females tend to self-report higher levels of subjective stress than males do (Miller & Kirch, 1987). They also have significantly higher rates of stress-related psychiatric conditions, such as depression and anxiety (Nolen-Hoeksema, 1987). Interestingly, hypothalamic-pituitary-adrenal (HPA) axis stress responses do not often parallel subjective reports of stress (e.g. Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999). For example, most research investigating the stress response has found that males display greater HPA-axis activation in response to psychological stress (Kirschbaum, Wust, & Hellhammer, 1992; Kirschbaum et al., 1999; Frankenhaeuser et al., 1978). Alternatively, cortisol secretion does not differ between males and females in response to physical stressors (Kirschbaum, Wust, Faig, & Hellhammer, 1992). Taken together, the results of these studies indicate that there are no fundamental sex differences in overall functioning of the HPA-axis. Rather, the suggestion is that HPA-axis response is differentially associated with the social environment, and that particular types of stressors induce stress differently for males and females.

Saliency of Laboratory Stressors

It has been suggested that the typical lab stressor, which tends to include elements of both social and achievement stressors, is not incredibly salient to female participants (Stroud, Salovey, & Epel, 2002). Female self-construal places a great deal of importance on social relationships (Cross & Madsen, 1997), and they are, on average, more attentive to social cues throughout the lifespan, beginning in infancy (Geary, Byrd-Craven, & Massey, 2014). Moreover, their behavioral reaction to stress is often better described as "tend-and-befriend" rather than "fight-or-flight" (Taylor et al, 2000), further suggesting that an interpersonal stressor would be more salient for females than an instrumental/achievement stressor.

It may also be the case that the typical lab stressor is not incredibly salient to male participants due to the blend of social and achievement components. It has been suggested that when one's self-worth is threatened, they are more likely to engage in self-defeating behaviors (Crocker & Wolfe, 2001). Further, Josephs and colleagues (1992) suggest that males and females differ in their contingencies of self-worth. For example, males may be more likely than females to base their self-worth on being independent and better than others; whereas females may be more likely than males to base their self-worth on being connected and interdependent with others. Therefore, perhaps male participants would elicit a more intense stress reaction to a purely achievement-based stressor, especially if they are led to believe that other participants found the task to be easy. Indeed, Stroud and colleagues (2002) found that males display higher cortisol secretion after achievement stressors and females display higher cortisol secretion after social rejection stressors, though they did not differ in the amount of stress they reported.

Respiratory Sinus Arrhythmia

While cortisol secretion is positively associated with increased food consumption (Lavagnino et al., 2014; Newman O'Connor, & Conner, 2006), other physiological measures of stress could be correlated with the consumption of highly palatable food in the absence of hunger. Respiratory sinus arrhythmia (RSA) quantifies oscillations in inter-beat intervals during the

respiration cycle, is modulated vagal inputs, and has been conceptualized as an autonomic indicator of stress (Porges, 2007). RSA reactivity to stress has been found to be a predictor of affective responses (i.e Fortunato et al., 2013, Yim et al., 2015) and emotion regulation (i.e. Fabes & Eisenberg, 1997; Calkins and Johnson, 1998). The polyvagal theory proposed by Porges (1995) states that greater RSA withdrawal in response to stress is an adaptive response facilitating energy mobilization. Thus, decreases in RSA from baseline indicate a physiological stress reaction. While there are currently no studies linking RSA to specific eating behaviors, it is a valid and popular measure of the physiological stress reaction.

Inconsistent Results in Previous Literature

There are several studies assessing the impact that stress has on eating behavior. A large number of these studies utilize an exclusively female sample (i.e. Groesz et al., 2011; Tomiyama, Dallman, & Epel, 2011; Tryon, DeCant, & Laugero, 2013). This is due to several studies reporting that female participants are more likely to engage in stress-induced emotional eating than are male participants (e.g. Greeno & Wing, 1994). Interestingly, although most studies reliably demonstrate that female participants report increase consumption of highly palatable food during times of stress, results regarding stress-induced or emotional eating in male samples are varied. For example, there are studies that have found that males eat less in response to stress (Grunberg & Straub, 1992), and other studies showing that they increase their eating in response to stress comparable to their female participant counterparts (Rutters, Nieuwenhuizen, Lemmens, Born, & Westerterp-Plantenga, 2009). Further, some studies have reported that males demonstrate an increase in consumption of highly palatable food after a no-stress condition when compared to a stress condition (Zellner et al., 2007).

Perhaps exposing males to an achievement stressor and females to a social stressor would reduce or eliminate the apparent sex-differences in stress-induced eating, as well as add clarity to the current literature regarding the status of stress-induced eating among males. However, even if

the sex-specific stress paradigm accounts for sex-differences in stress-induced eating, individual differences will likely also play a role.

Individual Differences

Food Addiction and Chronic Stress. The addiction literature suggests that brain reward circuitry might be a key component in stress-induced eating. Endogenous opioids appear to play a protective role against the potentially damaging effects of stress. Stress stimulates the release of opioids, and opioid release dampens the activity of the HPA-axis (Drolet, Dumonst, Gosselin, Kinkead, Laforest, & Trottier, 2001). Further, opioids increase the consumption of highly palatable foods, and highly palatable food consumption sustains the release of endogenous opioids. Therefore, it is possible that chronically stressed individuals develop addiction-like behaviors toward highly palatable foods, as the consumption of these foods appears to be a powerful means to decrease the noxious effects of stress (Adam & Epel, 2007).

Further demonstrating the ability of highly palatable food to act on brain processes, a study utilizing a sample of females showed (via fMRI) that chronic stress alters the brain in such a way that reinforces neural pathways involved in motivation and reward for highly palatable food, while decreasing activation in areas involved in strategic planning and emotional control (Tryon, Carter, DeCant & Laugero, 2013). Additionally, PTSD, a chronic stress condition that occurs in response to trauma, has been found to be predictive of food addiction symptoms (Clauss & Collier, under review). Food addiction, although currently not recognized by the DSM, describes a condition in which an individual loses their ability to control intake of highly palatable foods (Imperatori et al., 2014). The results of these studies suggest that individuals who have suffered from early life trauma, as well as individuals who endorse food addiction symptoms, may be more likely to cope with stress with food.

Food Preference and Disordered Eating. Although the food addiction literature suggests that foods high in fat, sugar, and/or salt lead to the uninhibited consumption of highly palatable foods, it is possible that there are sex differences in specific macronutrient preference

after the experience of stress. Grunberg and Straub (1992) found that females preferred more sweet foods after a lab-induced stressor compared to male participants. Additionally, males report a preference for high fat, salty foods when under stress (Wansink, Cheney, & Chan, 2003).

Restrained eating may also play a role in the likelihood to engage in stress-induced eating. Several studies investigating stress-induced or emotional eating have found that restrained eaters are more likely than non-restrained eaters to consume a large amount of food under stress (e.g. Wardle, Steptoe, Oliver, & Lipsey, 2000). However, other studies have found no such relationship (e.g. Oliver, Wardle, & Gibson, 2000). It has been suggested that the level of restraint applied to eating behavior is differentially associated with stress-induced eating (Epel, Tomiyama, & Dallman, 2013). Indeed, Groesz and colleagues (2011) found that individuals who endorsed rigid restraint over their eating behavior were more likely to engage in stress induced eating than individuals who employed flexible restraint over their eating habits.

Eating disorders could also potentially contribute to the likelihood of stress-induced eating. Exaggerated cortisol responses have been found in individuals with Bulimia Nervosa (Koo-Loeb, Costello, Light, & Girdler, 2000), and Binge Eating Disorder (Gluck, Geliebter, Hung, & Yahav, 2004). Since excess cortisol is associated with increased food consumption (e.g. Lavagnino et al., 2014), it is possible that these individuals will eat more HP food in reaction to stress than individuals without eating disorders.

Study Overview

The purpose of this study was to answer three main questions. The first question was: what is the impact of sex and a specific stressor on stress-induced highly palatable food consumption? Based on Stroud et al.'s (2002) research demonstrating significant differences in HPA-axis activation dependent on sex-specific stressors, it was hypothesized that stress-induced eating would depend on sex and stressor. Specifically, it was predicted that males who undergo the achievement stressor and females who undergo the social rejection stressor will be more likely to engage in stress-induced eating than females who undergo the achievement stressor,

males who undergo the social rejection stressor, and individuals who are assigned to design a theme park in a control condition.

