THE IMPACT OF REWARD SENSITIVITY ON THE RELATIONSHIP BETWEEN HEDONIC HUNGER AND LOSS OF CONTOL OVER EATING

by

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ABSTRACT

The current study investigates whether individual differences in reward sensitivity impact the well-established relationship between hedonic hunger and loss of control over eating (LOC) to better understand factors that influence eating behavior in the current obesogenic environment. One-hundred and twelve participants were administered surveys measuring select demographic information, hedonic hunger, reward responsivity (RR), and LOC. Exploratory analyses also were conducted to determine whether patterns of responding were impacted by sex differences. Results indicated that there was a positive correlation between hedonic hunger and LOC as well as between hedonic hunger and RR. No correlation was found between RR and LOC, and, in the tested mediation model, RR did not mediate the relationship between hedonic hunger and LOC as hypothesized. These results offer evidence that dispositional motivation toward reward does not necessarily mediate the relationship between hedonic hunger and loss of control over eating. Implications and future directions are discussed.

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CHAPTER I

INTRODUCTION

In the last quarter century, obesity has shifted from a public health concern to a global epidemic. As of 2016, nearly 13% of the world's adult population was obese, with that prevalence having tripled since 1975 (World Health Organization, 2021). Further, in 2018, adult obesity affected a staggering 42.4% of adults in the United States (Hales et al., 2017). Obesity has been associated with severe health consequences (such as heart disease, type 2 diabetes mellitus, high blood pressure, and stroke), emotional distress, and an economic impact of over $100 billion annually (Wellman & Friedberg, 2002). This dramatic impact has driven the need to better understand its underlying causes. The maintenance of body weight and the development of obesity is regulated through several interdependent mechanisms, both individual and environmental. These mechanisms include the physical contributions from endocrine and genetic components, psychological contributions of personality and behavioral components, and environmental contributions such as social and cultural factors (Dietrich et al., 2014; Maślak et al., 2020). One important factor contributing to body weight status is eating behavior (Blundell & Finlayson, 2004; Maślak et al., 2020).

Hedonic Hunger

As the increasing prevalence of global obesity suggests, a growing amount of food consumption appears to be driven by pleasure, not just by the need for calories (Lowe & Butryn, 2007; Stice et al., 2008). The behaviors associated with an individual's eating patterns are frequently broken down into three cognitive and physiological

categories: restraint, disinhibition, and hunger. Restraint and disinhibition can be thought of as opposing cognitive mechanisms that regulate the intake of food. Restraint involves the conscious control of the tendency to overeat by suppressing the impulse to eat, and disinhibition involves the difficulty resisting those impulses due to environmental cues or emotional variability. Hunger refers to the physical feeling experienced when one has a need for food and may evoke food intake (Maślak et al., 2020) This construct can be further broken down into two subcategories: homeostatic and hedonic. While homeostatic hunger refers to the state resulting from sustained food deprivation, hedonic hunger has been defined as the desire to consume palatable foods for pleasure, even in the absence of physiological need (Lowe & Butryn, 2007). Hedonic hunger has been proposed to be activated by a variety of triggers, including environmental cues (e.g., smelling freshly baked pastries, having highly palatable foods stockpiled in a pantry) and emotional or stress-based cues (e.g., ending a romantic relationship, change in employment) (Teegarden & Bale, 2007; Wansink et al., 2006). Further, Lowe and Kral (2006) found that even non-stressful cognitive activities (e.g., memorizing art images, performing a simple reaction time task) increased caloric intake, specifically in restrained eaters, or individuals who make a purposeful effort to restrict food consumption to control body weight. Although homeostatic and hedonic hunger do not always have a cut-and-dry distinction between the two, studies have shown that both food deprivation and access to palatable foods when physically satiated can produce a similar level of desire to eat (Lowe & Butryn, 2007). Current research literature suggests several different factors that distinguish between these two constructs.

Various studies have found that individuals who measure high in hedonic hunger, as measured by the Power of Food Scale (PFS) exhibit heightened responsivity to food cues and drive to consume as opposed to those who measure lower in hedonic hunger on the PFS. A 2013 fMRI study found that adults whose PFS scores indicated high levels of hedonic hunger had more prominent food cravings and efficiency in the visual cortex in response to imagery of palatable foods over neutral objects (Bullins et al., 2013). Rejeski and colleagues (2012) replicated these findings and advanced them by differentiating the neural response for those high in hedonic hunger in both fed and fasted states. When participants were in a fasted state, individuals high in hedonic hunger showed stronger connections in the regions of the cerebellum, basal ganglia, and thalamus, which is associated with craving, hunger, and drive to seek food, than those who measure low in hedonic hunger. Comparatively, in the satiated state participants with higher PFS scores presented with stronger connections in areas of the insula, medial prefrontal cortex, and orbitofrontal cortex associated with response to sensory stimuli (e.g., palatable food), and food responsivity and reward, while participants with lower PFS scores return to their default-mode network (Rejeski et al., 2012). Although the patterns were different for deprived compared to satiated states, hedonic hunger was associated with enhanced connectivity in both states. Burger and colleagues (2016) found that for adult women who measured high in hedonic hunger on the PFS, anticipatory cues preceding food intake, not actual receipt of food, revealed increased activity in areas of the postcentral gyrus. The activation in food-seeking and reward-related areas of the brain suggest that hedonic hunger is associated with elevated drives to consume regardless of hunger state (Rejeski et al., 2012).

Independently, hedonic hunger has not been consistently linked to caloric intake or BMI. Rather, it could be a risk factor to promote overconsumption when combined with other individual characteristics (Espel-Huynh et al., 2018). For example, women with high hedonic hunger and low inhibitory control consumed the greater amount of both palatable and non-palatable food than those with the opposing traits (Ely et al., 2015). In a similar study, overweight and obese women with high hedonic hunger and high impulsivity consumed more palatable food (not non-palatable food) in the absence of physiological need (Appelhans et al., 2011). European researchers examining unhealthy snacking in adolescents found that the ability to 'inhibit one's urges' moderated the positive relationship between higher PFS scores and amount of unhealthy snack consumption (Stok et al., 2015).

Loss of Control Eating

Another eating behavior that has been linked to body weight status is loss of control eating (LOC). Loss of control (LOC) eating is defined as a subjective sense of feeling compelled or driven to consume food during a distinct eating episode. LOC eating can occur as "objective binge episodes," in which an excessive amount of food is consumed, and "subjective binge episodes," in which a relatively normal amount of food is consumed (DSM-5; American Psychiatric Association, 2013). Despite the actual amount of food consumed, the degree to which a person experiences perceived loss of control is a chief distinction in different maladaptive eating patterns, as LOC is a central feature of binge eating and eating disorders involving binge eating. Research has supported the clinical significance of this construct in both clinical and community

samples (Palavras et al., 2013; Vallance et al., 2011). In both populations, LOC eating was determined to be a stronger predictor of eating disorders, comorbid psychopathology, and distress and impairment in psychosocial functioning than the amount of food intake in both adolescents and adults (Latner et al., 2014). To try and get a better understanding of what underlies this feeling of LOC, Espel-Huynh and colleagues (2018) conducted a literature review that points to LOC being one aspect of a broader hyper-motivational state triggered by various emotional or environmental cues. Given that hedonic hunger has also been linked to these emotional or environmental cues, it has further been associated with LOC eating behavior as an additional characteristic that may predict when the motivation to consume fosters heightened caloric intake.

