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ANTICIPATORY AND REACTIVE RESPONSES TO CHOCOLATE RESTRICTION IN FREQUENT CHOCOLATE CONSUMERS

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ANTICIPATORY AND REACTIVE RESPONSES TO CHOCOLATE RESTRICTION

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"You are braver than you believe, stronger than you seem, and smarter than you think."

—A.A. Milne

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ABSTRACT

Keeler, Chelsey L. M.S., Purdue University, May 2014. Anticipatory and Reactive Responses to Chocolate Restriction in Frequent Chocolate Consumers. Major Professor: Richard D. Mattes

Many individuals have difficulty adhering to a weight loss diet. One possible explanation could be that dietary restriction paradoxically contributes to overconsumption. The objective of this study was to examine ingestive behavior under a forced chocolate restriction, with a focus on the anticipatory restriction period and the post-restriction period in frequent chocolate consumers. Fifty-six male (N=18) and female (N=38) high chocolate consumers with high or low cognitive disinhibition aged 27.70 ± 11.09 years with a mean BMI of 25.68 ± 5.92 kg/m^2 participated. Chocolate snacks were provided for the first, second, and sixth week of the study to establish baseline, pre-restriction and post-restriction consumption respectively. Chocolate snacks were replaced with non-chocolate snacks during a three week chocolate restriction period. Highly disinhibited participants felt more guilty and consumed significantly more energy than low disinhibited participants across multiple snack conditions. Low disinhibited participants consumed significantly less in the post-restriction period compared to baseline and the pre-restriction period, while high disinhibited participants consumed the same amount

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across all conditions. Aggregating the data, high and low disinhibited chocolate consumers ate snacks more frequently in the pre-and post-restriction periods compared to the baseline period. This study suggests that for some individuals, i.e., those that exhibit high disinhibition and feelings of guilt about snacking, restriction of chocolate may be contraindicated for energy restriction and weight management.

CHAPTER 1. INTRODUCTION

1.1   Objective and hypothesis

The literature demonstrates that the anticipation of initiating a diet causes maladaptive

eating behaviors (Eldredge, Agras et al. 1994; Urbszat, Herman et al. 2002) and the

limiting of specific foods increases cravings for those foods (Weingarten and Elston

1990; Hill 2007). The impact of deprivation on eating behavior as measured by intake is

debated, however after a restriction from chocolate, chocolate intake increases in adults

and in children (Polivy, Coleman et al. 2005; Jansen, Mulkens et al. 2007). It remains

unknown if the pre- and post- restriction periods are equally responsible for the

maladaptive behaviors resulting from restriction of a specific food.

Craving is framed as different from hunger because it may occur when a person is in a

satiated state and in the absence of an energy deficit (Hill, Weaver et al. 1991). Cravings

are usually triggered by specific foods and may be attributable to certain sensory

properties of foods (Rozin, Levine et al. 1991). Individuals that exhibit disinhibited

eating, which is the tendency to over consume food in response to various environmental

and internal stimuli, may react differently to food restriction due to increased sensitivity

and negative reactions to environmental stressors (Haynes, Lee et al. 2003). Disinhibited

eating often results in over consumption of food, and highly disinhibited eaters have higher BMI than low disinhibited eaters (Hays and Roberts 2008).

The primary objective of the present study was to investigate the anticipatory-(before) and reactive-(after) craving and intake responses of regular chocolate consumers on a three-week total chocolate restriction. A secondary objective of this study was to examine if the observed responses before and after chocolate candy restriction can be predicted by participants' personality, ingestive behavior and food craving status. Providing different snacks to the participants during the restriction period allows determination of whether noted cravings are specific to chocolate or generalize to snacks with other sensory and nutritional profiles. The emotional response in relation to each snack condition was evaluated over the course of a week to determine if chocolate snacks generate a distinctly different emotional response over time compared to other types of snacks.

It was hypothesized that the chocolate consumption of frequent chocolate consumers would increase both before and after a chocolate restriction is imposed. It was also hypothesized that chocolate craving is specific to chocolate rather than its sweet taste, energy or macronutrient content, and that chocolate cravers are less willing to substitute salty, dried fruit, or sweet non-chocolate snacks during the restriction, as measured by change in preference over time. In addition, it was hypothesized that highly disinhibited eaters will react stronger to the chocolate pre- and post-restriction primes, and over consume compared to their less disinhibited counterparts.

1.2   Organization

In the subsequent sections of this thesis, a literature review presents the relevant findings on the importance of this topic (Chapter 2). Specifically, trends in the obesity epidemic and the role of snacking are addressed. In addition, the definition of craving and the hypothesized mechanisms for why chocolate craving, and thus chocolate snacking, occurs is explored. Chocolate consumption is also examined from a psychological perspective by reviewing previous literature on restrained and disinhibited eating. A separate section reviews methods and populations previously examined regarding chocolate craving. The literature review will then conclude with a justification of the selected participant population for the current study, and a rationale for the current study.

The study methods and materials are detailed in Chapter 3. An analysis of intake based on participant psychological characteristics, and the effect of snack condition on intake is presented in Chapter 4. Finally, Chapter 5 expounds on directions for future research based on the gaps in the current literature and the findings of the current study.

CHAPTER 2. REVIEW OF THE LITERATURE

2.1   Obesity epidemic

Obesity is now recognized as a public health crisis. According to a review of NHANES

data from 1960-2004, the prevalence of obesity has increased from 13% to 32% over the

past four decades. Annual increases in the prevalence of obesity in different demographic

groups range .3-.9 percentage points (Wang and Beydoun 2007). Despite the small

annual percentage point increase over time, data from 2011-2012 showed that there has

been no overall significant change since 2009-2010. Even amidst a potential leveling off

of obesity rates, in 2011-2012, 34.9% of adults were still categorized as obese (Ogden,

Carroll et al. 2013). This is not without consequence as overweight adults, with a BMI

from 25.0-29.9, are more likely to have hypertension, heart disease, diabetes, certain

types of cancers, and gallstones (Field, Coakley et al. 2001). Furthermore, the medical

costs for an obese individual are 42% higher than for a normal weight individual, with the

2008 estimated aggregated sum of medical spending attributed to obesity as high as $147

billion (Finkelstein, Trogdon et al. 2009). With regard to mortality, the number of annual

deaths in the United States resulting from obesity is estimated to be 112,000 (Flegal,

Graubard et al. 2005). The obesity epidemic is not only a problem in the United States;

globally as of 2008, 500 million adults, or 10-14%, of the world's population was

classified as overweight or obese (Malik, Willett et al. 2013).

Obesity is a complex condition influenced by a plethora of factors that makes it problematic to identify successful solutions for mitigation. Often, obesity is associated with modern lifestyles. Modernization in the home, work place, public places, and the overall urban lifestyle have contributed to a decrease in energy expenditure, and an increase in consumption of high energy and high fat convenience foods (Shortt 2004). Genetic factors can attribute up to 40% of the variation in BMI (Wardle, Carnell et al. 2008), and the fetal and early postnatal environments are also predictive of weight gain in adulthood (Lillycrop and Burdge 2011). Socioeconomic factors play a role in the development of obesity as well (Wang and Chen 2011). However, the upward trend in BMI over time occurs across racial, ethnic, educational, and income backgrounds, and indicates that the obesity epidemic is not only problematic for low socioeconomic and ethnic and racial groups, but the entire population (Ljungvall 2012). All together, these results suggest changes to modify the shared environment would be beneficial in the mitigation of obesity.

2.2   Snacking and obesity

One specific potentially problematic facet of the obesogenic environment is the constant availability of food. The availability of foods such as oils, shortening, meat, cheese, fruit juices, and sweeteners has increased from the period of 1909-2007, paralleling the increased prevalence of obesity (Barnard 2010). Snacking as a dietary habit has also paralleled the increase in food availability in recent decades. Specifically, in the United States, the proportion of adults that snack has increased from 71% in 1977, to 97% in

2003-2006 (Piernas and Popkin 2010). Increased snacking results in increased total daily energy intake (Zizza, Siega-Riz et al. 2001). The increase in energy intake is also accompanied by a decrease in nutrient density of the selected snacks, as the percentage of energy derived from energy-dense nutrient poor foods (EDNP) in the diet has increased over time (Kant 2000; Johnson and Anderson 2010). This trend could be problematic for body weight management. However, given a known set of factors from an individual, the calculated value for the risk of obesity derived from snacking can vary up to 70% based on the definition of a snack used in analyzing the data (Gregori 2011). The lack of a standardized definition of a snack complicates the conclusions from the literature, and makes public health recommendations based on snacking difficult.

Conflicting recommendations for snacking behavior are based on studies that identify snacking as a beneficial practice due to the satiating property of specific snack foods (Furchner-Evanson, Petrisko et al. 2010; Douglas, Ortinau et al. 2013), while other studies find that snacking does not alter subsequent meal energy intake or contribute to weight gain or weight loss (Bertéus Forslund H. 2008; Dougkas, Minihane et al. 2012). Unclear definitions and differing methods for analysis of what constitutes a snack only confuse well intentioned messages and dietary recommendations concerning snacking behaviors.

In addition, while increased snacking could be the underlying cause of the obesity epidemic via incomplete compensation for the energy snack foods provide, this has not been confirmed. Short and long term studies demonstrate biological control of body

weight amidst the intake of excess energy in certain populations (McKiernan, Hollis et al. 2008; Viskaal - van Dongen, Kok et al. 2009; Appleton, Martins et al. 2011; Jokisch, Coletta et al. 2012). However, many other studies support incomplete body weight regulation in the face of excess energy and fat content- both within a day, across a week, and within a year (Woods, Schwartz et al. 2000; Levitsky 2005; de Graaf 2006). The impact of body weight regulation and activity status is still unclear, as individuals that do compensate and individuals that do not compensate have been identified (Blundell, Stubbs et al. 2003). Overall, the extra energy derived from snacks and a lack of compensation could contribute to the obesity epidemic.

Claims that snacking, or multiple small eating events better controls appetite and energy intake are prevalent in the media; however, the area of research dedicated to the impact of several small eating episodes on appetite and intake of restricting certain snacks from the adult diet is underexplored. Children's snacking behaviors show that a parental restriction on certain snack foods increases non-hunger related eating for up to three years after the time of restriction (Johnson and Anderson 2010) and influences the behavioral responses of children towards the forbidden foods (Rollins, Loken et al. 2014). Therefore, while sweet and fatty foods may be a cause of the obesity epidemic (Drewnowski and Greenwood 1983) it may be even more detrimental to restrict these types of snacks from the diet.

Similarly, the Framingham Children's study found that parents with high levels of restraint and disinhibited eating patterns, who are more likely to monitor and restrict their

child's energy dense snack intake, were more likely to have children with excess body fat (Hood, Moore et al. 2000). In addition to the data on the perils of restricting palatable snack consumption in children, indulging in palatable snacks may hold health benefits. The Harvard Health Alumni study found that candy indulgence, including chocolate and non-chocolate candy, was positively associated with longevity. Greater candy consumption was associated with living almost a year longer (Lee and Jr 1998). Also, chocolate intake has been linked to lower central and total fatness in European adolescents and adults, even when factors such as activity, fruit and vegetable consumption, calories, and saturated fat are considered (Golomb Ba 2011; O'Neil, Fulgoni Iii et al. 2011; Cuenca-García, Ruiz et al. 2014).

Overall, this evidence suggests that restriction of a palatable food may make it even more desirable and promote overconsumption (Jansen, Mulkens et al. 2007). These studies are only correlational, but future work to demonstrate the cause and effect of restricting palatable but "unhealthy" snacks from the diet may be beneficial. Future snacking studies need to consider the effects of dietary restriction of desirable snacks before making recommendations about complete abolishment of these snacks from the diet.

2.3 Chocolate snacking and craving defined

Studies assessing self-reported cravings consistently find chocolate as the most craved item (Hill, Weaver et al. 1991; Gendall, Joyce et al. 1997; Osman and Sobal 2006). Chocolate is also significantly associated with between meal snacking (Alonso, de la

Fuente et al. 2005). Therefore chocolate is a good medium to examine the effect of restricting a palatable snack from the diet. Consequently, research aimed at understanding craving using chocolate models, and understanding the mechanism as to why chocolate elicits craving behaviors has been visited multiple times. However, this work has led to conflicted results.

While it is established that chocolate is often craved, it is valuable to view the definition of chocolate craving in a systematic manner. Chocolate craving is defined using terms such as preference, liking, and use. Use is defined as "the objective measurement of amount consumed," (Rozin, Levine et al. 1991). In the United States, chocolate use translates to consumption of about 5.3kg per person per year (Association of Swiss Chocolate Manufacturers). The use of chocolate is important economically, as despite the fact that cocoa prices hit a 30 year high in 2011, there still has been a 6% growth in the chocolate sector since 2006, and in 2011, retail sales of chocolate reached $18.6 billion (Browne 2012). While use is relatively straightforward, there is a distinction between preference and liking. Preference requires a choice between two alternatives, while liking is a measurement of an attitude towards a particular food. Craving is referred to as a special case of liking, but it is more intense, is periodic, and motivates behavior aimed at obtaining the craved food (Rozin, Levine et al. 1991). Craving is also defined as a specific food desire that varies on intensity as a function of specific situational factors (Cepeda-Benito, Gleaves et al. 2000). The vernacular use of the word craving coincides with the concept of specificity, as 69% of participants agree their experience of a craving is the same as having a "strong urge to eat a specific food" (Hill, Weaver et al. 1991).

The idea of specificity is also very important, especially when contrasting a food craving with hunger. Under feelings of hunger, numerous foods could be satisfying. Craving is different from hunger because it is the desire for something specific. However, similar to hunger cravings can increase after presentation of visual and taste stimuli regardless of hunger state (Lambert, Neal et al. 1991). Hunger can make cravings more likely to occur, but is not needed for a food craving to occur (Pelchat, Johnson et al. 2004). Some evidence supports that chocolate cravings are reflective of the physiological state and a craving or hunger for them may reflect needed nutrient intake, however there is also evidence to support that chocolate cravings are independent of an individual's physiological state (Hill and Heaton-Brown 1994). It is also well established that chocolate craving is based on more than fulfilling a biological need for nutrients (Weingarten and Elston 1990).

Previous literature has identified sensory and hedonic factors as the key mechanisms that drive cravings. Chocolate craving can be classified as a specific hedonic hunger rather than homeostatic hunger, as it is often consumed in the absence of an energy deficit. Hedonic hunger is a relatively recent concept as the psychological and physical availability of food has created a new type of eating motive. Psychological availability indicates that it is now socially acceptable to eat anywhere and anyhow (Lowe and Butryn 2007). However, despite the obesogenic environment where it is socially acceptable to consume food in a variety of settings, a desire for chocolate would still be classified as a craving rather than hunger, because chocolate is viewed socially and

cognitively as an indulgence, and it would not be socially appropriate to consume it in amounts that would satisfy a hunger state (Rogers and Smit 2000).

2.3.1 Chocolate craving defined: chocolate craving is not an addiction

Often in vernacular terms, frequent craving for a particular food item is synonymous with "people with addiction" for that specific food. A review of the phenomenon of craving using chocolate as a case study illustrates that there are a lot of neural activation commonalities between drug addiction and food craving pathways (Gearhardt, Yokum et al. 2011). Ultimately, however, the bulk of scientific evidence shows that food craving should not be classified as an addiction, as it is hard to label a substance that supports life itself as an addictive substance. Attributes of food craving that may appear similar to an addiction state include, "psychoactive mood effects, environmental control of appetites, and the cognitive factors of restraint, ambivalence, and attribution" (Rogers and Smit 2000). In addition, chocolate has strong rewarding effects, making it a strong reinforcer. Food reinforcement is defined as a stimulus that increases the rate of behavior that it follows (Epstein, Leddy et al. 2007). Food reinforcement effects have been demonstrated by the activation of the mesolimbic dopaminergic system and the influence of the opioid system (Martel and Fantino 1996). Further, food cues in the absence of actual consumption can trigger dopamine neurotransmission in the dorsal striatum to elicit motivation toward a certain food (Volkow, Wang et al. 2002). There is a lack of diagnostic criteria for food addiction in humans, but animal studies have used the rewarding effects of food to demonstrate food addiction (Ifland, Preuss et al. 2009).

Food addiction has been measured by giving mice free access to sugar and then assessing symptoms of withdrawal and intake after a period of sugar restriction. Symptoms of withdrawal include anxiety, aggressive behavior, vocalization, and depression (Avena, Long et al. 2005). However, the opiate- like withdrawal symptoms found using sugar as a model for food addiction were not demonstrated in fat fed and fat deprived animals (Avena, Rada et al. 2009; Bocarsly, Berner et al. 2011). This suggests that the mechanisms of food addiction are not universal, and it should be noted again that foods and kilocalories, unlike drugs, are needed for survival, so these pathways may very well be evolutionarily sanctioned. Caution in using animal models alone to demonstrate addiction in humans should also be exerted (Ahmed 2010).

Aside from sugar and fat, chocolate also contains substances such as biogenic amines, xanthine, theobromine, magnesium, and caffeine. As with the weak evidence in human models that sugar is addictive, there is little evidence for chocolate to be considered an addictive substance due to other components in the chocolate matrix. There are higher levels of these substances found in other foods that do not cause those foods to be addictive, for example biogenic amines are present in higher levels in cheddar cheese or pickled herring and they are not "addictive" (Rozin, Levine et al. 1991). A white chocolate bar, with similar sensory properties as a chocolate bar without the biogenic compounds, decreases chocolate craving ratings. Cocoa capsules that contain the bioactive ingredients of chocolate without the sensory properties, do not reduce chocolate cravings, suggesting that there is no role for pharmacological attributes, and chocolate cravings are satisfied by the sensory experience (Michener and Rozin 1994).

Methylxanthines in chocolate may play a role in liking chocolate, specifically as an explanation of why the liking for dark chocolate can be an acquired taste, but craving ratings regarding methylxanthines in chocolate have not been addressed (Smit and Blackburn 2005).

In addition to the fact that the components of chocolate are not addictive, chocolate consumption is different from drug addiction in that there is little evidence for physical dependence. There is little tolerance, sensitization, and withdrawal related to chocolate consumption, all of which are associated with the neuroadaptive effects of drugs. It is suggested that while the learning process plays a role in drug addiction, it is one of the main mechanisms of chocolate craving. Chocolate craving therefore is a strong desire rather than an addiction (Rogers and Smit 2000). In the classical sense, drug addicts are often diagnosed as "addicts" due to physiological responses that occur in conjunction with cravings when presented with drug-related cues. In chocolate cravers, no clear evidence has been presented to show that so-called chocolate addicts have an increased physiological response to chocolate compared to non-addicts, suggesting that perhaps addict is not the correct term to ascribe to high chocolate cravers (Tuomisto, Hetherington et al. 1999). Clinical criteria for drug addiction can also include the severity of the consequences resulting from discontinued use of the substance, whereas attempts to restrict the substance results in negative consequences. In individuals that exhibit normal eating behavior, it is hard to diagnose chocolate consumption as addiction, as there are no documented failed attempts to restrict it that result in severe negative consequences (Pelchat 2009).

In this fashion, chocolate craving is not harmful for most people, however it has been found to be associated with disordered eating behaviors (Lafay, Thomas et al. 2001; Moreno, Warren et al. 2009). Self-reported chocolate cravers consume more chocolate than non-cravers in laboratory conditions, and score higher on scales that measure problem eating behavior or dissatisfaction with body image and depression (Tuomisto, Hetherington et al. 1999). In addition, studies focusing on the transition of normal eating to binge eating find that instead of having positive effects after consumption, binge eaters start consuming palatable food due to the negative reinforcing effects, or behavior motivated at preventing a negative emotional state caused by the environment or the withdrawal from the substance (Parylak, Koob et al. 2011).Therefore, the term "chocolate addiction" may be applicable to binge eaters, but not for normal eating behavior exhibiting individuals that crave chocolate. It is hypothesized by some that the way food is used, in a restrictive but available manner, could produce a loss of control of eating (Corwin and Grigson 2009). The recently verified Yale Food Addiction Scale may be a way to distinguish self- identified food cravers from those that have lost control over their eating behavior and are disordered in their eating behaviors. This subset of individuals that have lost control do not obtain the positive reinforcement gained from eating and have disordered eating and binging behavior tendencies (Gearhardt, Corbin et al. 2009; Meule and Küblera 2012).

2.4   Chocolate craving and positive emotions based on sensory properties

Despite the ability of chocolate to act as a positive reinforcement, a negative reinforcement, or both, when consumed, there is a clear interaction between chocolate ingestion and positive emotion. However, there is little evidence for this liking of chocolate to be pharmacologically based (Rozin, Levine et al. 1991). The argument that the chocolate craving mechanism is based on deriving pleasure from sensory characteristics is further supported in that positive emotions are most pronounced at 5 to 30 minutes after consumption. This is indicative of early sensory mechanisms rather than pharmacological effects or neurochemical changes that would occur at later time points (Macht and Dettmer 2006). Research suggests that chocolate specific craving is principally related to the unique sensory properties of chocolate, particularly the body temperature melting point that imparts a characteristic mouth feel in combination with the pleasant aroma and taste of cocoa butter (Rozin, Levine et al. 1991). Data also supports that chocolate cravings are satisfied by sensory characteristics of the chocolate itself (Michener and Rozin 1994). Chocolate craving is not confounded with sweet craving based on self –report data as cravers report there is no non-chocolate substitute when they crave chocolate. This further confirms that there is something about chocolate consumption that is a unique sensory experience that can induce cravings (Weingarten and Elston 1991). Craving for chocolate has also been demonstrated as a form of self-medication based on mood, and is independent of other mechanisms, such as being a product of dieting or restrained eating. In times of a negative emotion state as opposed to a relaxation or joy state, individuals are more motivated to eat to regulate the emotional

state. Eating as a distraction, eating to relax, or eating to feel better are all ways eating functions to influence mood. Irregular eating is also common in these mood related eating episodes (Macht and Simons 2000). Instances of food craving are only weakly associated with dietary restraint, but are significantly influenced by mood and high food stimulus salience (Hill, Weaver et al. 1991).

2.5   Chocolate snacking behavior and restriction

In contrast to positive emotion seeking behavior as a mechanism that drives chocolate craving, it has also been suggested that cravings are induced by abstinence, which explains why cravings are highest when the withdrawal is the most severe (Weingarten and Elston 1990). Restrained eaters chronically diet, and ignore internal cues, such as hunger, in an attempt to follow self-set dieting regimens (Papies, Stroebe et al. 2008). This makes a restrained type of eater susceptible to chocolate cravings, as a highly palatable and energy-yielding food such as chocolate would be restricted from the diet. Restriction has been related to frequency of cravings, with the most craved foods being the ones that dieters were attempting to restrict (Massey and Hill 2012). In instances of successful restrained eaters, food restriction is effective in reducing energy intake in the short term, however the cycle of craving that leads to eventual overeating is never completely severed due to the neuromolecular mechanisms that respond to palatability and lead to overeating (Alsiöa, Olszewski et al. 2012).

Chocolate snacking is specific in the instance of restriction, due to the lack of a similar food to substitute in its place. For example, deprivation of chocolate leads to an increase in consumption post-deprivation in restrained eaters in contrast to a vanilla flavor diet restriction or a control of no diet restriction (Polivy, Coleman et al. 2005). Other short term studies have found that consumption is not increased, but thoughts about the forbidden product, and the desire to consume the restricted product increase (Mann and Ward 2001). While craving and amount consumed have not been shown to be related in some studies, highly stressed individuals are more likely to eat both sweet and high fat foods (Habhab, Sheldon et al. 2009). Also, the increased intake of a forbidden food has been correlated with disinihibition as determined by the validated Three Factor Eating Questionnaire (TFEQ) (Stunkard and Messick 1985; Hetherington and MacDiarmid 1993). After the restriction of a favorite snack, only high disinhibition, high restraint (HDHR) individuals over-consume the snack post-restriction (Soetens, Braet et al. 2008). Traditionally, groups with high disinhibition scores and low restraint scores (HDLR) consume the most food regardless of the situation, while groups with either: a) high disinhibition scores and high restraint scores (HDHR) or b) low disinhibition and low restraint (LDLR) are susceptible to overeating under stress. A forth category of low disinhibition, high restraint (LDHR) individuals are unaffected by stress with regard to a maladaptive eating behavior outcome (Haynes, Lee et al. 2003). It has been suggested that the anticipation of going on a diet can cause HDHR overweight eaters to consume more, known as the "last supper effect" (Eldredge, Agras et al. 1994). For example, when individuals are made to believe they had to go on a diet for the next week versus a control group that were not planning on going on a diet, restrained eaters in the diet

condition consumed more cookies in a taste test than restrained eaters in the non-diet condition. In this fashion, the anticipation of a diet promotes disinhibition in high restrained eaters, and because a diet is starting tomorrow, overindulgence can happen in the present (Urbszat, Herman et al. 2002).

In addition to disinhibition resulting in increased consumption, cravings have been translated to consumption amounts when experiments are conducted in a laboratory setting. Cravings for specific categories of snacks such as sweet starch products (i.e. cake, cookies) fats, and non-sweet starch products (i.e. bread, pasta) are related to their consumption in the laboratory (Martin, O'Neil et al. 2008). However, in a controlled setting, the study of restrained eaters depends heavily on their success in dealing with disinhibitors in order to influence consumption. The behavior of restrained eaters in the laboratory may demonstrate overeating, under eating, or an equal amount of eating compared to a non-dieter on any given day (Hill, Weaver et al. 1991). Also imposing a diet, or forced deprivation, as opposed to assuming a diet due to individual choice may have implications on intake (Cartwright, Stritzke et al. 2007). Among subjects that were restricted from chocolate (forbid), or strongly encouraged not to have chocolate (forbid choice), the desire for the "forbid choice" food decreased, while the desire for the food in the "forbid" category increased. Neither condition showed an increase in chocolate consumption resulting from the increased cravings, but this deprivation was short term (Mann and Ward 2001). Overall, while long term successful cognitive restraint does not influence cravings (Cepeda-Benito, Gleaves et al. 2000), there are several measures of

defining chocolate craving, inducing a chocolate craving, and assessing chocolate craving and consumption that can influence the outcome of a particular study.

