THE ASSOCIATION OF FOOD CRAVINGS AND PREFERENCES WITH FOOD INTAKE

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ABSTRACT

An ubiquitous assumption about food intake behavior is that people eat the types of foods that they crave and prefer. Food preferences reflect hedonic ratings of the degree to which people like certain foods. The present study investigated the association of food cravings and hedonic ratings with food intake behavior, assessed in the laboratory with a Universal Eating Monitor (Kissileff, Klingsberg, & Van Itallie, 1980). The study sample consisted of 162 adults who completed the Food Craving Inventory (FCI; White, Whisenhunt, Williamson, Greenway, & Netemeyer, 2001), a questionnaire that measures craving, including cravings for specific types of foods (i.e., High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats). Also, participants completed the Food Preference Questionnaire (FPQ; Geiselman et al., 1998), which assesses preference for fat and provides hedonic ratings of foods that vary in fat and carbohydrate content. Finally, participants completed the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), which assesses Dietary Restraint, Disinhibition and Perceived Hunger. The subscales of the FCI and FPQ were correlated with intake of the test food (i.e., cheesecake) during a test lunch conducted in a laboratory. The results revealed that the correlations of food cravings and hedonic ratings with food intake were relatively small, indicating that people do not eat large quantities of the types of foods that they crave and rate as liking. To explore the construct of food cravings, the subscales of the FCI, FPQ, and TFEQ were correlated. The pattern of correlations provided support for the concurrent and discriminant validity of the FCI, and the data indicated that the construct of food craving is very similar to hunger. The present study investigated other aspects of food intake behavior, including cumulative food intake curves. Cumulative food intake curves represent food intake as a function of time and are categorized as either decelerated (i.e., eating rate decreases during the meal) or linear (i.e., eating rate remains steady during the meal). The present study failed to replicate the association of Dietary Restraint with linear cumulative food intake curves. Furthermore, a relation between Disinhibition and body mass with decelerated curves was detected.

INTRODUCTION

Eating behavior is a complex phenomenon that is influenced by many diverse variables. Methodological issues are a formidable barrier in determining the influence of a variable on eating behavior. For example, the variable must be reliably and validly assessed and food intake must be accurately measured. The present study reviewed recent advances in assessing food intake, as well as variables assumed to influence eating behavior, particularly food cravings and preferences. The primary aim of the study was to test the hypothesis that people consume the types of foods that they report craving and preferring. Food preferences are reflected in hedonic ratings of the degree to which participants like certain foods.

Food intake is frequently assessed by self-report. Self-report of food intake allows a person to record food intake in their natural environment and report it to the experimenter. However, self-report has been found to have questionable validity (Block, 1982). Alternatively, food intake may be assessed in the laboratory. Laboratory assessment of food intake has been found to be reliable, valid, and to reflect intake in the natural environment accurately (Kissileff, Thornton, & Becker, 1982). One method for assessing food intake in the laboratory is the Universal Eating Monitor (UEM; Kissileff et al., 1980). The UEM covertly records meal characteristic data. Specifically, the UEM records the number of grams of food consumed, the duration of the meal or the time spent eating, and the rate of food intake. Furthermore, data from the UEM may be plotted to form a *cumulative food intake curve* that depicts the amount of food eaten as a function of time.

Research has found that typical cumulative food intake curves are decelerated, indicating that food intake decreases in the latter half of the meal. Linear curves indicate a steady rate of intake throughout the meal and are associated with Dietary Restraint (e.g., Westerterp-Plantenga, Wouters, & ten Hoor, 1990). Accelerated cumulative food intake curves indicate that eating rate increases during the meal. Accelerated curves are rare in studies investigating food intake, but they are known to occur in women who engage in binge eating behavior (Westerterp-Plantenga, Duijsens, & ten Hoor, 1992) and during the first course of a meal or during small meals where satiation is not likely to occur (M.S. Westerterp-Plantenga, personal communication, February 28, 2001).

Another form of food intake data, the *satiety quotient*, is derived from Visual Analogue Scales (VAS) that measure desire to eat before and after eating (Green, Delargy, Joanes, & Blundell, 1997). Satiety quotients are calculated by subtracting the desire to eat pre-eating episode from the desire to eat post-eating episode, which is divided by the number of grams of food consumed. The resulting quotient provides an index of satiety per gram of food. Finally, Visual Analogue Scales provide participant ratings of constructs such as hunger and desire to eat before and after eating. Frequently, VAS data are analyzed as within subjects variables.