Recent literature has outlined a positive relationship between binge eating and hedonic hunger in both clinical and non-clinical populations. Witt and Lowe (2014) compared hedonic hunger scores in adult women with anorexia nervosa, restricting type (AN-R), anorexia nervosa, binge-purge type (AN-BP), and bulimia nervosa (BN). They found that the PFS scores were highest in BN patients, followed by AN-BP patients, and that hedonic hunger was able to predict the frequency of binge episodes (Witt & Lowe, 2014). Additional researchers also distinguished whether obese adult women endorsed binge eating or had a diagnosed binge eating disorder (BED) based on their PFS score (Manasse et al., 2015). In non-clinical populations, Lowe and colleagues (2016) conducted a longitudinal study that examined the relationship between LOC eating behavior and hedonic hunger among weight-gain-prone college women. Findings indicated that hedonic hunger was associated with increased prevalence of LOC eating at baseline, and among those who did not endorse LOC eating at baseline, higher PFS

scores predicted greater risk of LOC onset with time. These results suggest that hedonic hunger is associated with risk for the onset and maintenance of LOC eating (Lowe et al., 2016). Together, this evidence indicates that hedonic hunger may influence the regularity and severity of LOC eating habits. With there being such a strong connection between LOC eating and hedonic hunger, how can we determine the interceding factor that causes heightened motivation to consume to cross the threshold into loss of ability to regulate overconsumption? One answer could be found by examining individual differences in personality traits.

Reinforcement Sensitivity Theory of Personality

Broadly, personality is theorized to reflect individual differences in behavior patterns, cognition, and emotion (Mischel et al., 2008). Although personality characteristics can shift slightly over the lifespan or as a result of major life events, it tends to remain reasonably stable across adulthood (Roberts & DelVecchio, 2000). While this assumption is, in general, universally accepted, it serves as one of the only major factors that personality psychologists agree upon. As the field of psychology has continued to evolve, so have the perspectives that psychologists have used to understand personality. From the origins of psychology that gave rise to the psychoanalytic perspective to more contemporary conceptualizations, such as the cognitive-behavioral perspective, there have been a wide variety of theories offered to help us explain and understand personality differences using biological, social, and psychological factors.

While many of these personality variables may encourage indulgent and uncontrolled eating (e.g., omnipresence of desirable food, advertisements, stress,

boredom), the pleasure and anticipation of pleasure reinforced by highly palatable food intake underlies a significant portion of this phenomenon. Individual sensitivity to reward may be another characteristic that predicts whether cognitive preoccupation with food will cross the threshold into overconsumption and higher caloric intake. Thus, the Reinforcement Sensitivity Theory of personality (RST) is a personality model that may be useful to help understand these individual differences.

Originally conceptualized by Gray (1982), RST was built off of one of the first biologically based personality theories to arise: Eysenck's Two-Factor Theory of Personality (1967). Eysenck postulated that individuals responded differently to cortical arousal based on their response threshold, which was measured by whether they were introverted or extraverted. He determined that introverts had a lower response threshold and, therefore, become aroused more easily when faced with some form of sensory stimulation. Conversely, extraverts had a higher response threshold and would require a higher level of sensory stimulation to become aroused. Additionally, he suggested that differences in activation of the limbic system resulted in variation in emotional stability, with lower levels of activation indicating emotional stability and higher levels of activation indicating instability or neuroticism (Eysenck, 1967). Gray's revision to this theory suggested that Eysenck's dimensions of extraversion and neuroticism were secondary factors to the fundamental principles of sensitivity to rewards and punishments. He predicted that individuals who had a high level of impulsivity are more sensitive to reward signals than those with low levels of impulsivity and individuals who were highly anxious would be more sensitive to punishment signals than those with low levels of anxiety (Corr, 2008).

The initial model of RST hypothesized that human behavior was strongly influenced by approach or avoidance tendencies toward various types of motivational stimuli (e.g., reward or punishment). This theory described three separate motivational systems. The Behavioral Activation System (BAS) was thought to be sensitive to conditioned appetitive stimuli (learned rewards) and related to trait impulsivity. The Fight-Flight-Freeze System (FFFS) was thought to be sensitive to unconditioned aversive stimuli (i.e., pain) and related to Eysenck's trait psychoticism. The Behavioral Inhibition System (BIS) was thought to be related to conditioned aversive stimuli (learned punishments) (Corr et al., 2013). Since its first conception, RST has undergone key revisions that better clarify its implications. It is now understood that the BAS is the mechanism by which active approach behaviors are controlled, such as task initiation. This system is activated by pleasurable stimuli or stimuli that indicate possible reward. The FFFS is the mechanism by which active avoidance behaviors are controlled, such as escape. This system is activated by aversive stimuli or stimuli that indicate possible punishment. The BIS is the mechanism by which passive avoidance behaviors are controlled, such as apprehension or indecision. This system is activated by conflict of goals (Corr, 2008).

Gray postulated that the degree to which these systems are activated remain relatively consistent throughout our lives. Given the general reliability of these personality dispositions, it is reasonable to think that these motivational systems may serve as an underlying motivator in individual eating habits. For instance, the link between an individual's sensitivity to reward and general health behaviors and overall well-being has been well-documented. Scott-Parker and Weston (2017) conducted a

literature review synthesizing the impact of reward sensitivity on risky decision-making and health behaviors. They found that individuals with higher reward sensitivity and lower punishment sensitivity were more likely to engage in substance misuse (e.g., marijuana, alcohol, ecstasy), dysfunctional drinking habits, and dysfunctional eating styles, all of which are related to dysfunction in the dopaminergic reward systems (Berridge et al., 2010; Scott-Parker & Weston, 2017).

Decades of animal studies have found that variation in dopamine responsivity can change the motivation or drive for reward, based on reward-related cues, without actually altering how rewarding the stimulus is once it is received (Berridge et al., 2010; Stice & Yokum, 2016). For instance, an excessive amount of dopamine in the brains of mice have shown an increase in "wanting" highly palatable foods by higher levels of consumption without any increase in "liking" expressions (Peciña et al., 2003). Conversely, mice with lack of dopamine in the brain (through antagonistic drugs or mesolimbic ablation) still acknowledge the palatability of hedonic foods and express preferences for sweeter rewards without increased drive to consume them (Peciña et al., 2003; Tindell et al., 2006). These results have been further replicated in human studies. Neuroimaging studies have revealed the correlation between dopamine levels and subjective sense of "wanting" for reward rather than pleasure of "liking" the reward (Volkow et al., 2002). Moreover, dopamine antagonists don't appear to reduce the subjective sense of pleasure derived from rewarding stimuli (Leyton, 2010; Wachtel et al., 2002).

These dopaminergic reward pathways are also involved in the creation of gradually stronger anticipatory responses to highly palatable food stimuli (Berridge et al.,

2010; Stice & Yokum, 2016). For example, two studies found that the sensitivity to reward was significantly and positively related to unhealthy snack (i.e., fatty foods and sugar sweetened beverages) intake in adolescents. Further, the relationships were partially mediated by hedonic eating styles (de Cock et al., 2016; Hunt et al., 2017). Even hunger during our "normal" eating pattern of three meals a day appears to be partially evoked by anticipation of food, rather than an energy deficit (Woods, 1991). Loxton and Tipman (2017) hypothesized that high reward sensitivity may offer a trait marker of susceptibility to excessive overeating. They found the relationship between reward sensitivity and number of food addiction symptoms to be uniquely mediated by binge-eating and hedonic eating styles; thus, further distinguishing a link between reward sensitivity, hedonic eating and LOC that is associated with binge eating.