A difference in stress-induced eating should follow the successful induction of stress through our stress manipulations. Therefore, a second question was: Will sex-specific stress manipulations adequately induce a stress reaction? It was hypothesized that physiological stress reactions would vary based on sex and the type of stressor a participant underwent. Specifically, it was expected that males would demonstrate a greater physiological stress reaction in response to the achievement stress task and females would demonstrate a greater physiological stress reaction in response to the social rejection stress task, as measured by RSA, consistent with Stroud et al., (2002).

The third question was: how much of the variance in stress-induced eating can be explained by individual differences? It was hypothesized that several individual differences would contribute to the likelihood of stress-induced food consumption. As previously mentioned, it is possible that participants who indicate adverse childhood experiences, food addiction, restrained eating behavior, or an eating disorder may be more likely to over consume highly palatable food post stressor than individuals who do not endorse any of these conditions.

Finally, the fourth question was: will there be sex differences in the type of food consumed? There is limited evidence that females prefer highly palatable sweet foods after stress and males prefer highly palatable salty foods after stress (Grunberg & Straub, 1992; Wansink et al, 2003). Further, it is possible that the female menstrual cycle may play a role in their food consumption. Therefore, exploratory analyses were conducted to explore possible sex differences in taste preference, as well as any correlations between menstrual cycle and highly palatable food consumption post-stressor.

CHAPTER III

METHODOLOGY

Participants

An a-priori power analysis was conducted using G*Power software to determine an appropriate sample size for each planned statistical analysis. Using a medium effect size, the largest sample size required to obtain a power of .85 in each analysis was determined to be 190. However, 113 participants were recruited due to time restraints associated with training confederates and low participation rates, especially among males. Additionally, 7 participants were excluded from the analysis due to reported anorexia/low BMI (4 participants), reported food allergies (3 participants), and flawed heart rate readings (12 participants). After excluding these participants, 94 participants were left for analysis. Most of the sample was female (female = 66.7%), Caucasion (Caucasion: 70.8%), and between the ages of 18-21 (92.2%; see Demographics in Table 7). Participants were recruited from the psychology subject pool at Oklahoma State University and received course credit for their participation.

Stress Manipulations

Mathematical Challenge (Achievement Stressor; Ben Zeev, 1995). Participants were taught the rules for a difficult, hypothetical numbering system called “New Roman.” After learning the rules, participants were asked to use the “New Roman” numbering system to solve 24 challenging math problems.

Further, participants witnessed two confederates appear to do exceedingly well on this task. They were given 30 minutes to solve the math problems. Participants were then asked to explain their reasoning into a recorder.

Verbal Challenge (Achievement Stresor; Stroud, Salovey, & Epel, 2002). Participants were given 10 minutes to memorize a passage from Paradise Lost (Milton, 1953). After their 10 minutes for memorization ended, participants were asked to recite the passage into a recorder for 3 minutes. Once again, participants witnessed two confederates appear to do exceedingly well on this task.

Social Rejection Challenge (Social Stressor). The Yale Interpersonal Stressor (**Stroud, Tanofsky-Kraff, wilfley, & Salovey, 2000)** was used for the induction of social rejection stress. Two extensively trained undergraduate confederates gradually excluded and rejected the participant during an interaction segment. For the first 5 minutes, confederates are friendly and engaging with the participant. After which time, confederates appeared to connect well with each other, while using a variety of verbal and nonverbal techniques to exclude the participant. In order to not appear planned, exclusion of the participant was gradual. Confederates and the participant were instructed to talk for 40 minutes about college friendships and weekend activities.

Control Condition. Participants who were randomly assigned to the control condition were paired with a confederate and given the task of drawing theme park plans. Each group was given graphing paper and was instructed to work together to draw a theme park plan that they would both enjoy going to. They were given a list of 15 possible items to include (e.g., roller coaster, ferris wheel, train ride) and were asked to choose 10 items to include in their park. Confederates were trained to behave in a neutral to positive manner. This allowed participants to interact socially on a task that is not challenging.

Assessment of Impact of Stress Manipulation

A disconnect between self-reported stress levels and physiological measures of stress has been documented (e.g. Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999). Therefore, physiological and psychological indices of arousal were collected. For the physiological stress measure, electrocardiogram (ECG) data was collected using Biopac MP 36 hardware and software system (Biopac Systems, Inc.)at 1000 Hz sampling rate. Disposable Ag/AgCl electrodes were placed in a three-lead configuration on the participants' torso (Andreassi, 2013). Baseline was averaged between two readings taken over a 5-minute period. Heart rate was then measured continuously during the stress and control conditions. ECG data were imported into QRSTool (Allen, Chambers, & Towers, 2007), and ectopic beats and artifacts were hand corrected. After artifact correction, data were analyzed via CMet, for RSA calculations. RSA is estimated by CMet using the natural logarithm of the variance of high-frequency heart period within the frequency bandpass associated with respiration (.12-.40 Hz; Porges, 1995). Lower RSA scores indicate parasympathetic withdrawal (i.e more arousal).

The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess mood on arrival in the laboratory and after the stress manipulation. Further, participants were asked to rate the perceived stressfulness of the study using a visual analog scale during the debriefing portion of the study.

Assessment of Eating Behavior

To ensure a reasonably standardized level of deprivation, participants were asked to refrain from eating for 4 hours before they arrived in the laboratory. Hunger state was measured using a visual analog scale at the time of arrival in the laboratory, and after the stress or control conditions. To measure the effect of the stress manipulation on eating behavior, food choice and intake were measured. Foods included in the waiting room were selected based on the food addiction literature (e.g. Gearhardt, Corbin, & Brownell, 2009). The Yale Food Addiction Scale (YFAS) includes items that ask about stress-induced eating as well as an item that asks

specifically which foods individuals most often resort to. Individuals who endorse a significant number of food addiction symptoms report that their problem foods are highly palatable and high in refined sugar, salt and/or fat. Therefore, the food categories included in the waiting room were: highly palatable sweet (e.g. cookies, chocolate), highly palatable salty (e.g. chips), bland (e.g. white bread), nutritious sweet (e.g. berries, grapes), and nutritious non-sweet (e.g. broccoli florets, celery). All of the highly palatable options were high in calories, and all of the nutritious options were low in calories.

Food Intake. Participants were permitted to eat freely for 20 minutes from tables consisting of foods from each of the above-mentioned categories. The foods were weighed to the nearest tenth of an ounce before and after the eating condition to determine the amount consumed. For analysis, all food variables were established by calculating the sum of the change scores (food weight after condition – food weight before condition) for all of the foods in their respective categories, as well for an "overall food eaten" variable. Change scores were used instead of overall calorie consumption for the sake of simplicity, since all of the food in the highly palatable category were high calorie, and all of the foods in the nutritious category were low calorie. For the "highly palatable" food variable used in the analysis, all of the highly palatable sweet and salty foods were combined (cookies, chocolate, and chips). The "nutritious" food variable was also calculated using all of the foods in the nutritious categories (berries, grapes, broccoli, and celery).

Individual Differences Variables

Chronic Life Stressors. The Adverse Childhood Events Questionnaire (ACE; Felitti et al., 1998) was used to gather information regarding this type of potential chronic life stressor. It performed well in the current study (α = .71).

Food Addiction. The Yale Food Addiction Scale (YFAS; Gearhardt et al., 2009) was used to assess food addiction symptoms among participants. It consists of 25 self-report items measuring addictive eating behaviors and is based on substance dependence criteria in the DSM-

IV-TR. Two scoring options are available; either a categorical diagnosis score or a continuous "symptom count" score. For the purposes of the current study, the continuous symptom count score was used. Gearhardt and colleagues (2009) have demonstrated that the YFAS exhibits adequate internal consistency (α = .86). The YFAS also demonstrates good convergent validity with measures of similar constructs, such as the Eating Disorder Examination, and adequate discriminant validity has been found. It performed well in the current study (α = .81).

Eating Style. The eating style of participants was assessed using the Dutch Eating Behavior Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986). The DEBQ consists of 33 items that assess three categories of eating styles: (1) emotional eating which involves eating in response to emotional arousal states like fear, anger, or anxiety; (2) external eating which refers to eating in response to sight and smell of food; and (3) restrained eating which refers to overeating when the cognitive resolve to diet is abandoned after a period of slimming (van Strien et al., 1986). Scores on the DEBQ range from 1 (Never) to 5 (often). Higher scores indicate higher frequency of behavior. The DEBQ has demonstrated adequate internal consistency among several subsamples (α = .81-.95; van Strien et al., 1986), adequate external reliability (r = .86), and satisfactory concurrent and discriminant validity. It performed very well in the current study (α = .93).