The data reviewed above may be classified into three categories. First, information about the number of grams of food consumed, meal duration, and eating rate describe basic meal characteristics. Second, cumulative food intake curves provide information about the rate of food intake as a function of time. Third, VAS and satiety quotients provide information about participants' subjective sense of satiation, desire to eat, and hunger. The three types of food intake data provide a detailed description of food intake behavior and are useful when investigating variables that affect eating. For example, food cravings and preferences are assumed to influence eating behavior, yet few studies have tested the association of cravings and preference for specific types of foods with consumption of those foods.

One reason for the dearth of literature in this area is the historically poor definition and measurement of food cravings and preferences. However, there have been recent advances in measuring food cravings and preferences for specific types of foods. The Food Craving Inventory (FCI; White et al., 2001) measures cravings for foods in four categories: High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats, which comprise the higher order construct of "food craving" (White et al.). Also, the Food Preference Questionnaire (FPQ) measures preferences for fats (i.e., the "Fat Preference Index") and provides hedonic ratings or ratings of how much a participant "likes" foods that differ in fat, carbohydrate, and protein content (FPQ; Geiselman et al., 1998). For the purpose of the present study, "hedonic ratings" and "ratings of liking" will be used interchangeably and refer to ratings for specific categories of foods (e.g., foods that are High in Fat/High in Simple Sugar), as defined by the FPQ. The term "food preference" will be reserved for the Fat Preference Index, which is derived from the FPQ and has been found to be a valid measure of preference for fat. With the development of the FCI and FPQ, it is possible to test the effects of cravings, fat preference, and hedonic/liking ratings for specific types of food on eating behavior, including the number of grams consumed, cumulative food intake curves, and satiety quotients.

Meal characteristic data may be used to evaluate the effects of other variables on eating behavior, as well. For instance, the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) assesses Dietary Restraint, Disinhibition, and Perceived Hunger. Dietary Restraint refers to the intent and ability to restrict caloric intake and Disinhibition refers to the tendency to episodically overeat. Dietary Restraint and Disinhibition are known to affect eating behavior, yet their influence is not fully understood (Lawson et al., 1995; Smith et al., 1998). Perceived Hunger refers to the subjective sense of hunger. Furthermore, the effects of gender and body mass on eating behavior are not fully understood. Examining the association of these variables with the amount of food consumed, cumulative food intake curves, and satiety quotients will provide valuable information about the extent and nature of their influence on eating behavior.

The present study individually administered a test lunch to 168 non-obese and obese male and female participants. Participants were administered the Food Craving Inventory (FCI; White et al., 2001), Food Preference Questionnaire (FPQ; Geiseleman et al., 1998), and Three Factor Eating Questionnaire (Stunkard & Messick, 1985). Following completion of the FCI, FPQ, and TFEQ, participants were provided with a test lunch that consisted of sandwich squares. Shortly after participants finished eating the sandwich squares, they were given a large piece of cheesecake, a food that is high in fat and sweet, for desert. Cheesecake was considered the test food and was of primary interest in the study. A Universal Eating Monitor (UEM) covertly recorded the amount of intake of the test food, meal duration, and rate of intake. Additionally, Visual Analogue Scales (VAS) were administered that assessed hunger and desire to eat before and after consumption of the test food.

Data from the UEM and VAS were used to record the following three categories of dependent variables that assessed three aspects of food intake behavior. First, characteristics of the meal were recorded for each participant, including the number of grams of the test food consumed, meal duration, and eating rate. Second, cumulative food intake curves were calculated for each participant to determine if they produced a decelerated or linear cumulative food intake curve. Third, satiety quotients were calculated for each participant, providing an index of satiety per gram of cheesecake. Also, hunger and desire to eat, assessed by VAS, before and after intake of the test food, were recorded. The three categories of dependent variables were used to investigate three aims of the present study.

The first aim of the study was to test the hypothesis that people consume the types of foods that they crave. Also, the hypothesis that people consume the types of foods that they report as hedonically pleasing or liking was tested. The amount of the test food consumed was expected to vary as a function of cravings and hedonic ratings for certain types of foods. To test the hypothesis, the number of grams of the test food eaten was examined as a function of food cravings and hedonic ratings of various foods. Food cravings were measured with the FCI and hedonic ratings or ratings of how much participants liked foods were measured with the FPQ. The FCI and FPQ subscale scores were correlated with the number of grams of the test food eaten. It was predicted that there would be a stronger positive correlation with the High Fats and Sweets subscales of the FCI with test food intake compared to the Carbohydrates/Starches and Fast Food Fats subscales. It was predicted that the High Fats and High Simple Sugar factors of the FPQ would be strongly correlated with test food intake, particularly the cell of the FPQ that represents High Fat/High Simple Sugar foods.