Hypotheses

Building upon the existing literature, individual differences in reward sensitivity should be evaluated to understand variations in eating behaviors and related outcomes in the current obesogenic environment. Seeing as the neurological response in the dopaminergic reward pathways are similar for heightened motivation to perceived reward and heightened hedonic hunger, it is likely that this is a significant contributor to promote excessive consumption of highly palatable foods. The present study aimed to determine whether reward sensitivity could mediate the relationship seen between hedonic hunger and loss of control eating. The study's hypotheses were as follows:

H1: It was hypothesized that the total score for hedonic hunger, as measured by the Power of Food Scale (PFS), would be positively associated with reward sensitivity, as

measured by the reward responsivity (RR) subscale score of the Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS Scales).

H2: It was hypothesized that the total score for hedonic hunger, as measured by the PFS, would also be positively associated with loss of control (LOC), as measured by the total score on the Loss of Control Over Eating Scale (LOCES).

H3: It was hypothesized that reward sensitivity, as measured by the RR subscale of the BIS/BAS scales, would be positively associated with LOC, as measured by the total score on the LOCES.

H4: It was hypothesized that the relationship between hedonic hunger and LOC in H2 would be at least partially mediated by RR such that the inclusion of RR in model predicting LOC from hedonic hunger would significantly reduce the strength of the relationship between those two variables.

CHAPTER II

METHOD

Participants

Estimating a moderate effect size and using an alpha of .05, an a priori power analysis determined that this study would require a sample of at least 71 participants (Fritz & MacKinnon, 2007). All participants were at least 18 years of age, fluent in English, and were recruited through a psychology department research pool at Middle Tennessee State University during the spring semester. Individuals that were pregnant, diagnosed with endocrine disorders (e.g., diabetes, hypothyroidism), or being treated for cancers were excluded as these conditions can greatly impact various hormone levels that would possibly interfere with some of the appetite related measures. Individuals with mental health disorders (e.g., mood disorders, eating disorders), taking medications (e.g., steroids, anti-depressants, stimulants, anti-psychotics), or other recreational substances (e.g., nicotine, marijuana) that are associated with increase or decrease in appetite also were excluded as these factors could also have impacted the variables being measured (Appendix A). Participants received extra credit or course credit in their enrolled psychology course for participation. One hundred and seventy survey responses were gathered in total. Of these respondents, 126 qualified for inclusion in the study. Eleven of those responses were excluded for being duplicates of a participant who already submitted a response, two participants did not pass the validity measures, and one had an incomplete data set leaving a total of 112 responses used in the analyses of this study. The demographic breakdown of the final sample is detailed in Table 1.

Table 1

Descriptive Frequencies of the Final Sample

	Women (*n* = 80)		Men (*n* = 31)		Prefer Not to Say (*n* = 1)		Total (*n* = 112)	
Variable	*%*	*n*	*%*	*N*	%	n	%	n
Race/Ethnicity								
Black/African American	14%	16	3%	3	0%	0	17%	19
Asian/Asian American	7%	8	3%	3	0%	0	10%	11
White/Caucasian	38%	42	16%	18	0%	0	54%	60
Hispanic/Latino/Latina	4%	5	2%	2	0%	0	6%	7
Native American	0%	0	0%	0	0%	0	0%	0
Native Hawaiian/Pacific Islander	0%	0	0%	0	0%	0	0%	0
Middle Eastern	2%	2	4%	4	0%	0	5%	6
Multi-racial	4%	4	1%	1	0%	0	4%	5
Prefer not to say	2%	2	0%	0	1%	1	4%	4
Age (in years)								
18 - 24	69%	77	23%	26	1%	1	93%	10
25 – 30	2%	2	3%	3	0%	0	4%	4
31+	1%	1	2%	2	0%	0	3%	5

Materials and Measures

Demographics Questionnaire. Participants were given a measure of demographics following the completion of other measures (Appendix B). They were asked to report their sex, ethnicity, and age.

Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS Scales). The behavioral inhibition scale (BIS) and behavioral activation scale (BAS), developed by

Carver and White (1994), is a 20-item instrument designed to measure dispositional sensitivities based on the Reinforcement Sensitivity Theory of personality (Gray, 1982). These scales cover four domains: BAS reward responsiveness, BAS drive, BAS fun seeking, and BIS. The BAS scales are comprised of 13 items that measure reward anticipation, motivation toward goals, and interest in engaging with novel situations when reward is expected, respectively. The BIS scale is comprised of the remaining seven items that measure proclivity to withdraw or avoid stimuli when punishment is expected. Each item response uses a 4-point Likert scale (1 = *strongly agree*, and 4 = *strongly disagree*). Higher scores indicate higher levels of respective dispositional sensitivities.

These scales demonstrate adequate test-retest reliability (r = .68 to .72) and internal consistency (α = .66 to .76; Carver & White, 1994). They have demonstrated good convergent and concurrent validity as higher BAS scores are associated with positive affect and higher BIS scores are associated with depression and anxiety (Campbell-Sills et al., 2004). BIS/BAS scores also show a significant relationship with Five Factor Model traits of neuroticism and extraversion, supporting the trait-like nature of the constructs measured (Smits & Boeck, 2006). Although participants completed the entire measure, as that is the standardized method of administration, the variable of interest in this measure is the BAS reward responsiveness subscale score (RR) with possible scores ranging from 5 to 20. In accordance with previously reported psychometrics, adequate internal consistency was observed for the RR subscale score among the present sample (α = .73).

Power of Food Scale (PFS). The Power of Food Scale (PFS), developed by Lowe and colleagues (2009), is a 15-item instrument designed to measure individual differences in the anticipation (but not the consumption) of highly palatable foods in the environment for reasons other than physiological hunger. This scale is comprised of three subscales which assess appetitive drive at different proximities to palatable food: Food Available, Food Present, and Food Tasted. Participants are asked to indicate the extent to which each statement describes them. Each item response is on a 5-point Likert scale (1 = *don't agree at all*, and 5 = *strongly agree*). Higher scores indicate higher levels of drive to consume.

The total score has been shown to have adequate test-retest reliability (r = .77) and demonstrates strong internal consistency (α = .78 to .84; Lowe et al., 2009). The concurrent and convergent validity of this instrument is illustrated by its high correlation with other measures of problematic consumption behaviors, such as the Dutch Eating Behavior Questionnaire (Emotional Eating subscale) and the Three-Factor Eating Questionnaire (Disinhibition subscale) (Vainik et al., 2015). There appears to be no significant relationship between PFS scores and BMI, supporting the notion that this measure captures the drive to consume rather than amount of food consumed (Burger et al., 2016; Cappelleri et al., 2009). The variable of interest in this measure is the total PFS score, with possible scores ranging from 1 to 5. In accordance with previously reported psychometrics, strong internal consistency was observed for the total scale score among the present sample (α = .83).