Disordered Eating. The Eating Disorders Diagnostic Scale (EDDS; Stice, Telch, & Rizvi, 2000) is a 22-item self-report scale intended to assess the criteria for anorexia nervosa, bulimia nervosa, and binge eating disorder, as well as provide an overall symptom composite indicative of pathological eating behaviors and attitudes (Stice et al., 2004; Stice et al., 2000). This measure is well validated and has been demonstrated to be reliable (Stice et al., 2004). The EDDS has been used successfully with college samples including both males and females (e.g., Dunn et al., 2003). It is important to calculate the internal consistency of the EDDS symptom composite by calculating Cronbach's alpha for the standardized items that make up the score

(Stice et al., 2004). When calculated for the current sample, internal consistency in the current study was poor (α = .58).

Contingencies of Self-Worth. The Contingencies of Self Worth Scale (Crocker, Luhtanen, Cooper, & Bouvrette, 2003) was designed to measure 7 sources of self-esteem; including academics, appearance, approval from others, competition, family support, God's love, and virtue. All of the subscales of the Contingencies of Self-Worth Scale have demonstrated high internal consistency and reliability. Therefore, only the relevant subscales, approval from others and competition, were utilized in the current study. The internal consistency in the current study was poor (α= .58).

Procedure

One day prior to the stress manipulation, participants arrived at the lab and completed a "rest" session. The rest session was designed to provide participants time to habituate to the laboratory setting and reduce the novelty of the situation before beginning the experimental manipulation on the following day (Stroud et al., 2002). The rest session also better ensured that any differences in reactivity to the stress manipulation could be attributed to the type of stressor experienced. The rest session lasted 30 minutes and was identical for all participants. During this time, participants completed a battery of questionnaires. Participants were randomly assigned to condition in session one prior to their participation.

The day after the rest session and following the design by Oliver and colleagues (2000), participants were asked to be at the lab to begin the study between 11:30 AM and 1:30 PM, or 3:30-5:30 PM since these are timeframes in which most individuals would normally eat a meal. Once participants arrived at the laboratory, they were asked to confirm that they had not eaten for 4 hours prior. Participants who indicated that they have eaten less than 3 hours prior to the beginning of the study were asked to reschedule their participation. This only occurred with two participants. Baseline measures of heart rate, mood, and hunger were assessed. Participants were then be randomly assigned and receive instructions for either the stress or control task. All stress

conditions were based on the design by Stroud and colleagues (2002), and include an achievement stress condition and a social rejection challenge.

In the achievement stress condition, participants were told that the experimenters are studying the relationship between intelligence and physiological responses. Participants were also be told that they would be ranked on their ability to complete challenging mathematical and verbal tasks and that participants in previous sessions had found the tasks to be easy. The participant and the confederate were seated at tables separated by a partition and handed paper instructions for each task that the researcher read aloud. Math and verbal tasks were counterbalanced. For the math task, 32-total minutes were allotted: 10 minutes to read the numbering system rules, 20 minutes to finish the math problems using the numbering system, and 2 minutes to recite their reasoning into a voice recorder. For the verbal task, 13 total minutes were allotted: 10 minutes to memorize the passage, and 3 minutes to recite it into a voice recorder. In sum, the tasks took 45 minutes to complete. After the allotted time for each task, participants witnessed trained confederates excelling at each task.

The social rejection challenge involved two same-sex confederates. The participant and confederates were told that the experimenters were interested in how individuals get to know one another and the subsequent physiological cascade. They were also told that they would discuss two different topics while their interactions were recorded. Participant and confederates then engaged in discussion of two general topics: weekend activities and college friendships. For the first 5 minutes of the challenge, confederates were generally friendly and engaging with the participant. After the initial 5 minutes, the participant was excluded by the confederates. The overall challenge lasted 40 minutes.

In the control condition, participants were told that experimenters are interested in finding out how group work impacts mood and physiology. Participants were instructed to work with a partner (confederate) to design a theme park that they would both enjoy going to. After the control task ended, participants filled out the PANAS.

Immediately after either the stress or control condition mood was measured again to confirm efficacy of the stress task, and heart rate data was saved. After these measures are completed, participants were moved to a waiting room containing various types of foods. It took approximately 45 minutes from the start of the lab session until they entered this food room. Participants were told that they have one more task to complete (bogus task) assessing their experience and rating the experimenters, but that the room in which they will be completing that task has a limited capacity. The confederates will be seen going into this room first to complete the “final task,” while participants will be instructed to wait in the “food room.” Participants will be told that the food is provided due to the length of the study and the requirement that they have not eaten in 4 hours, that they should eat whatever and as much as they want, and that it may be a 20-25-minute wait.

After a 20-minute waiting period in the "food room," participants began the debriefing, at which time the true nature of the study was revealed. The debriefing included a rating of the perceived stressfulness of the study, and height and weight will be recorded.

Analyses

Data collected from participants were analyzed using IBM SPSS 23 statistical software and were screened for assumptions and cleaned before analysis began. After data screening and cleaning, several analyses were conducted to effectively answer all research questions. First, a two-way between groups Analysis of Variance (ANOVA) was conducted to assess the impact of sex and specific laboratory stressor (independent variables) on highly palatable food consumption (dependent variable; Hypothesis 1). To better ensure that it is due to stress-induced eating in the absence of hunger, a follow up multiple regression analysis was conducted to determine whether highly palatable food consumption was also predicted by ratings to items on the hunger scale.

A second ANOVA was conducted to assess the impact of sex and specific laboratory stressor (independent variables) on RSA (dependent variable; Hypothesis 2). Next, a multiple regression was conducted to determine how much of the variance in stress-induced eating of HP

food (outcome variable) was explained by the individual difference variables (predictor variables; Hypothesis 3).

Finally, to assess possible sex differences (independent variable) in the type of food consumed (salty, sweet, or bland; dependent variables), an independent-samples t-test and Pearson-product moment correlation analysis was utilized (Hypothesis 4).

CHAPTER IV

RESULTS

Pearson product-moment correlation analysis was conducted to assess correlations between all study variables (see Table A6).

Hypothesis 1

A two-way between groups analysis of variance was conducted to assess the impact of sex and sex-specific laboratory stressors on highly palatable food consumption (see Table A1). Participants were divided into three groups based on condition assignment (achievement stressor, social rejection stressor, and control). The interaction between sex and amount of highly palatable food consumption was not statistically significant (see Figure A1). There was a significant main effect for condition, F (2, 86) = 4.23, p = .02, η^2= .05. Post hoc comparisons using the Games-Howell test indicated that the mean score for the social rejection condition (M = 4.06, SD = 4.17) was significantly different from the control condition (M = 1.55, SD = 1.47), MD = 2.50, SE = .82, p = .01, $CI_{.95}$[.49, 4.51], indicating that more highly palatable food was consumed after the social rejection stressor than the control stressor. The mean score for the achievement condition (M = 3.66, SD = 4.21) was also significantly different from the control condition, MD = 2.11, SE = .77, p = .02, $CI_{.95}$[.23, 3.99]. There was not a significant difference between the social rejection and achievement conditions in highly palatable food consumption.

To be sure that the amount of highly palatable food consumed by participants was not predicted by hunger, a follow up hierarchical multiple regression was conducted using highly palatable food consumption as the dependent variable. Dummy variables were created to represent each of the experimental conditions. Experimental conditions and the hunger scale were used as predictor variables. The experimental condition dummy variables were entered into the equation at step 1, and the overall model was significant, R^2= .09, F (2, 86) = 4.08, p = .02. The Hunger Scale variable was entered into the equation at step 2, and did not add anything further to the prediction of highly palatable food consumption, R^2= .09, ΔR^2= .001, ΔF(1,85) = .07, p = .79. Therefore, self-reported hunger adds nothing to the prediction of highly palatable food consumption. .

Hypothesis 2

A two-way between-groups analysis of variance was conducted to explore the impact of sex and experimental condition (achievement stressor, social rejection stressor, and control) on stress (as measured by RSA; see Table 2). There was a significant interaction effect between sex and experimental condition, F (2, 86) = 6.73, p = .002, η^2= .06 (see Figure A2). An analysis of the simple main effects revealed that male participants demonstrated greater parasympathetic withdrawal in the achievement condition compared to females, MD = -.88, SE, .34, p = .01, $CI_{.95}$[-1.56, -.20], indicating greater stress reaction. Similarly, females demonstrated greater parasympathetic withdrawal in the social condition than males, MD = -1.05, SE = .40, p = .01, $CI_{.95}$[-1.85, -.25]. There were no significant differences in parasympathetic withdrawal between males and females in the control condition.

Hypothesis 3

A hierarchical multiple regression was performed to assess the ability of several individual difference variables (food addiction, chronic life stressors, restrained eating behavior, disordered eating, contingencies of self-worth, and BMI) to predict stress-induced highly palatable food consumption (outcome variable) after controlling for the influence of sex (see Table A3). Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity, and homoscedasticity. Sex was entered at step one, and the remaining independent difference variables were entered at step two. The model was not statistically significant after the entry of sex at step one or the entry of the individual difference variables at step two.