2.6   Methods to assess chocolate craving: chocolate craving and restraint

A review of cravings suggests multiple ways a food craving can be assessed (Weingarten and Elston 1990). Specifically, studies have measured weight of consumption, speed of consumption, and psychophysiological measures such as heart rate, and salivary excretion. The discussion that consumption should not be used as a standalone measure of cravings is debated as the two are logically circular. In addition, it is cautioned that salivary secretion could just be a product of thinking about impending consumption, or a cephalic phase reaction (Gendall, Joyce et al. 1997). Alternative methods to assess craving have been explored. The time spent on an anagram when the participant knows their chocolate snack is available has been utilized in addition to consumption levels to assess craving (Polivy, Coleman et al. 2005). Studies use Likert type scales to determine how much a target food is thought about and how much it is desired (Mann and Ward 2001). The Food Craving Inventory was also developed to test if cravings are a standalone concept, or if there are identifiable subsets of foods within food cravings and population differences based on what specifically is craved. Ultimately it is demonstrated that fat cravers had a higher BMI, and that cravings do correlate with consumption in this instance (White, Whisenhunt et al. 2002). Other methods have been developed that specifically focus on chocolate as a craved food item, but are unable to isolate which dimension (sweet, fat, etc.) of chocolate is specifically craved. Despite this

limitation of the Food Craving Inventory, the current study includes participants that are all frequent chocolate consumers and identification of the component in chocolate responsible for craving is not a primary objective of the investigation. While this scale provides insight regarding cravings, a measurement tool that characterizes the chocolate craving experience in a way that is relatable, and distinguishes those that are susceptible to the pre-and post- restriction chocolate period from those that are not would be more pertinent.

2.6.1 Orientation to chocolate questionnaire

The Orientation to Chocolate Questionnaire (OCQ) analyzes the components of chocolate craving (approach, avoidance, and guilt) and correlates them to self- reported consumption amounts and frequency of consumption (Cartwright, Stritzke et al. 2007). Using the OCQ, guilt and avoidance are positively predicted by restrained and disordered eating (i.e. body image dissatisfaction and binge eating tendencies), while approach is negatively predicted by restrained eating. Gender accounts for a significant amount of variance in restrained eaters, and BMI explains a small amount of variance in restrained eaters (Cartwright and Stritzke 2008). Even in older children, conditions of high guilt, strong avoidance, high BMI, and being female are associated with increased dieting (Cartwright, Stritzke et al. 2007) meaning that notions regarding chocolate and body image are strongly culturally ingrained from a young age. Overall, using the OCQ, craving dimensions differentially predict frequency and quantity of chocolate consumption, in addition to disordered eating. While this information would be of value

to the current investigation to characterize why certain participants consume more chocolate than others, the participants in the study are unaware of the focus on chocolate as to not disrupt normal consumption patterns. An administered questionnaire focused on chocolate craving would alert attention to the true nature of the study and may induce feelings of guilt or avoidance concerning consumption given the outright nature of the questions. Also, participants consume other types of snacks in addition to chocolate, and a more generalized approach to craving may be more appropriate to truly characterize snack consumption behavior in the study.

2.6.2   Attitude to chocolate questionnaire

The Attitude to Chocolate Questionnaire (ACQ) is another questionnaire that was developed to assess the mechanisms of chocolate craving (Benton, Greenfield et al. 1998). This questionnaire includes guilt, a functional approach to chocolate, and craving. Craving is further divided into the categories of general preoccupation with chocolate, or craving under instances of emotional stress. Unlike the OCQ, using the ACQ and self-reported data, high craving, but not guilt is associated with consumption of chocolate. The ACQ has been verified using a German version of the ACQ, and used in conjunction with the dimensions of eating behavior, personality, emotionality, and tests of the pleasantness, sweetness, and intensity of sugar and chocolate (Müller, Dettmer et al. 2008). This combination of variables found that guilt correlates significantly with the Dutch Eating Behavior Questionnaire (DEBQ) factors, emotional eating and restrained eating. Craving and emotional eating also correlated significantly and with the TAS-20

factor ''difficulty identifying feelings.'' This demonstrates that there is a tendency to crave chocolate when participants experience strong mood and emotion states. A third factor termed functional approach, defined as using chocolate as an energy source or meal substitute, was found by Benton et al. (1998) but has not been replicated by others. Other craving questionnaires also demonstrate that guilt scores are more associated with disordered eating than high craving scores (Cramer and Hartleib 2001). As with the OCQ, the ACQ calls outright attention to chocolate, and despite international replication of the questionnaire, the fact that replication efforts have not been consistent is justification to use an alternate scale that is used more prevalently in the literature.

2.6.3 Food cravings questionnaire (FCQ)

Recent studies make use of the Food Cravings Questionnaire to measure cravings. It was created to unify the general combination of questions using subjective self-reports that are asked in craving studies, and to measure the overall psychometric aspects of craving. It consists of two self-report subscales: the Food Cravings Questionnaire-Trait (FCQ-T) and the Food Cravings Questionnaire-State (FCQ-S). The State subscale assesses the function of context (stress, mood, hunger, and hormone cycles) in specific cravings, encompassing the psychological and physiological aspects of food cravings. The Trait subscale is based on identifying the craving profiles within individuals or populations. Previous studies have found that the FCQ-T has excellent internal consistency (overall alpha=.97 and subscale alphas ranged between .81-.94) (Cepeda-Benito, Gleaves et al. 2000). The test-retest reliability was also found to be strong for the FCQ-T (overall r=.88,

and subscale test-retest reliability ranged from r=.72-.88). The internal consistency for the FCQ-S was also excellent (overall alpha=.94 and subscale alphas ranged from .82-.88), but the test-retest reliability was lower for the FCQ-S (overall r=.56 and subscale test-retest reliability ranged from r=.40-.63). A modification to the FCQ-S might be needed in future research studies, given that this subscale appears to have lower reliability over time than what is recommended.

The FCQ-S and FCQ-T were modified to create the Food Chocolate-Craving Questionnaire Trait and State (FCCQ-S, FCCQ-T) by tailoring the questions to chocolate. The internal consistency of the FCCQ-S and FCCQ-T were verified by testing women from Britain and Spain (total score alpha=.97)(Rodríguez, Warren et al. 2007). It is suggested that the FCCQ-T be used over the ACQ as it gives more of a "fine-tuned multidimensional assessment" which extends its use and versatility, especially in differentiating stable trait cravings from context varying state cravings (Rodríguez, Warren et al. 2007). The FCQ-T has also been remodeled and renamed as the Trait and State General Food Cravings Questionnaires (G-FCQ-T and G-FCQ-S) with the purpose of creating a more economical and time efficient questionnaire that lends itself to more of a general craving than a specific craving assessment instrument (i.e.. the G-FCQ-T was edited down to a 4-factor structure from a 9-factor structure). This modification was based on a study using the FCQ-S and FCQ-T that found evidence for the emotional craving function, but not the guilt and craving as a physiological state function, so they were removed to create an abbreviated questionnaire. Also, the relationship between the G-FCQ-T and the Dutch Eating Behavior Questionnaire (DEBQ) has been examined. The

G-FCQ-T scores correlate well with the emotional eating and the external eating function of the DEBQ based on Pearson correlations (Nijs, Franken et al. 2007), which provides evidence for convergent validity. As the FQC and the subsequent variations of the questionnaire are well validated, generalized and not specific toward chocolate, and differentiate between state and trait conditions, this questionnaire is an appropriate choice for the objectives of the current study to determine if there is a difference in craving status regarding individuals susceptible and those not susceptible to the pre-and-post chocolate restriction periods. However, as the concept of guilt seems to be specific to the nature of chocolate based on previous studies, the non-abbreviated questionnaires that include the construct of guilt will be used.

2.6.4   Guilt and dietary restraint

As the various questionnaires designed to analyze cravings report contradictory outcomes regarding the role of restraint and guilt, it is valuable to further explore the literature on this topic and characterize the role of guilt pertaining to chocolate consumption. The concept of guilt and its association with chocolate consumption is both a cognitively and socially derived notion. Chocolate can be framed in terms of ambivalence where chocolate is "naughty but nice." This paradox occurs simply because chocolate is a palatable indulgence, but is socially expected to be eaten with restraint. This gives chocolate cravers both pleasure and anxiety when faced with chocolate (Rogers and Smit 2000). In this fashion, food craving has been related to reward sensitivity, in addition to body weight (Franken and Muris 2005). Many chocolate consumers often experience

feelings of guilt after chocolate consumption. Guilt is associated with chocolate in both dieters and non-dieters, but dieters are more likely to categorize foods based on guilt/non-guilt (King, Herman et al. 1987). Diet independent of restraint, does not appear to change one's craving for chocolate, nor is it affected by images of chocolate (Fletcher, Pine et al. 2007). However, it has been demonstrated that dieters experience more negative feelings concerning control than non-dieters. Guilt, especially in overweight individuals, could arise pre-consumption in addition to post-consumption as a response to giving in to approach, and this could later lead to episodes of binge eating (Rodgers, Stritzke et al. 2011). Often restraint scores do not predict actual food intake, but are correlated with guilt scores (de Witt Huberts, Evers et al. 2013). Dietary restriction in this sense is counterproductive as it increases the desire for the item being forbidden, and increases the likelihood of losing control while on a diet, further generating negative emotions and prompting eating. The influence of negative emotions is also demonstrated by a trial where participants that wanted to lose weight and associated chocolate cake with guilt were not successful in losing weight over a three month period compared to participants that also wanted to lose weight but associated chocolate cake with celebration (Kuijer and Boyce 2014). Taken together, restriction, worry, and guilt over food have also been demonstrated as counterproductive with regard to weight management.

While dieters and dietary restraint are a focus of many studies, others report food cravings are not associated with dietary restraint (Weingarten and Elston 1991). When data was categorized into the groups of dieters that plan to lose weight versus dieters that plan to maintain and not gain weight, the dieters that plan to lose weight do have an increase in cravings. Both groups still craved chocolate most frequently, as chocolate

craving was responsible for 37% of the documented cravings (Massey and Hill 2012).

With regard to dieters, the FCQ-T scale is able to differentiate between successful dieters,

unsuccessful dieters and non-dieters. Overall the difference in reported food cravings

depends on the success or failure of the dieters (Meule, Lutz et al. 2012). An interaction

was observed between restrained eating and FCQ-T scores, and for the first time, the idea

was presented that the conflicted findings regarding restraint, cravings, and feelings of

guilt in previous literature is a function of the restraint scale that is used. Validated

restraint scales include the Revised Restraint Scale, the DEBQ, and the TFEQ, which

identify restrained eaters (Stunkard and Messick 1985).

2.6.5   Depravation of chocolate: a trait aspect

Many studies suggest that chocolate craving is a trait aspect with less emphasis on

restraint and disinhibition traits as behavioral drivers. In the face of a two week chocolate

deprivation (Moreno-Dominguez, Rodríguez-Ruiz et al. 2012) in high versus low female

chocolate cravers that were classified using the top and bottom percentile responses

(scores above the 85th percentile and below the 15th percentile respectively) on the FCQ-T,

the high craving but non-deprived group consumed the most chocolate. In addition, all

deprived conditions experienced increased cravings for chocolate, supporting the

forbidden food concept previously discussed (Mann and Ward 2001). High chocolate

cravers had a significantly higher BMI than the low chocolate cravers at baseline, showed

a more negative mood, felt guiltier after eating chocolate, and had more anxiety than non-

cravers. However, all of these attributes are indicative of restraint behavior which was not

included in the scope of this study. High cravers were also found to be different than lower cravers with regard to the risk/clinical levels for the diagnosis of eating disorders. This significant difference between low cravers and high cravers remained, even when only the high cravers still below the risk and clinical levels for disorder diagnosis were considered (Rodríguez, Fernández et al. 2005). This may be attributed to a motivational conflict theory of chocolate craving based on the differences between high and low chocolate cravers. The chocolate craving experience for high cravers is emotionally laden, as exposure to chocolate images activates both the appetitive and avoidance state simultaneously. This is why high chocolate cravers rate chocolate images as both more positive and more negative than low chocolate cravers. Overall, high cravers find chocolate images more pleasant, more arousing, but they experience less of a sense of control, which could perhaps tie into feelings of guilt found in previous studies.

There is no difference in hunger between chocolate cravers and non-cravers although self-reported chocolate cravers ate two times as many chocolate bars/chocolate containing foods per week as non-cravers (Kemps, Tiggemann et al. 2005). A difference in hunger in high verses moderate cravers was not observed at baseline in another instance, but a significant difference in the presence of food was observed. Situations pertaining to appetite excitation and questions such as desire to eat and prospective consumption demonstrate a significant difference between high and moderate cravers. Despite having no difference in restraint measurements between the two groups, high cravers scored higher in disinhibition, hunger, external and emotional eating, were more depressed, and had a higher score on the binge eating disorder questionnaire. High

cravers may have a tendency to be resistant to satiation, and lack sensory specific satiety compared to moderate eaters (Hetherington and Macdiarmid 1995). Taken together, craving status and disinhibition rather than restraint and hunger may be meaningful to assess chocolate craving.

2.6.6 Males and females, cross cultural differences

Many studies involving chocolate use only women as participants with the justification that women are more prone to dieting and negative feelings after satisfying a food craving (Hill, Weaver et al. 1991; Fletcher, Pine et al. 2007; Moreno-Dominguez, Rodríguez-Ruiz et al. 2012). An examination of comfort food which is defined as "foods that provide a dimension of psychological and physiological comfort when they are consumed" showed that women prefer snacks that are viewed as more unhealthy indulgences such as chocolate, while men turn to hearty foods such as steak. This choice preference explains why women are more likely to turn towards chocolate as a comfort food, and then feel guiltier about consuming it (Wansink, Cheney et al. 2003). However, whereas women tend to feel more guilty about consuming chocolate, the strength of craving chocolate and acting on craving does not differ between males and females (Cramer and Hartleib 2001). Approximately 86% of females and 85% of men are likely to give in to their craving, but only the females feel guilty about it (Weingarten and Elston 1991).

In addition, to similar craving behaviors, chocolate liking is not significantly different in males verses females. However, this particular analysis was completed by excluding premenstrual cravers which may or may not have distorted the analysis (Rozin, Levine et al. 1991). While the menstrual cycle is often held responsible for chocolate craving in females, there is evidence to suggest that chocolate craving and its relation to the menstrual cycle is a cultural construct. Due to the fact that chocolate craving is strongly associated with the premenstrual period in American women but not Spanish women, it is theorized that in American women, the cue of the premenstrual period is associated with chocolate, and therefore triggers chocolate craving on future occasions (Zellner, Garriga-Trillo et al. 2004; Osman and Sobal 2006). In addition, British women consume more chocolate and have more cravings than Spanish women, further suggesting that chocolate cravings are influenced by cultural factors (Rodríguez, Warren et al. 2007). This is consistent with a learning theory, where situational, or sensory cues entrain an expectation for a rewarding or a pleasurable consequence as a result of the craved food (Rozin, Levine et al. 1991; Gibson and Desmond 1999). Craving changes are also not associated with the lowering of mood during the menstrual/premenstrual cycle (Hill and Heaton-Brown 1994).

In addition to using cultural comparisons to study the chocolate craving behaviors of premenstrual women, the question of cultural orientation towards chocolate has been examined. European countries consume more chocolate per person than the United States, with Switzerland, the UK, Belgium, Germany, and Ireland consuming the most. The Swiss, for example, consume 9.9 kg of chocolate per person per year compared to 5.3 kg

in the United States (Afoakwa 2010). It is speculated that the demand for chocolate will increase greatly in Asian countries in the future, particularly China. After immigration, Asian students in America consume more salty and sweet snack items, and 25% report consuming more chocolate, demonstrating that a preference for chocolate as a snack is easily adopted unlike other cultural food practices (Pan, Dixon et al. 1999).

Ultimately, the manufacturing, marketing, and economic processes are very different across cultures, and are responsible for the differences observed in chocolate consumer preferences and consumption patterns. The initial processing of chocolate is different from country to country, and differences are apparent in the mixing, refining, conching, termpering, and final crystallization of the product (Bordin Schumacher, Brandelli et al. 2009). In terms of processing differences, in the United States, chocolate undergoes the conching process, or an agitation at high temperature, for shorter time durations than European chocolate which leads American made chocolate to be grittier in texture. In addition, most European chocolate is required to be at least 30% cocoa solid while the requirement in the United States is 10%. Finally, historic traditions are upheld in that the Spanish prefer bitter chocolate with minimal sugar as it was initially brought to them from the Americas, while the Swiss prefer milky smooth chocolate, as the production of milk chocolate was invented in Switzerland. Individuals in the United States traditionally prefer highly sweetened chocolate (Alberts and Cidell 2006). In terms of marketing, pure chocolate bars in Europe are marketed as a food that is incorporated into the lifestyle of active daily life, which may explain why it is consumed at higher levels. In contrast, Americans view chocolate as an indulgence, and are more likely to consume chocolate as

part of a candy, cake or cookie rather than plain (Alberts and Cidell 2006). However, despite the underlying stereotype that Europeans value chocolate more for its pleasure aspects and have less of a stigma towards chocolate as being an unhealthy food, overweight French women still experienced high levels of guilt after chocolate consumption (Rodgers, Stritzke et al. 2011) suggesting that cultural notions may only be a part of how chocolate is viewed in everyday lifestyles.

2.6.7 Justification of participant characteristics and design

To be able to generalize the effect of restriction of a food product in a particular study sample to the entire population, specific participant eligibility characteristics were included when considering the study design. Both healthy males and females of all races and ethnicity groups were recruited with the caveat of having lived in the United States for at least a majority of their life as different cultures have different behaviors and preferences concerning chocolate consumption as previously discussed. In addition, individuals were characterized as high and low disinhibitors based on a tertile split of the TFEQ with the rationale to focus on the extremes of disinhibited eaters. Many previous studies set limits for traits post-hoc based on the sample recruited, however by pre-selecting for a specific range, it ensures data are more robust for a defined group. The use of both males and females is justifiable as the current craving literature is heavily based on female sample populations, and it is useful to have craving information regarding males in addition to females to be able to generalize findings to the entire population (Weingarten and Elston 1991).

In addition, the study was designed as a single blind study towards the restricted food, chocolate, which has not been explicitly explored previously in the restriction literature. Subjects were unaware that the study was about chocolate intake and assumed that it was only one of many snack food options. This is justified, as dietary restraint causes eaters to ignore internal cues such as hunger, and be more responsive to environmental cues (Papies, Stroebe et al. 2008). Shifting the focus away from chocolate ensured that the pre- and post-restriction condition was the main cue, rather than a focus on chocolate.
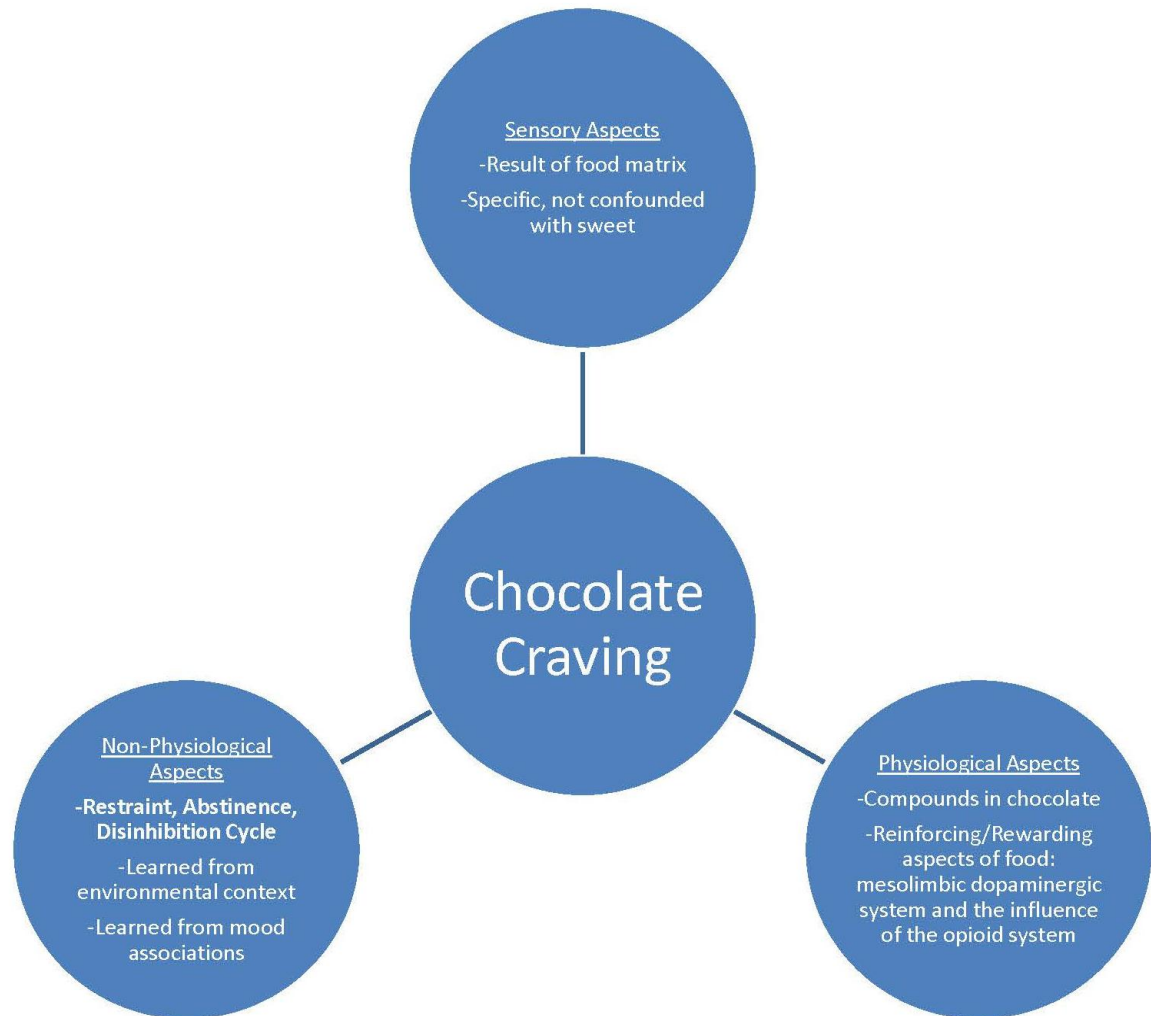
Figure 2.1 Proposed mechanisms responsible for chocolate craving

2.7   Current research implications and hypothesis

The various contributors to chocolate craving identified in the previous literature review are depicted above in Figure 2.1. In particular, the area of study involving restraint, abstinence, disinhibition, and the impact of these factors on craving is robust. Yet despite examining similar concepts, conflicting findings from studies on the topic stem from the fact that there is not one standardized way to define, induce, or measure a craving (Rozin, Levine et al. 1991). In addition, past studies that have induced and measured cravings have limitations. For example, using a target food that may be easily substituted or not having a method to enforce compliance concerning the restricted food is problematic in that it could weaken the effect of the craving, and thus weaken the results of the maladaptive behaviors resulting from cravings. This may be the reason that increased craving does not necessarily translate to increased consumption (Hill 2007). Also, previous chocolate and snacking restriction studies are confined to a laboratory setting instead of free-living, are short term, and are obvious as to the actual goal of inducing temptation during the restriction periods, particularly in one instance where participants had to carry around a bag of the prohibited food with them at all times (Stirling and Yeomans 2004; Soetens, Braet et al. 2008). Another aspect of chocolate craving that is unclear from previous research is if chocolate craving is specific, or if the craving can be fulfilled by alternate snacks of different sensory and nutritional traits. While chocolate entails a unique sensory experience that can induce cravings (Weingarten and Elston 1991), it is unclear if the craving itself is confounded with sweet craving in a period of restriction. Also, while the post-restriction period is well examined

by previous studies, the knowledge gained from the influence of an anticipatory restriction period on intake may be more applicable to daily life and the mindset of a dieter.

Given these past limitations and areas of uncertainty in previous literature, the current study aims to examine behavior under a forced chocolate restriction with a focus on the anticipatory restriction period and the post-restriction period. Many individuals have difficulties in maintaining a weight loss diet, and perhaps succumbing to cravings and the overconsumption of palatable foods due to restriction of these foods from the diet could explain this phenomenon (Papies, Stroebe et al. 2008). This mechanism might also support that chocolate consumption in moderation, rather than a restriction of chocolate may be healthy, and explain the results in a recent study that found an increase in the frequency of chocolate consumption was associated with lower BMI (Golomb Ba 2011). As studies of restrained eaters depend heavily on their success in dealing with disinhibition to influence consumption, the focus of this study is on individuals that exhibit either high or low disinhibition, and artificially simulates restraint for all participants via a restriction period of chocolate. The hypothesis is that high disinhibited participants will be more susceptible to the anticipatory and post- chocolate restriction phases and consume the most chocolate under both the pre-and post-chocolate restriction conditions.

CHAPTER 3. MATERIALS AND METHODS

3.1   Participant eligibility and screening protocol

Participants (n=57) were recruited beginning in March 2013 via forms of public advertisement that included the Laboratory for Sensory and Ingestive Studies website, newspaper ads, social media, list-serves, and posted flyers (Appendix B). After expressing interest via email, participants were asked to complete an initial health questionnaire, personality questionnaires, and a semi-quantitative food frequency questionnaire (Appendix D). Eligible participants were contacted via e-mail to schedule an enrollment visit and begin the study.

Eligible individuals included those aged 18-60 years, not dieting, not allergic to test foods, not taking medications that affected appetite or metabolism, willing to comply to the study protocol and to eat test foods, report snacking between meals, and consume chocolate (> 4 times/week) based on a validated semiquantitative food frequency questionnaire used previously for chocolate intake (Willett, Sampson et al. 1985; Djoussé, Hopkins et al. 2011). In addition, participants were eligible if disinhibition scores measured by the Three Factor Eating Questionnaire were in the ranges of 0-5 or 10-16 (Stunkard and Messick 1985). Individuals were classified as low disinhibition eaters with

scores in the range of 0-5, or high disinhibition eaters with scores in the range of 10-16. An equal number of participants were recruited for the high and low disinhibition groups. Gender and ethnicity were not an eligibility requirement, and individuals of all genders and ethnicities were recruited. However, participants were required to have been born in the United States, or have lived in United States for the majority of their life, as different cultures have been shown to have dissimilar chocolate preferences and consumption patterns as previously justified.