Loss of Control Over Eating Scale (LOCES). The Loss of Control Over Eating Scale (LOCES), developed by Latner and colleagues (2014), is a 24-item self-report instrument designed to evaluate the global sensation of loss of control over eating. This scale is comprised of three subscales: Behavioral, Cognitive/Dissociative, and Positive/Euphoric aspects. The behavioral subscale evaluates the physical behaviors that manifest in relation to LOC-eating (e.g., continued eating despite being satiated, feeling unable to control eating). The cognitive/dissociative subscale evaluates cognitive aspects of an eating episode and any subsequent dissociation that accompanies it (e.g., feeling outside of one's body, inability to focus on anything other than eating). The positive/euphoric subscale assesses perceived positive experiences during the eating episode (e.g., feeling rush of euphoria or sense of relief). Participants are asked to indicate the frequency of occurrence within the last 28 days on a on a 5-point Likert scale (1 = *never*, and 5 = *very often*) with higher scores indicating a higher level of LOC over eating.

The LOCES demonstrates very high internal consistency (α = .96) and good test-retest reliability (r = .86) in a university population sample (Latner et al., 2014; Stefano et al., 2016). Concurrent and convergent validity was demonstrated with other loss-of-control eating measures such as the Eating Loss of Control Scale and Binge Eating scale across both clinical and non-clinical samples (Bodell et al., 2018). The variable of interest for this measure is the total score with possible scores ranging from 1 to 5. In accordance with previously reported psychometrics, a very strong internal consistency was observed for the total scale score among the present sample (α = .95; Latner et al., 2014).

Effort/Validity Testing. Several studies have examined the performance validity of non-clinical undergraduate student populations used in research, with rates ranging from 2.6% to 55.6% of participants demonstrating sub-optimal effort (An et al., 2012; Ross et al., 2016). To help mitigate this, three validity items were inserted between each survey presented to ensure participants were engaged and attentive throughout the process (Appendix C). If a participant missed any of the three validity items, their data were not included in the analysis.

Procedure

Approval from Middle Tennessee State University's Institutional Review Board was obtained prior to conducting this online study (Appendix D). Participants were recruited using the psychology department's research pool. Interested participants were given a link to follow to reach the study content through Qualtrics, an online survey platform. Prior to volunteering as a study participant, individuals verified they were at least 18 years of age and met all the study inclusion criteria (Appendix A). Once this was confirmed, they were directed to begin the study. The informed consent was presented which detailed the task requirements, exclusions, risks and benefits associated with their participation (Appendix E). Consenting participants were asked to check boxes to provide their consent.

After informed consent was obtained, participants were presented instructions for and administered digital renditions of several surveys. The BIS/BAS scales, Power of Food Scale, and LOCES instruments each were presented in randomized order with a validity question at the end of each survey, followed by the demographic questionnaire at

the end. Once participants completed the study, they were provided with a debriefing that included the goal and intent of the study, contact information for the principal investigator and the faculty advisor, and resources for counseling services (Appendix F). Finally, the participants were directed to click to the next page to return to the Psychology Research Pool to receive credit for study participation.

CHAPTER III

RESULTS

Descriptive Statistics

The statistical software SAS Studio (version 3.80) was used to perform all statistical analyses. For each of the study variables (i.e., hedonic hunger, reward responsivity, and loss of control), mean scores and standard deviations are reported for this sample (Table 2). Skewness, kurtosis, and the Kolmogorov-Smirnov test were used to check for normality. PFS scores were within normal distribution limits. LOCES scores were mildly positively skewed, and RR scores were mildly negatively skewed (Table 1). RR and LOCES scores were thus appropriately transformed, however, the mediation results of the transformed variables (PFS, 4-SQRT(21-RR), and Log10(LOCES)) demonstrated practically no difference from the mediation results based on the original variables (PFS, RR, and LOCES). Therefore, the results based on the original variables are reported.

Table 2

Descriptive Statistics of the Overall Sample

Variable	Mean	*SD*	Skewness	Kurtosis
PFS	2.41	0.81	0.34	-0.65
RR	17.57	2.15	-0.88	0.10
LOCES	1.89	0.69	0.93	0.31

Note. n = 112, PFS possible scores range from 1 – 5, RR possible scores range from 5 – 20, LOCES scores range from 1 - 5

Hypotheses Testing

Hypothesis 1. Hypothesis one predicted a positive relationship between hedonic hunger, as measured by the PFS, and reward responsivity, as measured by the BIS/BAS subscale, RR. Hedonic hunger was significantly positively correlated with reward responsivity (r = .32, n = 112, p = .0006, 95% CI [.14, .48]). This indicates a moderate degree of covariance between these variables, signifying that as the observable values associated with PFS increase so do the observable values in RR. Therefore, hypothesis one was supported by the data.

Hypothesis 2. Hypothesis two predicted a positive relationship between PFS and loss of control over eating, as measured by the LOCES scale. As hypothesized, PFS was significantly and positively associated with LOCES (r = .59, n = 112, p > .0001, 95% CI [.45, .70]). This indicates a large degree of covariance between these variables, signifying that as the observable values associated with PFS increase so do the observable values in LOCES.

Hypothesis 3. Hypothesis three predicted a positive relationship between RR and LOCES. This hypothesis was not supported, because RR did not have a statistically significant relationship with LOCES (r = .04, n = 112, p = .65, 95% CI [-.15, .22]). This indicates a lack of covariance between these variables.

Hypothesis 4. Hypothesis four explored the possibility of RR acting as a mediating variable on the relationship between PFS scores and LOCES scores. The total effect of hedonic hunger on loss of control over eating is significant, (β = .59, SE = .08,

BC 95% CI [.42, .74]). The direct effect of hedonic hunger on loss of control is also significant, (β = .64, SE = .08, BC 95% CI [.47, .79]). The indirect effect of hedonic hunger on loss of control eating through reward responsivity is significant as well, (β = -.05, SE = .03, BC 95% CI [-.13, -.004]). While this does denote reward responsivity as a mediator, contrary to what was hypothesized, the estimate of effect between RR and LOCES (path *b* in Table 3 and Figure 1) was in the opposite direction than what was expected based upon the previously reported bivariate relationship between the two variables. Additionally, the standardized estimate associated with direct effect between PFS and LOCES (path *c'* in Table 3 and Figure 1) increased relative to the previously reported bivariate relationship between these two variables. This suggests the presence of classical suppression whereby the inclusion of RR appears to strengthen the relationship between PFS and LOCES. Taken together, these results do not support the hypothesis that RR mediates the relationship between PFS and LOCES in the manner that would be predicted by the extant literature.

Table 3

Observed Path Values for the Tested Mediation Analysis

	B	*β*	*SE*	*t*
a (PFS – RR)	.85	.32	.09	3.73***
b (RR – LOCES)	-.05	-.16	.08	-2.01*
c' (PFS – LOCES)	.55	.64	.06	9.89***

Note. *$p < .05$, **$p < .01$, ***$p < .001$.