Hypothesis 4

To determine whether there were sex differences in food preferences post stressor, an independent samples t-test was conducted using sex as the grouping variable and highly palatable sweet food and highly palatable salty food as the testing variables. Results indicated there were no sex differences in type of food preferred post stressor (see Table A4).

To determine whether female menstrual cycle was correlated with the amount and type of food consumed by female participants, a Pearson-product moment correlation test was performed with the variables: cycle phase (menstrual phase, follicular phase, ovulation phase, and luteal phase), highly palatable food consumption, bland food consumption, nutritious food consumption, and overall food consumption (Table A5, Figure A3). Results indicated that menstrual cycle phase was significantly and positively associated with the amount of highly palatable food eaten ($r = .35$, $p = .01$), the amount of bland food eaten ($r = .39$, $p = .003$), and the amount of food overall eaten ($r = .38$, $p = .01$). Further, females in the luteal phase consumed a significantly greater amount of highly palatable food. However, when looking at the difference in consumption between highly palatable sweet food and highly palatable salty food, females in the

ovulation phase consumed significantly more highly palatable salty food. There were no significant associations between cycle and highly palatable sweet food consumption.

CHAPTER V

DISCUSSION

Several factors influence human eating behavior. One factor appears to be stress, though the pattern of male stress-induced eating behavior is unclear in the literature. With a positive correlation between BMI and stress being independent of sex, it seems likely that males and females both engage in some degree of stress-induced consumption of highly palatable foods. One potential reason information regarding male stress-induced eating habits is so varied could be that many experimental designs do not utilize salient stressors.

It has been suggested that there is a sex difference in the HPA-axis stress response to achievement and social rejection stressors, such that males demonstrate higher cortisol levels (indicating a greater stress reaction) to achievement stress and females demonstrate higher cortisol levels to social rejection stress (Stroud et al., 2002). Therefore, utilizing an experimental design with these stressors should lead to a successful induction of stress and subsequent stress-induced consumption of highly palatable food in males and females.

The current study used RSA as a measure of stress reaction to the achievement and social rejection laboratory stressors. In our sample, males displayed a greater stress reaction to the achievement stressor than females, and females displayed a greater stress reaction to the social rejection stressor than males did, supporting the hypothesis. The experimental design proposed by Stroud and colleagues (2002) has not been tested using autonomic response as an indication of stress reaction.

Thus, to our knowledge, this is the first study to demonstrate that sex differences in response to sex-specific stress paradigms can be measured using RSA as an indicator of arousal.

RSA and other measures of heart rate variability have been used extensively in combination with the Trier Social Stress Test (TSST) and have been met with mixed results. For example, one study utilizing the Trier Social Stress Test (TSST) found that heart rate variability was not significantly different between the TSST and a control condition (Rohleder et al., 2006). Though another study did find a significant change in heart rate variability between pre- and post-TSST measurement (Lackshewitz et al., 2008). More recently, Yim and colleagues (2015) found that RSA was significantly associated with the TSST, and was comparable to cortisol reaction to the same test. This is notable, due to the well-documented relationship between cortisol reactivity and the TSST (e.g. Kirschbaum, Pirke, & Hellhammer, 1993).

The fact that autonomic withdrawal appears to be a good indicator of an acute stress reaction, and that it led to increased consumption of highly palatable food for both males and females, regardless of condition, leads to some important implications. For example, it is possible that heart rate variability and RSA could be targeted in a therapeutic sense to help reduce stress-induced highly palatable food consumption among individuals who are prone to such behavior. This could be done through the use of HRV-biofeedback techniques. Such techniques have often been employed in the use of mental disorder treatment. For example, biofeedback has been shown to reduce negative symptoms in patients with PTSD and anxiety disorders (Zucker et al., 2009). In non-clinical samples, lower heart rate variability has been associated with lowered self-regulation (Segerstrom & Nes, 2007) and emotional control (Appelhans & Luecken, 2006). In the realm of eating behavior, lowered HRV has been associated with strong chocolate cravings and unsuccessful dieting (Rodriguez-Ruiz et al., 2009). Biofeedback techniques work to increase heart rate variability through manipulation of RSA. Increasing heart rate variability may also lead to decreasing stress and subsequent likelihood to engage in stress-induced highly palatable food consumption. Indeed, one study found that participants who endorsed a lack of control over their

eating behavior and who were self-reported “strong cravers” reported reduced symptoms after engaging in biofeedback sessions (Meule, Freund, Skirde, Vogele, Kubler, 2012). However, in that study, the biofeedback technique did not increase heart rate variability. It is possible that sessions did not continue long enough to increase baseline heart rate variability. Future research should focus on specific mechanisms responsible for the relationship between autonomic withdrawal and eating behavior which remain to be elucidated.

The first hypothesis was partially supported. Contrary to the first hypothesis, there was no significant interaction effect of sex and experimental condition on highly palatable food consumption. However, while no sex differences were observed, participants assigned to the social rejection or achievement stress conditions did consume more highly palatable food post-stressor than participants assigned to the control condition. Therefore, since there were sex differences in the induction of stress based on condition such that males were more stressed after the achievement condition and females were more stressed after the social rejection condition, and the consumption of highly palatable food went up after both conditions regardless of sex, it appears specific level of stress did not play a role in stress-induced eating. Small to large increases in arousal led to greater consumption.

Males also appeared to eat more highly palatable food after the social rejection stressor than females did, though this result was not significant. There are several potential reasons for this result. First, it could be due could be the lack of male participants in the current study. Indeed, when overall amount of food eaten is assessed, males did tend to eat more after the achievement stressor than they did after the social rejection stressor (see Figure 4). Second, female participants could have reacted with greater restraint after a stress condition in which they perceived social threat. Dietary restraint was measured as a trait in the current study, with no significant correlation between restraint and highly palatable food consumption found. However, it is possible that some female participants who acutely perceived social evaluation reacted with a temporary state of restraint. This would be in line with the intrasexual competition theory of

dietary restraint, which hypothesizes that processes of intrasexual competition can lead to restrictive eating attitudes and behaviors either temporarily, or to a maladaptive extent (Abed, 1998). According to this perspective, competition between members of the same sex for status serves an adaptive purpose of attracting mates. As such, any situation that provokes status competition salience may lead to conscious or nonconscious concerns of mating desirability. For females, status and mating desirability is associated with youthful appearance, including thinness, at least in Western cultures. Therefore, females who are particularly sensitive to intrasexual competition cues may restrict eating after situations where they perceive social threat or competition. Indeed, Li and colleagues (2010) found that heterosexual females who were exposed to intrasexual competition cues reported greater body dissatisfaction and more restrictive eating attitudes post experiment than females who were not exposed to these cues. Though the current study was not designed to elicit intrasexual competition, it is possible that the nature of social rejection stressors make intrasexual competition cues salient to females who are more competitive by trait, and those particular females engage in less public stress-induced eating. Indeed, in the current study, females did consume more *nutritious* food than males after the social rejection stressor. This result was non-significant, but that could be due to the limited sample size.

A third potential explanation for this result is the influence of the menstrual cycle. Food intake during different phases of the menstrual cycle varies, and physiological stress reaction also varies during the different phases of the menstrual cycle. For example, according to a meta-analysis, the follicular phase of the menstrual cycle is associated with the lowest food intake, when estradiol levels are high; and highest during the luteal phase, when progesterone levels are high (Buffenstein, Poppitt, McDevitt, & Prentice, 1995). Similarly, cortisol levels affect self-reported mood differentially depending on menstrual cycle phase. For example, one study found that higher post stressor cortisol levels were significantly associated with a reduction in negative affect among females in the follicular phase; whereas higher cortisol levels were significantly associated with an increase in negative affect among females in the luteal phase of their cycle

(Duchesne & Pruessner, 2013). The current study calculated menstrual cycle based on collected self-reported information about the menstrual cycles of female participants and found a significant association between cycle and highly palatable food eaten. This could be a potential reason there was no significant interaction between sex and condition on stress-induced consumption of highly palatable food. However, menstrual cycle calculations determined from self-reported information on cycle length and date of last period are often inaccurate (Small, Manatunga, & Marcus, 2006). Future studies should collect estradiol and/or progesterone in addition to self-reported data to accurately measure cycle and better determine how menstrual cycle phase impacts stress-induced eating.