3.2   Study design and testing day protocol

The testing day protocol along with figures depicting the process are presented below. At the enrollment session, participants were asked to read and sign an informed consent form (Appendix C). Measurements taken at the enrollment visit included height (to nearest cm) using a wall-mounted stadiometer, as well as body weight and body fat (to nearest kg) using bioelectrical impedance analysis (Body Fat Analyzer Scale, Model TBF-410, Tanita Corporation of America, Inc. Arlington Heights, IL.). Questionnaires were administered and elicited information about cravings (Cepeda-Benito, Gleaves et al. 2000), depression (Zung 1965), disordered attitudes towards food (Garner and Garfinkel 1979; Stunkard and Messick 1985), sensation seeking (Stephenson, Hoyle et al. 2003), personality (Sato 2005), stress level (Sheldon, Kamarck et al. 1983), mood (Watson, Clark et al. 1988), and food attitudes (Raudenbush, Van Der Klaauw et al. 1995; Bushmakin, Cappelleri et al. 2009). After the initial screening and enrollment period, testing was divided into three distinct phases.

3.2.1   Phase one: baseline consumption of chocolate

Participants visited the laboratory on Monday, Wednesday, and Friday for a week under the intentional misdirection that they were participating in a study examining the effect of different snacks on blood pressure, and that each snack category would be provided to them for a period of one week. For the first week, at each session, the participant was provided with a bag containing a large serving size, 250 grams, of their preferred chocolate choice to take home to consume the amount they desired at their leisure. Participants chose one chocolate type for each day, but were given the option of 5 different types of chocolates as choices in hopes that at least one option was desirable given individual preferences. Both milk chocolate and dark chocolate were included as chocolate options to account for individual preference (See Appendix E for a descriptive listing of snack types and brands). Participants were instructed to bring the uneaten portion back to the next session. Participants were also provided with separate snack bags to take home on days that they did not come into the laboratory (Tuesday, Thursday, and the weekend). On Monday, Wednesday, and Friday, body weight was measured on a clinical scale, and body composition was measured by bioelectric impedance (Body Fat Analyzer Scale, Model TBF-410, Tanita Corporation of America, Inc. Arlington Heights, IL.). The participants were told that the purpose of the body analysis was to measure body water which can influence blood pressure. At each visit, 3 blood pressure (BP) measurements were taken (Series 5 Upper Arm Blood Pressure Monitor BP742, Omron Inc. Bannockburn, IL.) Participants answered appetite and mood questionnaires while BP measurements were taken. Each visit was 15 minutes in duration. Daily chocolate candy

consumption was covertly measured by weighing what was returned from the participant's snack bags after the participant had left the study session, and recorded as the "baseline consumption."

3.2.2   Phase two: pre-restriction of chocolate

The length and protocol of Phase 2 was similar to Phase 1, and participants were given the same treatment and chocolate snack options. However, during every visit of Phase 2, participants were informed that theobromine in chocolate may influence BP measurements, as theobromine is a demonstrated vasodilator. Participants were told that they will be asked to refrain from eating chocolate, as it is the major source of theobromine in the diet, for the following 3 weeks, but that they were going to be given chocolate for a second week to obtain an accurate baseline measurement of blood pressure with theobromine in their system. Daily chocolate candy consumption was measured by weighing what was returned from their snack bag after the participant had left the study session, and recorded as the "pre-restriction consumption."

3.2.3   Phase three: restriction of chocolate

Phase 3 entailed total chocolate restriction for 3 weeks. Participants continued to visit the laboratory on Monday, Wednesday, and Friday for BP measurements and to fill out questionnaires, but instead of chocolate, they were provided with different substitutes in a random order each week: a) a salty snack, b) a non-chocolate sweet candy snack, or c) a natural (dried fruit) snack. These snacks were also provided in the same clear bag format as the chocolate, and in large serving sizes, or four times the quantity of the

manufacturer's recommended serving size for each product, as the size of the serving influences intake regardless of product (Rolls, Roe et al. 2004; Wansink and Kim 2005). To ensure compliance to the restriction, a ruse was introduced in which participants were told that their saliva samples (collected using ordinary filter paper during their visits for BP measurements) will tell if they have been eating chocolate using a method developed by a study funded by the Hershey Center for Health and Nutrition (Ptolemy, Tzioumis et al. 2010). They were also told that their study compensation would be increased if they are found to be compliant during the 3-week chocolate-candy restriction period. In actuality, the saliva theobromine was not measured and all participants received full compensation for successfully completing the study.

3.2.4   Phase four: post-restriction of chocolate

In Phase 4, participants returned after the chocolate-candy restriction for the final week of BP measurements. Participants were told that the researchers are interested in investigating the effect on blood pressure with the re-introduction of theobromine into their daily diets and that they would be provided with chocolate snacks as in Phase 1. On the last session, participants were asked if they had been told the true purpose of the study by an outside source prior to completion of the study. Participants were then debriefed about the actual objective of this study. They were re-consented (Appendix C) and had the option to exclude their data from analyses after being informed of the true purpose of the study. Participants were told they would receive a payment of $25 as compensation for any inconvenience caused by participating in this study and that they would receive an additional $25 if saliva theobromine tests confirmed that they were

compliant with the chocolate restriction. Thus, participants received a total of $50 for completion of the study.
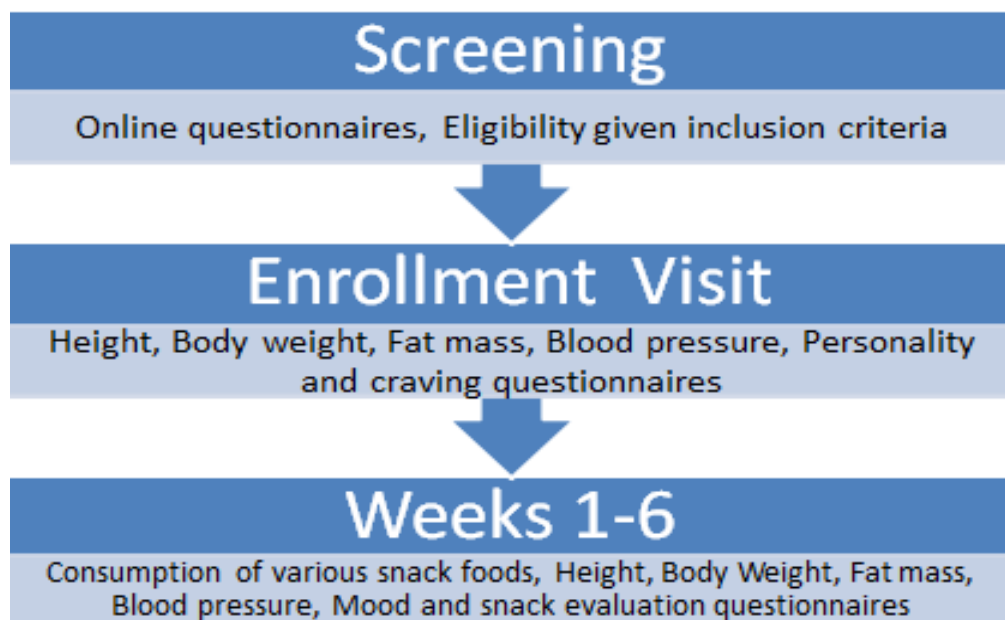
Figure 3.1 Study Overview: Broad

SCREENING

Inclusion criteria: healthy adult males and females, snackers, frequent chocolate candy eaters (4X/week), Native-born, lived in the US for majority of life. TFEQ disinhibition score in ranges of (0-5), or (10-16).

Enrollment Visit

Written consent, Anthropometric measurements, personality and ingestive behavior questionnaires.

PHASE 1 (BASELINE: 1 WEEK)

Daily body weight & BP, chocolate candy consumption.

PHASE 2 (PRE-RESTRICTION: 1 WEEK)

Daily body weight & BP, chocolate candy consumption after being informed that all chocolate products have to be restricted for 3 weeks.

Note: 3 week conditions in randomized order

PHASE 3 (RESTRICTION: 1 WEEK)

Salty snacks
Daily weight & BP, snack consumption.

PHASE 3 (RESTRICTION: 1 WEEK)

Natural Snacks (Dried Fruit)
Daily weight & BP, snack consumption.

PHASE 3 (RESTRICTION: 1 WEEK)

Sweet snacks- Not Chocolate
Daily weight & BP, snack consumption.

PHASE 4 (POST-RESTRICTION: 1 WEEK)

Daily body weight & BP, chocolate candy consumption after 3 weeks of chocolate products restriction. Debriefing on last session.

Figure 3.2 Study overview: In-depth
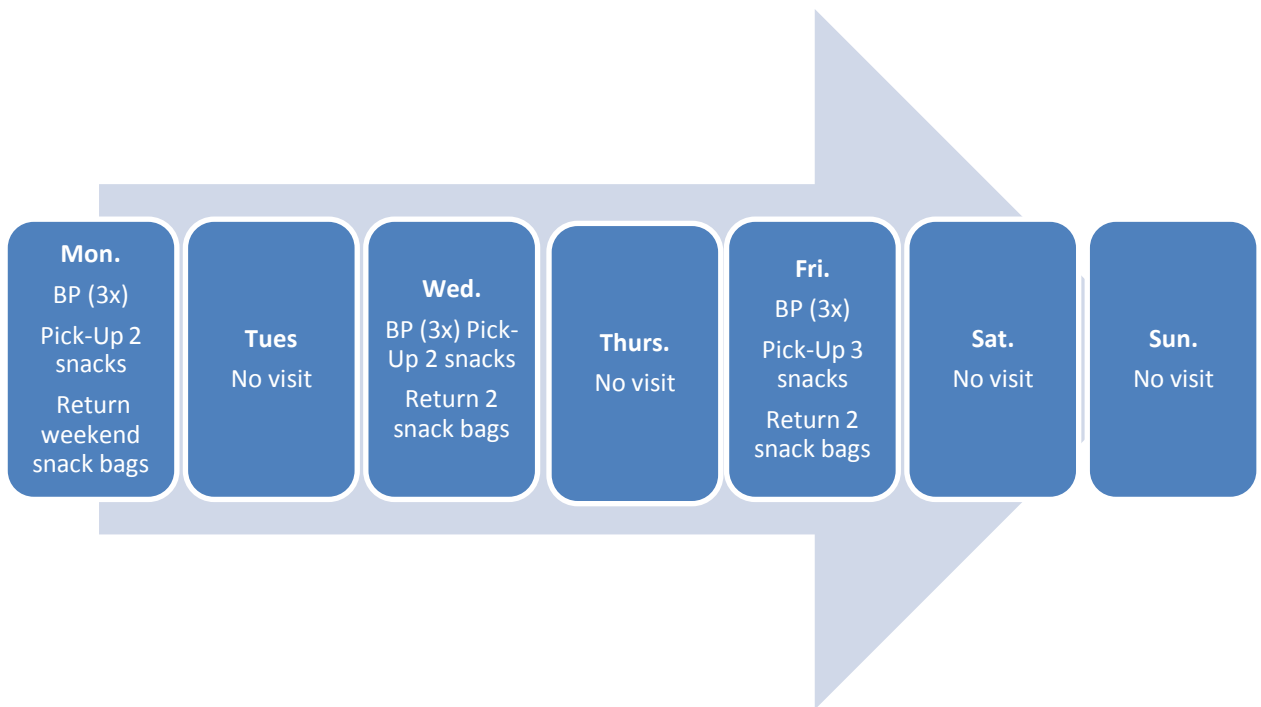
Figure 3.3 Study overview: Weekly schedule

3.3 Statistical analysis

All statistical analyses were performed using SAS version 9.3 (SAS Institute Inc. Cary, NC. USA). As total energy intakes exhibited a positively skewed distribution, log transformations were used to improve normality. For ease of interpretation, all data values and standard errors are back-transformed to represent kilocalories consumed. Participants were grouped as high (1) or low (0) disinhibition based on the TFEQ as previous justified, and high (>6) and low restriction (<7) based on the median. Data points of consumption less than 5 kilocalories on a given day were not considered to be an ingestive event, and were coded as 0, where other data points greater than 5 kilocalories were coded as 1 and considered an ingestive event. When data points less than 5 kilocalories are included in all analyses, results are consistent as to when they are excluded, however these points are identified as outliers based on the studentized residual, and therefore removed. A logistic regression was conducted to determine how disinhibition and the pre- or post- restriction conditions predict the occurrence of an ingestive event. A mixed model ANOVA was then run using the data where an ingestive event was initiated to determine if intake changed over time within chocolate condition (baseline chocolate consumption, pre-restriction period of chocolate and post- restriction period of chocolate consumption) using log of total kilocalories as a dependent variable, and the fixed effects of disinhibition, chocolate condition, and milk or dark chocolate choice. Differences in subject characteristics were analyzed using a one way ANOVA, and post hoc analyses using the t-test or Wilcoxon rank-sum test for data exhibiting non-normality. Subject characteristic data in Table 4.1 are presented as ± standard deviation of the mean. Statistical significance was set at $\alpha = 0.05$. Snack evaluation data was analyzed using a longitudinal regression model to evaluate change in response over time. Bonferroni corrections were applied for multiple testing, and resulted in a final criterion of $p < 0.0083$ for the snack evaluation data.

CHAPTER 4. RESULTS

4.1 Participant characteristics

A total of 789 individuals responded to study advertisements. Fifty-seven individuals fit the inclusion requirements and were enrolled, and 56 completed the study. Out of the 789 interested individuals, 327 successfully completed the screening process, but were not included in the study as they did not meet the disinhibition trait eligibility requirement, or consume a serving of chocolate 4 times or more per week. Of these individuals, one participant was terminated from the study due to not showing for multiple study appointments. Participant characteristics grouped by disinhibition trait are summarized in Table 4.1. Participants in the high disinhibition trait category had a higher body weight, BMI, and fat mass. These participants also scored higher on the Power of Food Scale, exhibited more craving behaviors, were more depressed, scored higher on the EAT-26, and reported a higher preference for the chocolate provided in the study compared to individuals in the low disinhibition category. Low disinhibited participants reported to be significantly more stressed than high disinhibited participants. Restraint scores were higher in those that exhibited high disinhibition, but this difference was not significant.

Table 4.1 Subject Characteristics by Disinhibition Status

SUBJECT CHARACTERISTICS[3]	LOW DISINHIBITION	HIGH DISINHIBITION
Age (y)	25.1±9.2	30.9±12.5
Height (cm)	169.1±10.7	167.2±9.9
BW (kg)	66.1±11.3[a]	80.6±18.3[b]
BMI (kg/m^2)	23.1±3.1[a]	28.9±7.0[b]
FM (kg)	14.3 ±6.3[a]	29.9±14.5[b]
TFEQ dietary restraint score	6.5±3.4	8.4±4.9
TFEQ disinhibition score	3.2±1.3[a]	12.2±1.5[b]
Power	30.3±6.3[a]	43.7±8.5[b]
Trait Crave	95.3871[a]	132.6[b]
State Crave	37.1±7.1[a]	46.0±9.1[b]
Stress	26.5±5.0 [a]	21.2±6.2[b]
Zung	30.5 ±6.0 [a]	36.9 ±9.1[b]
Eat-26	5.6 ±4.2[a]	11.0 ±9.8[b]
EPQR	8.3±3.1	8.3±3.4
Finicky	8.5±3.6	9.6±4.2
BSS	13.7±3.5	13.8±2.8
FASCho	11.5241[a]	12.9680 [b]

[1] Values with different superscript letters are significantly different, $p < 0.05$ (t-test or Wilcoxon rank-sum test);
[2] Mean ± SD (all such values).
[3]BW, body weight; BMI, Body Mass Index; FM, Fat Mass; TFEQ, Three-Factor Eating Questionnaire; Power, Power of Food Scale; Zung, Zung Self-Rating Scale (Depression); EAT-26, Eating Attitudes Test (Disordered Attitudes Toward Foods); Finicky, Food Attitudes Survey; BSS, Brief Sensation Seeking Scale 4; FASCho, Food Action Rating Scale (Food Preferences);

4.2   Effect of disinhibition and condition on chocolate intake

4.2.1   Segmentation based on initiation of eating

When chocolate intake data was segmented into meaningful ingestive events, defined as greater than 5 kilocalories, disinhibition score and chocolate condition (baseline, pre- or post-chocolate restriction) significantly predicted the occurrence of an ingestive event. High disinhibited participants had ingestive events less frequently than low disinhibition individuals regardless of the chocolate condition $(p < 0.0001)$. When data from both high disinhibited participants and low disinhibited participants were aggregated, as depicted in Figure 4.1, it was apparent that ingestive events occurred less frequently in the baseline condition compared to the pre-chocolate restriction period $(p < 0.005)$. Ingestion also occurred less frequently in the baseline condition compared to the post-chocolate restriction period $(p < 0.0005)$. There was no difference in the amount consumed in the pre-restriction versus the post-restriction period $(p < 0.15)$. These results maintain significance after Bonferroni correction resulting in a final criterion of $p < 0.017$.
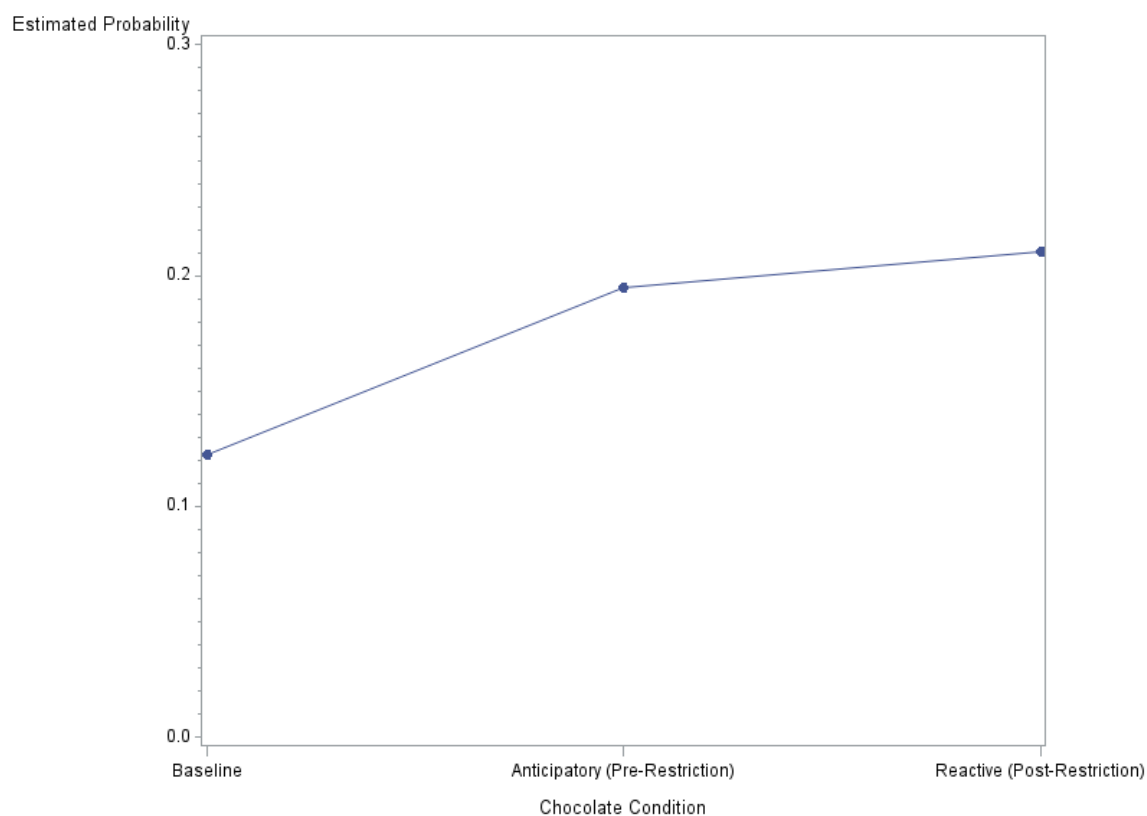
Figure 4.1 Estimated probability of an ingestive event. Ingestive events occurred less frequently in the baseline condition compared to the pre-chocolate restriction period (p < 0.005) and in the baseline condition compared to the post-chocolate restriction period (p< 0.0005). There was no difference in the amount consumed in the pre-restriction versus the post-restriction period (p< 0.15).

4.2.2 Effect of disinhibition and condition on chocolate intake when eating is initiated

When observations in which eating was initiated were analyzed with a mixed model ANOVA, total kilocalories consumed was predicted by disinhibition status ($p < 0.0001$), milk chocolate or dark chocolate selection $(p < 0.0102)$ and the interaction between disinhibition status and chocolate condition ($p < 0.0081$). As depicted in Figure 4.2, low disinhibited participants consumed significantly less chocolate than high disinhibited participants regardless of chocolate condition. As depicted in Figure 4.3, low disinhibited

participants consumed an equal amount of chocolate in the pre-restriction period

compared to baseline intake *(p >0.017)*, but consumed significantly less chocolate in the

post-restriction period compared to baseline *(p <0.0006)*. This finding is in contrast to

high disinhibited participants who consumed the same amount of chocolate regardless of

condition, as represented in Figure 4.4. These results maintain significance after

Bonferroni correction for multiple testing resulting in a final criterion of *p* < 0.017.
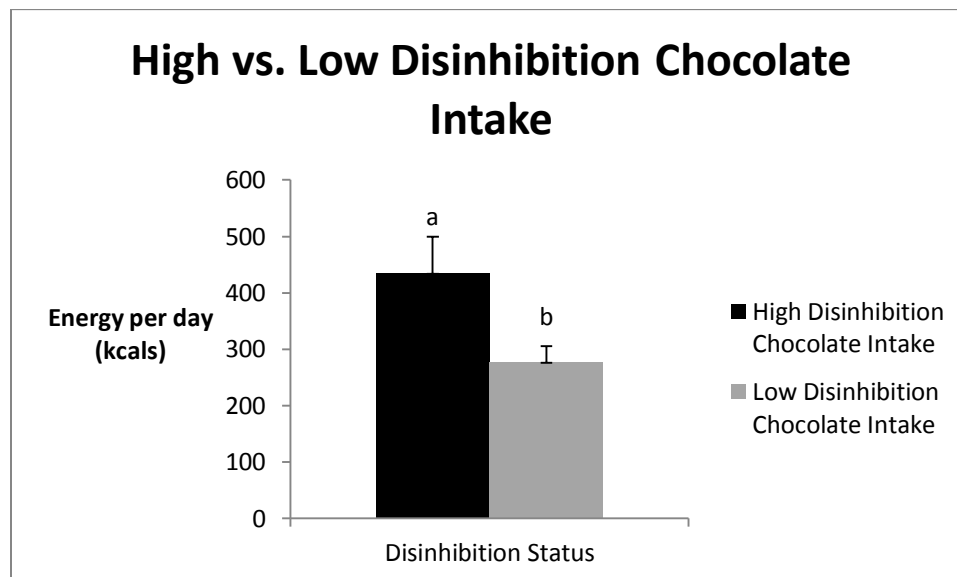
Figure 4.2 Estimated average intake of high disinhibited eaters versus low disinhibited eaters across all chocolate conditions. Different letters indicate significant difference in energy intake as a result of disinhibition status, p < 0.05.

Low Disinhibition Chocolate Intake
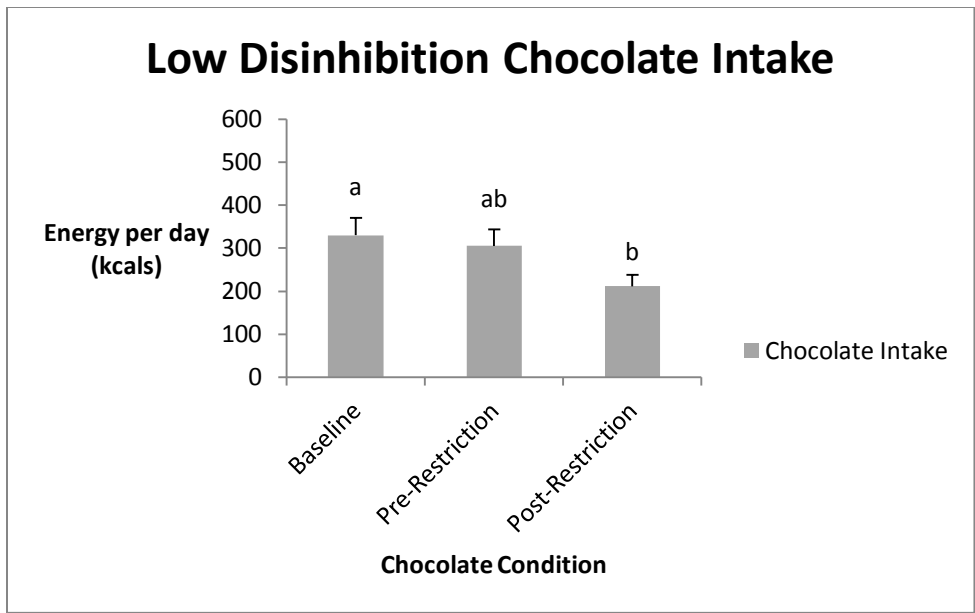
Figure 4.3 Estimated average intake of low disinhibited eaters across the chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of chocolate condition p < 0.017.

High Disinhibition Chocolate Intake
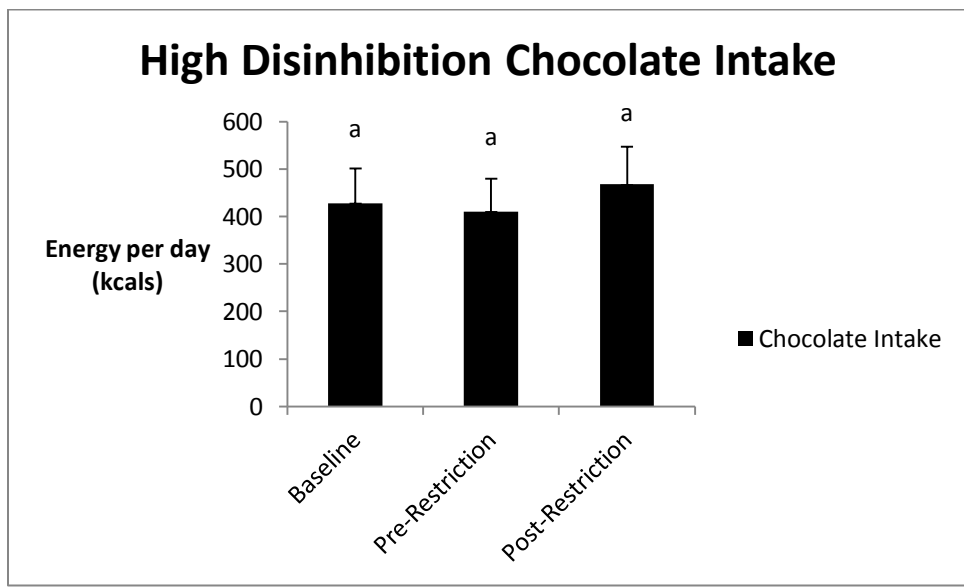
Figure 4.4 Estimated average intake of high disinhibited eaters across the chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of chocolate condition $p < 0.017$.