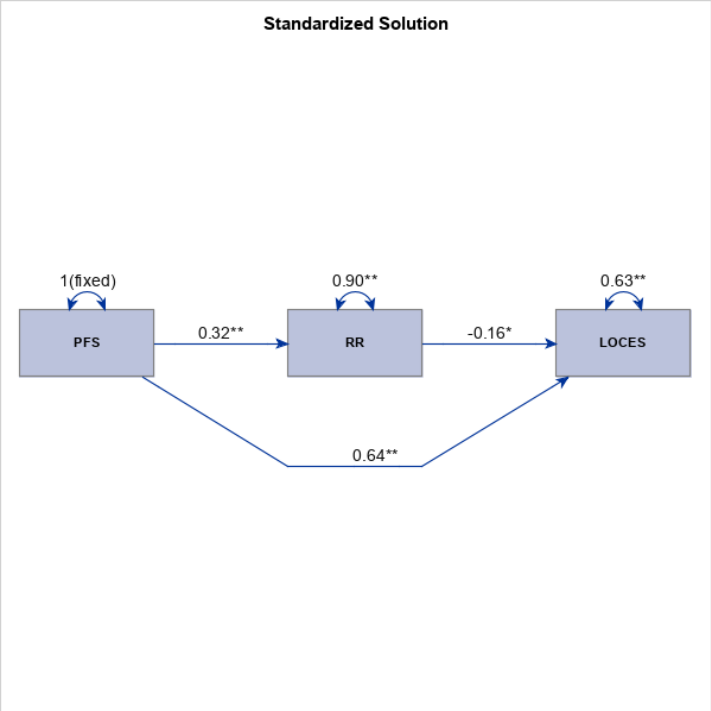

Figure 1. *Mediating relationship of RR on PFS and LOCES*

Note. *$p < .05$. **$p < .01$.

Exploratory Analyses

Exploratory analyses were conducted to determine if there were differences between sexes, as much of previous research with LOCES has been conducted primarily with women. One participant that preferred not to identify their sex was removed from the data set for the purpose of this analysis. Welch independent samples *t* tests were conducted for the total scores of all variables. With respect to the PFS, women tended to

report higher levels of hedonic hunger than men. Likewise, the LOCES data demonstrated that women reported higher degrees of loss of control over eating relative to men. Finally, RR data revealed that men and women did not differ significantly with respect to trait appetite reward motivation. These results are summarized in Table 4.

Separate correlations for females and males were also conducted to further examine whether the correlations among PFS, RR, and LOCES differed for females and males. The results, detailed in Table 5, revealed that despite sex differences in responses, the correlation between PFS and LOCES measures were significant in both men (r = .51, n = 31, p = .003, 95% CI [.19, .73]) and women (r = .60, n = 80, p < .0001, 95% CI [.44, .72]). This indicates that the previously reported high degree of covariance between these variables remains consistent between men and women, despite observable differences in the level at which these variables are reported between sexes. However, the significant relationship between PFS and RR disappears in men (r = .28, n = 31, p = .13, 95% CI [-.08, .58], as compared to women, (r = .60, n = 80, p = .003, 95% CI [.43, .72]) and when they are analyzed together. Upon further examination, it is noted that despite the change in significance between samples there is a very minor difference in the correlation coefficients themselves (i.e., .28 in men, .33 in women and .32 overall). This suggests that the difference observed is primarily a result of decreased statistical power due to the much smaller sample size of men.

Table 4

Descriptive Statistics Based on Sex of Participants

	Women			Men					
	Mean	*SD*	*n*	Mean	*SD*	*n*	Mean Difference	Lower CI	Upper CI
PFS	2.49	.81	80	2.16	.71	31	-0.33*	-.65	-.02
RR	17.75	2.28	80	17.16	1.75	31	-0.59	-1.40	.22
LOCES	1.99	.73	80	1.64	.53	31	-0.35**	-.60	-.10

Note. 95% Confidence Intervals are provided; *$p < .05$, **$p < .01$.

Table 5

Correlations Among PFS, RR, and LOCES for Men (n=31) and Women (n=80)

	1	2	3
1. PFS	-	.28	.51**
2. RR	.33**	-	-.18
3. LOCES	.60**	.06	-

Note. Correlations for men are provided above the diagonal; correlations for women are provided below the diagonal. *$p < .05$, **$p < .01$.

CHAPTER IV

DISCUSSION

Research has suggested that the obesity epidemic has grown due to a complex interaction of many factors across different individuals and different environments. In evaluating individual characteristics and behaviors that contribute to this phenomenon, several aspects of eating behavior, including eating disinhibition, food responsiveness and enjoyment, reinforcement of food, and dispositional impulsivity and self-control have been implicated in contributing to weight gain (French et al., 2012). Given the inter-related nature of many of the factors, there is a greater need to investigate the relationships between these components to better understand how they integrate.

Within this paradigm, LOC and reward sensitivity have been individually linked with higher BMI and/or increased food consumption as well as with higher levels of hedonic hunger (Blundell & Finlayson, 2004; Dietrich et al., 2014, Goldschmidt, 2016). However, higher levels of hedonic hunger, by itself, does not appear to predict higher BMI and/or increased food consumption (Appelhans et al., 2011; Burger et al., 2016; Lowe, et al., 2009) . The current study was designed to explore this empirically established progression of being highly motivated by palatable food, even in the absence of homeostatic hunger to feeling a loss of control over one's eating habits to eventual weight gain. More specifically, it aimed to determine if dispositional reward responsivity could account for any variance within the established relationship between hedonic hunger and LOC that could explain the difference in outcomes of BMI, when considering these two factors individually. Exploratory analyses were also conducted to examine

whether other sex differences could be observed within this dynamic. The results obtained were somewhat mixed compared to what was initially predicted.

In accordance with previous research, the association between hedonic hunger on LOC was significant for both the overall sample, and in men and women separately. While this adds to growing evidence on this relationship in women, it helps verify that this relationship is also present in men, as the literature on that population is not as developed (Manasse et al., 2015; Lowe et al., 2016, Striegel-Moore, et al., 2009). Additionally, the relationship between hedonic hunger and reward responsivity was found to be significant for the overall sample as well, aligning with and further clarifying previous research suggesting that eating behaviors in conjunction with heightened reward responsivity could predict increased food consumption and/or higher BMI (Blundell & Finlayson, 2004; Dietrich et al., 2014). While this relationship does not remain consistent when analyzing the sample of men only, as previously mentioned, the correlation coefficients are incredibly similar, and thus it is possible that this insignificance was due to a lack of power in the small sample size, rather than a true lack of relationship. Future research examining the relationship between these two measures should seek a more robust sample of men to understand the nature of this relationship more confidently.

RR was expected to be a mediator in this relationship between PFS and LOCES, however, within the present study and the obtained sample RR acted as a suppressor, as the relationship between PFS and LOCES was strengthened when accounting for RR. RR, by itself, was not found to be correlated to LOC. While it may be possible that RR does act as a suppressor within this dynamic, these findings were unexpected based on

the literature and could have been caused by a number of variables, such as flawed assumptions about the directionality of these relationships or measurement confounds or errors. Meaningful interpretation of these results is limited within the context of this study design, so further investigation using other methodology (i.e., experimental) will be important for clarification on how dispositional reward responsiveness influences the relationship between hedonic hunger and LOC.

As the RR scale is designed to measure how responsive one is when anticipating a reward and the PFS is designed to measure how responsive one is when anticipating rewarding food, it could be surmised that the PFS taps into the more specific aspects of reward anticipation than RR does. Thus, it is surprising that the mediating relationship was in the opposite direction of what was predicted, given the conceptual similarity and supporting literature between these measures (Chang, et al., 2014; de Cock, et al., 2016; Espel-Huynh et al., 2018; Loxton & Tipman, 2016). This deviation merits further consideration of what these instruments measure and how they differ, as this appears to be the crucial factor that may have impacted the relationship dynamic being examined.