None of the individual difference variables were predictive of highly palatable food consumption, contrary to hypothesis three. Many of the individual difference variables addressed disordered eating behavior, and few participants endorsed such behaviors. Additionally, the Eating Disorder Diagnostic Scale had poor internal consistency. Further, the current study did not assess depressive or anxious psychopathology, and many of the disordered eating behaviors that were assessed are often exacerbated by such psychopathology (i.e. Hudson, Hiripi, Pope, & Kessler, 2007).

It is also possible that the occurrence of pathological eating behaviors is not high enough to capture in a small sample. The current study was underpowered, and thus, any potential effect of pathological eating traits could have been missed. Indeed, most participants did not endorse any eating pathology. It will be important for future research to collect data from a much larger sample made up equally of males and females.

There were also no significant sex differences in salty or sweet food preferences. This analysis was exploratory due to a lack of empirical evidence and consensus. However, some research suggests that the female menstrual cycle phase plays a role in food preferences, but the evidence is varied. For example, some researchers have reported an increase in the consumption of fat and carbohydrates during the premenstrual period (e.g. late ovulation phase, into follicular

phase; Cross, Marley, Miles, & Wilson, 2001); while others have not found any change in macronutrient preference (Dye & Blundell, 1997). When taking cycle phase into account, the current study found that females in the ovulation phase consumed more highly palatable salty foods. However, this result should be met with caution since female participants self-reported information used to calculate menstrual cycle, and there were only 5 participants in their ovulation phase according to those calculations. Further, males only made up 32% of the total sample. With more male participants, it is possible that an overall sex difference in taste preference could be found.

Summary and Conclusion

The current study replicated the effects of a sex-specific experimental stress induction paradigm (Stroud et al., 2002) using RSA as a measure of physiological stress. While significant sex differences were found in reaction to the achievement and social rejection stressors, most participants who were assigned to the experimental conditions displayed some stress reaction regardless of sex. Further, participants consumed more highly palatable foods post-stressor compared to participants in the control condition, regardless of sex. This suggests that even mild stress induction can lead to stress-induced consumption of highly palatable food. Further, given the finding that RSA provided an accurate measure of stress that resulted in stress-induced eating, it is possible that biofeedback could be used to reduce instances of stress-induced highly palatable food consumption. However, one question that remains to be answered is whether there is a specific threshold of stress reaction that must be reached to lead to stress-induced consumption of highly palatable food, and finding the mechanistic connection between autonomic withdrawal and eating behavior may provide information that could benefit individuals who display pathological and non-pathological patterns of stress-induced consumption of highly palatable food.

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APPENDICES

Appendix A

Table A1

2x2 Analysis of Variance for the Effect of Sex and Experimental Condition on Highly Palatable Food Consumption

Source of Variance	*SS*	*df*	*MS*	*F*	*p*	Partial η^2
Sex	5.36	1	5.36	.41	.52	.005
Condition	109.60	2	54.80	4.23	.02	.09
Sex*Condition	13.92	2	6.96	.54	.59	.01
Error	1113.32	86	12.95			
Total	2136.27	92				
Corrected	1239.02	91				

Note: R^2 = .10, Condition = achievement stress, social rejection stress, and control

Appendix B

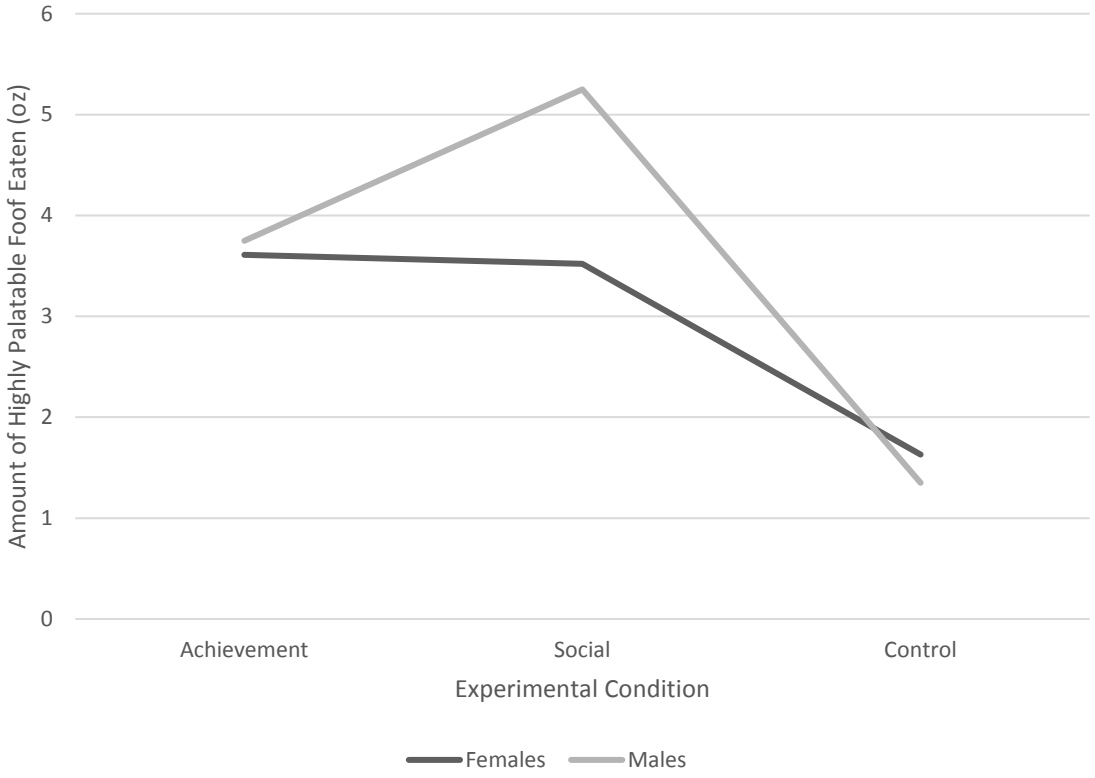

Figure A1. Main Effect of Stress-Induced Highly Palatable Food Consumption by Experimental Condition.

Appendix C

Table A2

2x2 Analysis of Variance for the Effect of Sex and Experimental Condition on Respiratory Sinus Arrhythmia

Source of Variance	*SS*	*df*	*MS*	*F*	*p*	Partial η^2
Sex	.03	1	.03	.03	.87	.05
Condition	17.81	2	8.91	9.66	.000	.98
Sex*Condition	12.40	2	6.20	6.73	.002	.91
Error	79.25	86	.92			
Total	218.50	92				
Corrected	118.36	91				

Note: R^2 = .33, Condition = achievement stress, social rejection stress, and control

Appendix D

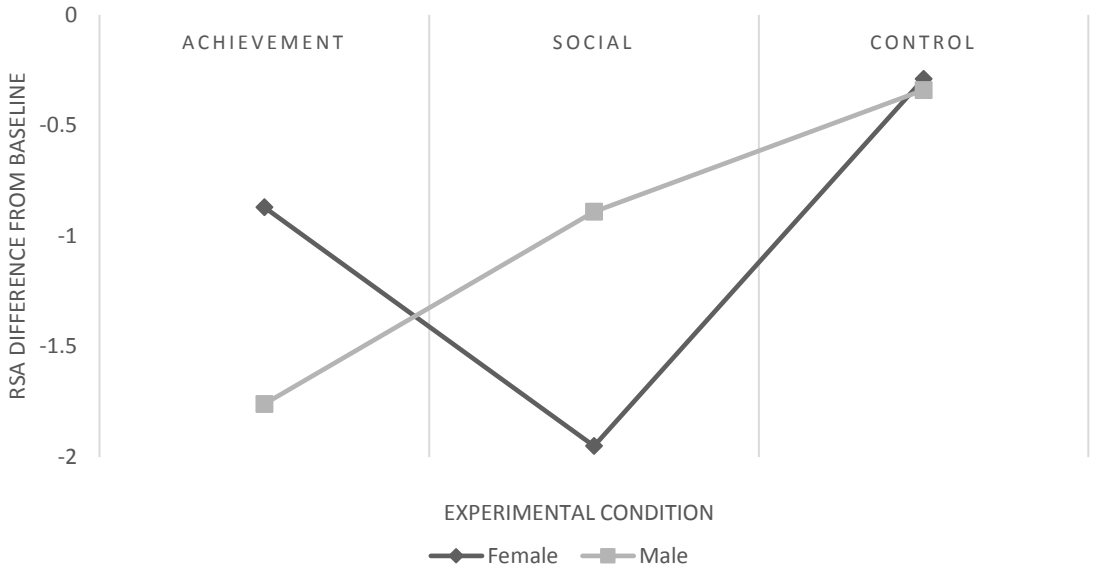

Figure A2. Effect of the Interaction between Sex and Condition on Respiratory Sinus Arrhythmia (RSA)