In addition, as depicted by Figure 4.5, when segmented by chocolate condition and disinhibition, the only significant difference was between high and low disinhibited individuals in the post-chocolate restriction period when high disinhibited individuals consumed more energy from chocolate than low disinhibited individuals. Finally, as depicted in Figure 4.6, milk chocolate consumers consumed more energy (kilocalories) compared to dark chocolate consumers regardless of disinhibition status. While gender was not a primary outcome consideration in the current study, gender was not significantly associated with disinhibition ($p= .7066$). Males did consume more than females across the snack conditions, which is logical given the larger body weights and increased energy needs of males (males, 431.7 ± 62.8, females, 318.4 ± 37.7, $p= .0006$).

Figure 4.5 Estimated average intake of high and low disinhibited eaters across the chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of chocolate condition $p < 0.017$. All significance comparisons are based on disinhibition status.

Milk vs. Dark Chocolate Intake

[Bar chart showing Energy per day (kcals) on the y-axis from 0 to 600, with Chocolate Type on the x-axis. Milk Chocolate bar (black) reaches approximately 385 kcals labeled "a"; Dark Chocolate bar (gray) reaches approximately 310 kcals labeled "b". Legend indicates Milk Chocolate (black) and Dark Chocolate (gray).]

Figure 4.6 Estimated average intake of milk and dark chocolate observations. Different letters indicate significant differences in energy intake as a result of chocolate type choice $p < 0.05$.

4.3 Effect of disinhibition and condition on non-chocolate intake

4.3.1 Segmentation based on initiation of eating

When non-chocolate intake data were segmented into meaningful ingestive events (i.e., greater than 5 kilocalories), disinhibition score and condition (sweet non-chocolate, salty, or dried fruit) significantly predicted the occurrence of an ingestive event. Similar to chocolate intake patterns described above, high disinhibited participants had ingestive events less frequently than low disinhibited participants regardless of the chocolate condition $(p < 0.0002)$. When data from both high disinhibited and low disinhibited participants were aggregated, ingestive events occurred less frequently in the dried fruit

condition compared to the sweet non-chocolate condition *(p < 0.0015)*. Ingestion also occurred less frequently in the dried fruit condition compared to the salty snacks condition *(p <0.0008)*. There was no difference in the amount consumed in the sweet non-chocolate snack condition versus the salty snack condition *(p< 0.03)*. These results maintain significance after Bonferroni correction for multiple testing, resulting in a final criterion of *p < 0.017*.

4.3.2 Effect of disinhibition and condition on non-chocolate intake when eating is initiated

When observations in which eating was initiated was analyzed with a mixed model ANOVA, total kilocalories consumed was significantly predicted by disinhibition status ($p < 0.0006$), and the interaction between disinhibition status and snack condition ($p <0.05$). As depicted in Figure 4.7, low disinhibited individuals consumed significantly less non-chocolate snacks than high disinhibited individuals.

High vs. Low Disinhibition Overall Non- Chocolate Intake
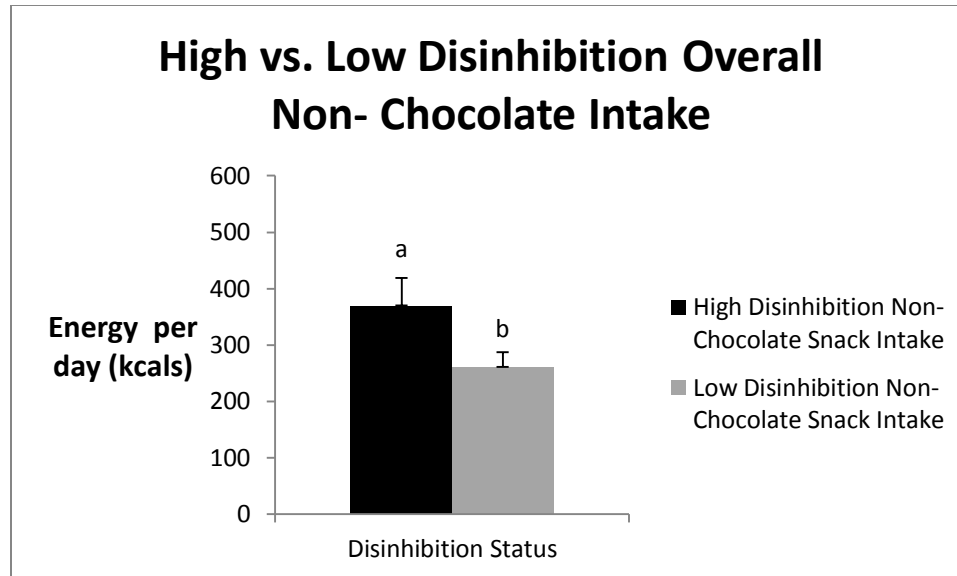
Figure 4.7 Estimated average intake of high disinhibited eaters versus low disinhibited eaters across all non-chocolate conditions. Different letters indicate significant difference in energy intake as a result of disinhibition status, $p < 0.05$.

As depicted in Figure 4.8, low disinhibited participants consumed an equal amount of dried fruit and sweet snacks, and an equal amount of salt and sweet snacks, but consumed more salty snacks than fruit snacks $(p< 0.007)$. This is in contrast to high disinhibited participants who consume more salty and sweet snacks compared to dried fruit snacks $(p < 0.0001)$, as depicted in Figure 4.9.
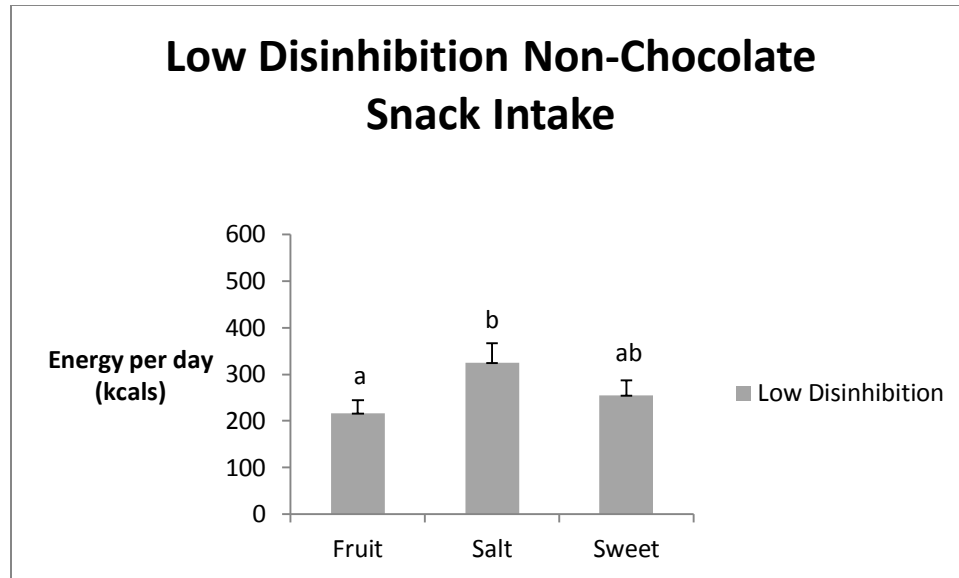
Figure 4.8 Estimated average intake of low disinhibited eaters across the non-chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of snack condition $p < 0.017$.
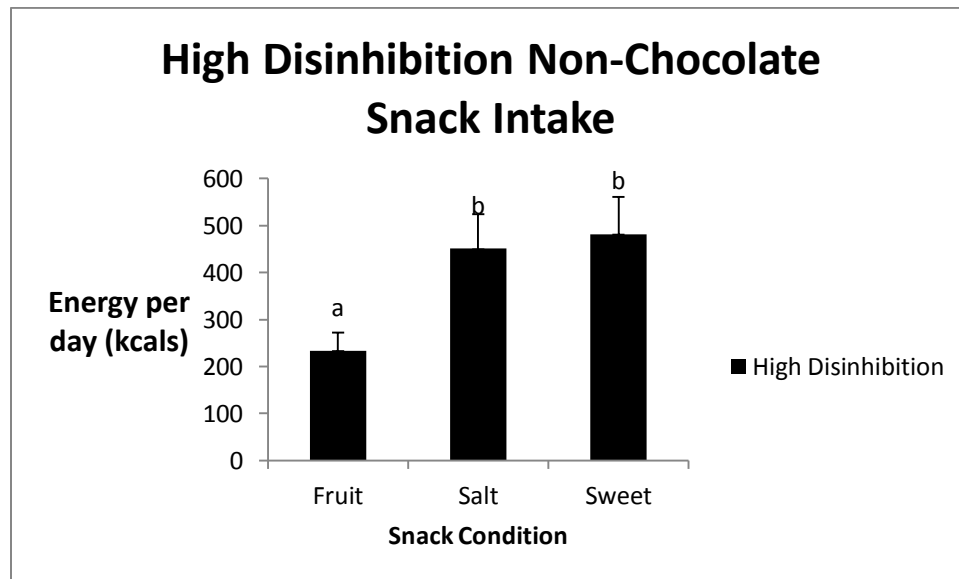
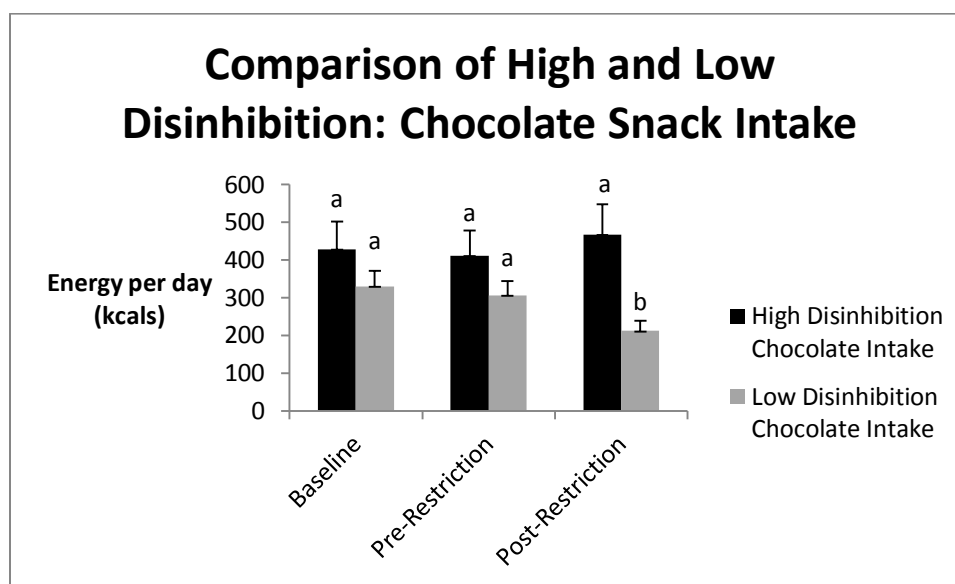Figure 4.9 Estimated average intake of high disinhibited eaters across the non-chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of snack condition $p < 0.017$.

In addition, as depicted by Figure 4.10, when segmented by snack condition and disinhibition, the only significant difference was between high and low disinhibited individuals in the sweet non-chocolate snack condition where high disinhibited participants consumed significantly more than low disinhibited participants ($p < 0.0001$).
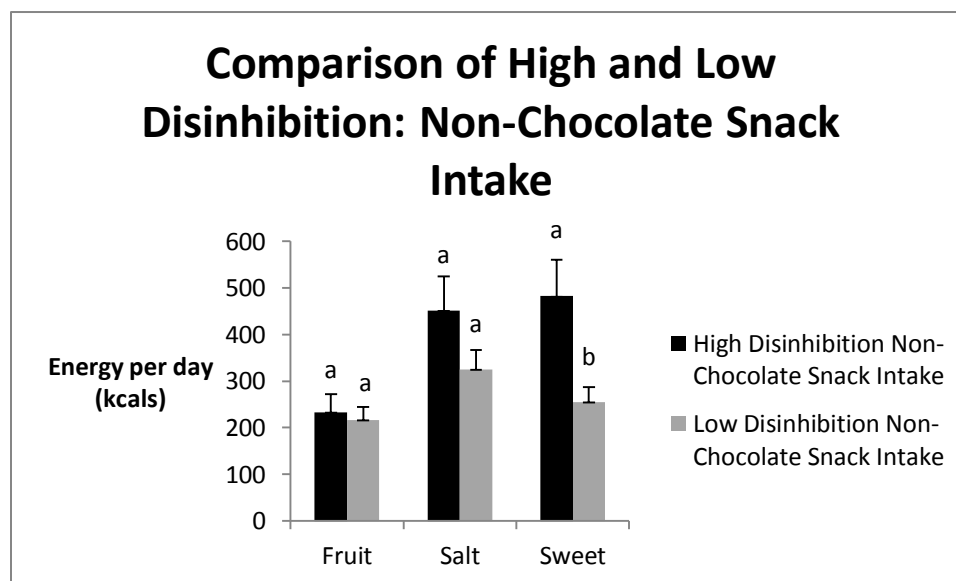
Figure 4.10 Estimated average intake of high and low disinhibited eaters across non-chocolate snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, in energy intake as a result of snack condition $p < 0.017$. All significance comparisons are based on disinhibition status.
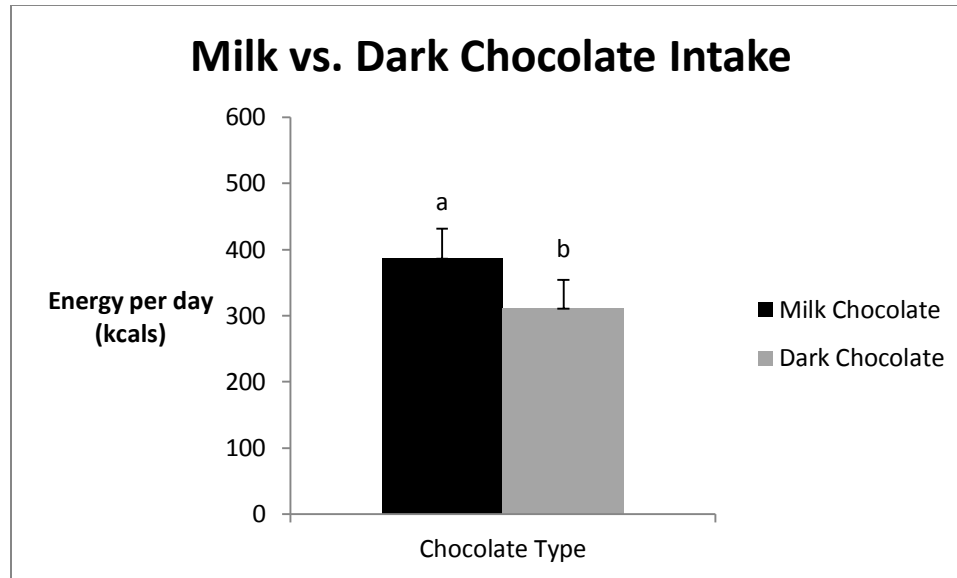
4.4   Effect of Snack Type on Emotional and Hedonistic Evaluations

Participants reported to the lab on day 1, day 3, and day 7 of each snack condition. When asked to evaluate their emotional and hedonistic responses to the snack received at the previous study visit on a scale of 1 to5, clear differences were observed between high and

low disinhibited participants. Differences in hedonistic and emotional responses were also observed between the various snack categories. Change in emotional and hedonistic response was evaluated for each snack condition over time, but responses did not significantly change over time in any condition. Reported excitement for snacks was not statistically different over time, condition, or disinhibition category.

4.4.1   Reported Guilt

As depicted in figure 4.11, across all snack conditions, perceived guilt did not change over time. High disinhibited participants reported feeling more guilty about their snacking experience than low disinhibited participants $(p < 0.004)$. An interaction was also noted with chocolate condition. Specifically, as shown in figure 4.12, high disinhibited participants felt significantly more guilty than low disinhibition participants during the baseline chocolate condition $(p < 0.0001)$. As depicted in figure 4.13, when data from high disinhibited and low disinhibited participants were aggregated, all participants felt more guilty during the first week of the experiment, the baseline chocolate condition, $(p < 0.0001)$. In addition, participants felt significantly less guilty during dried fruit week $(p < 0.0055)$ compared to the other snack conditions, especially sweet non-chocolate snacks.

Figure 4.11 Perceived guilt ratings regressed over time. Reported guilt did not change over time (visit day) for any snack condition.

Figure 4.12 Estimated average reported guilt of high and low disinhibited eaters across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, p < 0.0083. All significance comparisons are based on disinhibition status.
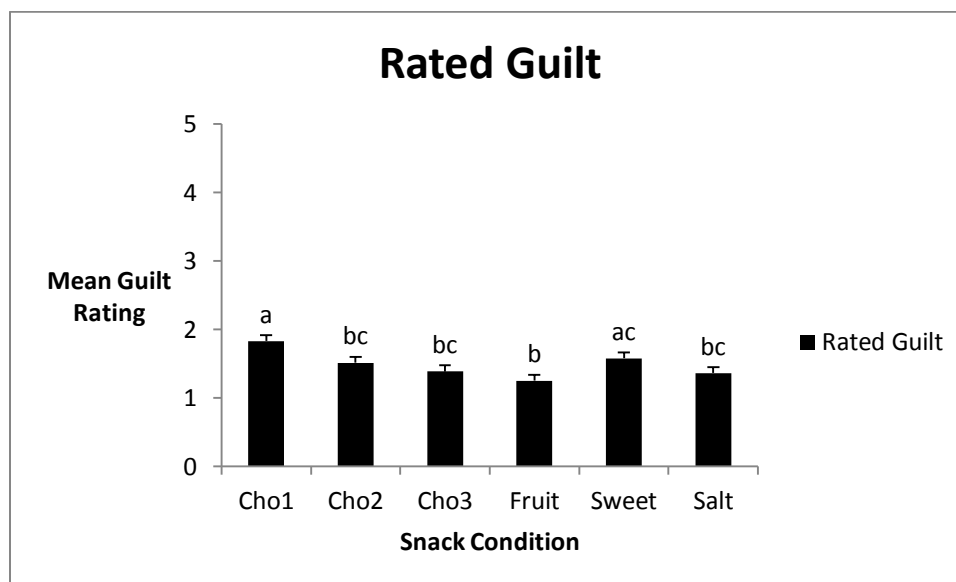
Figure 4.13 Estimated average reported guilt of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, p < 0.0083.

4.4.2 Reported Liking

As depicted in figure 4.14, across all snack conditions, perceived liking did not change over time. Disinhibition status did not significantly impact reported liking for any snack condition. However, as depicted in figure 4.15, when the data from high disinhibited and low disinhibited participants was aggregated, all participants reported liking the baseline chocolate snacks more than dried fruit snacks ($p <0.0001$). In addition, liking was reported greater in the post-chocolate restriction condition compared to the dried fruit condition ($p <0.0007$) and greater in the salty snack condition than the dried fruit snack condition ($p <0.0003$). Interestingly, while chocolate snacks were liked more than dried fruit in the baseline condition and the post-restriction condition, chocolate snacks were not liked more than dried fruit in the pre-restriction period even though the same snacks were provided for all three of the chocolate weeks. This suggests a negative impact of the pre-chocolate restriction on chocolate liking compared to baseline and post-chocolate restriction conditions.
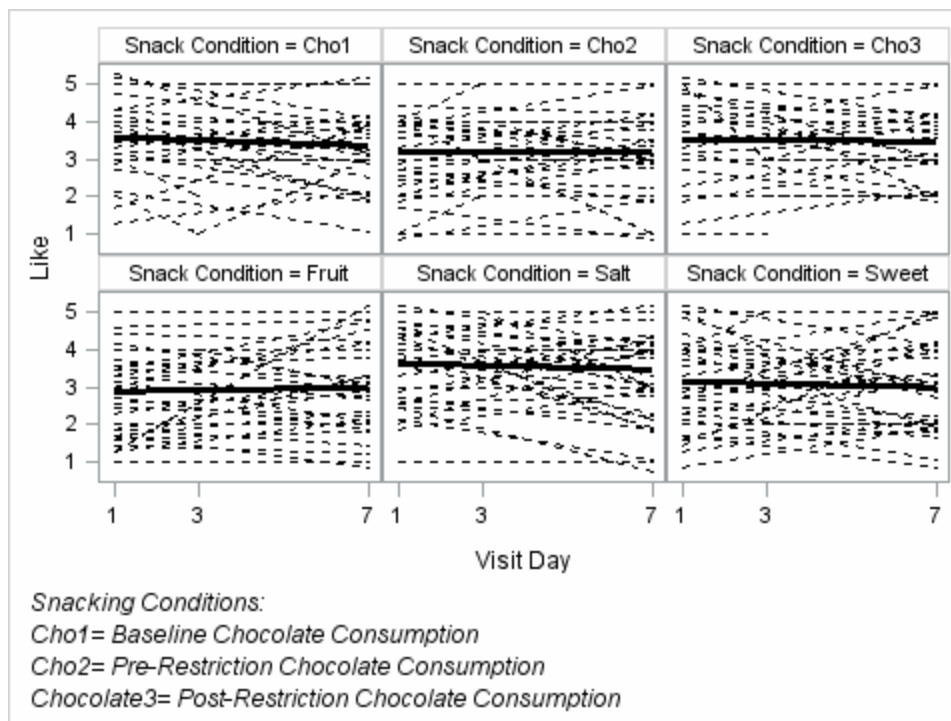
Figure 4.14 Perceived liking ratings regressed over time. Reported liking did not change over time (visit day) for any snack condition.

Figure 4.15 Estimated average reported liking of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, p < 0.0083.

4.4.3 Reported Disgust

As depicted in figure 4.16, across all snack conditions, perceived disgust did not change over time. Disinhibition status did not significantly impact reported disgust during any snack condition. However, as depicted in figure 4.17, when the data from high disinhibited and low disinhibited participants were aggregated, participants reported dried fruit as being more disgusting than chocolate in the post-restriction period (p <0.0009). The same snacks were provided in the baseline chocolate and pre-restriction chocolate conditions, but they were rated as significantly different with regard to disgust compared to the dried fruit condition.

Figure 4.16 Perceived disgust ratings regressed over time. Rated disgust did not change over time (visit day) for any snack condition.

Figure 4.17 Estimated average reported disgust of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$.