Consumption of the test food, meal duration, and eating rate were examined as a function of gender, body mass, Dietary Restraint, and Disinhibition. For example, researchers reported that females more frequently crave foods that are high in fat and sweet compared to males (Weingarten & Elston, 1991), and obese people are known to eat more food and prefer high fat, sweet foods, compared to lean people (Drewnowski, Brunzell, Sande, Iverius, & Greenwood, 1985). Therefore, it was expected that females would consume more of the test food compared to males, and that body mass would be positively associated with test food intake.

The second aim of the present study was to determine if Dietary Restraint, Disinhibition, gender, body mass, food cravings, and food preferences influenced the shape of cumulative food intake curves. To test the hypotheses, cumulative food intake curves were analyzed to determine if they were decelerated or linear. Additional analyses assessed if either decelerated or linear cumulative food intake curves were associated with the variables listed above.

Research on the influence of gender, body mass, food cravings, and food preferences on cumulative food intake curves is limited. However, Dietary Restraint and Disinhibition have been investigated. Research suggests that normal weight and overweight people scoring high on Dietary Restraint produce linear cumulative food intake curves, while those scoring low on Dietary Restraint produce decelerated cumulative food intake curves (Westerterp-Plantenga, van den Heuvel, Wouters, & ten Hour, 1992). Additionally, Westerterp-Plantenga, Westerterp et al. (1990) found that normal weight people scoring high on Disinhibition demonstrated linear cumulative food intake curves, while overweight people scoring high on Disinhibition demonstrated decelerated curves. Based on these findings, the present study predicted that Dietary Restraint would be associated with linear cumulative food intake curves, while Disinhibition would be associated with linear cumulative food intake curves in non-obese, but not obese participants.

The influence of food cravings and preferences on the shape of cumulative food intake curves was examined. No previous studies have examined the effect of food cravings and preferences on the linearity of cumulative food intake curves; therefore, no predictions were stated.

The third aim of the present study was to examine the association of food cravings and preferences, Dietary Restraint, Disinhibition, gender, and body mass with satiety quotients and VAS. Satiety quotients were recently developed (Green et al., 1997) and there is no research examining how they are affected by the variables assessed in the present study. Nonetheless, it may assumed that people who crave or prefer foods that are high in fat and sweet would experience less satiation per gram of cheesecake compared to those who do not crave or prefer high fat, sweet foods. Differences in gender may also be detected. Females are known to crave and prefer foods similar to the test food, such as chocolate; consequently, females may report less satiety per gram of test food than males. Visual Analogue Scales were examined, as well.

As outlined above, the present study evaluated the association of food cravings, food preferences, Dietary Restraint, Disinhibition, gender, and body mass with three categories of food intake data. The respective three aims of the study examined meal characteristics (grams of the test food consumed, meal duration, eating rate), cumulative food intake curves, and satiety quotients/VAS.

Food Intake

Assessment of Food Intake

The first aim of the study was to test the relationship between test food intake and food cravings, food preferences, Dietary Restraint, Disinhibition, gender, and body mass. Hence, the present study required calculation of the number of grams of test food consumed, a task that appears simplistic. Nevertheless, the methodology used to collect the data can influence its accuracy, as well as the amount of data extracted from the eating episode. Two popular methods of food intake assessment are self-report and direct observation.

Assessment of Food Intake: Self-Report. When food intake is assessed with self-report, participants typically record or recall the type and amount of food eaten in their natural environment and report it to the experimenter. Self-reported food intake is frequently utilized, yet there are inherent problems with the methodology (Block, 1982). First, evidence indicates that self-reported food intake is highly suspect and frequently inaccurate (Block, 1982). Second, examining the validity of self-reported food intake data is difficult, if not impossible, due to the fact that actual intake is not known (Block, 1982).

Block's review of the validity of methods used to assess dietary intake in participants living in their natural environment yielded discouraging results. Block found evidence for the reliability of the self-report methods, but failed to find evidence for the validity of the methods when assessing food intake for individual participants. Questionable validity and the desire to obtain more precise information on food intake contributed to the development of laboratory methods for assessing food intake.

Assessment of Food Intake: Laboratory. Direct observation of food intake typically occurs in a laboratory. One popular laboratory method for assessing food intake is the Universal Eating Monitor (UEM; Kissileff et al, 1980). Kissileff et al. developed the UEM as a reliable and valid assessment of food intake in the laboratory. The UEM covertly records the amount and rate of food intake by recording the weight of a plate of food from which a participant eats.