The lack of relationship between RR and LOCES demonstrates that dispositional RR cannot be generalized to influencing LOCES when considered outside of the specific food-related context. Part of this may be due to the way in which these instruments are measuring their respective constructs. The LOCES contains many items that rely on the participant to be conscious of bodily experiences. This interoceptive awareness, or possible lack thereof, could be a key component that is not directly assessed by any of these measures. Another explanation for this is that the specification of food being the

rewarding experience could tap into a more primal, evolutionary basis, than generally rewarding stimuli. It has been theorized that humans developed a strong drive to consume highly palatable food in a time when it was not as readily available, and we needed the excess fat and sugar intake to store energy for future use (Ahlstrom et al., 2017). This need to consume for survival may translate to what we now conceptualize as the "compulsive" desire to eat that accompanied the drive to seek out foods. This would mean that the feeling of inability to stop eating even after satiation may have been an adaptive trait and specific to the experience of having these kinds of food available as opposed the general concept of higher anticipation to anything rewarding.

An additional conceptual difference between these instruments is that the PFS measures anticipation to rewarding food in an environment in which highly palatable food is available, present, or tasted, whereas the RR scale does not indicate any specific rewarding experience or present the respondent with a situation in which a rewarding experience is within easily attainable proximity. This may suggest that loss of control is only related to anticipation of rewarding foods in an environment in which the reward is easily accessible and identifiable, rather than more abstract rewarding experiences that may require more effort to seek out. The Marginal Value Theorum, described by Kacelnik and Todd (1992) provide some conceptual basis for this postulation. They found that patch exploitation by pigeons decreased as travel time increased, suggesting that behavior is not only elicited by rewarding value of a stimuli, but the ratio of expected gain in relation to time spent to achieve it. Other studies have since found more complex interactions of proximity on behavior variability. One study suggested that proximity of reward and probability of reward interacted to produce higher variation in response rate

to the possible reward (Leising et al., 2014). A more recent study found that in a gambling context, being farther away from attaining one's goal decreased the vigor of continuing to pursue that goal than a more proximal loss did (Chen, Reimer & Verbruggen, 2020). In a food-related context, it was found that proximity and visibility of chocolate increased consumption amount in adults (Wansink, et al., 2006). Taken together, these studies support the idea that perhaps the LOC factor associated with higher anticipation of food reward is only applicable when the reward goal is identifiable and within reach. So, these constructs might be better studied in an experimental or quasi-experimental context where reward salience can be manipulated by proximity.

Additionally, some limitations of this study should be taken into consideration when conceptualizing the results. Most notably, there may be problems generalizing to the greater population in several ways based on the sample and recruitment method used for this study. All participants obtained from this study were recruited from a state, primarily white institution or university, which by default may be missing representation from various communities. Participants were mostly young adults (18-24), with only seven participants being of older demographic groups. While trait characteristics are thought to remain relatively stable throughout our lives, studies show that frontal lobe development continues into early adulthood (Romine & Reynolds, 2005). It is possible that having a majority demographic whose frontal lobes (and thus executive functions involving decision making and impulse control) may not be fully developed, that these results may limit the generalizability of the results to adults aged 25 and older. Although ethnicity distribution appeared to be relatively equivalent to that of the university, the university itself had low representation of several ethnic and racial minorities whose

experiences are not captured within this sample, making it difficult to determine whether these results remain consistent across those communities. A more heterogenous sample will be required to determine these results generalizability.

Further, with a sample of only thirty-one men, sex differences among the study variables were difficult to explore and may partly explain why significant sex differences were found. While there were no differences in response between men and women for RR, there were significant differences in responses for PFS and LOCES. This is consistent with previous research that found men were more likely to endorse overeating, while women were more likely to endorse LOC when evaluating the prevalence of eating disorder symptomology (Striegel-Moore et al., 2009). These distinctions could be valuable, as most of the current literature on eating disorders and LOC is focused on women and some reward sensitivity and punishment sensitivity research has reported statistically significant variations between men and women. Dietrich and colleagues (2014) found that BAS reward responsiveness was negatively related to BMI in men, but positively linked to BMI in women. An fMRI study found that men showed higher sensitivity to reward and neural sensitivity than women, while women demonstrated individual differences in sensitivity to punishment in conjunction with specific diminished neural responses (Dhingra et al., 2021). Researchers looking to further investigate these variations should seek out a more representative portion of men within the overall sample to assess sex differences more adequately.

A more logistical limitation of this study could be that the self-report instruments used were not the most accurate indicators of the constructs we sought to measure. Using

the Eating Loss of Control Scale (ELOCS) as opposed to the chosen LOCES, could provide an alternate measure of LOC. While the LOCES scale had been previously validated in undergraduates (Stefano et al., 2016), a comparison study between these different measures suggested that the 16-item ELOCS may be a more psychometrically powerful measure to determine severity of LOC in non-clinical samples (Bodell et al., 2018). Additionally, there are several validated self-report measures designed to measure reward responsivity and other aspects of personality associate with RST. Corr (2016) suggests that the Reinforcement Sensitivity Theory of Personality Questionnaire (RSTPQ) is one of the best measures of the BAS subscales for the most updated revision of RST, as it captures the multidimensionality of the BAS construct by using 4 subscales. If future investigators are interested in correlations using other facets of RST, the RSTPQ may also provide a better measure for the BIS and FFFS, compared to the BIS Anxiety and BIS Fear subscales used on the BIS/BAS Scales (Corr, 2016). While self-report measures, by design, may include some bias in reporting, there are a multitude of ways that could improve methods of data collection.

As previously mentioned, performance validity of non-clinical undergraduate student populations used in research has rates ranging from 2.6% to 55.6% of participants demonstrating sub-optimal effort (An et al., 2012; Ross et al., 2016). As the participants are required to engage in a certain amount of research as a class requirement, it is possible that despite embedded validity checks that participants did not respond as intentionally and accurately as would be desired. This may be exacerbated by the fact that these measures were administered in an easily accessible online format and were not administered in a controlled environment, due to COVID-19 and limitations on in-person

contact. Conducting a more controlled experiment with an in-lab design could help mitigate some of these uncontrolled variables, as well as provide an opportunity to obtain physiological measures that may be a more objective measurement of the biological factors associated with these constructs. Measuring participant height and weight or analyzing body composition would allow us to determine if any of these relationships did correlate with BMI or excessive caloric intake. Like other studies that have measured hedonic hunger or reward sensitivity (e.g., Berridge, et al., 2010; Bullins et al., 2013; Leyton, 2010), physiological measures of appetitive hormones levels or neuroimaging techniques may provide more clear relationships between anticipation of reward and corresponding brain activations for more objective data measurements than any of the self-report measures could capture. Thus, conducting a more controlled experiment in a laboratory setting may yield more precise data than the measures employed in the current study.

In spite of its limitations, the current study builds upon previous research and encourages more expansive projects within this topic. Future research could include a larger, more diverse sample with a wider range of individuals across different ages, genders, health status, and ethnic and racial backgrounds. It also could utilize a multimodal assessment of data gathering techniques, such as physiological measures in addition to self-report instruments to strengthen the robustness of the data. As overconsumption and subsequent weight gain can lead to many adverse health outcomes, gaining insight into factors that promote these behaviors will be useful in providing informed strategies to support individuals who may be at greater risk.

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APPENDICES

APPENDIX A

EXCLUSION SCREENING QUESTIONNAIRE

To your knowledge, have you ever been diagnosed with an endocrine disorder (e.g., thyroid disease, diabetes, polycystic ovarian syndrome, etc.) by a licensed health professional?

- ○ Yes
- ○ No

Have you been diagnosed with and are currently being treated for any cancer by a licensed health professional?