4.4.4 Reported Healthiness

As depicted in figure 4.18, across all snack conditions, perceived healthiness did not change over time. Disinhibition status did not significantly impact reported perceived healthiness for any snack condition. However, as depicted in figure 4.19, when the data from high disinhibited and low disinhibited participants were aggregated, participants reported that snacks provided during the dried fruit condition were significantly healthier than any other condition ($p < 0.0001$). In addition, sweet non-chocolate snacks were perceived as significantly less healthy than the salty snacks ($p < 0.0001$).
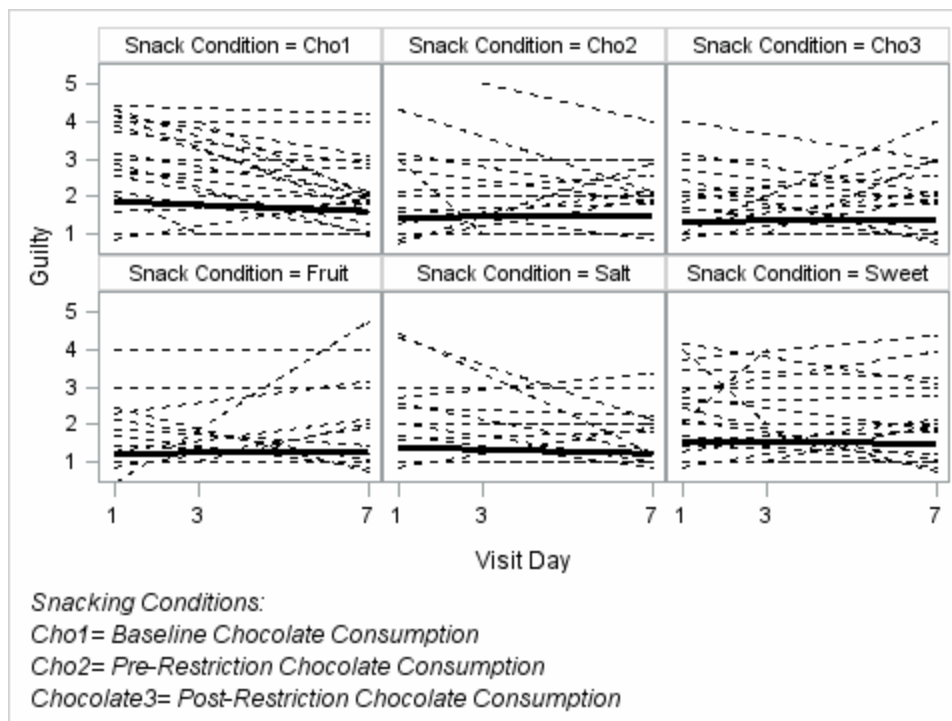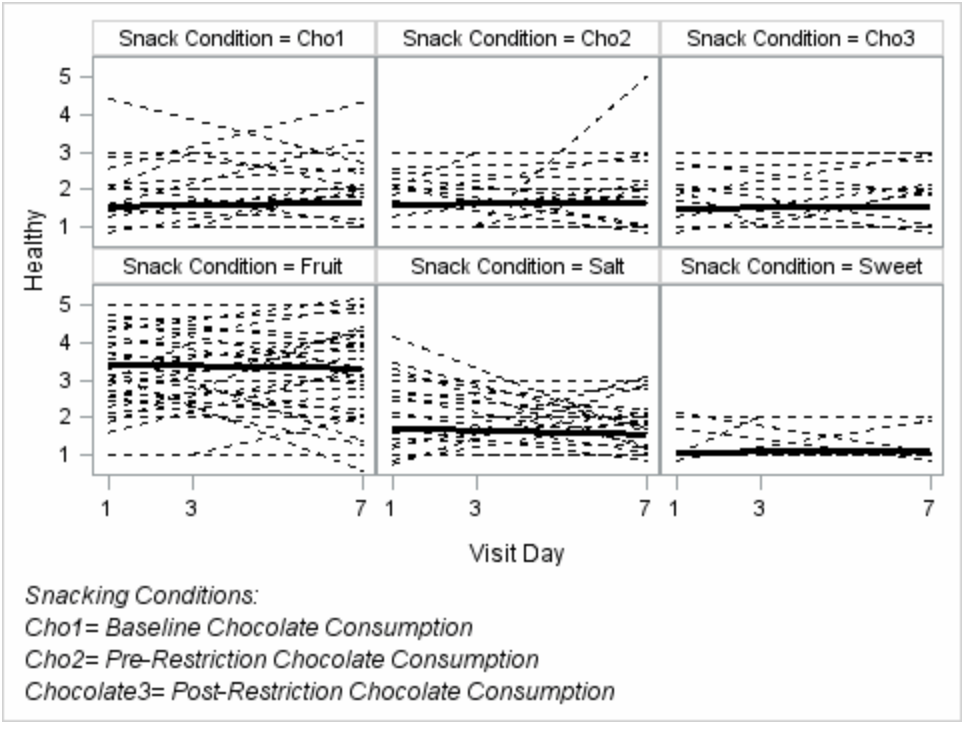
Figure 4.18 Perceived healthiness ratings regressed over time. Rated healthiness did not change over time (visit day) for any snack condition.
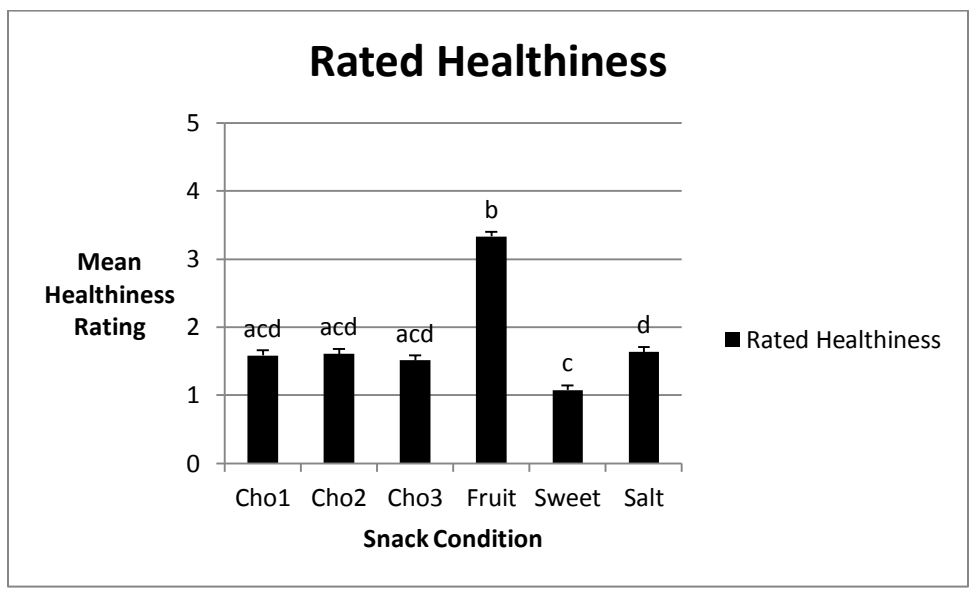
Figure 4.19 Estimated average reported healthiness of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$.

4.4.5   Reported Desirability

As depicted in figure 4.20, across all snack conditions, perceived desirability did not change over time. While disinhibition status and condition alone did not significantly impact the perceived desirability of a snack (Figure 4.21), the interaction between condition and disinhibition status was significant. This significance was driven by the difference in desirability of the chocolate snacks provided in the post-restriction period ($p < 0.007$). Low disinhibited participants found the chocolate snacks in the post-restriction period to be less desirable than high disinhibited participants. This finding matches the intake difference in the post- restriction period, as low disinhibited individuals consumed less in the post- restriction period compared to baseline, whereas high disinhibited individuals consumed the same amount of chocolate compared to baseline intake.

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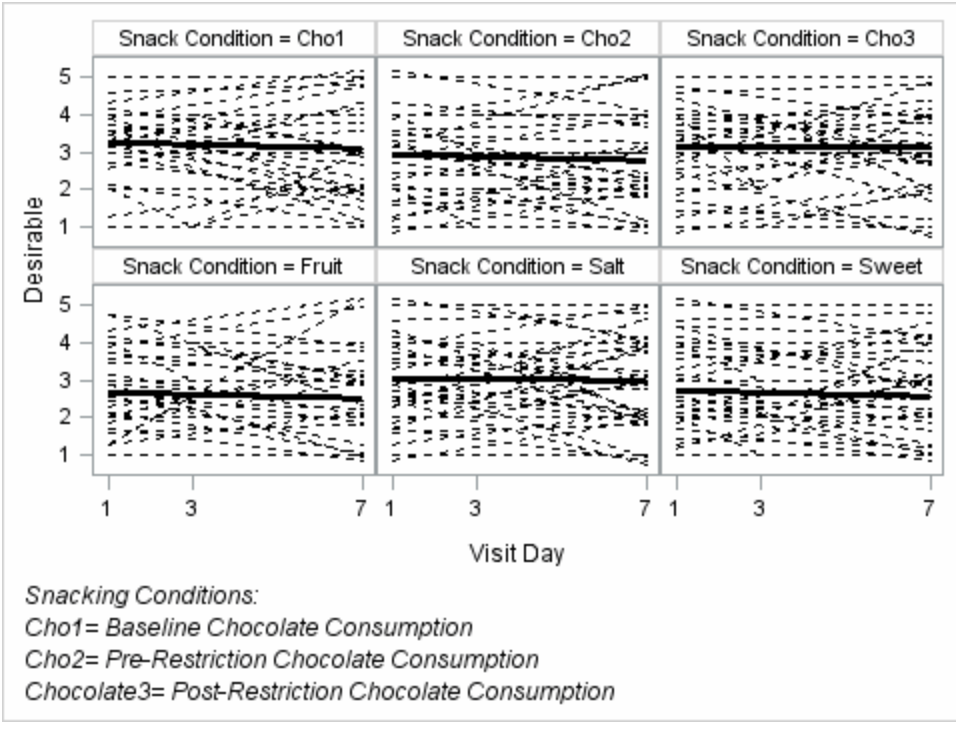
Figure 4.20 Perceived desirability ratings regressed over time. Rated desirability did not change over time (visit day) for any snack condition.
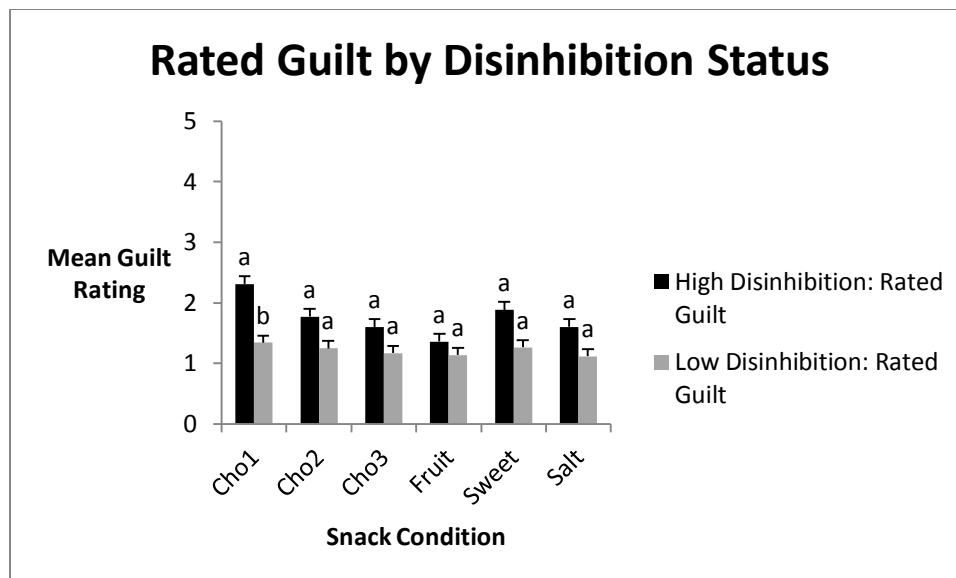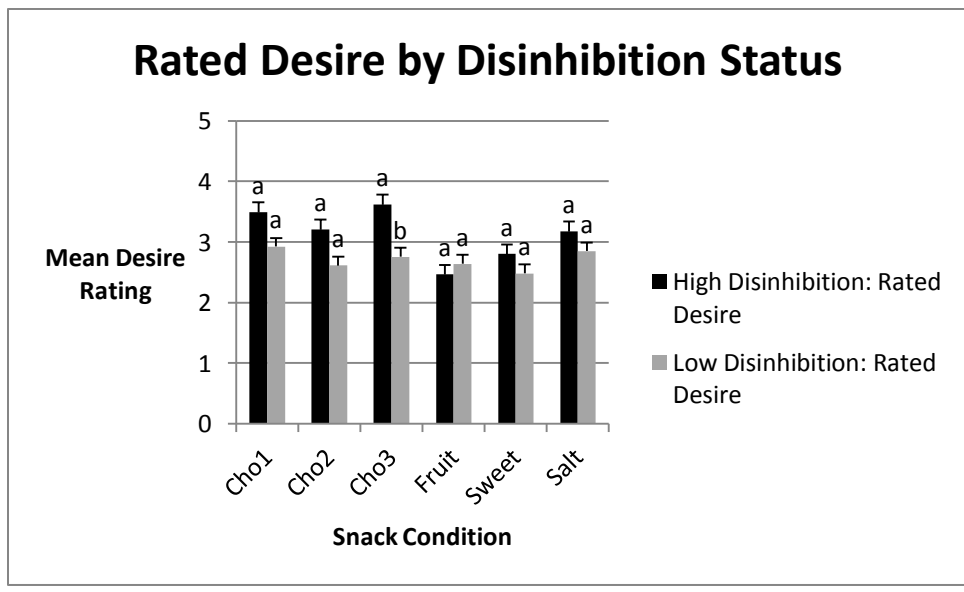

Figure 4.21 Estimated average reported desirability of high and low disinhibited eaters across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$. All significance comparisons are based on disinhibition status.

4.4.6 Reported Avoidance

As depicted in figure 4.22, across all snack conditions, perceived avoidance (rated in response to the question "I frequently avoid this type of snack") did not change over time. Disinhibition status did not significantly impact reported perceived avoidance for any snack condition. However, as depicted in figure 4.23, when the data from high disinhibited and low disinhibited participants were aggregated, participants reported that snacks provided during the dried fruit condition were significantly more avoided than any other condition with the exception of salty snacks.
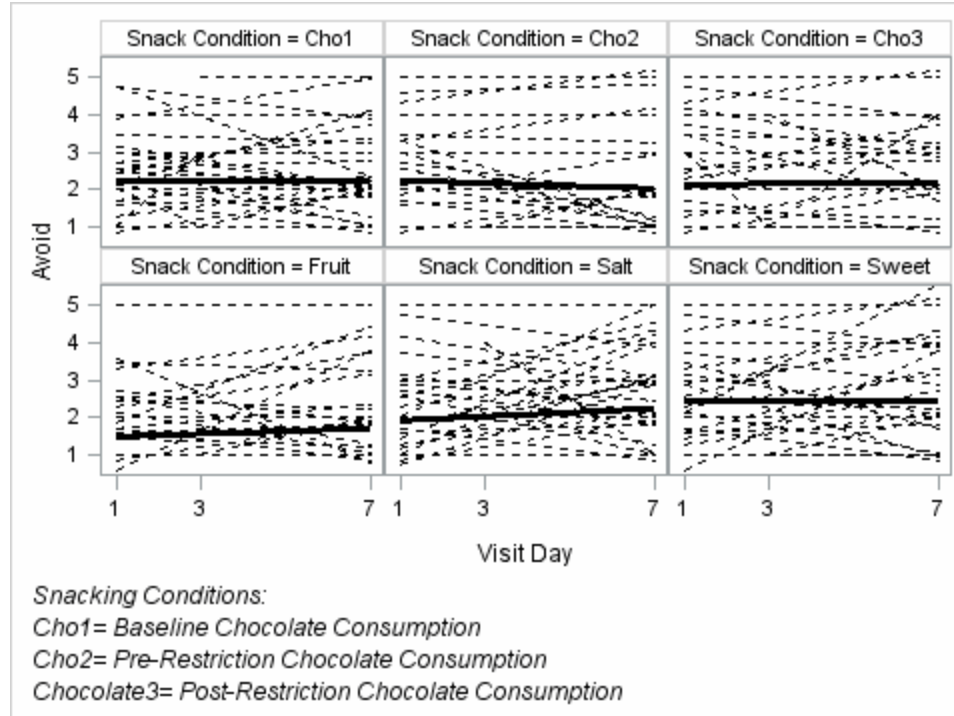
Figure 4.22 Perceived avoidance ratings regressed over time. Rated avoidance did not change over time (visit day) for any snack condition.

Rated Avoidance

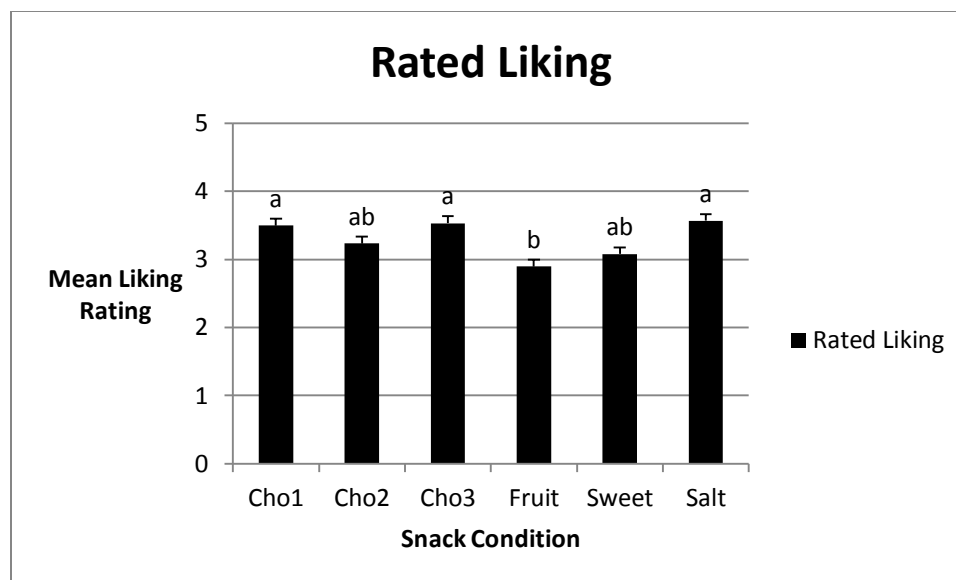Mean Avoidance Rating

Snack Condition
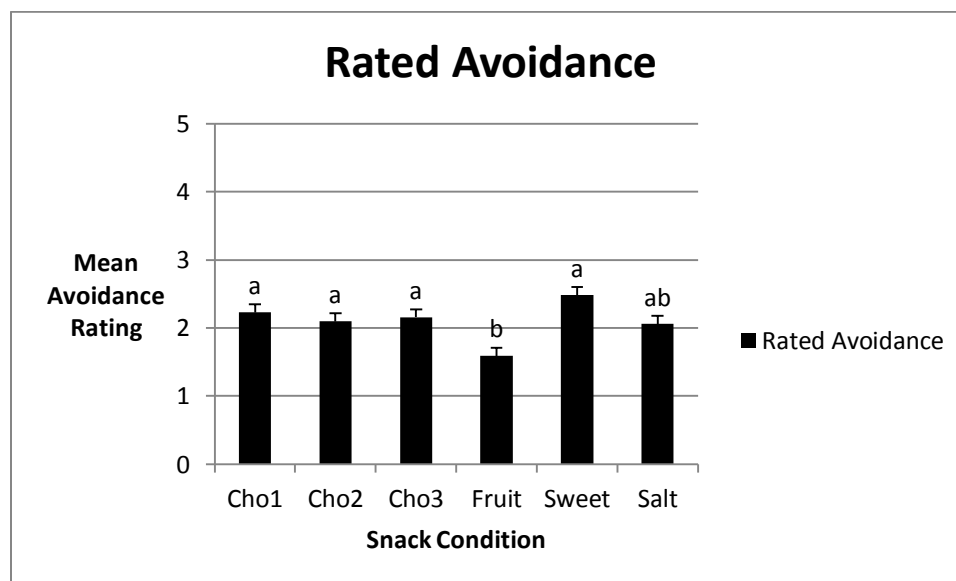
■ Rated Avoidance

Figure 4.23 Estimated average reported avoidance of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$.

4.4.7 Reported Craving

As depicted in figure 4.24, across all snack conditions, perceived craving did not change over time. High disinhibited participants did not report more cravings than low disinhibited participants as depicted in Figure 4.25, however the interaction between disinhibition and condition was significant. Specifically, high disinhibited participants reported more instances of craving for chocolate in the baseline condition (($p <0.003$), pre-chocolate restriction condition ($p <0.003$) and post- chocolate restriction condition ($p <0.002$) compared to low disinhibited participants. However, low disinhibited participants reported craving dried fruit snacks more so than high disinhibited participants ($p <0.004$). As depicted in figure 4.26, when data from high disinhibited and low disinhibited participants were aggregated, all participants craved dried fruit less than

chocolate in the pre-restriction (p <0.003), post-restriction (p <0.006), and salty snacks (p <0.006). Sweet non-chocolate snacks were craved less than chocolate in the post-restriction condition (p <0.001).
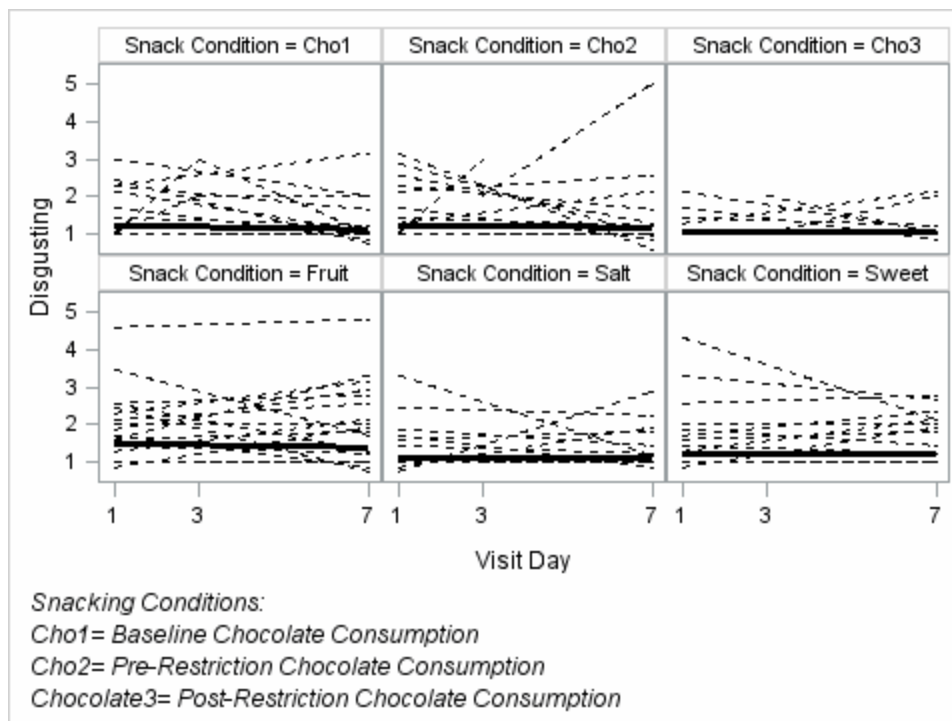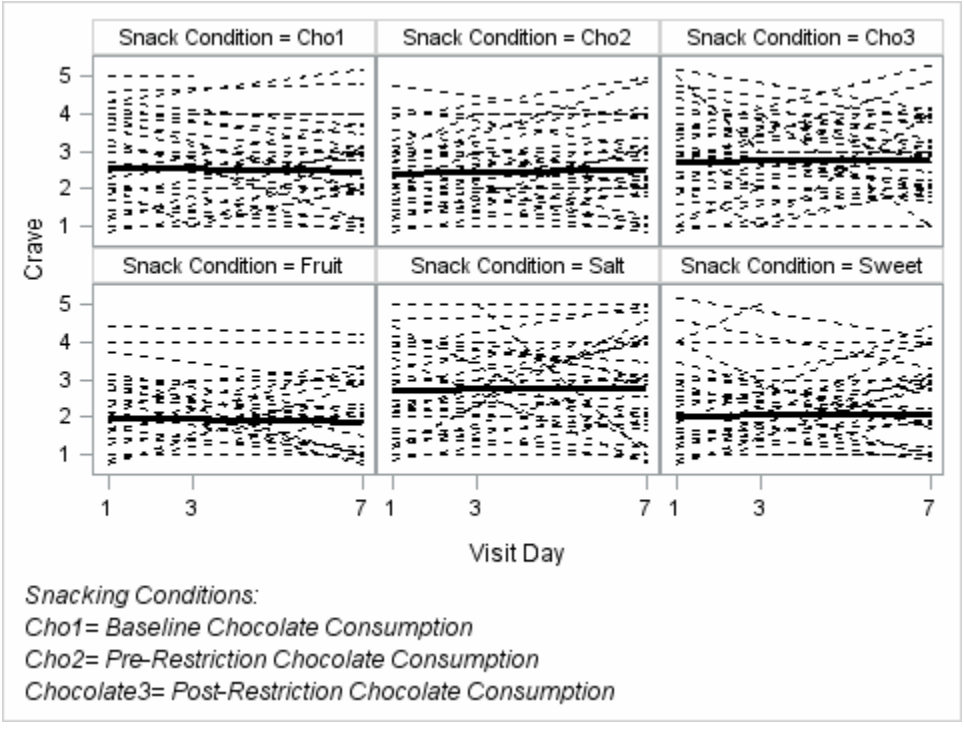

Figure 4.24 Perceived craving ratings regressed over time. Rated craving did not change over time (visit day) for any snack condition.
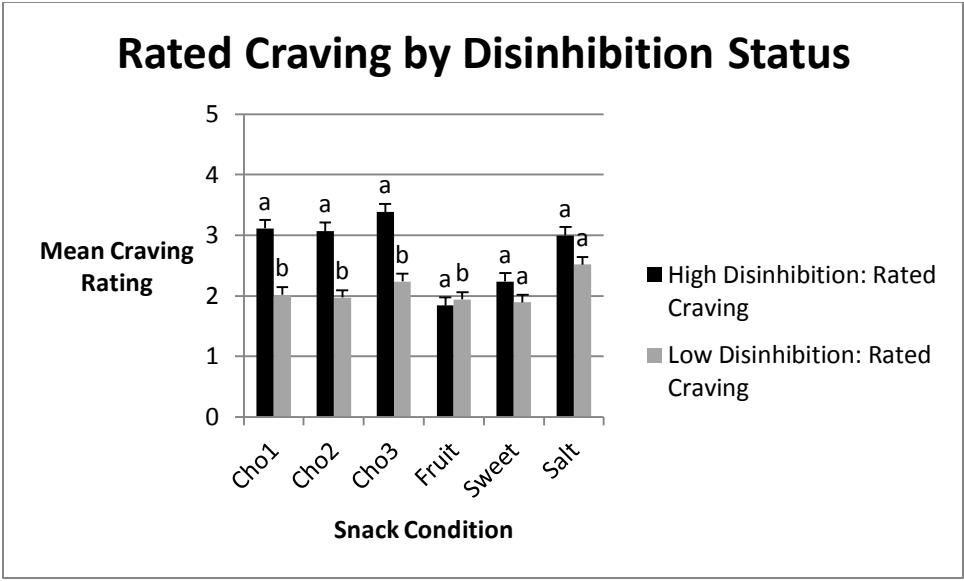
Figure 4.25 Estimated average reported craving of high and low disinhibited eaters across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$. All significance comparisons are based on disinhibition status.
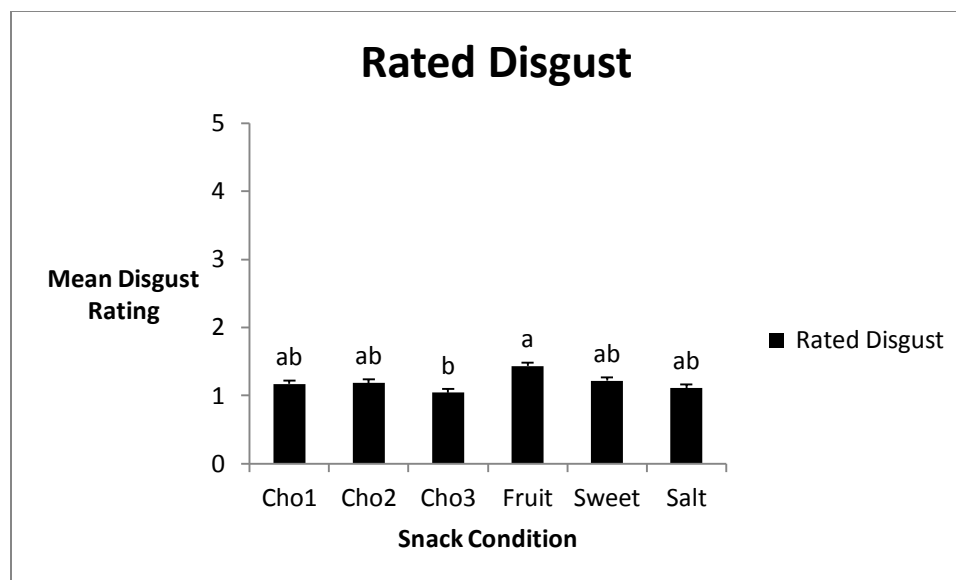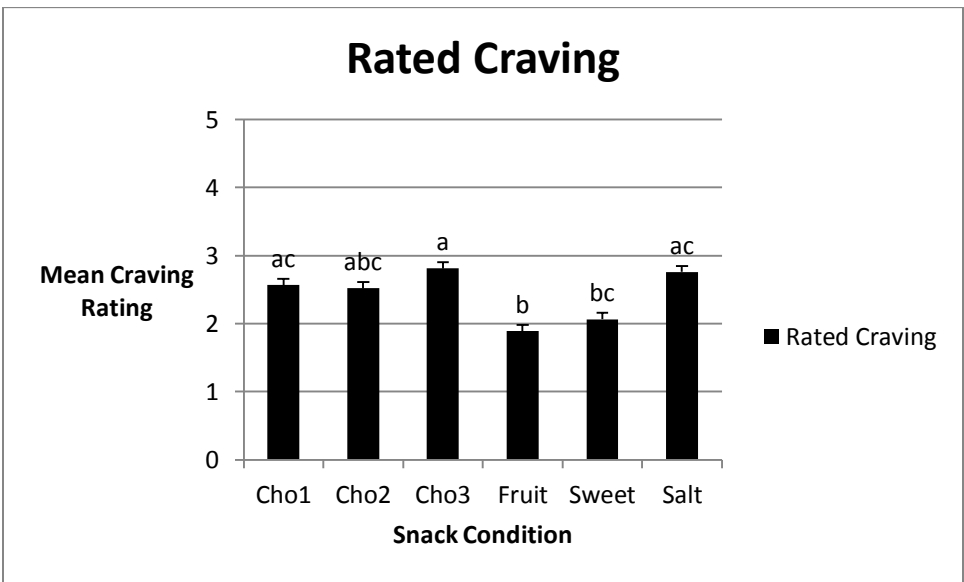

Figure 4.26 Estimated average reported craving of aggregated data across all snack conditions. Different letters indicate significant differences, with an applied Bonferroni correction, $p < 0.0083$.