Evidence suggests that eating behavior in the laboratory is consistent with eating behavior in the natural environment (Kissileff et al., 1982). The UEM provides very specific and accurate assessment of the number of grams of food consumed, the duration of the meal, and the eating rate. The UEM will be utilized in the present study to record meal characteristic data.

Food Intake and Food Craving

Food craving is an important construct in food intake literature. Researchers investigating food cravings invariably assume that individuals consume foods that they crave. Despite the ubiquity of this hypothesis, efforts to test it have been hampered by historically poor definitions and measures for food cravings. In addition, food intake and food cravings have been found to vary across the menstrual cycle. Food intake and food cravings peak during the luteal or premenstrual phase of females' menstrual cycles (e.g., Buffenstein, Poppitt, McDevitt, & Prentice, 1995; Dye & Blundell, 1997; Dye, Warner, & Bancroft, 1995). The influence of endogenous and exogenous hormones on food intake and food cravings is pronounced and complicates the study of food intake and food cravings, particularly in females.

Definition and Prevalence of Food Craving. The construct of craving frequently appears in scientific literature, yet a widely accepted definition remains illusive. Kozlowski and Wilkinson (1987) reviewed craving literature and concluded that a proper definition of craving requires that the substance be intensely desired. Nonetheless, Weingarten and Elston (1990) found that most definitions of craving used in food intake studies did not meet this basic requirement.

One definition of food craving defines craving as consumption, based on the assumption that the individual who consumed a food must have craved the food. Gendall, Joyce, and Sullivan (1997) and Weingarten and Elston (1990) note that this definition is circular. Furthermore, this definition may confuse hunger with craving, and it fails to provide information about the psychological aspects of craving (Gendall et al., 1997; Weingarten & Elston, 1990).

Authors have argued that cravings are elicited by biological or physiological needs of the body that serve to correct bodily deficits (Weingarten & Elston, 1990). Despite the appealing nature of the argument, it is not supported by empirical evidence. For instance, Harvey, Wing, and Mullen (1993) found that restricting certain types of foods did not lead to increased cravings for the restricted foods, and Hill, Weaver, and Blundell (1991) found that food deprivation was not a necessary condition for food cravings to occur. In addition, nutritional deficiencies do not differ between cravers and non-cravers and people crave foods high in certain nutrients, while failing to crave other foods that contain greater levels of the same nutrient (Weingarten & Elston, 1990). Therefore, data suggest that factors other than biological needs drive craving and the factors may be psychological in nature or rely on the sensory characteristics of foods. Weingarten and Elston (1990) caution that limited evidence indicates that cravings may correct biological need states, yet these data suggest that such need states cannot explain all cravings or all aspects of cravings.

Estimates of the prevalence of food cravings in the general population vary widely, partly due to inconsistencies in the definition of craving. Weingarten and Elston (1991) found that 97% of women and 68% of men in a college sample reported food cravings. Gendall et al. (1997) studied a female sample ranging in age from 18-45 and found that 58% reported craving foods. Gendall et al. reported using a more restrictive definition of craving than Weingarten and Elston (1991); therefore, they consider their estimate to be more conservative.

The frequency of food cravings has been studied by Hill and Heaton-Brown (1994) and Hill et al. (1991). Hill and Heaton-Brown (1994) found that women who reported cravings experienced, on average, 2.2 cravings during a five-day interval. Hill et al. studied the frequency of food cravings in women and found that their sample reported 4.2 cravings during a 7-day interval. Hill et al. found that all of the reported cravings occurred after mid-day and 67% occurred in evening. Chocolate appears to be one of the most frequently craved foods, particularly among women (Weingarten and Elston, 1991). Nine of 10 cravers report craving chocolate and chocolate accounted for 49% to 60% of cravings (Hill & Heaton-Brown, 1994; Hill et al.).

Gender, Body Mass, and Food Craving. Studies on food craving have found differences in the types of foods craved between males and females. Gendall et al., (1997) reported that foods high in fat and sweet, such as cake and ice cream, were the most frequently craved foods among females. Similarly, other researchers found that chocolate is the most frequently craved food among females, but not among males (Weingarten & Elston, 1991).