Appendix E

Table A3

Hierarchical Multiple Regression of Individual Difference Variables Effect on Stress-Induced Consumption of Highly Palatable Food

Source of Variance	*M*(SD)	*B*	*SE(B)*	*β*	*t*	*p*	*R*	R^2	$Adj.R^2$	ΔR^2	ΔF	*df1*	*df2*	*Sig F Δ*
Step 1							***.08***	***.01***	***-.06***	***.01***	***.10***	***1***	***16***	***.75***
Sex	1.68(.47)	-.62	1.95	-.07	-.32	.75								
Step 2							***.28***	***.08***	***-.96***	***.07***	***.08***	***8***	***8***	***.99***
Sex		-.48	2.92	-.06	-.17	.87								
FA	2.06(1.36)	.25	1.23	.09	.20	.84								
ACE	5.47(11.08	-.03	.12	-.08	-.23	.82								
RE	21.70(8.58)	-.09	.27	-.20	-.33	.75								
EE	25.78(10.26)	-.03	.19	-.07	-.14	.89								
EDDS	41.92(8.99)	.00	.26	.01	.01	.99								
CSW-A	3.76(1.34)	.26	1.46	.10	.18	.86								
CSW-C	4.26(1.25)	-.59	1.19	-.20	-.50	.63								
BMI	25.36(5.63)	.06	.23	.09	.26	.80								

Note: HP Food = Highly Palatable Food, FA= Food Addiction, ACE = Adverse Childhood Experiences, RE = Restrained Eating, EE = Emotional Eating, EDDS = Eating Disorder Diagnostic Scale, CSW-A = Contingencies of Self Worth – Approval, CSW-C = Contingencies of Self Worth – Competition, BMI = Body Mass Index.

Appendix F

Table A4

Independent Samples t-test Assessing Sex Differences in Taste Preference Post-Stressor

	Males		**Females**			
Variable	*N*	*M (SD)*	*N*	*M (SD)*	*t*	*p*
HP Sweet	27	5.65(5.10)	63	6.00(4.50)	-.33	.74
HP Salty	27	.60(.70)	63	.87(1.13)	-1.14	.26

Note: HP = Highly Palatable

Appendix G

Table A5

Correlations Between Phases of the Menstrual Cycle and Food Consumption

Variable	1	2	3	4	5	6	7	8	9	10
1. Cycle	-									
2. Menstrual Phase	-.47**	-								
3. Follicular Phase	-.09	-.31**	-							
4. Ovulation Phase	.16	-.16	-.17	-						
5. Luteal Phase	.85**	-.37**	-.39**	-.20	-					
6. HP Food	.26*	-.12	-.12	.08	.25*	-				
7. Bland Food	.31**	-.10	-.18	-.09	.39**	.27**	-			
8. Nutritious Food	.03	.00	-.08	-.08	.10	.03	.26**	-		
9. Overall Food	.15	-.02	-.23	.02	.22	.33**	.39**	.89**	-	
10. HP Sweet Food	.07	-.01	-.13	-.06	.14	.29**	.08	.42**	.61**	-
11. HP Salty Food	.19	-.09	-.19	.41**	.07	.42**	-.03	-.02	.19*	.08

Note: *p < .05; ** p < .001; *N* = 62; HP Food = Stress-induced highly palatable food consumption, HP = Highly Palatable

Appendix H

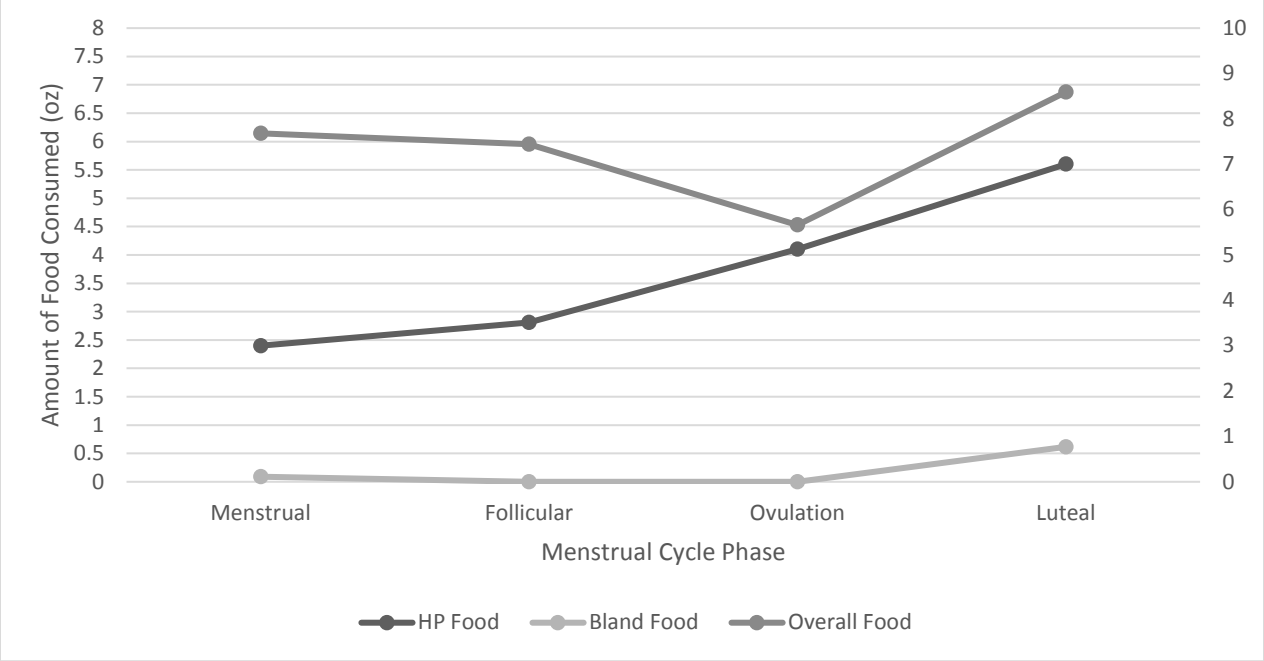

Figure A3. Amount of Post-Stressor Food Consumed Based on Menstrual Cycle Phase

Table A6

Correlations Between All Study Variables

Variable	M(SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Sex	-	-																	
2. PS	2.53(2.13)	.14	-																
3. RSA_Stress	-1.04(1.14)	.04	-.03	-															
4. Restrained Eating	21.70(8.58)	.10	-.01	.25*	-														
5. Emotional Eating	25.78(10.26)	.32**	.17	-.02	.36**	-													
6. CSW-A	3.76(1.34)	.04	.54**	-.04	-.10	.36	-												
7. CSW-C	4.26(1.25)	-.12	.16	.02	-.25	.14	.44	-											
8. PANAS-P	16.97(5.27)	-.02	.17	.07	.05	.09	.23	.50	-										
9. PANAS-N	20.54(5.75)	-.01	.22*	.11	.02	.15	.33	.56	.88**	-									
10. Food Addiction	2.07(1.36)	.14	.17	.10	.31**	.62**	.24	.03	.05	.07	-								
11. Overall Food	8.07(7.21)	-.01	-.04	-.23*	-.04	-.04	-.13	.40	-.05	-.04	.12	-							

12. HP Food	3.13(3.67)	-.08	-.02	-.43**	-.16	-.10	.03	-.09	-.15	-.14	-.00	.33**	-						
13. Nutritious Food	5.50(7.33)	-.06	-.04	-.17	.03	-.02	-.13	.38	.00	-.03	.09	.89**	.03	-					
14. Bland Food	.38(.97)	-.20	.03	-.10	-.07	.02	-.08	.10	-.05	-.12	-.04	.39**	.27**	.26*	-				
15. EDDS	41.92(8.99)	.12	.22	.20	.68**	.37**	.39*	-.03	.19	.21*	.41**	-.05	-.08	-.03	-.06	-			
16. BMI	25.36(5.63)	-.13	-.12	.06	.02	.03	.15	.08	.04	.06	.07	.06	.10	-.04	-.08	.09	-		
17. Cycle Phase	2.24(1.44)	-	-.05	.12	.05	-.05	-.11	-.14	-.08	-.14	.15	.15	.26*	.03	.31*	.07	-.09	-	
18. HP Sweet Food	5.89(4.63)	.04	-.01	-.23*	-.08	-.02	-.05	.40	-.05	-.05	.13	.61**	.29**	.42**	.08	-.11	-.01	.07	-
19. HP Salty Food	.80(1.02)	.12	-.12	-.28**	-.11	-.02	-.28	-.26	-.09	-.09	-.02	.19	.42**	-.02	-.03	-.01	.07	.19	.08