4.5   Discussion

The present findings demonstrate that high disinhibited individuals did not consume the provided snacks more frequently than low disinhibited individuals when combined or assessed by the individual types. However, when the high disinhibited individuals did initiate eating, they consumed more energy from the snacks than the low disinhibited individuals. This outcome supports the hypothesis that there would be a difference between high and low disinhibited eaters. This result is also consistent with previous literature regarding the parallels of high disinhibited eaters exhibiting binge-like eating behaviors (Bryant, King et al. 2008).

The current results also replicate the conclusions of a study conducted on populations of high and low chocolate cravers. In this study, self-defined high chocolate cravers scored higher on disinhibition, hunger, external and emotional eating, were more depressed, and had a higher score on the binge eating disorder questionnaire (Hetherington and Macdiarmid 1995). This matches Table 4.1 which outlines the psychological profile of high disinhibited eaters. In addition, in the 1995 study, high cravers tended to be resistant to satiation, and lacked sensory specific satiety, the satiation for a food characterized by a specific sensory property in a single eating episode, compared to non-cravers. In the current study when eating was initiated, low disinhibited individuals consumed an equal amount of chocolate in the baseline and pre-restriction period, but consumed significantly less chocolate in the post-restriction period. High disinhibited individuals consumed the same amount of chocolate regardless of condition. The contrasting result of ingestive

behavior in the post-restriction period between high and low disinhibited participants could either be interpreted as a lack of "long term sensory-specific satiety" or a diminished response to monotony in the high disinhibited individuals. Sensory specific satiety is the diminishing hedonic response to the sensory properties of a specific food as it continues to be consumed over time, but refers to stimulus satiation in a single eating episode rather than across a matter of days or weeks (Rolls 1986). Long term sensory specific satiety was termed based on the finding that refugees confined in a refugee camp for six months with a continuous diet of three foods rated three new foods as more pleasant compared to refugees that were only at the camp for two days (Rolls and de Waal 1985). Long term sensory specific satiety has also been demonstrated in snacks as opposed to meals, and is thought to be responsible for the decrease in hedonic ratings when participants were fed the same snack for eight weeks verses a control condition of mixed snacks (Raynor, Niemeier et al. 2006). Snacking on chocolate has also been investigated regarding long term sensory specific satiety, as the pleasantness and desire to eat chocolate were found to decline over a period of 15 days while intake did not change (Hetherington, Pirie et al. 2002). While similar in concept to the results of the current study whereas low disinhibited individuals demonstrated decreased intake in the post-restriction period while high disinhibited individuals maintained intake and demonstrated increased desire and craving, caution should be exerted in the usage of the term "long term sensory specific satiety" as monotony, a decrease in preference over time as a function of how many times a specific food is consumed, may be a more reasonable explanation for these findings. The main difference between monotony and long term sensory specific satiety is monotony occurs when consumers are cognitively aware of

their decreased pleasure for a repeated food stimulus while sensory specific satiety is a subconscious awareness (Hetherington, Pirie et al. 2002). Anecdotal evidence from the current study suggests that participants were well aware that they were experiencing monotony during the second and third weeks of chocolate snacks. Chocolate also may be particularly good at inducing feelings of monotony. Staple foods can be eaten on a frequent basis without perceived monotony, whereas highly palatable foods (i.e. chocolate) may be more well liked than staple foods, but might have a faster decrease in derived pleasure upon repeated exposure (Hetherington, Bell et al. 2000). Demonstrated both in humans and animals, it is proposed that habituation, or the decrease in response to a stimulus and then a subsequent return to full response with the presentation of a novel stimulus, may be the mechanism responsible for the effects of both sensory specific satiety and monotony (Swithers-Mulvey and Hall 1992; Epstein, Caggiula et al. 1993). The results of the current study therefore could demonstrate differences in the population regarding long term sensory specific satiety, monotony, or habituation depending on the interpretation of the definition of such phenomena.

The psychological profile of high disinhibited eaters and the parallels between Hetherington and Macdiarmid's findings (Hetherington and Macdiarmid 1995) demonstrate that high disinhibited individuals and self-defined high craver individuals are highly correlated, and that there may be differences in the population concerning susceptibility to long term sensory specific satiety, monotony, or habituation. This hypothesis aligns with the emotional and hedonistic data presented in section 4.4.5, where low disinhibited individuals rated the chocolate snacks as less desirable in the

post-restriction period compared to the baseline and pre-restriction periods while no changes were observed with the high disinhibited participants.

Alternatively, another explanation of the difference in consumption in the post-restriction period could be that high disinhibited individuals just prefer chocolate over low disinhibited participants as suggested by the significant difference in the Food Action Scale score (Table 4.1). High disinhibited individuals also reported craving chocolate snacks more than low disinhibited individuals; however liking scores were not significantly associated with disinhibition alone. In addition, baseline and pre-restriction consumption are similar regardless of disinhibition status indicating that reported cravings were not acted upon until the post-restriction period. Overall, chocolate consumption, regardless of condition, was greater in high disinhibited individuals, which indicates that preference, or potentially reported cravings, were acted upon.

An additional finding was that sweet non-chocolate snacks may be an acceptable substitution for chocolate, at least compared to sweet dried fruit snacks or salty snacks based on equivalent total energy consumption in high disinhibited individuals. The greater chocolate and sweet snack intake in high disinhibited individuals compared to low disinhibited individuals might stem from greater inherent liking or drive to seek out sweet foods. The "sweet tooth hypothesis," or the idea that individuals that seek out sweet snacks also consume a great amount of fruit (Wansink, Bascoul et al. 2006), was not supported in this instance as fruit consumption was much lower than any other snack category consumption. However, only dried fruits were provided in the study and this

may only extend to fruit in a non-dried form. The hedonic results indicate that individuals felt the dried fruit snacks were healthy and felt less guilty about consuming them compared to the other snack conditions, but potentially due to palatability factors, did not feel they had a "license to indulge" or over consume given the supposed healthy nature of the fruit snacks.

This trial also revealed that consumers of milk chocolate ate significantly more kilocalories of chocolate compared to consumers of dark chocolate. The concentrations of sugar and fat in chocolate are important in determining sensory characteristics (Guinard and Mazzucchelli 1999) and much of the flavor in chocolate arises from processing techniques (Beckett 2003) which may have influenced consumption based on the specific chocolate provided in the study. However, other studies have demonstrated that dark chocolate promotes satiety and decreases the desire to eat additional sweet foods based on the stronger flavor of the cocoa , or through the mechanism of slower gastric empting properties due to the increased prevalence of cocoa butter, and hence steric acid, in dark chocolate (Steinberg, Bearden et al. 2003; Sorensen and Astrup 2011). Generally, milk chocolate is more energy dense due to its milk fat content. However, the average energy content of both the dark and milk chocolate options provided in the study was 5.0 kilocalories per gram, so that was not the cause of this discrepancy in the current study.

Finally, the results support a role for guilt as a driver of consumption differences between high and low disinhibited individuals. Rated feelings of guilt towards the snacks were

consistently higher in high disinhibited individuals. These findings raise a question about whether guilt is higher in high disinhibited individuals due to the overeating itself, or if overconsumption of food in high disinhibited individuals occurs in response to negative emotions, such as feelings of guilt. Taken together with the result that eating events tend to occur more frequently in the pre-and post-restriction period compared to baseline, these findings suggest that, for some individuals, particularly those that exhibit high disinhibition tendencies and guilty feelings about snack consumption, outright restriction of chocolate may be detrimental with respect to total energy intake.

CHAPTER 5. STRENGTHS, LIMITATIONS AND FUTURE DIRECTIONS

5.1 Strengths

Data from the current study suggest that individuals, exhibiting the high disinhibition trait and feelings of guilt about snacking, may benefit from practicing moderation rather than outright restriction of chocolate due to susceptibility to overconsumption in a response to restriction. While previous work has examined the effects of restriction, most notably conducted with children (Rollins, Loken et al. 2014), and also with abusers of drugs and alcohol (Cox, Gutzler et al. 2001), few study designs employ foods that individuals identify as a prime for an "addictive-type" response. In addition, the uniqueness of chocolate serves as a model system for restriction and an inducer of cravings (Weingarten and Elston 1991). The use of a free-living study design can also be considered a strength, as it is expected that the behaviors captured in this study are reflective of actual ingestive behaviors instead of an artificial laboratory construct. Another strength of the current study design is that the restriction period was three weeks in duration. Most individuals that resolve to restrict foods and diet are unsuccessful at maintaining the restriction for periods ranging from a week to six months after starting the restriction (Norcross, Ratzin et al. 1989; Markey and Markey 2013) . Therefore, a three week restriction is of longer

duration than previous restriction trials and may appropriately mimic the expected duration of a real life imposed restriction.

The snack format and options provided also speaks to the strength of the study design. Participants had the choice of multiple snack options in each condition to ensure that the test food was well liked and results were not just an effect of initial palatability. The finding that ingestion of chocolate may be driven by behavior motivated by sweet taste rather than the sensory and nutritional profile specific to chocolate is also unique in that this finding did not extend to sweet, dried fruit. Pairing intake data, hedonic response, and emotional response allow for a more complete picture of ingestive behavior rather than if only one outcome was assessed.

5.2   Limitations

Despite the strengths of the study design, it is also worthwhile to consider the assumptions and resulting limitations of the study design. In this trial, it was assumed participants did not share their snacks, and that participants only consumed snacks provided by the study. It was also expected that participants maintained similar dietary habits at meals, similar exercise patterns, and substituted the provided snacks for their usual non-meal snacks throughout the study. In the instances that participants were not compliant with these instructions, (i.e. intentional disregard for the study instructions or

inadvertent meal compensation) the conclusions drawn from the results may be inaccurate.

All in all, the free-living design relies heavily on the honor system regarding compliance to the study instructions. While the finding that ingestion of chocolate may be driven by behavior motivated by sweet taste rather than the sensory and nutritional profile specific to chocolate is a valid outcome and a strength mentioned previously, these finding may be inherently flawed from the participant recruitment stage where high chocolate consumers were selected. These individuals may be high chocolate consumers because of their drive for sweetness instead of individuals that are willing to substitute sweet products for chocolate as the current study suggests. The generalizability to the overall population based on these high chocolate consumers also must be considered as a weakness of the current study, in addition to the limited diversity in participant demographics which would hinder generalizability to the overall population.

The finding that chocolate intake did not increase in response to a restriction period was contrary to the hypothesis of the study, and is slightly counter-intuitive based on literature detailing the susceptibility of high disinhibited eaters to ingestive environmental cues (Bryant, King et al. 2008).This finding, or rather lack of finding, may demonstrate a critical defect in the study design. It may have been that high disinhibited eaters were more susceptible to environmental cues, but instead of the restriction cue as intended, were more susceptible to the effects of being weighed at every study visit. Previous studies have demonstrated the effect of the presence of a bodyweight scale, even

regarding its impact on chocolate consumption. For example, participants modeled a confederate's chocolate intake behavior, but when a scale was placed unobtrusively in the room, participants ate less than the confederate, demonstrating subconscious awareness of the health prime message (Brunner 2010; Brunner and Siegrist 2012). It would therefore be advisable to repeat the current investigation without the presence of a scale and without weighing participants at every visit to see if intake behaviors differ from the current findings. However, as part of the intentional misdirection for the reason behind the second week of chocolate, participants were told that "theobromine in chocolate may have beneficial effects regarding blood pressure" and this did not cause an unintentional health prime to increase consumption, but may have played a pivotal role in the finding that participants felt significantly more guilty during the first week of chocolate consumption than during subsequent weeks.

In consideration to the snacks offered, while a variety of snack options increases the likelihood that participants will find the snacks desirable, it has also been demonstrated numerous times that increased variety promotes intake (Raynor and Epstein 2001; Kahn and Wansink 2004). The chocolate, salty, and dried fruit snacking conditions may have been more conducive to sensory specific satiety within a snacking episode due to lack of perceived variety and could explain the increased intake in sweet-non chocolate snacks in high disinhibited individuals compared to the other non-chocolate snack categories (Rolls, Rowe et al. 1982). As depicted in Appendix E, it should also be noted that the energy density of each snack option was about the same, but still ranged from 3.0 to 5.7 kilocalories per gram, and were not the same from condition to condition. Chocolate and

salty snacks were more energy dense compared to the sweet and salty snacks, which makes overall comparisons concerning the amount of each snack type consumed difficult. In addition, portion sizes were not completely standardized, but four times the normal manufacturer defined portion size was provided to ensure that participants were given as much food as they desired.

<div align="center">5.3   Future Directions</div>

Building upon the weaknesses identified and continued questions resulting from the conclusions of the current study, future directions could include examining the impact of behavior under restriction of other substances. Future testing using other consumable products such as soda or coffee in a restriction paradigm may be valuable, as such products contain caffeine, but in larger doses (Mandel 2002). The Diagnostic and Statistical Manual of Mental Disorders classifies between 15-25% of the caffeine beverage consuming population as dependent on caffeine (Keast and Riddell 2007) so these products may have a stronger reinforcing value compared to chocolate and may exhibit magnified consumption differences in a pre-or post-restricted state. Sweetness, or sugar, is viewed by some as addictive, and while the data for "sweetness addiction" presented by animal and human investigations are weak (as referenced by Section 2.3.1), it might also be valuable to examine the concept of sweetness in a restriction paradigm. While many caffeinated beverages are confounded by sweet taste, this could easily be remedied (i.e. black coffee). Also, the intake before and after restriction of sweet non-chocolate snacks is needed to be able to establish cause and affect claims concerning the specificity of sweetness driving consumption of chocolate.

Mandatory food diaries or daily food frequency questionnaires in conjunction with intake measurements would have been valuable to collect to help ensure compliance. In addition, this information would be beneficial to more accurately assess the substitutability of the different snack types, if outside snacks were eaten, and to determine if kilocalories derived from meals were reduced to compensate for extra snacking that may have occurred due to the availability of free snacks. The very nature of the study, or the offering of free, large portions of palatable food might have also induced excessive consumption and misrepresent real world energy intake (de Castro 2010). Demonstrative of this, the mean per capita daily intake of chocolate and candy in the United States is 5.9g, or about 44 kilocalories, and constitutes about 3.1% of total saturated fat intake (O'Neil, Fulgoni Iii et al. 2011; Murphy, Barraj et al. 2013). Despite the fact that high chocolate consumers who probably consume above the mean per capita daily intake of chocolate candy were selected to take part in this study, excessive intake may have been promoted by the nature of the study. Weight change was not significant during the study given the relatively short time duration, but with a larger number of participants and longer study period, weight change may be a valuable aspect for further consideration. However, as previously mentioned, since weight change was not significant in the current study, it might be worthwhile to not examine weight change at all, but to investigate if the outcomes maintain consistent with and without the scale (health related prime) present.

 Also, examining the impact of the pre-and post- restriction on different populations rather than healthy adults from a university setting might be valuable. It has been previously demonstrated that females and overweight individuals snack more frequently

and chocolate/candies were one of the primary items differing in consumption frequency between these and male focused or normal weight populations. These populations therefore may be especially susceptible to the pre-and post- chocolate restriction conditions (Bertéus Forslund, Torgerson et al. 2005).

In addition, added insight to the current study's findings regarding disinhibition could be gained by study designs that include additional measures of impulsiveness and cognitive inhibition. Impulsiveness is defined as a reaction to a temptation of interest and is often interchangeable with behavioral under-control and behavioral disinhibition. Disinhibition is grouped as a type of impulsiveness along with sensation seeking, executive attention bias, and inhibitory control which prevents impulses from influencing behavior (Reynolds, Ortengren et al. 2006; Dick, Smith et al. 2010). Impulsivity measures correlate with disinhibition on the TFEQ, but not restraint (Yeomans, Leitch et al. 2008). Self-control, on the other hand, is a critical part of successful restrained eating (Keller and Siegrist 2014). Those who want to avoid a high energy snack such as chocolate, but have weak cognitive inhibition, consume more than those with strong inhibitory control (Hofmann, Friese et al. 2009; Allan, Johnston et al. 2010). Further information on impulsiveness and cognitive inhibition would be valuable and could perhaps differentiate and provide further insight into high disinhibited eaters and low disinhibited eaters and their respective responses to environmental stimuli.

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APPENDICES

Appendix A   Institutional Review Board Application

Ref. # _____

APPLICATION TO USE HUMAN RESEARCH SUBJECTS
Purdue University
Institutional Review Board

1.   Project Title: Effect of Three-Week Chocolate Candy Restriction on Pre- and Post-restriction Chocolate Candy Consumption in Healthy Adults

2.   Full Review ☐   Expedited Review ☒

3.   Anticipated Funding Source: _____Internal_____

4.   Principal Investigator *[See Policy on Eligibility to serve as a Principal Investigator for Research Involving Human Subjects]*:

Name and Title	Department, Building, Phone, FAX, E-mail address
Prof. Rick Mattes	Nutrition Science, Stone Hall, Ph: 765-494-0662
(Distinguished Professor of Nutrition Science)	Fax No.: (765)494-0674;
	E-mail: mattes@purdue.edu

5.   Co-investigators and key personnel *[See Education Policy for Conducting Human Subjects Research]*:

Name and Title	Department, Building, Phone, FAX, E-mail address
Sze Yen Tan	Nutrition Science, Stone Hall, Ph: 765-496-3067
(Post-doctoral Research Associate)	Fax: 765-494-0674, tan66@purdue.edu
Chelsey Keeler	Nutrition Science, Stone Hall, Ph: 607-331-9701
(Graduate Research Assistant)	Fax: 765-494-0674, ckeeler@purdue.edu

6.   Consultants *[See Education Policy for Conducting Human Subjects Research]*:

Name and Title	Department, Building, Phone, FAX, E-mail address
Judy George	Nutrition Science, Stone Hall, Ph:765-494-6192
(Laboratory Manager)	Fax:765-494-0674, georgej@purdue.edu
Robin Rhine	Nutrition Science, Stone Hall, Ph:765-494-6192
(Laboratory Technician)	Fax:765-494-0674, rrhine@purdue.edu

7.   The principal investigator agrees to carry out the proposed project as stated in the application and to promptly report to the Institutional Review Board any proposed changes and/or unanticipated problems involving risks to subjects or others participating in the approved project in accordance with the HRPP Guideline 207 Researcher Responsibilities, Purdue Research Foundation-Purdue University Statement of Principles and the Confidentiality Statement. The principal investigator has received a copy of the Federal-Wide Assurance (FWA) and has access to copies of 45 CFR 46 and the Belmont Report. The principal investigator agrees to inform the Institutional Review Board and complete all necessary reports should the principal investigator terminate University association.

_____   _____
   Principal Investigator Signature   Date

8. The Department Head (or authorized agent) has read and approved the application. S/he affirms that human subjects in this project is relevant to answer the research question being asked and has s scholarly merit. Additionally s/he agrees to maintain research records in accordance with the IRB s research records retention requirement should the principal investigator terminate association with the University.

_____   _____
Department Head *(printed)*   Department Name

_____   _____
Department Head Signature   Date

APPLICATION TO USE HUMAN RESEARCH SUBJECTS

9. This project will be conducted at the following location(s): (please indicate city & state)
   - ☒ Purdue West Lafayette Campus
   - ☐ Purdue Regional Campus (Specify): _____
   - ☐ Other (Specify): _____

10. If this project will involve potentially vulnerable subject populations, please check all that apply.
    - ☐ Minors under age 18
    - ☐ Pregnant Women
    - ☐ Fetus/fetal tissue
    - ☐ Prisoners Or Incarcerated Individuals
    - ☒ University Students (PSYC Dept. subject pool ____)
    - ☐ Elderly Persons
    - ☐ Economically/Educationally Disadvantaged Persons
    - ☐ Mentally/Emotionally/Developmentally Disabled Persons
    - ☐ Minority Groups and/or Non-English Speakers
    - ☐ Intervention(s) that include medical or psychological treatment

11. Indicate the anticipated maximum number of subjects to be enrolled in this protocol as justified by the hypothesis and study procedures: _____75_____

12. This project involves the use of an **Investigational New Drug** (IND) or an **Approved Drug For An Unapproved Use**.
    ☐ YES   ☒ NO
    Drug name, IND number and company: _____

13. This project involves the use of an **Investigational Medical Device** or an **Approved Medical Device For An Unapproved Use**.
    ☐ YES   ☒ NO
    Device name, IDE number and company: _____

14. The project involves the use of **Radiation or Radioisotopes**:
    ☐ YES   ☒ NO

15. Does this project call for: (check-mark all that apply to this study)
    - ☐ Use of Voice, Video, Digital, or Image Recordings?
    - ☒ Subject Compensation? Please indicate the maximum payment amount to subjects. $__50.00___
      Purdue's Human Subjects Payment Policy   Participant Payment Disclosure Form
    - ☐ VO2 Max Exercise?
    - ☐ More Than Minimal Risk?
    - ☐ Waiver of Informed Consent?
    - ☐ Extra Costs To Subjects?
    - ☐ The Use of Blood?   Total Amount of Blood _____
                                   Over Time Period (days) _____
    - ☐ The Use of rDNA or Biohazardous materials?
    - ☐ The Use of Human Tissue or Cell Lines?
    - ☐ The Use of Other Fluids that Could Mask the Presence of Blood (Including Urine and Feces)?
    - ☐ The Use of Protected Health Information (Obtained from Healthcare Practitioners or Institutions)?
    - ☐ The Use of academic records?

16. Does investigator or key personnel have a potential financial or other conflict of interest in this study?
    ☐ YES   ☒ NO

APPLICATION NARRATIVE

A.   PROPOSED RESEARCH RATIONALE

Craving differs from hunger because it occurs even when a person is in a satiated state and in the absence of an energy deficit. Craving is usually triggered by specific foods and may be attributable to certain sensory properties of foods. Foods that are craved are often regarded as less healthy choices, and are higher in energy content. Chocolate is one of the most commonly reported foods craved by people in this country. Together, craving for chocolate has been suggested to be a possible cause of weight gain and access to chocolate therefore needs to be restricted.

However, it remains unknown if restriction may induce maladaptive eating behaviors of chocolate cravers. The anticipation of going on a diet has been shown to cause restrained and disinhibited eaters to react by consuming more chocolate. In this study, we will examine if this response is also found in chocolate cravers when they are asked to undergo three weeks of chocolate restriction. This study will also examine chocolate cravers' response after the chocolate restriction is lifted. We hypothesize that chocolate consumption of cravers will increase both before and after chocolate restriction is imposed. We also hypothesize that chocolate craving is specific to the food rather than its sweet taste, and that chocolate cravers are less willing to substitute chocolate for salty snacks, natural snacks, and sweet non-chocolate snacks during the restriction.

B.   SPECIFIC PROCEDURES TO BE FOLLOWED

Study design:

The study will have a 6-week, single-blinded, cross-over design that includes adult males and females who are regular chocolate candy eaters (>4 times/week). This study will be advertised as a study of blood pressure and snacking so that participants remain naïve to study objectives and maintain their habitual chocolate candy consumption throughout the study. This study is divided into four phases: Phase 1 measures of habitual chocolate candy consumption (1 week), Phase 2 assesses participants' chocolate consumption while anticipating an oncoming chocolate candy restriction (1 week), Phase 3 is the total chocolate candy restriction period, but participants will be given 3 non-chocolate-candy snack substitutes in a random order (1 week per snack type, 3 weeks total), and Phase 4 examines participants' chocolate candy consumption when the 3-week restriction is lifted (1 week).

Primary objective:

The primary objective of this study is to investigate the anticipatory- (before) and reactive-responses (after) of regular chocolate candy consumers to a three-week total chocolate candy restriction. A secondary objective of this study is to examine if the observed responses before and after chocolate candy restriction can be predicted by participants' personality, ingestive behavior and food craving status. Providing different snacks to the participants during the restriction period will allow us to determine if craving is specific to specific foods, in the case of this study, chocolate.

Experiment protocol:

Screening Procedures: Potential participants will respond to public advertisements of varying media (see attached for examples). They will be asked to complete a general online screening questionnaire for the Laboratory for Sensory and Ingestive Studies (www.cfs.purdue.edu/lsis, IRB approval #504002017). Potential participants will be asked to fill in a food frequency questionnaire containing common food items, among them chocolate candy, so that frequency of consumption can be assessed without resulting in attention biases. Potential participants meeting pre-set criteria will be enrolled. They will be scheduled for an Enrollment Visit, and then they will commence the study (Figure 1).