- ○ Yes
- ○ No

Are you currently pregnant?

- ○ Yes
- ○ No
- ○ Unsure

Have you been diagnosed with and are currently being treated for any of the following mental health conditions by a licensed health professional? Select all that apply.

- ☐ Mood Disorders (e.g., Major Depressive Disorder, Bipolar Disorder, Persistent Depressive Disorder, etc.)
- ☐ Eating Disorders (e.g., Anorexia Nervosa, Bulimia Nervosa, Binge Eating Disorder, etc.)
- ☐ Psychotic Disorders (e.g., Schizophrenia, Schizoaffective Disorder, etc.)

- [ ] Neurodevelopmental Disorders (e.g., ADHD, ASD)
- [ ] I am not currently diagnosed with any of these conditions.

Are you currently taking any of these types of medications? Select all that apply.

- [ ] Anti-depressants/Mood Stabilizers (e.g., Zoloft, Paxil, Celexa, etc.)
- [ ] Attention Medications (e.g., Adderall, Vyvanse, Ritalin, etc.)
- [ ] Anti-psychotic Medications (e.g., Risperdal, Abilify, Zyprexa, etc.)
- [ ] Endocrine Medications: (e.g., Synthroid, Insulin, Metformin, etc.)
- [ ] Steroid Medications (e.g., Dianabol, Nandrolone, Testosterone, etc.)
- [ ] I am not currently taking any of these types of medications.

Have you used any nicotine products (e.g., cigarettes, chewing tobacco, vapes, etc.) in the past 60 days?

- ○ Yes
- ○ No

Have you used any recreational drugs (e.g., marijuana, ecstasy, cocaine, etc.) in the past 60 days?

- ○ Yes
- ○ No

APPENDIX B

DEMOGRAPHICS QUESTIONNAIRE

What is your biological sex?

- ○ Male
- ○ Female
- ○ Intersex
- ○ Prefer not to say

Choose the ethnicity you consider yourself to be:

- ○ African American
- ○ Asian American
- ○ Caucasian
- ○ Hispanic/Latinx
- ○ Native American
- ○ Native Hawaiian/Pacific Islander
- ○ Other: _____
- ○ Prefer not to say

How old are you (in years)?:

_____

APPENDIX C

VALIDITY QUESTIONS

Which of the following is NOT a piece of fruit?

- ○ Apple
- ○ Peach
- ○ Banana
- ○ Basket

27 – 7 =

- ○ 0
- ○ 20
- ○ 48
- ○ 156

What wags its tail, barks, and plays fetch?

- ○ Dog
- ○ Whale
- ○ Ostrich
- ○ Beetle

APPENDIX D

MIDDLE TENNESSEE STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129
FWA: 00005331/IRB Regn.. 0003571

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN007 – EXEMPTION DETERMINATION NOTICE

Wednesday, January 05, 2022

Protocol Title	***The Impact of Reward Sensitivity on the Relationship between Hedonic Hunger and Loss of Control Eating***
Protocol ID	**22-1082 2q**
Principal Investigator	**Samantha Eisenberg-Godsey** (Student) *Faculty Advisor:* James Loveless
Co-Investigators	NONE
Investigator Email(s)	*sre3c@mtmail.mtsu.edu; james.loveless@mtsu.edu*
Department/Affiliation	Psychology

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category ***(2) Educational Tests, surveys, interviews or observations of public behavior*** *(Qualtrics Survey).* A summary of the IRB action and other particulars of this protocol are shown below:

IRB Action	**EXEMPT from further IRB Review** Exempt from further continuing review but other oversight requirements apply
Date of Expiration	**6/30/2024** *Date of Approval:* **1/5/22** *Recent Amendment:* **NONE**
Sample Size	500 (FIVE HUNDRED)
Participant Pool	**Healthy adults (18 or older) - MTSU SONA**
Exceptions	Online consent followed by internet-based survey using Qualtrics is permitted (Qualtrics links on file).
Type of Interaction	☐ Non-interventional or Data Analysis ☒ Virtual/Remote/Online Interview/survey ☐ In person or physical– Mandatory COVID-19 Management (refer next page)
Mandatory Restrictions	**1. All restrictions for exemption apply.** **2. The participants must be 18 years or older.** **3. Mandatory ACTIVE informed consent. Identifiable information including, names, addresses, voice/video data, must not be obtained.** **4. NOT approved for in-person data collection.**
Approved IRB Templates	*IRB Templates:* Online Informed Consent and SONA Recruitment Script *Non-MTSU Templates:* Recruitment Email and Verbal Recruitment Script
Research Inducement	Class Credit (SONA)
Comments	NONE

Summary of the Post-approval Requirements: The PI and FA must read and abide by the post-approval conditions (Refer "*Quick Links*" in the bottom):

- ***Final Report:*** The Faculty Advisor (FA) is responsible for submitting a final report to close-out this protocol before **6/30/2024**; if more time is needed to complete the data collection, the FA must request an extension by email. REMINDERS WILL NOT BE SENT. **Failure to close-out (or request extension) may result in penalties** including cancellation of the data collected using this protocol or withholding student diploma.
- ***Protocol Amendments***: IRB approval must be obtained for all types of amendments, such as:
  - Addition/removal of subject population and sample size.
  - Change in investigators.
  - Changes to the research sites – appropriate permission letter(s) from may be needed.
  - Alternation to funding.
  - Amendments must be clearly described in an addendum request form submitted by the FA.
  - The proposed change must be consistent with the approved protocol and they must comply with exemption requirements.
- ***Reporting Adverse Events:*** Research-related injuries to the participants and other events , such as, deviations & misconduct, must be reported within 48 hours of such events to compliance@mtsu.edu.
- ***Research Participant Compensation:*** Compensation for research participation must be awarded as proposed in Chapter 6 of the Exempt protocol. The documentation of the monetary compensation must Appendix J and MUST NOT include protocol details when reporting to the MTSU Business Office.
- ***COVID-19:*** Regardless whether this study poses a threat to the participants or not, refer to the COVID-19 Management section for important information for the FA.

COVID-19 Management:
The FA must enforce social distancing guidelines and other practices to avoid viral exposure to the participants and other workers when physical contact with the subjects is made during the study.

- The study must be stopped if a participant or an investigator should test positive for COVID-19 within 14 days of the research interaction. This must be reported to the IRB as an "adverse event."
- The FA must enforce the MTSU's "Return-to-work" questionnaire found in Pipeline must be filled and signed by the investigators on the day of the research interaction prior to physical contact.
- PPE must be worn if the participant would be within 6 feet from the each other or with an investigator.
- Physical surfaces that will come in contact with the participants must be sanitized between use
- **FA's Responsibility:** The FA is given the administrative authority to make emergency changes to protect the wellbeing of the participants and student researchers during the COVID-19 pandemic. However, the FA must notify the IRB after such changes have been made. The IRB will audit the changes at a later date and the PI will be instructed to carryout remedial measures if needed.

Post-approval Protocol Amendments:
The current MTSU IRB policies allow the investigators to implement minor and significant amendments that would not result in the cancellation of the protocol's eligibility for exemption. ***Only THREE procedural amendments will be entertained per year*** *(changes like addition/removal of research personnel are not restricted by this rule).*

Date	Amendment(s)	IRB Comments
NONE	NONE.	NONE

Post-approval IRB Actions:
The following actions are done subsequent to the approval of this protocol on request by the PI or on recommendation by the IRB or by both.