Note: *p<.05; **p<.001; PS: Perceived Stress; RSA_Stress: Respiratory Sinus Arrhythmia difference from baseline; CSW-A: Contingencies of Self-Worth – Approval from Others; CSW-C: Contingencies of Self-Worth – Competition; PANAS-P: Positive Affect; PANAS-N: Negative Affect; HP: Highly Palatable; EDDS: Eating Disorder Diagnostic Scale

Appendix J

Table A7

Sample Demographic Information

	Total		Males		Females	
Variable	*N*	*%*	*N*	*%*	*N*	*%*
BMI	**92**		**29**		**63**	
Underweight	4	4.3	0	0	4	6.3
Normal	44	47.9	14	48.3	30	47.6
Overweight	25	27.1	7	24.1	18	28.6
Obese	19	20.7	8	27.6	11	17.5
Race	**91**		**29**		**62**	
Hispanic/Latino	7	7.3	2	6.7	5	8.1
African American	2	2.1	0	0	2	3.2
Caucasian	68	70.8	20	66.7	48	77.4
Asian	3	3.1	2	6.7	1	1.6
Pacific Islander	1	1	1	3.3	0	0
Native American	10	10.4	4	13.3	6	9.7
Age	**90**		**27**		**63**	
18-21	83	92.2	22	81.5	61	96.8
22-30	5	5.6	5	18.5	0	0
>30	2	2.2	0	0	2	3.2
Eating Disorder	**92**		**29**		**63**	
None	79	82.3	27	93.2	52	82.5
Anorexia	4	4.2	0	0	4	6.3
Full threshold bulimia	5	5.2	1	3.4	4	6.3
Subthreshold bulimia	4	4.2	1	3.4	3	4.8
Binge Eating Disorder	0	0	0	0	0	0
Sex	**94**					
Male	30	31.3				
Female	64	66.7				

Appendix K
New Roman Problem Set

Instructions: Below you will find a list of base-10 numbers and their representation in New Roman. You will also find four rules of the New Roman numbering system. Please use the information in this table to complete the set of addition problems using the New Roman numbering system.

List of base-10 numbers and their New Roman representation		
0 = 00	11 = 0101	40 = 0400
1 = 01	12 = 0102	50 = 0500
2 = 02	13 = 0103	60 = 6000
3 = 03	14 = 0104	70 = 6100
4 = 04	15 = 0105	80 = 6200
5 = 05	16 = 0160	90 = 6300
6 = 60	17 = 0161	100 = 010000
7 = 61	18 = 0162	
8 = 62	19 = 0163	
9 = 63	20 = 0200	
10 = 0100	30 = 0300	

New Roman Fundamental Rules:
1) Each digit in base 10 is split into two digits in New Roman
2) In each pair of New Roman digits the right digit ranges between 0-5
3) In each pair of New Roman digits the left digit can only be either 0 or 6
4) 64 and 65 are not allowed to represent 10 and 11 because they violate the first rule.

Example Problems Using New Roman System:

Example 1 No Carry	**Example 2** Carry into 6	**Example 3** Carry from 6	**Example 4** Carry into and from 6
0361 +0202 0563	04 +04 ~~8~~ Invalid number 62 Carry a six leave remainder	0261 +0162 0423 Sum columns carry a ten 04~~23~~ Add digits 0405 Form valid number	62 +0305 ~~7~~ Invalid number so so carry a six and leave remainder 0421 Sum columns carry a ten 04~~21~~ Add digits 0403 Form valid number

Solve:

(1) 010401
+ 600302

(2) 606160
+020161

(3) 030063
+020205

(7) 010263
+040302

(8) 010105
+600103

(9) 016105
+620160

(13) 020263
+600201

(14) 026360
+606102

(15) 600100
+010304

(4) 036002
+020405

(5) 606202
+020403

(6) 026002
+026161

(10) 616005
+026202

(11) 010263
+600104

(12) 026360
+606102

(16) 010105
+000103

(17) 030063
+020260

(18) 016202
+010403

(19) 020401
+010201

(20) 010304
+020203

Appendix L
Verbal Task

Instructions: Please spend 10 minutes practicing and memorizing the following passage. After 10 minutes, you will be asked to recite the passage into a voice recorder.

"Is this the region, this the soil, the clime,"

SAID THEN THE LOST ARCHANGEL, "THIS THE SEAT
That we must change for Heaven?--this mournful gloom
For that celestial light? Be it so, since he
Who now is sovereign can dispose and bid
What shall be right: farthest from him is best
Whom reason hath equalled, force hath made supreme
Above his equals. Farewell, happy fields,
Where joy for ever dwells! Hail, horrors! hail,
Infernal world! and thou, profoundest Hell,
Receive thy new possessor--one who brings
A mind not to be changed by place or time.
The mind is its own place, and in itself
Can make a Heaven of Hell, a Hell of Heaven.
What matter where, if I be still the same,
And what I should be, all but less than he
Whom thunder hath made greater? Here at least
We shall be free; th' Almighty hath not built
Here for his envy, will not drive us hence:
Here we may reigh secure; and, in my choice,
To reign is worth ambition, though in Hell:
Better to reign in Hell than serve in Heaven."

Appendix M
Plan a Theme Park

Instructions:

You are to plan a theme park with rides and attractions that would appeal to people of all ages. Please use the graphing paper provided to design your theme park. The number beside each item indicates the maximum number of blocks it can take up on the graphing paper. Choose 10 items from the list below to include in your park. Please label rides and attractions appropriately.

Item	Maximum # of Blocks
Roller Coaster	11 X 11
Water Ride	12 X 12
Ferris Wheel	10 X 10
Bumper Cars	10 X 10
Tilt-A-Whirl	9 X 9
Himalaya	10 X 10
Swinging Boat	8 X 8
Virtual Reality Ride	10 X 10
Carnival Game Booths	9 X 9
Gift Shop	8 X 8
Carousel	8 X 8
Train Ride	12 X 12
Mini Roller Coaster	8 X 8
Concession Stand or Restaurant	10 X 10
Amphitheater (for shows)	12 X 12

Appendix N
Positive and Negative Affect Scale

Instructions: This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way right now, that is, at this present moment. Use the following scale to record your answers:

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

___interested
___distressed
___excited
___upset
___guilty
___scared
___hostile
___enthusiastic
___proud
___irritable
___alert
___ashamed
___inspired
___nervous
___determined
___attentive
___jittery
___active
___afraid

Appendix O
Perceived Stressfulness of Study

Please read each question carefully and rate how much you **feel that way at the present moment**.

You may mark anywhere on each line with a perpendicular line (I). Be sure to mark each line *only once.*

How stressed do you feel?

Not very _____ Very much

Appendix P
Hunger Scale

Please read each question carefully and rate how much you **feel that way at the present moment**. You may mark anywhere on each line with a perpendicular line (I). Be sure to markeach line *only once*.

How hungry do you feel?

Not very _____ Very much

How full (not hungry) do you feel?

Not very _____ Very much

How strong is your urge to eat?

Not very _____ Very much

Appendix Q
Yale Food Addiction Scale

Instructions: This survey asks about your eating habits in the past year. People sometimes have difficulty controlling their intake of certain foods such as:

- Sweets like ice cream, chocolate, doughnuts, cookies, cake, candy, ice cream
- Starches like white bread, rolls, pasta, and rice
- Salty snacks like chips, pretzels, and crackers
- Fatty foods like steak, bacon, hamburgers, cheeseburgers, pizza, and French fries
- Sugary drinks like soda pop

When the following questions ask about "CERTAIN FOODS" please think of ANY food similar to those listed in the food group or ANY OTHER foods you have had a problem with in the past year.

0. Never
1. Once a month
2. 2-4 times a month
3. 2-3 times a week
4. 4 or more times or daily

In the past 12 months:

1. I find that when I start eating certain foods, I end up eating much more than planned
2. I find myself continuing to consume certain foods even though I am no longer hungry
3. I eat to the point where I feel physically ill.
4. Not eating certain types of food or cutting down on certain types of food is something I worry about
5. I spend a lot of time feeling sluggish or fatigued from overeating
6. I find myself constantly eating certain foods throughout the day
7. I find that when certain food are not available, I will go out of my way to obtain them. For example, I will drive to the store to purchase certain foods even though I have other options available for me at home.
8. There have been times when I consumed certain foods so often or in such large quantities that I started to eat food instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy.
9. There have been times when I consumed certain foods so often or in such large quantities that I spent time dealing with negative feelings from overeating instead of working, spending time with my family or friends, or engaging in other important activities or recreational activities I enjoy.
10. There have been times when I avoided professional or social situations where certain foods were available, because I was afraid I would overeat.
11. There have been times when I avoided professional or social situations because I was not able to consume certain foods there.
12. I have had withdrawal symptoms such as agitation, anxiety, or other physical symptoms when I cut down or stopped eating certain foods. (Please do NOT include withdrawal symptoms caused by cutting down on caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.)
13. I have consumed certain foods to prevent feelings of anxiety, agitation, or other physical symptoms that were developing. (Please do NOT include consumption of caffeinated beverages such as soda pop, coffee, tea, energy drinks, etc.)
14. I have found that I have elevated desire for or urges to consume certain foods when I cut down or stop eating them.
15. My behavior with respect to food and eating causes significant distress.