Body mass is purported to influence the amount of food, as well as the types of foods, that people ingest. Body Mass Index (BMI) is represented by weight in kilograms divided by height in meters^2 and is commonly used to describe body composition (Billewicz, Kelmsley, & Thompson, 1962). Due to the physiological processes and requirements of the body, food intake increases as a function of body weight or BMI (Bray, 1998). Obese participants have been found to prefer higher levels of fat (> 34% lipid) in their food compared to normal weight (20% lipid) participants (Drewnowski et al., 1985). Also, body mass index was found to be associated with binge eating in cravers (Gendall, Joyce, Sullivan, & Bulik, 1998) and cravings for sweet foods (Schlundt, Virts, Sbrocco, & Pope-Cordle, 1993).

Measurement of Food Craving. Historically, the measurement of craving has proved to be a difficult task, partly due to the lack of a well formulated and agreed upon definition. Many studies defined and quantified food craving by relying on unvalidated questionnaires that simply asked participants if they had "craved" any particular foods over a given period of time (Weingarten & Elston, 1990). Even though this procedure is economical and intuitively appealing, it relies on participants' subjective interpretation of the term craving and provides no objective criteria for the participant to make an informed decision (Gendall et al., 1997). Furthermore, the approach fails to differentiate between cravings for different types of foods.

Recently, White et al. (2001) developed the Food Craving Inventory (FCI) that measures cravings for specific types of foods. The FCI provides a definition for craving that meets Kozlowski and Wilkinson's (1987) criterion that the craved substance be intensely desired. Hence, the definition provided by White et al. reduces reliance on participants' subjective interpretation of the term craving when completing the inventory. The FCI was found to be a reliable and valid measure for the assessment of cravings for specific types of foods, namely: High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats, all of which comprise the higher order construct of "food craving" or the FCI Total score (White et al.). The FCI may be used to test the hypothesis that people eat the types of foods that they crave, as the FCI has the ability to assess cravings for different types of foods.

Food Intake and Food Craving. The assumption that individuals consume the types of foods that they crave is ubiquitous in food intake literature. Nonetheless, methodological issues, including the definition and measurement of food cravings, have compromised formal investigations into the relationship between food cravings and food consumption.

Most studies investigating the relationship between food cravings and food consumption relied on participants' reports of whether or not they "gave in" and consumed the craved food. Studies that have used this methodology have found that participants frequently report consuming craved foods. Hill and Heaton-Brown (1994) found that 80% of craving episodes in women resulted in eating, and Weingarten and Elston (1991) found that roughly 85% of male and female college students indulged in their cravings the majority of the time. The findings demonstrate that people frequently report consuming craved foods.

Hypothesis #1: Food Intake and Food Craving. The first hypothesis was based on the finding that the majority of cravings resulted in consumption of the craved food (Hill & Heaton-Brown, 1994; Weingarten & Elston, 1991). The first hypothesis predicted that participants would consume the specific types of foods that they reported craving, as assessed by the Sweets, High Fats, Carbohydrates/Starches, and Fast Food Fats subscales of the FCI. To test the hypothesis, the number of grams the test food eaten was correlated with the Sweets, High Fats, Carbohydrates/Starches, and Fast Food Fats subscales of the FCI, as well as the FCI Total score. It was predicted that there would be a stronger positive correlation with the Sweets and High Fats subscales with intake of the test food compared to the Carbohydrates/Starches and Fast Food Fats subscales. The hypothesized pattern of correlations would reflect the tendency for participants who scored high on the Sweets and High Fats subscales to consume more of the test food than participants who scored low on those subscales or who scored high on the other subscales of the FCI. Support for the first hypothesis would suggest that participants consume more of the types of foods that they crave. Also, males and females were compared on the FCI subscales, including the FCI Total score, with BMI as a covariate.

<u>Hypothesis #2: Food Intake, Gender, and Body Mass.</u> The second hypothesis was based on the following findings. First, females crave foods such as chocolate more frequently than males (Weingarten & Elston, 1991). Second, food cravings frequently lead to consumption of the craved food (Hill & Heaton-Brown, 1994). Third, BMI is associated with food intake and preference for high fat foods (Drewnowski et al., 1985). Fourth, BMI is associated with binge eating and craving sweets (Gendall et al., 1998; Schlundt et al., 1993). Fifth, the present study used cheesecake, a food that is high in fat and sweet, as the dependent variable. Based on these considerations, the second hypothesis predicted that females would consume more grams of test food compared to males, when body weight was controlled by using BMI as a covariate. The second hypothesis predicted that body mass would be a significant covariate and be positively associated with test food intake. Also, males and females were compared on meal duration and eating rate, yet specific hypotheses about these variables were not stated.