Date	IRB Action(s)	IRB Comments
NONE	NONE.	NONE

Mandatory Data Storage Requirement:
All research-related records (signed consent forms, investigator training and etc.) must be retained by the PI or the faculty advisor (if the PI is a student) at the secure location mentioned in the protocol application. The data must be stored for at least three (3) years after the study is closed. Additionally,

the Tennessee State data retention requirement may apply (*refer "Quick Links" below for policy 129*). Subsequently, the data may be destroyed in a manner that maintains confidentiality and anonymity of the research subjects. **The IRB reserves the right to modify/update the approval criteria or change/cancel the terms listed in this notice**. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:

- Post-approval Responsibilities: http://www.mtsu.edu/irb/FAQ/PostApprovalResponsibilities.php
- Exemption Procedures: https://mtsu.edu/irb/ExemptPaperWork.php
- MTSU Policy 129: Records retention & Disposal: https://www.mtsu.edu/policies/general/129.php

APPENDIX E

INFORMED CONSENT

Information and Disclosure Section

The following information is provided to inform you about the research project in which you have been invited to participate. Please read this disclosure and feel free to ask any questions. The investigators must answer all of your questions and please save this page as a PDF for future reference.

- Your participation in this research study is voluntary.
- You are also free to withdraw from this study at any time without loss of any benefits.

For additional information on your rights as a participant in this study, please contact the Middle Tennessee State University (MTSU) Office of Compliance (Tel 615-494-8918 or send your emails to irb_information@mtsu.edu. (URL: http://www.mtsu.edu/irb).

Please read the following and respond to the consent questions in the bottom if you wish to enroll in this study.

1. **Purpose**: This research project is designed to help us evaluate how the relationship between an individual's drive to consume food when they are not objectively hungry and their perceived sense of control over their eating habits is significantly impacted by their individual sensitivity to reward.
   .
2. **Description**: This study involves collecting information about a person's sensitivity to reward and their thoughts and feelings about food and while eating. Participants will be asked to answer 85 survey questions, lasting approximately 15-20 minutes. There will be an opportunity to learn more about the study during the debriefing process at the end of the session. Benefits involve learning more about research and helping us learn more about how your individual differences in reward sensitivty can impact eating habits. You will NOT be audio recorded or videotaped in this study.

3. **IRB Approval Details**
   - Protocol Title: The Impact of Reward Sensitivity on The Relationship Between Hedonic Hunger and Loss of Control Eating
   - Primary Investigator: Samantha Eisenberg-Godsey
   - PI Department & College: Department of Psychology, College of Behavioral &Health Sciences
   - Faculty Advisor (if PI is a student): Dr. James Loveless

- Protocol ID: 22-1082 2q_ Approval Date: 01/05/2022_ Expiration Date: 06/30/2024_

4. **Duration**: The whole activity should take about 15-20 minutes. The subjects must take at least 15 minutes to complete the study.

5. **Here are your rights as a participant:**
   - Your participation in this research is voluntary.
   - You may skip any item that you don't want to answer, and you may stop the experiment at any time (but see the note below)
   - If you leave an item blank by either not clicking or entering a response, you may be warned that you missed one, just in case it was an accident. But you can continue the study without entering a response if you didn't want to answer any questions.
   - Some items may require a response to accurately present the survey.

6. **Risks & Discomforts:** Risks in this project are no more than what one would encounter in everyday life.

7. **Benefits:**
   a. There are no direct benefits to you
   b. Benefits to the field of science or the community: A better understanding of how individual differences in personality and reward sensitivity can impact a person's relationship with food and possibly overconsumption.

8. **Identifiable Information**: You will NOT be asked to provide identifiable personal information.

9. **Compensation: There is no monetary compensation. However,** the participants recruited through the psychology department's participant pool will receive 1 SONA credit for their participation. Participants recruited through an institutional course may receive extra credit at the instructor's discretion. However, participants recruited via other means will not be compensated for their participation.

Compensation Requirements:

a) The qualifications to participate in this research are: You must be at least 18 years old, fluent in English, have never been diagnosed with an endocrine disorder, are not currently being treated for any cancers, mood disorders, eating disorders, neurodevelopmental disorders, or psychotic disorders, are not pregnant, and have not used any steroids, nicotine products or recreational drugs in the past 60 days. If you do not meet these qualifications, you will not be included in the research and you will not be compensated.

b) *After you complete this consent form you will answer screening questions. If you fail to qualify for the research based on these questions, the research will end, and you will not be compensated.*
c) *Please do not participate in this research more than once. Multiple attempts to participate will not be compensated.*

10. **Confidentiality.** All efforts, within reason, will be made to keep your personal information private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, *if* you or someone else is in danger or if we are required to do so by law.

11. **Contact Information.** If you should have any questions about this research study or possibly injury, please feel free to contact Samantha Eisenberg-Godsey by email, sre3c@mtmail.mtsu.edu OR my faculty advisor, Dr. James Loveless, at James.Loveless@mtsu.edu. You can also contact the MTSU Office of compliance via telephone (615-494-8918) or by email (compliance@mtsu.edu). This contact information will be presented again at the end of the experiment.

You are not required to do anything further if you decide not to enroll in this study. Just quit your browser. Please complete the response section below if you wish to learn more or you wish to part take in this study.

Participant Response Section

☐No ☐Yes I have read this informed consent document pertaining to the above identified research

☐No ☐Yes The research procedures to be conducted are clear to me

☐No ☐Yes I confirm I am 18 years or older

☐No ☐Yes I am aware of the potential risks of the study

By clicking below, I affirm that I freely and voluntarily choose to participate in this study. I understand I can withdraw from this study at any time without facing any consequences.

☐ NO, I do not consent

☐ Yes I consent

APPENDIX F

DEBRIEFING FORM

Study Debriefing

What is the purpose of the study?

To determine the whether the relationship between an individual's drive to consume food when they are not objectively hungry and their perceived sense of control over their eating habits is significantly impacted by their individual sensitivity to reward.

How is this study designed to accomplish that purpose?

The researchers are using a validated measure for each of the constructs they seek to measure. A portion of the Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) scales are used to determine an individual's reward responsivity, or how likely and how strongly they react when faced with a possible reward. The Power of Food Scale (PFS) is used to determine how much an individual is impacted by highly palatable food at different proximities when they are not hungry, or a construct called hedonic hunger. The Loss-of-Control Over Eating Scale (LOCES) is used to measure how much control a person feels they have over their eating habits. The results of these measures will allow the researchers to analyze how much variation in the relationship between hedonic hunger and loss-of-control is accounted for by an individual's reward responsivity, and possibly allow us to better understand what type of factors can lead to overconsumption.

Can I obtain a summary of the results of the study? What form will this summary take?

To obtain details of the results contact the researcher at sre3c@mtmail.mtsu.edu

How can I contact the researcher if I have any further questions or if, for any reason, I wish to withdraw my data once I have left?

You may email the researcher at sre3c@mtmail.mtsu.edu or the faculty advisor at James.Loveless@mtsu.edu

If you feel you have been adversely affected by taking part in this study, and would like to speak to a counseling service you are advised to seek help from:

MTSU Counseling Services:
https://www.mtsu.edu/countest/services.php
(615) 898-2670
KUC 326-S

I have concerns about this study, or the way in which it was conducted – who should I contact?

MTSU Office of Compliance:
https://www.mtsu.edu/compliance/
(615) 898-2400