16. I experience significant problems in my ability to function effectively (daily routine, job/school, social activities, family activities, health difficulties) because of food and eating.
17. My food consumption has caused significant psychological problems such as depression, anxiety, self-loathing, or guilt.
18. My food consumption has caused significant physical problems or made a physical problem worse.
19. I kept consuming the same types of food or the same amount of food even though I was having emotional and/or physical problems.
20. Over time, I have found that I need to eat more and more to get the feeling I want, such as reduced negative emotions or increased pleasure.
21. I have found that eating the same amount of food does not reduce my negative emotions or increase pleasurable feelings the way it used to.
22. I want to cut down or stop eating certain kinds of food
23. I have tried to cut down or stop eating certain kinds of food.
24. I have been successful at cutting down or not eating these kinds of food
25. How many times in the past year did you try to cut down or stop eating certain foods altogether?
    a. 1 time
    b. 2 times
    c. 3 times
    d. 4 times
    e. 5 or more times
26. Please choose ALL of the following foods you have problems with:

Ice cream	Chocolate	Apples	Doughnuts
Broccoli	White Bread	Rolls	Lettuce
Pasta	Strawberries	Pretzels	French fries
Carrots	Steak	Bananas	Pizza
Soda pop	Cookies	Rice	Bacon
Cake	Crackers	Hamburgers	Candy
Chips	Cheese burgers	None of the above	

27. Please list any other foods that you have problems with that were not previously listed:

Appendix R
Adverse Childhood Experiences Questionnaire

1. Did a parent or other adult in the household often or very often swear at, insult, or put you down?
2. Did a parent or other adult in the household often or very often act in a way that made you afraid that you would be physically hurt?
3. Did a parent or other adult in the household often or very often push, grab, shove, or slap you?
4. Did a parent or other adult in the household often or very often hit you so hard that you had marks or were injured?
5. Did an adult person at least 5 years older ever touch or fondle you in a sexual way?
6. Did an adult person at least 5 years older ever have you touch their body in a sexual way?
7. Did an adult person at least 5 years older ever attempt oral, anal, or vaginal intercourse with you?
8. Did an adult person at least 5 years older ever actually have oral, anal, or vaginal intercourse with you?
9. Did you live with anyone who was a problem drinker or alcoholic?
10. Did you live with anyone who used street drugs?
11. Was a household member depressed or mentally ill?
12. Did a household member attempt suicide?
13. Was your mother sometimes, often or very often pushed, grabbed, slapped, or had something thrown at her?
14. Was your mother sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?
15. Was your mother ever repeatedly hit over at least a few minutes?
16. Was your mother ever threatened with, or hurt by, a knife or gun?
17. Did a household member go to prison?

Appendix S

Dutch Eating Behavior Questionnaire

Instructions: Please indicate the frequency with which you engage in the behaviors described: (1) never, (2) seldom, (3) sometimes, (4) often, and (5) very often.

1. If you have put on weight, do you eat less than you usually do?
2. Do you try to eat less at mealtimes than you would like to eat?
3. How often do you refuse food or drink offered because you are concerned about your weight?
4. Do you watch exactly what you eat?
5. Do you deliberately eat foods that are slimming?
6. When you have eaten too much, do you eat less than usual the following days?
7. Do you deliberately eat less in order not to become heavier?
8. How often do you try not to eat between meals because you are watching your weight?
9. How often in the evening do you try not to eat because you are watching your weight?
10. Do you take into account your weight with what you eat?
11. Do you have the desire to eat when you are irritated? *
12. Do you have a desire to eat when you have nothing to do?*
13. Do you have a desire to eat when you are depressed or discouraged? *
14. Do you have a desire to eat when you are feeling lonely*
15. Do you have a desire to eat when somebody lets you down?*
16. Do you have a desire to eat when you are cross?*
17. Do you have a desire to eat when you are approaching something unpleasant to happen?
18. Do you get the desire to eat when you are anxious, worried, or tense?
19. Do you have the desire to eat when things are going against you or when things have gone wrong?
20. Do you have a desire to eat when you are frightened?*
21. Do you have a desire to eat when you are disappointed?*
22. Do you have a desire to eat when you are emotionally upset?*
23. Do you have a desire to eat when you are bored and restless?*
24. If food tastes good to you, do you eat more than usual?
25. If foods smells and looks good to you, do you eat more than usual?
26. If you see or smell something delicious, do you have a desire to eat it?
27. If you have something delicious to eat, do you eat it straight away?
28. If you walk past the baker do you have the desire to buy something delicious?
29. If you walk past a snackbar or a café, do you have the desire to buy something delicious?
30. If you see others eating, do you also have the desire to eat?
31. Can you resist eating delicious foods?*
32. Do you eat more than usual, when seeing others eating?
33. When preparing a meal are you inclined to eat something?

*Questions 1-10 are probing **restrained eating behavior**, Questions 11-23 are probing **emotional eating behavior**, and Questions 24-33 are probing **external eating behavior**.*

** Indicates reverse scoring is necessary*

Appendix T

Eating Disorder Examination

Please carefully complete all questions.

Over the past 3 months…

	Not at all		Slightly		Moderately		Extremely
1. Have you felt fat?	0	1	2	3	4	5	6
2. Have you had a definite fear that you might gain weight or become fat?	0	1	2	3	4	5	6
3. Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6
4. Has your shape influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6

5. During the past 6 months have there been times when you felt you have eaten what other people would regard as an unusually large amount of food (e.g. a quart of ice cream) given the circumstances? YES NO

6. During the times when you ate an unusually large amount of food, did you experience a loss of control (feel you couldn't stop eating or control what or how much you were eating)? YES NO

7. How many DAYS per week on average over the past 6 MONTHS have you eaten an unusually large amount of food and experienced a loss of control? 0 1 2 3 4 5 6 7

8. How many TIMES per week on average over the past 3 MONTHS have you eaten an unusually large amount of food and experienced a loss of control? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

During these episodes of overeating and loss of control did you…

9. Eat much more rapidly than normal? YES NO

10. Eat until you felt uncomfortably ill? YES NO

11. Eat large amounts of food when you didn't feel physically hungry? YES NO

12. Eat alone because you were embarrassed by how much you were eating? YES NO

13. Feel disgusted with yourself, depressed, or very guilty after overeating? YES NO

14. Feel very upset about your uncontrollable overeating or resulting weight gain? YES NO

15. How many times per week on average over the past 3 months have you made yourself vomit to prevent weight gain or counteract the effects of eating? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

16. How many times per week on average over the past 3 months have you used laxatives or diuretics to prevent weight gain or counteract the effects of eating? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

17. How many times per week on average over the past 3 months have you fasted (skipped at least 2 meals in a row) to prevent weight gain or counteract the effects of eating? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

18. How many times per week on average over the past 3 months have you engaged in excessive exercise specifically to counteract the effects of eating episodes? 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

19. How much do you weigh? If uncertain please give your best estimate _____lbs

20. How tall are you? ____ft ____in

21. Over the past 3 months, how many menstrual periods have you missed? 1 2 3 4 *na*

22. Have you been using contraceptives during the past 3 months? YES NO

Appendix U
Contingencies of Self-Worth Scale

Instructions: Please indicate the degree to which you agree with each of the statements below:

Strongly Disagree			Neutral			Strongly Agree
1	2	3	4	5	6	7

Others' approval subscale

1. I don't care what other people think of me. *
2. What other people think of me has no effect on what I think about myself. *
3. I don't care if other people have a negative opinion about me. *
4. My self-esteem depends on the opinions others hold of me.
5. I can't respect myself if others don't respect me.

Competition subscale

1. Doing better than others give me a sense of self-respect.
2. Knowing that I am better than others on a task raises my self-esteem.
3. My self-worth is affected by how well I do when I am competing with others.
4. My self-worth is influenced by how well I do on competitive tasks.
5. I feel worthwhile when I perform better than others on a task or skill.

VITA

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