Food Intake and Food Preference

Similar to food craving, food preference is an important construct in food intake literature, and a common assumption is that people eat foods that they report preferring. However, methodological issues, including reliable and valid measurement of food preferences, have limited investigation of the effect of food preference on food consumption. The recent development of a measure that assesses preferences for fats and assesses hedonic ratings or how much a participant likes different types of foods has facilitated testing the hypothesis that people eat the types of foods that they report preferring or liking.

Definition and Measurement. Food preference is typically defined by asking participants to rate how much they like or prefer certain foods on a 9-point hedonic scale ranging from "Dislike Extremely" to "Like Extremely." When assessing food preference in study participants, most researchers develop a preference questionnaire for food items utilized in their study. For this reason, there have been few attempts to develop a food preference questionnaire that assesses preferences for a wide variety of foods. However, Geiselman et al. (1998) developed the Food Preference Questionnaire (FPQ) to assess preference for fat. The FPQ contains a wide variety of foods found in the American diet. The FPQ measures hedonic ratings of how much participants like foods that vary in fat (High Fat, Low Fat) and carbohydrate (High Simple Sugar, High Complex Carbohydrate, and Low Carbohydrate/High Protein) content. Therefore, the FPQ provides an index of fat preference (i.e., the Fat Preference Index), as well as hedonic ratings or ratings of how much participants like foods in six different cells (e.g., High Fat/High Simple Sugar, High Fat/High Complex Carbohydrate, etc.).

Food Intake and Food Preference. Few studies have tested whether individuals select and consume foods that they report preferring or liking. Testing this hypothesis may appear wasteful, as food preference and selection are assumed to be highly correlated (Wyant & Meiselman, 1984). Nevertheless, when participants are asked to rate their preference for foods, they are rating whether or not they like a food independent of method of preparation or physical and emotional state (Wyant & Meiselman, 1984). When they make actual food selections, their choice is influenced by their physical and emotional state, the preparation of the food, the quality of the food, and the latency since their last meal (Wyant & Meiselman, 1984). Consequently, the correlation between food preferences and food selection may not necessarily be strong.

Studies have found significant correlations between food preference ratings and actual food intake. Wyant and Meiselman (1984) found significant correlations between food preference ratings and food selection in a group of male and female military personnel. Additionally, Geiselman et al. (1998) found strong correlations between fat preference, as measured by the FPQ, and fat intake in the laboratory and self-reported fat intake.

Hypothesis #3: Food Intake and Food Preference. The third hypothesis is based on the following findings. First, Wyant and Meiselman (1984) found that food preference and food selection were significantly correlated. Second, Geiselman et al. (1998) found strong correlations between reported fat preference, as measured by the FPQ, and actual fat intake in the laboratory and self-reported fat intake. Based on these findings, the second hypothesis predicted that participants would consume the specific types of foods that they reported liking, as measured by the FPQ. To test the hypothesis, the number of grams of test food consumed was correlated with the factors of the FPQ. Because the test food is a food that is high in fat and sweet, it was predicted that there would be a stronger positive correlation with test food intake and the High Fat and High Simple Sugars factors of the FPQ, specifically the High Fat/High Simple Sugar cell, compared to the Low Fat, High Complex Carbohydrate, and Low Carbohydrate/High Protein factors. Support for the third hypothesis would suggest that people consume the specific types of foods that they report as hedonically pleasing or liking. In addition, males and females were compared on the subscales of the FPQ, with BMI as a covariate, and the relation between the FPQ and FCI were explored with a correlational analysis.

Food Intake, Dietary Restraint, and Disinhibition

The effects of Dietary Restraint and Disinhibition on food intake behavior have been frequently investigated. Dietary Restraint is conceptualized as the intent and ability to restrict dietary intake and Disinhibition refers to the tendency to episodically overeat, often in response to external cues. Herman and Polivy's Restraint Scale (Herman & Polivy, 1975) was initially used to define Dietary Restraint, yet the Restraint Scale has been found to measure both Dietary Restraint and Disinhibition (Lowe, 1993). Consequently, the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) was designed to assess Dietary Restraint and Disinhibition separately, as well as Perceived Hunger.

The influence of the menstrual cycle on food cravings and food intake was previously mentioned. Similarly, assessing the phase of the menstrual cycle is important when evaluating the effects of Dietary Restraint and Disinhibition on food intake. For instance, food intake does not increase during the luteal phase of females' menstrual cycles if hormone levels do not fluctuate (Dye & Blundell, 1997). Also, restrained eaters do not demonstrate an increase in food intake during the luteal phase (Schweiger et al., 1992).