Enrollment visit: Written consent will be obtained from eligible participants during their enrollment visit to the laboratory. Measurements at enrollment include:
 a. Height and weight measurements
 b. Craving (FCQ-T) and personality questionnaires
 c. Snacking Preferences
  • Participants will be asked to rank chocolate containing snacks, salty snacks, sweet non-chocolate snacks, and natural (dried fruit) snacks for preference.

Together, the enrolment visit will take approximately 30 minutes.

Figure 1:

SCREENING (N=50)
Inclusion criteria: adult males and females, snackers, frequent chocolate candy eaters (4X/week), Native-born, lived in the US for majority of life. Disinhibited (n=25) vs. Non-Disinhibited(n=25). Personality and ingestive behavior questionnaires.

Enrollment Visit
Written consent, Anthropometric measurements, craving assessment, snacking preferences

PHASE 1 (BASELINE: 1 WEEK)
Daily body weight & BP, chocolate candy consumption.

PHASE 2 (PRE-RESTRICTION: 1 WEEK)
Daily body weight & BP, chocolate candy consumption after being informed that all chocolate products have to be restricted for 2 weeks.

PHASE 3 (RESTRICTION: 1 WEEK)
Salty snacks
Daily weight & BP, snack consumption.

PHASE 3 (RESTRICTION: 1 WEEK)
Sweet Snacks (Not Chocolate Flavored)
Daily weight & BP, snack consumption.

PHASE 3 (RESTRICTION: 1 WEEK)
Natural snacks (dried fruit)
Daily weight & BP, snack consumption.

Note: 3 week conditions in randomized order

PHASE 4 (POST-RESTRICTION: 1 WEEK)
Daily body weight & BP, chocolate candy consumption after 2 weeks of chocolate products restriction. Debriefing Process.

Phase 1: Baseline Consumption Participants will visit the laboratory on Monday, Wednesday and Friday for a week. At each session the participant will be provided with a bag containing their preferred chocolate candies to take home to consume as much as they like. They will be instructed to bring it to the next session to be weighed. Participants will also be provided with separate snack bags for days that they do not come into the laboratory (Tuesday, Thursday, and the weekend). Three snack varieties will be provided to prevent consumption fatigue. On Monday, Wednesday, and Friday, daily body weight will be measured by a clinical scale and body composition will be measured by bioelectric impedance (participant will be told that the purpose is to measure body water which can influence blood pressure), and 3 BP measurements will be taken, once every five minutes. Participants will answer appetite and mood questionnaires while BP measurements are taken. Each visit is estimated to take 15 minutes.

Phase 2: The study length and protocol will be similar to Phase 1, except that during every visit of Phase 2, participants will be informed and reminded that theobromine in chocolate may affect BP measurements, and they will be asked to restrict chocolate candy for the following 3 weeks, after they complete their BP measurement in Phase 2. Daily chocolate candy consumption of participants will be measured by weighing what is returned from their snack bags will be recorded during Phase 2. This data will be regarded as the "pre-restriction consumption".

Phase 3: This phase entails total chocolate candy restriction for 3 weeks. Participants will continue to visit the laboratory on Monday, Wednesday, and Friday for BP measurements and to fill out questionnaires, but instead of chocolate candies, they will be provided with different substitutes in a random order each week: a) a salty snack b) a non-chocolate sweet candy snack, or c) a natural snack. To ensure compliance to the restriction, a ruse will be introduced where participants will be told that their saliva samples (collected using ordinary filter paper during their visits for BP measurements) will tell if they have been eating chocolate. They
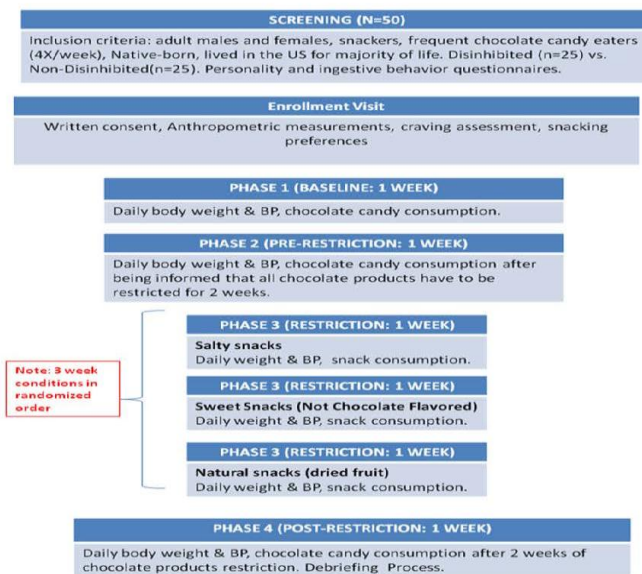
will also be told that their study compensation will be increased if they are found to be compliant during the 3-week chocolate-candy restriction period. In actuality, it is not possible to measure saliva theobromine, so all participants will receive full compensation.

Phase 4: Participants return after chocolate-candy restriction for the final week of BP measurements. The study protocol for this phase is similar to Phase 2, where participants will be told that the researchers are interested in investigating the re-introduction of chocolate into their daily diets on BP. They will be provided with chocolate candy snacks as in Phase 1. On the last Friday session, participants will be asked if they had been told the true purpose of the study by an outside source prior to completion of the study. Participants will then be debriefed about the actual objective of this study. They will also be re-consented and have the option to exclude their data from analyses. The data from participants that were told about the true purpose of the study prior to completion of the study will be excluded.

C. **SUBJECTS TO BE INCLUDED**

Sixty adult participants (age 18-60 years) who are regular chocolate candy eaters (> 4 times/week, at least 1 serving each time) are needed to complete this study. To allow for attrition, a maximum of 75 participants will be recruited by various forms of public media at Purdue University. This study will be advertised as a study of blood pressure (BP) and snacking so that chocolate candy snacking behavior is not affected throughout the study. Additional eligible criteria include:

- Subjects high and low in restraint/disinhibition based on TFEQ
- BMI between 18-35
- American born, or have lived in United States for majority of life, as different cultures have been shown to have lower chocolate preferences and consumption.
- Snack on a regular basis
- No allergies to test foods
- Not taking medications that affect appetite or metabolism
- Willing to comply to study protocol and to eat test meals
- Consume chocolate, or chocolate candies more than 4 times per week

D. **RECRUITMENT OF SUBJECTS AND OBTAINING INFORMED CONSENT**

Participants will be recruited through public advertisements on the Laboratory for Sensory and Ingestive Studies website: www.cfs.purdue.edu/lsis (IRB approval #504002017), newspaper ads, Purdue Today, Boiler TV, PurduE-board, and posted flyers (see attached). After expressing interest, subjects will be asked to complete the initial health and personality questionnaires described above. Those meeting the preset criteria, described above, will be contacted via e-mail to schedule a screening visit. Eligible participants will be asked to read and sign an informed consent form at the beginning of the enrollment session. Participants will also be re-consented and have the option to exclude their data from analyses after being informed of the true purpose of the study.

E. **PROCEDURES FOR PAYMENT OF SUBJECTS**

Participants will receive a payment of $ 25 as compensation for any inconvenience caused by participating in this study. A payment of $4/7-day testing period will be made to participants should they withdraw or be withdrawn from the study for sessions completed. Participants will be told that they will receive an additional $ 25 if saliva theobromine tests confirm that they are compliant with eating the diets. In actuality, it is not possible to measure saliva theobromine, so all participants will receive full compensation. Thus, they will receive a total of $50 for completion of the study.

F. CONFIDENTIALITY

Participant will be coded and the record of participant progress in the study will be kept in a confidential file in a locked filing cabinet. The confidentiality of any computer record will also be carefully guarded by never including the participant's name on any data file. The information will be stored electronically in a password-protected file indefinitely. For participants who do not meet pre-set criteria, screening data will be immediately destroyed. The key linking ID numbers and data will be destroyed upon completion of the study. A copy of the written consent form will be retained for three years after termination of the study, at which time it will be destroyed. No information by which participants can be identified will be released or published. However, participants will be informed that to process their payments, it will be necessary to provide their name, social security number, and address to the university business office. In addition, participants will be notified that their research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight.

G. POTENTIAL RISKS TO SUBJECTS

Participants will not be faced with a level of risk greater than normally encountered on a daily basis. We are attempting to induce a craving, but this is short term and one that is commonly experienced in daily life by chocolate consumers. It is expected to have no long term consequences. The snacks provided are comprised of commercially available products and pose no foreseeable risk outside of the possibility of allergic reactions. There is the risk of having an allergic reaction to the test food. For example, peanuts, a common food allergen, are included in this study. If participants experience an allergic reaction, they are instructed to stop consuming the test food immediately and seek medical assistance. Gastrointestinal distress, such as gas or diarrhea, may occur but is not expected as the snacks provided are often already part of the participant's routine diet, and are presented in amounts that are not foreseen to cause gastrointestinal distress Participants will be re-consented at the end of the study and have the option to have their data not included in analyses.

H. BENEFITS TO BE GAINED BY THE INDIVIDUAL AND/OR SOCIETY

There are no foreseeable direct benefits to participants. The knowledge gained from this study may provide new insights for the management of food craving and obesity – the nation's most pressing public health problem.

I. INVESTIGATOR'S EVALUATION OF THE RISK-BENEFIT RATIO

Participants will not be faced with a level of risk greater than normally encountered on a daily basis. The findings may yield insights for obesity. Thus, the potential benefits outweigh the possible risks.

J. WRITTEN INFORMED CONSENT FORM

See attached consent form and re-consent form.

K. WAIVER OF INFORMED CONSENT OR SIGNED CONSENT

Not Applicable

L. INTERNATIONAL RESEARCH

Not Applicable.

M. SUPPORTING DOCUMENTS

See attached:
- Study Advertisements
  - o Recruitment Flyer
  - o Newspaper/Newsletter Advertisement
- Brief Questionnaire
- Food Frequency Questionnaire
- Informed Consent Form
- Re-Consent Form
- Power of Food Scale
- Food Craving Questionnaire—State
- Food Craving Questionnaire-Trait
- Perceived Stress Scale
- Zung Self-Rating Scale (Depression)
- Eating Attitudes Test (Disordered Attitudes Toward Foods)
- Eysenck Personality Questionnaire-Revised (Extraversion)
- Food Attitudes Survey (Finickiness)
- Brief Sensation Seeking Scale 4
- Food Action Rating Scale (Food Preferences)
- Physical Activity Questionnaire
- Appetite Logs
- Positive and Negative Affect Scale (PANAS)
- Revised Restraint Scale
- Three Factor Eating Questionnaire
- Example of Snack Evaluation Questionnaires

Appendix B   Study Advertisements

Poster Advertisement

Newspaper Advertisement

Newspaper/Newsletter Advertisement

Men and women ages 18-60 years are needed by the Purdue Nutrition Science Department for a study of blood pressure and snacking (Principal investigator: Richard Mattes, Professor of Nutrition Science). Participants must have been born in the United States, be in general good health, have no allergies to the test foods, and are not taking medications that affect appetite or metabolism. The study involves 3 visits a week over a 6-week period. Compensation: $50 upon completion of the study. For more information, contact Chelsey at almeal@purdue.edu.

Appendix C   Consent Forms

Initial Consent Form

Research Project Number   _____

RESEARCH PARTICIPANT CONSENT FORM
Blood Pressure and Snacking Study

Principal Investigator: Richard Mattes, MPH, PhD, RD
Purdue University
Department of Nutrition Science, Stone Hall
West Lafayette, IN 47907
(765) 494-0662

Purpose of Research

This study will examine the effects of snacking on blood pressure.

Study overview

This 6-week study requires 19 visits to the laboratory (Room 226 of Stone Hall, Purdue University). You will come into the laboratory every Monday, Wednesday, and Friday for no more than 30 minutes to have 3 blood pressure (BP) measurements, and answer a few appetite questionnaires between measurements. You will be given bags of snack food on these days to take home with you to consume at your leisure. You do not have to eat all of the snack food, just as much as you wish. You will be asked to maintain your normal diet and schedule throughout the duration of the study, but refrain from eating snacks that are not provided by this study. You will be asked to return the uneaten snack portion on your next visit. The figure below shows the flow and activities involved in this study.
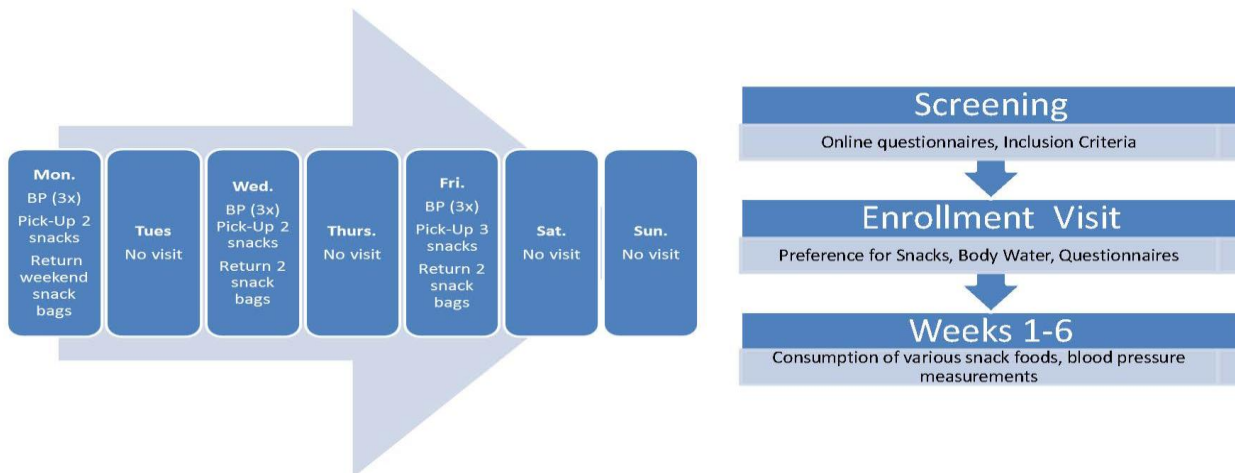
Date: _____   Page 1 of 3   Participants initial: _____

Research Project Number   _____

Specific Procedures
Enrollment visit
a. Preference for snacks
b. Body water, composition and height (Body water will be measured by a clinical scale that you stand on-body water composition will be measured by bioelectric impedance while standing on the scale.)
c. You will complete a short questionnaire to determine:
 i. If you crave foods
 ii. If you are stressed
 iii. If you are depressed
 iv. Your attitudes toward food
 v. If you are outgoing
 vi. If you are a picky eater
 vii. If you are a risk taker
 viii. Your food preferences
 ix. Your activity at work and home

Study Visits (Week 1-6), approximately 15 minutes each visit
a. Body water composition using the same scale as in the enrollment visit (above)
b. Saliva sample to measure compliance (During weeks 3-5 only)
c. 3 blood pressure measurements, once every 5 minutes
d. Fill out short mood and appetite questionnaires while waiting between blood pressure measurements

Duration of Participation
In total, your participation in this study requires 6 weeks and includes 19 visits. You will be required to attend:
a. All testing visits which will be conducted at Purdue University
b. The length of each visit is:
 i. **Enrollment visit**: 30 minutes
 ii. **Visits every Monday, Wednesday and Friday**: 15 minutes each

Risks
The risk of participating in this study is minimal. The snacks provided are comprised of commercially available products and pose no foreseeable risk outside of the possibility of allergic reactions. There is the risk of having an allergic reaction to the test food. For example, peanuts, a common food allergen, are included in this study. If you experience an allergic reaction, stop consuming the test food immediately and seek medical assistance. Gastrointestinal distress, such as gas or diarrhea, may occur but is not expected as the snacks provided are often already part of your routine diet, and are presented in amounts that are not foreseen to cause gastrointestinal distress. There is a chance of breach of confidentiality, but records will be protected as described in the Confidentiality section below.

Benefits
There are no expected benefits to you from your participation. However, the knowledge gained from this work may provide new insights for the management of body weight.

Compensation
You will receive a payment up to $50 for successfully completing the study, as compensation for any inconvenience caused by participating in this study. A prorated payment of $4/week will be made should you withdraw or be withdrawn from the study (for example, for failure to report to study sessions).

Date: _____   Page 2 of 3   Participants initial: _____

Research Project Number _____

Injury or Illness
Purdue University will not provide medical treatment or financial compensation if you are injured or become ill as a result of participating in this research project. This does not waive any of your legal rights nor release any claim you might have based on negligence.

Confidentiality
If you are deemed ineligible for study after the screening session all of your data will be destroyed. The record of your progress in the study will be kept in a confidential file in a locked filing cabinet. The confidentiality of any computer record will also be carefully guarded by never including your name on any data file. The information will be stored electronically in a password-protected file indefinitely. The key linking ID numbers and data will be destroyed upon completion of the study. A copy of the consent form will be retained for three years after termination of the study at which time it will be destroyed. No information by which you can be identified will be released or published. However, to process your payments, it will be necessary to provide your name, social security number, and address to the university business office. In addition, your research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight.

Voluntary Nature of Participation
You do not have to participate in this research project. If at any point a question makes you feel uncomfortable, you do not have to answer it, and you will still be eligible to continue participating in the study. Failure to report to study sessions and failure to bring back the previous days' snack bags (even if all that is left is the bag), will be judged as non-compliant and result in your participation in the study to be terminated. If you agree to participate in the study, you can withdraw your participation at any time without penalty.

Contact Information
If you have any questions about this research project, contact the principal investigator, Prof. Richard Mattes, at (765) 494-0662. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu.

Documentation of Informed Consent
I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research project and my questions have been answered. I am prepared to participate in the research project described above. I will receive a copy of this consent form after I sign it.

_____   _____
Participant's Signature   Date

_____
Participant's Name

_____   _____
Researcher's Signature   Date

Date: _____   Page 3 of 3   Participants initial: _____

Re-Consent Form

RESEARCH PARTICIPANT RE-CONSENT FORM
Blood Pressure and Snacking Study

Principal Investigator: Richard Mattes, MPH, PhD, RD
Purdue University
Department of Nutrition Science, Stone Hall
West Lafayette, IN 47907
(765) 494-0662

For IRB Office Use Only

Did anyone tell you the actual purpose of this study prior to your completion of the study? (Please circle yes or no).
Yes   No

Purpose of Research

The primary objective of this study was to investigate chocolate consumption behavior. Specifically, chocolate consumption behavior was examined when participants thought that chocolate was going to be restricted for three weeks, and then again after chocolate consumption was actually restricted for three weeks. A secondary objective of this study was to examine if the observed responses before and after chocolate candy restriction was predicted by personality traits, and by food craving status. Finally, a third objective of the study was to use different snacks (salty, sweet, and healthy/natural snacks) to determine if chocolate craving is specific to chocolate, or if other snacks can replace chocolate for individuals that crave chocolate.

Why Deception Was Necessary

You were deceived and not told the true purpose of the study until after completion of the study. The purpose of the study did not involve blood pressure, and the testing of saliva for theobromine content was a ruse to ensure that you did not consume chocolate during the chocolate restriction period. In actuality, the saliva was collected using ordinary filter paper which was discarded after you left the room. In addition, you were told we were measuring body water for the purpose of it relating to blood pressure, when really we were obtaining body water and body weight for body composition purposes to see how it changed throughout the course of the study. This deception was necessary because if you knew we were measuring chocolate consumption and body composition from the beginning, your consumption behavior may have changed, and it would not have been possible to measure pre-restriction and post-restriction of chocolate accurately without bias.

Study overview

This 6-week study required 19 visits to the laboratory (Room 226 of Stone Hall, Purdue University). You came into the laboratory every Monday, Wednesday, and Friday for no more than 30 minutes to have 3 blood pressure (BP) measurements, and to answer a few appetite questionnaires between measurements. You were given bags of snack food on these days to take home with you to consume at your leisure. You were asked to maintain your normal diet and schedule throughout the duration of the study, and to refrain from eating snacks that were not provided by this study. You did not have to eat all of the snack food, just as much as you wanted. You were asked to return the uneaten snack portion on your next visit. The figure on the next page shows the flow and activities involved in this study.

Research Project Number _____
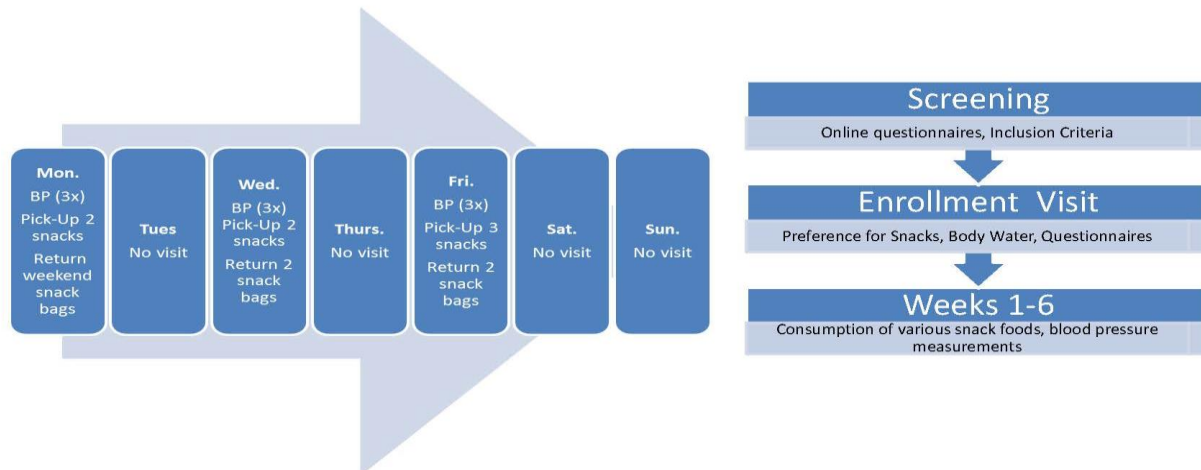
Specific Procedures
Enrollment visit
      a.   Preference for snacks
      b.   Body weight, composition and height (Body weight was measured by a clinical scale that you stood on, and body water was measured by bioelectric impedance while you stood on the scale, which allowed us to get an accurate assessment of body composition).
      c.   You completed a short questionnaire to determine:
        x. If you crave foods
      xi. If you are stressed
     xii. If you are depressed
    xiii. Your attitudes toward food
    xiv. If you are outgoing
     xv. If you are a picky eater
    xvi. If you are a risk taker
   xvii. Your food preferences
  xviii. Your activity at work and home
Study Visits (Week 1-6), approximately 15 minutes each visit
    a. Body weight and composition using the same scale as in the enrollment visit (above)
    b. Saliva sample to measure compliance (During weeks 3-5 only)
    c. 3 blood pressure measurements, once every 5 minutes
    d. Filled out short mood and appetite questionnaires while waiting between blood pressure measurements

Research Project Number _____

Duration of Participation
In total, your participation in this study required 6 weeks and included 19 visits. You were required to attend:
- c. All testing visits which were conducted at Purdue University
- d. The length of each visit was:
    - iii. **Enrollment visit**: approximately 30 minutes
    - iv. **Visits every Monday, Wednesday and Friday**: approximately 15 minutes each

Risks
The risk of participating in this study was minimal. The snacks that were provided are comprised of commercially available products and posed no foreseeable risk outside of the possibility of allergic reactions. There was the risk of having an allergic reaction to the test food. For example, peanuts, a common food allergen were included in this study. If you experienced an allergic reaction, you were instructed to stop consuming the test food immediately and to seek medical assistance. Gastrointestinal distress, such as gas or diarrhea, may have occurred, but was not expected to as the snacks provided were often already part of your routine diet, and were presented in amounts that were not foreseen to cause gastrointestinal distress. There was a chance of breach of confidentiality, but records are protected as described in the Confidentiality section below.

Benefits
There are no expected benefits to you from your participation. However, the knowledge gained from this work may provide new insights for the management of body weight.

Compensation
You will receive a payment up to $50 for successfully completing the study, as compensation for any inconvenience caused by participating in this study. A prorated payment of $4/week would have been made should you have withdrawn or have been withdrawn from the study (for example, for failure to report to study sessions).

Injury or Illness
Purdue University will not provide medical treatment or financial compensation if you are injured or become ill as a result of participating in this research project. This does not waive any of your legal rights nor release any claim you might have based on negligence.

Confidentiality
If you are deemed ineligible for study after the screening session all of your data will be destroyed. The record of your progress in the study will be kept in a confidential file in a locked filing cabinet. The confidentiality of any computer record will also be carefully guarded by never including your name on any data file. The information will be stored electronically in a password-protected file indefinitely. The key linking ID numbers and data will be destroyed upon completion of the study. A copy of the consent form and re-consent form will be retained for three years after termination of the study at which time it will be destroyed. No information by which you can be identified will be released or published. However, to process your payments, it will be necessary to provide your name, social security number, and address to the university business office. In addition, your research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight.

Voluntary Nature of Participation
You did not have to participate in this research project. If at any point a question made you feel uncomfortable, you did not have to answer it, and you were still eligible to continue participating in the study. Failure to report to the study sessions, and failure to bring back the previous days' snack bags (even if all that was left was the bag), was judged as non-compliant and resulted in your participation in the study to be terminated. If you agreed to participate you could withdraw your participation at any time without penalty.

Date: _____   Page 3 of 4   Participants initial: _____

Contact Information
If you have any questions about this research project, contact the principal investigator, Prof. Richard Mattes, at (765) 494-0662. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu.

Documentation of Informed Consent
I have been fully debriefed by the experimenter, I have had the opportunity to read this Consent Form, and I have been given the opportunity to ask questions about the research project. As a result, please discard all data collected, or I give permission to have my data used in this research project. I will receive a copy of this consent form.

_____   _____
Participant's Signature   Date

_____
Participant's Name

_____   _____
Researcher's Signature   Date

Date: _____   Page 4 of 4   Participants initial: _____

Appendix D   Study Questionnaires

Instructions: This questionnaire will give us information about your eating habits. There are no "right" or "wrong" answers.

Use the past year for a standard for how you eat.

Recall the times during the day when you ate and what you had. Include snacks as well as meals and beverages.

Be sure to answer every item on this form. Do not leave any lines blank.

For each of the foods listed, please consider the average serving size, and place an X in the category that best fits your intake.

Once completed, save your answers and email back as an attachment to ckeeler@purdue.edu. Thanks!