The effects of Dietary Restraint on eating behavior have been studied in groups of people who score high and low on measures of Dietary Restraint. People who score high and low on Dietary Restraint are referred to as "restrained" and "unrestrained" eaters, respectively. Using the Restraint Scale (Herman & Polivy, 1975) to identify restrained and unrestrained eaters, Herman and Mack (1975) utilized a preload paradigm, where normal weight participants were given a milkshake preload prior to an *ad libitum* ice cream taste test. They found that unrestrained eaters ate less ice cream after consuming a preload than those who did not consume a preload. Restrained eaters who ate a preload ate *more* than those who did not eat a preload. Herman and Mack described this phenomenon as *counterregulation*, as theories of food intake would predict a reduction in intake following a preload. According to Dietary Restraint theory, counterregulation is the result of rigid, dichotomous beliefs that restrained eaters adopt about eating. When the rigid eating rules are violated by a disinhibiting event (e.g., dietary violations, preload), restrained eaters temporarily interrupt their efforts at dietary restriction and consume more food than normal.

Studies have found that food intake among restrained and unrestrained eaters is variable and that counterregulation among restrained eaters is not a robust phenomenon. Typically, restrained eaters increase or maintain their level of consumption following a disinhibiting event such as a preload (Sylvestre, Tournier, Verger, Chabert, & Delorme, 1989). However, some restrained eaters have been found to significantly decrease consumption following a disinhibiting event, and these groups of people have been referred to as "successful dieters" or "weight suppressors" (Duchmann, Williamson, & Stricker, 1989; Eldredge, 1993; Lowe & Kleifield, 1988; Ruderman & Christensen, 1983). Furthermore, some unrestrained eaters, who are expected to decrease consumption following a disinhibiting event, have been found to overeat (Lawson, et al., 1995; Westenhoefer, Pudel, & Maus, 1990; Williamson et al., 1995). These groups of people have been referred to as "unrestrained overeaters" (Lawson, et al. 1995).

Studies on the effect of Dietary Restraint on eating behavior may have produced inconsistent findings for many reasons. First, earlier studies relied on the Restraint Scale (Herman & Polivy, 1975) to assess Dietary Restraint, and the Restraint Scale has been criticized for also measuring Disinhibition (Lowe, 1993) and weight history (Drewnowski, Riskey, & Desor, 1982). Ruderman (1986) concluded that the Restraint Scale had inadequate psychometric properties among overweight people and similar scores were qualitatively different for normal weight and overweight individuals. Second, most studies did not control for the effect of Disinhibition on eating behavior. Consequently, the Three Factor Eating Questionnaire has been utilized to assess Restraint and Disinhibition, and results indicate that Disinhibition appears to be significantly associated with eating behavior, more so than Dietary Restraint.

Studies by Smith et al. (1998) and Lawson et al. (1995) used the TFEQ to assess Dietary Restraint and Disinhibition, separately. They defined 4 groups of people: low Restraint/low Disinhibition, low Restraint/high Disinhibition, high Restraint/low Disinhibition, and high Restraint/high Disinhibition. Smith et al. used a preload paradigm and did not find counterregulation in restrained eaters. In fact, Smith et al. found that Restraint was unrelated to food intake. Their results are similar to those of Lowe and Kleifield (1988) who used the TFEQ to define Restraint and failed to find counterregulation. The finding of Smith et al. indicate that Disinhibition was associated with excessive eating and an increased rate of eating, suggesting that Disinhibition has a stronger influence on food intake behavior compared to Dietary Restraint.

Lawson et al. (1995) also found that Disinhibition had a significant effect on eating. Lawson et al. reported that females scoring low on Restraint and high on Disinhibition reported overeating and were obese. These participants were characterized as “unrestrained overeaters.” However, females scoring high on Restraint and high on Disinhibition did not report as much food intake and were not as heavy, suggesting that Dietary Restraint moderated the effect of Disinhibition. Westenhoefer et al. (1990) found similar findings, indicating that low Restraint/high Disinhibition was associated with increased body mass and food intake, while high Restraint/high Disinhibition was associated with lower body mass and decreased food intake.

The findings of Smith et al. (1998), Lawson et al. (1995), and Westenhoefer et al. (1990) demonstrate the combined effects of Dietary Restraint and Disinhibition, and suggest that Disinhibition has more influence on eating behavior compared to Restraint. A 2 (High Restraint, Low Restraint) X 2 (High Disinhibition, Low Disinhibition) table illustrates the association of Dietary Restraint and Disinhibition with body mass and food intake (see Table 1). Body mass is defined by BMI. Body Mass Indexes of 20-24.9 are considered normal weight, while 25-29.9 is overweight, and 30 and higher is considered obese. Body Mass Indexes represented in the table are taken from Lawson et al., Westenhoefer et al., and Lowe and Kleifield (1988). Body Mass Index is highly correlated with food intake; therefore, the amount of food consumed between the groups represented in Table 1 may be estimated by examining differences in BMI.