Food Item	Never, Less than 1 per Month	1-3 Servings per Month	Once a week	2-4 Servings Per Week	5-6 Servings Per Week	Once a day	2-3 Per Day	4-5 Per Day	6+ Per Day	Average Serving
Example Food	☐	☐	☐	☑	☐	☐	☐	☐	☐	**Example Serving Size**
Alcoholic Drinks	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 Drink
Apricot, Dried	☐	☐	☐	☐	☐	☐	☐	☐	☐	3 slices
Apple, Dried	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	1 Apple
Banana Chips	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup
Candy Bars	☐	☐	☐	☐	☐	☐	☐	☐	☐	2 Mini Bars
Candy Corn	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 handful
Caramels	☐	☐	☐	☐	☐	☐	☐	☐	☐	2 pieces
Chocolate, milk chocolate	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/2 Bar, 1/4 cup chips
Chocolate, Dark chocolate	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/2 Bar, 1/4 cup chips

	Never, Less than 1 per Month	1-3 Servings per Month	Once a week	2-4 Servings Per Week	5-6 Servings Per Week	Once a day	2-3 Per Day	4-5 Per Day	6+ Per Day	Average Serving
Coffee	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 Cup
Cottage Cheese	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 Cup
Coated Candies (ex. M&Ms)	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 handful
Cheetos	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup
Dorito Chips	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 Cup
Doughnuts	☐	☐	☐	☐	☐	☐	☐	☐	☐	1
Dried Pineapple	☐	☐	☐	☐	☐	☐	☐	☐	☐	4 Slices
Fish or shellfish	☐	☐	☐	☐	☐	☐	☐	☐	☐	4oz
Frito Chips	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	1/2 Cup
Goldfish Crackers	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup
Grapes	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup
Green Beans	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/2 Cup
Gummy Candy	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	☐ Chec	1/4 Cup
Mayonnaise	☑	☐	☐	☐	☐	☐	☐	☐	☐	1 Tbsp
Marshmellows	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/2 Cup
Pretzels, salted	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup

	Never, Less than 1 per Month	1-3 Servings per Month	Once a week	2-4 Servings	5-6 Servings	Once a day	2-3 Per Day	4-5 Per Day	6+ Per Day	Average Serving
Raisins	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 handful
Red Meat	☐	☐	☐	☐	☐	☐	☐	☐	☐	4 ounces
Reeses Peanut Butter Cups	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 package
Salad Dressing	☐	☐	☐	☐	☐	☐	☐	☐	☐	2 Tbsp
Sliced Beets	☐	☐	☐	☐	☐	☐	☐	☐	☐	1/4 Cup
Sweetened Beverage	☐	☐	☐	☐	☐	☐	☐	☐	☐	1 Can/Cup
Wheat Bread	☐	☐	☐	☐	☐	☐	☐	☐	☐	2 slices

Overview Questionnaire

Blood Pressure Study
Brief Questionnaire

Please complete the brief questionnaire (below) and the Food Frequency Questionnaire (attached).
Type a response to each question, save the document, and e-mail it to almeal@purdue.edu

1. What is your full name? _____

2. What name do you like to be called? _____

3. What is your e-mail address? _____

4. What is your age? _____ years

5. What is your weight? _____ lbs
   - How much has your weight changed within the last 3 months? _____ lbs

6. Do you exercise (yes/no)? _____
   - If yes, what do you do for exercise? _____
   _____

7. Has your exercise pattern changed within the last 3 months (yes/no)? _____
   - If yes, how has your exercise pattern changed? _____
   _____

8. Has your diet/eating changed within the last 3 months (yes/no)? _____
   - If yes, how has your diet/eating changed? _____
   _____

9. Do you have food allergies (yes/no)? _____
   - If yes, what food(s) are you allergic to? _____
   _____

10. Do you take medications (yes/no)? _____
    - If yes, what medications do you take? Please list each medication's name, dose, and length of time taken. _____
    _____

11. Do you have diabetes (yes/no)? _____

12. Do you have hypertension (yes/no)? _____

13. Do you currently, or have you ever, had gastrointestinal disease (e.g., diverticulitis, inflammatory bowel disease, impaired gag reflex, gastroesophageal reflux disease) (yes/no)? _____
    - If yes, please list the name(s) of the gastrointestinal disease and when it/they were experienced. _____ _____

14. Do you currently, or have you ever, smoked (yes/no)? _____
    - If you smoked in the past, when did you quit? _____

15. Were you born in the United States, and have lived here for the majority of your life? If not, please elaborate. _____

** REMEMBER **

You must also complete the Laboratory for Sensory and Ingestive Studies questionnaire, which can be found by clicking the "Participate in a Study" link at: www.cfs.purdue.edu/Isis. After both questionnaires are evaluated, you will be contacted by e-mail and informed if you are or are not eligible for screening. If you are eligible, an appointment will be scheduled.

Power of Food Questionnaire

Response options are on a 5-point Likert scale ranging from (1) don't agree at all to (5) strongly agree. Possible range of scores 15 (lowest hedonic food score) to 75 (highest hedonic food score).

I find myself thinking about food even when I'm not physically hungry.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

I get more pleasure from eating than I do from almost anything else.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

If I see or smell a food I like, I get a powerful urge to have some.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

When I'm around a fattening food I love, it's hard to stop myself from at least tasting it.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

It's scary to think of the power that food has over me.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

When I know a delicious food is available, I can't help myself from thinking about having some.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

I love the taste of certain foods so much that I can't avoid eating them even if they're bad for me.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

Just before I taste a favorite food, I feel intense anticipation.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

When I eat delicious food I focus a lot on how good it tastes.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

Sometimes, when I'm doing everyday activities, I get an urge to eat "out of the blue" (for no apparent reason).

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

I think I enjoy eating a lot more than most other people.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

Hearing someone describe a great meal makes me really want to have something to eat.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

It seems like I have food on my mind a lot.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

It's very important to me that the foods I eat are as delicious as possible.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

Before I eat a favorite food my mouth tends to flood with saliva.

(1) I don't agree	(2) I agree a little	(3) I agree somewhat	(4) I agree quite a bit	(5) I strongly agree
1	2	3	4	5

Cappelleri JC, Bushmakin AG, Gerber RA, Leidy NK, Sexton CC, Karlsson J & Lowe MR (2009) Evaluating the Power of Food Scale in obese subjects and a general sample of individuals: development and measurement properties. *Int J Obes* **33**, 913-922.

Food Craving Questionnaire 1

Possible range of scores 15 (lowest food craving score) to 75 (highest food craving score).

1. **I have an intense desire to eat one or more specific foods.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

2. **I'm craving one or more specific foods.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

3. **I have an urge for one or more specific foods.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

4. **Eating one or more specific foods would make things seem just perfect.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

5. **If I were to eat what I am craving, I am sure my mood would improve.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

6. **Eating one or more specific foods would feel wonderful.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

7. **If I ate something I wouldn't feel so sluggish and lethargic.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

8. **Satisfying my craving would make me feel less grouchy and irritable.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

9. **I would feel more alert if I could satisfy my craving.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

10. **If I had one or more specific foods, I could not stop eating it.**
   ( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
      1   2   3   4   5

11. **My desire to eat [one or more specific foods] seems overpowering.**
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
   1   2   3   4   5

12. **I know I'm going to keep on thinking about one or more specific foods until I actually have it.**
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
   1   2   3   4   5

13. **I am hungry.**
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
   1   2   3   4   5

14. **If I ate right now, my stomach wouldn't feel as empty.**
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
   1   2   3   4   5

15. **I feel weak because of not eating.**
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
   1   2   3   4   5

Cepeda-Benito A, Gleaves DH, Williams TL & Erath SA (2000) The development and validation of the State and Trait Food-Cravings Questionnaires. *Behav Ther* **31**, 151-173.

Food Craving Questionnaire 2

Possible range of scores 39 (lowest food craving score) to 195 (highest food craving score)

1. Being with someone who is eating often makes me hungry.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

2. When I crave something, I know I won't be able to stop eating once I start.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

3. If I eat what I am craving, I often lose control and eat too much.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

4. I hate it when I give in to cravings.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

5. Food cravings invariably make me think of ways to get what I want m eat.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

6. I feel like 1 have food on my mind all the time.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

7. I often feel guilty for craving certain foods.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

8. I find myself preoccupied with food.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

9. I eat to feel better.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

10. Sometimes, eating makes things seem just perfect.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

11. Thinking about my favorite foods makes my mouth water.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

12. I crave foods when my stomach is empty.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

13. I feel as if my body asks me for certain foods.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

14. I get so hungry that my stomach seems like a bottomless pit.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

15. Eating what I crave makes me feel better.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

16. When I satisfy a craving I feel less depressed.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

17. When I eat what I am craving I feel guilty about myself.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

18. Whenever I have cravings, I find myself making plans to eat.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

19. Eating calms me down.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

20. I crave foods when I feel bored, angry, or sad.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree
1   2   3   4   5

21. I feel less anxious after I eat.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
Disagree   Agree

1	2	3	4	5

22. If I get what I am craving I cannot stop myself from eating it.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

23. When I crave certain foods, 1 usually try to eat them as soon as I can.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

24. When I eat what I crave I feel great.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

25. I have no will power to resist my food crave.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

26. Once I start eating, I have trouble stopping.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

27, I can't stop thinking about eating no matter how hard I try.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

28. I spend a lot of time thinking about whatever it is 1 will eat next.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

29. Ifl give in to a food craving, all control is lost.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

30. When I'm stressed out, 1 crave food.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

31. I daydream about food.
( ) Strongly Disagree   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly Agree
       1   2   3   4   5

32. Whenever I have a food craving, I keep on thinking about eating until I actually eat

the food.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

33. If I am craving something, thoughts of eating it consume me.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

34. My emotions often make me want to eat.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

35. Whenever I go to a buffet I end up eating more than what I needed.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

36. It is hard for me to resist the temptation to eat appetizing foods that are in my reach.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

37. When I am with someone who is overeating, I usually overeat too.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

38. When I eat food, I feel comforted.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

39. I crave foods when I'm upset.
( ) Strongly   ( ) Disagree   ( ) Neutral   ( ) Agree   ( ) Strongly
   Disagree   Agree
     1   2   3   4   5

Cepeda-Benito A, Gleaves DH, Williams TL & Erath SA (2000) The development and validation of the State and Trait Food-Cravings Questionnaires. *Behav Ther* **31**, 151-173.

Perceived Stress Questionnaire

PSS-10 scores are obtained by reversing the scores on the four positive items, e.g., 0=4, 1=3, 2=2, etc. and then summing across all 10 items. Items 4, 5, 7, and 8 are the positively stated items. Possible range of scores: 0 (lowest stress score) to 40 (highest stress score).

1. In the last month, how often have you been upset because of something that happened unexpectedly?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

2. In the last month, how often have you felt that you were unable to control the important things in your life?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

3. In the last month, how often have you felt nervous and "stressed"?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

4. In the last month, how often have you felt confident about your ability to handle your personal problems?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　4　　　　　　3　　　　　　　2　　　　　　　1　　　　　　　0

5. In the last month, how often have you felt that things were going your way?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　4　　　　　　3　　　　　　　2　　　　　　　1　　　　　　　0

6. In the last month, how often have you found that you could not cope with all the things that you had to do?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

7. In the last month, how often have you been able to control irritations in your life?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　4　　　　　　3　　　　　　　2　　　　　　　1　　　　　　　0

8. In the last month, how often have you felt that you were on top of things?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　4　　　　　　3　　　　　　　2　　　　　　　1　　　　　　　0

9. In the last month, how often have you been angered because of things that were outside of your control?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?
____0=never ____1=almost never ____2=sometimes ____3=fairly often ____4=very often
　　　0　　　　　　1　　　　　　　2　　　　　　　3　　　　　　　4

Cohen S, Kamarck T & Mermelstein R (1983) A global measure of perceived stress. *J Health Soc Behav* **24**, 385-396.

Depression Questionnaire

Possible range of scores 20 (lowest depression score) to 80 (highest depression score):
≤ 49 normal range; 50-59 mildly depressed; 60-69 moderately depressed; ≥ 70 severely depressed.

1. **I feel down-hearted and blue.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

2. **Morning is when I feel the best.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　4　　　　　　　3　　　　　　　2　　　　　　　1

3. **I have crying spells or feel like it.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

4. **I have trouble sleeping at night.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

5. **I eat as much as I used to.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　4　　　　　　　3　　　　　　　2　　　　　　　1

6. **I still enjoy sex.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　4　　　　　　　3　　　　　　　2　　　　　　　1

7. **I notice that I am losing weight.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

8. **I have trouble with constipation.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

9. **My heart beats faster than usual.**
   (　) A little of　　(　) Some of　　(　) Good part　　(　) Most of
   　　the time　　　　the time　　　of the time　　　the time
   　　1　　　　　　　2　　　　　　　3　　　　　　　4

10. **I get tired for no reason.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      1   2   3   4

11. **My mind is as clear as it used to be.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

12. **I find it easy to do the things I used to.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

13. **I am restless and can't keep still.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      1   2   3   4

14. **I feel hopeful about the future.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

15. **I am more irritable than usual.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      1   2   3   4

16. **I find it easy to make decisions.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

17. **I feel that I am useful and needed.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

18. **My life is pretty full.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      4   3   2   1

19. **I feel that others would be better off if I were dead.**
( ) A little of   ( ) Some of   ( ) Good part   ( ) Most of
    the time   the time   of the time   the time
      1   2   3   4

20.   I still enjoy the things I used to do.

( ) A little of	( ) Some of	( ) Good part	( ) Most of
the time	the time	of the time	the time
4	3	2	1

Zung WWK (1965) A self-rating depression scale. *Arch Gen Psychiatry* **12**, 63-70.

Disordered Eating Questionnaire

Possible range of scores 0 (lowest disordered eating score) to 78 (highest disordered eating score). Scores > 20 indicate disordered eating.

1. Am terrified about being overweight.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

2. Avoid eating when I am hungry.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

3. Find myself preoccupied with food.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

4. Have gone on eating binges where I feel that I may not be able to stop.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

5. Cut my food into small pieces.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

6. Aware of the calorie content of foods that I eat.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

7. Particularly avoid foods with a high carbohydrate content (i.e. bread, rice, potatoes, etc.).
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

8. Feel that others would prefer if I ate more.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

9. Vomit after I have eaten.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

10. Feel extremely guilty after eating.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

11. Am preoccupied with a desire to be thinner.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

12. Think about burning up calories when I exercise.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

13. Other people think that I am too thin.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

14. Am preoccupied with the thought of having fat on my body.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
   3   2   1   0   0   0

15. Take longer than others to eat my meals.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

16. Avoid foods with sugar in them.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

17. Eat diet foods.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

18. Feel that food controls my life.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

19. Display self-control around food.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

20. Feel that others pressure me to eat.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

21. Give too much time and thought to food.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

22. Feel uncomfortable after eating sweets.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

23. Engage in dieting behavior.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

24. Like my stomach to be empty.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

25. Enjoy trying new rich foods.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    0   0   0   1   2   3

26. Have the impulse to vomit after meals.
( ) Always   ( ) Usually   ( ) Often   ( ) Sometimes   ( ) Rarely   ( ) Never
    3   2   1   0   0   0

Garner DM & Garfinkel PE (1979) The Eating Attitudes Test: an index of the symptoms of anorexia nervosa. *Psychol Med* **9**, 273-279.

Personality Questionnaire

Are you a talkative person?	Extravert
Are you rather lively?	Extravert
Do you enjoy meeting new people?	Extravert
Can you usually let yourself go and enjoy yourself at a lively party?	Extravert
Do you usually take the initiative in making new friends?	Extravert
Can you easily get some life into a rather dull party?	Extravert
Do you tend to keep in the background on social occasions?	Introvert
Do you like mixing with people?	Extravert
Do you like plenty of bustle and excitement around you?	Extravert
Are you mostly quiet when you are with other people?	Introvert
Do other people think of you as being very lively?	Extravert
Can you get a party going?	Extravert

Eysenck SBG, Eysenck HJ & Barrett P (1985) A revised version of the psychoticism scale. *Pers Indiv Differ* **6**, 21-29.

Eysenck HJ, Eysenck SBG (1992) *Manual of the Eysenck Personality Questionnaire-Revised.* San Diego CA: Educational and Industrial Testing Service.

Finickiness and Sensation Seeking Questionnaires

Possible score range 4 (least finicky) to 20 (most finicky).

I have been called a picky eater
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I consider myself a picky eater
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I find many foods distasteful
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I think that many foods are disgusting
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

Raudenbush B, Van Der Klaauw NJ & Frank RA (1995) The contribution of psychological and sensory factors to food preference patterns as measured by the Food Attitudes Survey (FAS). *Appetite* **25**, 1-15.

I would like to explore strange places.
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I like to do frightening things.
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I like new and exciting experiences, even if I have to break the rules.
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

I prefer friends who are exciting and unpredictable.
(1) strongly agree   (2) agree   (3) neutral   (4) disagree (5) strongly disagree
5   4   3   2   1

Stephenson MT, Hoyle RH, Palmgreen P & Slater MD (2003) Brief measures of sensation seeking for screening and large-scale surveys. *Drug Alcohol Depen* **72**, 279-286.

Food Rating Questionnaire

I would eat this food EVERY OPPORTUNITY I had.

I would eat this VERY OFTEN.

I would FREQUENTLY eat this.

I like this and would eat it NOW and THEN.

I would eat this IF AVAILABLE but would not go out of my way.

I don't like it but would eat it ON AN OCCASION.

I would HARDLY EVER eat this.

I would eat this only if there were NO OTHER FOOD CHOICES.

I would eat this only IF I WERE FORCED TO.

I have never tried this.

Schutz HG (1965) A food action rating scale for measuring food acceptance. *J Food Sci* **30**, 365-374.

Emotion Rating Questionnaire

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 the 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
___ strong
___ guilty
___ scared
___ hostile
___ enthusiastic
___ proud
___ irritable
___ alert
___ ashamed
___ inspired
___ nervous
___ determined
___ attentive
___ jittery
___ active
___ afraid

Watson D, Clark LA, & Tellegen A (1988) Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology 54(6), 1063-1070

TFEQ

APPENDIX: THREE-FACTOR EATING QUESTIONNAIRE

One point is given for each item in Part I and for each item (numbered question) in Part II. The correct answer for the true/false items is underlined and beside it is the number of the factor that it measures. The direction of the question in Part II is determined by splitting the responses at the middle. If the item is labelled ' + ', those responses above the middle are given a zero. Vice versa for those with a '−'. For example, anyone scoring 3 or 4 on the first item in Part II (item No. 37) would receive one point. Anyone scoring 1 or 2 would receive a zero.

Part I

				Factor Number
1.	When I smell a sizzling steak or see a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.	T	F	2
2.	I usually eat too much at social occasions, like parties and picnics.	T	F	2
3.	I am usually so hungry that I eat more than three times a day.	T	F	3
4.	When I have eaten my quota of calories, I am usually good about not eating any more.	T	F	1
5.	Dieting is so hard for me because I just get too hungry.	T	F	3
6.	I deliberately take small helpings as a means of controlling my weight.	T	F	1
7.	Sometimes things just taste so good that I keep on eating even when I am no longer hungry.	T	F	2
8.	Since I am often hungry, I sometimes wish that while I am eating, an expert would tell me that I have had enough or that I can have something more to eat.	T	F	3
9.	When I feel anxious, I find myself eating.	T	F	2
10.	Life is too short to worry about dieting.	T	F	1
11.	Since my weight goes up and down, I have gone on reducing diets more than once.	T	F	2
12.	I often feel so hungry that I just have to eat something.	T	F	3
13.	When I am with someone who is overeating, I usually overeat too.	T	F	2
14.	I have a pretty good idea of the number of calories in common food.	T	F	1
15.	Sometimes when I start eating, I just can't seem to stop.	T	F	2
16.	It is not difficult for me to leave something on my plate.	T	F	2
17.	At certain times of the day, I get hungry because I have gotten used to eating then.	T	F	3
18.	While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.	T	F	1
19.	Being with someone who is eating often makes me hungry enough to eat also.	T	F	3
20.	When I feel blue, I often overeat.	T	F	2
21.	I enjoy eating too much to spoil it by counting calories or watching my weight.	T	F	1
22.	When I see a real delicacy, I often get so hungry that I have to eat right away.	T	F	3
23.	I often stop eating when I am not really full as a conscious means of limiting the amount that I eat.	T	F	1
24.	I get so hungry that my stomach often seems like a bottomless pit.	T	F	3
25.	My weight has hardly changed at all in the last ten years.	T	F	2
26.	I am always hungry so it is hard for me to stop eating before I finish the food on my plate.	T	F	3
27.	When I feel lonely, I console myself by eating.	T	F	2
28.	I consciously hold back at meals in order not to gain weight.	T	F	1
29.	I sometimes get very hungry late in the evening or at night.	T	F	3

30.	I eat anything I want, any time I want.	T	F	1
31.	Without even thinking about it, I take a long time to eat.	T	F	2
32.	I count calories as a conscious means of controlling my weight.	T	F	1
33.	I do not eat some foods because they make me fat.	T	F	1
34.	I am always hungry enough to eat at any time.	T	F	3
35.	I pay a great deal of attention to changes in my figure.	T	F	1
36.	While on a diet, if I eat a food that is not allowed, I often then splurge and eat other high calorie foods.	T	F	2

Part II

Directions: Please answer the following questions by circling the number above the response that is appropriate to you.

37. How often are you dieting in a conscious effort to control your weight?

1	2	3	4	
rarely	sometimes	usually	always	+ 1

38. Would a weight fluctuation of 5 lbs affect the way you live your life?

1	2	3	4	
not at all	slightly	moderately	very much	+ 1

39. How often do you feel hungry?

1	2	3	4	
only at mealtimes	sometimes between meals	often between meals	almost always	+ 3

40. Do your feelings of guilt about overeating help you to control your food intake?

1	2	3	4	
never	rarely	often	always	+ 1

41. How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours?

1	2	3	4	
easy	slightly difficult	moderately difficult	very difficult	+ 3

42. How conscious are you of what you are eating?

1	2	3	4	
not at all	slightly	moderately	extremely	+ 1

43. How frequently do you avoid 'stocking up' on tempting foods?

1	2	3	4	
almost never	seldom	usually	almost always	+ 1

44. How likely are you to shop for low calorie foods?

1	2	3	4	
unlikely	slightly unlikely	moderately likely	very likely	+ 1

45. Do you eat sensibly in front of others and splurge alone?

1	2	3	4	
never	rarely	often	always	+ 2

46. How likely are you to consciously eat slowly in order to cut down on how much you eat?

1	2	3	4	
unlikely	slightly likely	moderately likely	very likely	+ 1

47. How frequently do you skip dessert because you are no longer hungry?

1	2	3	4	
almost never	seldom	at least once a week	almost every day	− 3

48. How likely are you to consciously eat less than you want?

1	2	3	4	
unlikely	slightly likely	moderately likely	very likely	+ 1

49. Do you go on eating binges though you are not hungry?

1	2	3	4	
never	rarely	sometimes	at least once a week	+ 2

50. On a scale of 0 to 5, where 0 means no restraint in eating (eating whatever you want, whenever you want it) and 5 means total restraint (constantly limiting food intake and never 'giving in'), what number would you give yourself?

           0

eat whatever you want, whenever you want it   + 1

           1

usually eat whatever you want, whenever you want it

           2

often eat whatever you want, whenever you want it

           3

often limit food intake, but often 'give in'

           4

usually limit food intake, rarely 'give in'

           5

constantly limiting food intake, never 'giving in'

51. To what extent does this statement describe your eating behavior? 'I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow.'

1	2	3	4	
not like me	little like me	pretty good description of me	describes me perfectly	+ 2

Stunkard, A. J. and S. Messick (1985). "The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger." J Psychosom Res 29(1): 71-83.

Snack Evaluation Questionnaire

Study code:_____

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 the present moment about the snacks you have had for the past two days**. Use the following scale to record your answers:

1 very slightly or not at all	2 a little	3 moderately	4 quite a bit	5 extremely

1) The snacks were sweet _____

2) The snacks were salty _____

3) The snacks were sour _____

4) The snacks were bland _____

5) The snacks were exotic _____

6) The snacks were stale _____

7) The flavors were exciting _____

8) The snacks were disgusting _____

9) I like these snacks _____

10) I feel upset right now _____

11) These snacks are healthy _____

12) I often crave these snacks _____

13) These snacks are expensive _____

14) These snacks are desirable _____

15) I usually avoid these snacks _____

16) I was given enough of these snacks to be satisfied _____

17) I prefer other snacks that I was given while participating in this study _____

18) What snack would you eat right now? Please write in one of the snacks you were provided with during the course of this study.
_____

19) What snack would you eat right now? Please write in any type of snack, even if it was not provided to you in the course of this study.
_____

Appendix E   Provided Snacks

Product	Brand	kcal per gram	Condition
Candy Coated Chocolate	ADM Foodservice Ambrosia Magic Pieces	4.54	Chocolate
Dark Chocolate Chips	Barry Callebaut Van Leer Tulsa Semi-Sweet Chocolate Ezmelt	4.9	Chocolate
Milk Chocolate Squares	Barry Callebaut Van Leer Tkenosha Milk Chocolate Ezmelt	5.4	Chocolate
Dark Chocolate Wafers	Bloomer Chocolate Company Chocolate Discs	5.15	Chocolate
Milk Chocolate Wafers	Bloomer Chocolate Company Chocolate Discs	5.32	Chocolate
Dried Pineapple	Great Value Dried Pineapple	3.5	Natural
Dried Apple	Great Value Dried Apple	3	Natural
Dried Raisin	Sun-Maid Raisin	3.25	Natural
Dried Apricot	Daily Chef Dried Mediterranean Apricots	2.5	Natural
Banana Chips	Great Value Banana Chips	5.36	Natural
Corn Chips	Fritos Original	5.65	Salty
Nacho Chips	Doritos Nacho Cheese	4.95	Salty
Pretzels	Rold Gold Tiny Twists	3.89	Salty
Cheddar Crackers	Goldfish	4.65	Salty
Cheese Puffs	Cheetos	5.3	Salty
Fruit Marshmallows	Jet Puffed FunMallows	3.33	Sweet
Gummy Bears	Ferrara Candy Company	3.17	Sweet
Gummy Orange Slices	Ferrara Candy Company	3.49	Sweet
Caramels	Goetze Caramel Creams	3.7	Sweet
Candy Corn	Kroger Candy Corn	3.59	Sweet