Table 1: The association of Dietary Restraint and Disinhibition with Body Mass Index (BMI) and food intake.

	Low Disinhibition	**High Disinhibition**
Low Restraint	"Normal Eaters" Low/Normal Weight (BMI = 19-22)	"Unrestrained Overeaters" Overweight/Obese (BMI = 28-37)
High Restraint	"Restrained Eaters" Normal Weight (BMI = 23)	"Weight Suppressors" or "Successful Dieters" Overweight (BMI = 25-28)

Based on the findings reviewed above, it is clear that the effect of Restraint on eating behavior may be overshadowed by the effect of Disinhibition. Studies suggest that Disinhibition has a stronger influence on eating behavior compared to Restraint, and Restraint moderates or interacts with Disinhibition to affect eating behavior. Hence, predictions about the influence of Restraint or Disinhibition on eating behavior must consider the interaction of the two constructs.

Hypothesis #4: Food Intake, Dietary Restraint, and Disinhibition. The fourth hypothesis made specific predictions about test food consumption and BMI when compared among the four groups of participants (i.e., low Restraint/low Disinhibition, high Restraint/low Disinhibition, low Restraint/high Disinhibition, high Restraint/high Disinhibition). The predictions were based on the findings reviewed above concerning the association of Dietary Restraint, Disinhibition, and their interaction with BMI and food intake. In summary, the fourth hypothesis predicted that the low Restraint/high Disinhibition group would have significantly higher BMI and test food consumption compared to the high Restraint/high Disinhibition group. The high Restraint/high Disinhibition group was expected to have significantly higher BMI and test food intake compared to the low Restraint/low Disinhibition and high Restraint/low Disinhibition groups, who were not expected to differ from each other. Additionally, the fourth hypothesis examined the association of Dietary Restraint and Disinhibition with meal duration and eating rate.

Hypothesis #5: Dietary Restraint and Food Craving. Theories of food craving originally assumed that cravings were the result of a physiological or biological deficit of the craved food (Weingarten & Elston, 1990), suggesting that Dietary Restraint would be associated with food cravings. Nevertheless, research studies have found that Dietary Restraint is not necessarily associated with food cravings. First, Harvey et al. (1993) found that restricting certain types of foods did not lead to increased cravings for the restricted foods. Second, Weingarten and Elston (1991) found that dieting was not associated with an increase in food cravings. Third, Hill et al. (1991) found that food deprivation was not a necessary condition for food cravings to occur. Based on these findings, the fourth hypothesis predicted that Dietary Restraint would not be associated with food cravings, as measured by the FCI.

Hypothesis #6: Disinhibition, Perceived Hunger, and Food Craving. At the time of the present study's proposal, there was a dearth of literature on the association of Disinhibition and Perceived Hunger with food cravings. Recently, authors have found a significant association of Disinhibition and Perceived Hunger with food cravings (Cepeda-Benito, Gleaves, Williams, & Erath, 2000). The sixth hypothesis predicted that Disinhibition would be associated with food cravings, as measured by the FCI. Also, the sixth hypothesis examined the association of Perceived Hunger with food cravings. At the time of the study's proposal, predictions about the association of Perceived Hunger with food cravings were not established.

Cumulative Food Intake Curves

The Universal Eating Monitor (Kissileff et al., 1980) provides information about the amount of food eaten over the course of a meal. Cumulative food intake curves are created by plotting the cumulative amount of food consumed on the y-axis against time units on the x-axis. Research has demonstrated that typical cumulative food intake curves are decelerated, where eating rate decreases around the third temporal quarter of the meal. (Westerterp-Plantenga, Westerterp et al., 1990). However, some people produce linear cumulative food intake curves. Linear cumulative food intake curves depict a steady rate of food intake throughout the eating episode and are associated with Dietary Restraint. Accelerate curves are exceptionally rare and indicate that eating rate increases during the meal.

The second aim of the present study was to test the hypothesis that the shape of cumulative food intake curves are influenced by Dietary Restraint, Disinhibition, gender, body mass, and food cravings and preferences. To test this hypothesis, cumulative food intake curves were analyzed to determine if they were decelerated, linear, or accelerated. Secondary analyses were conducted that determined if the linearity of the curves was associated with the variables listed above.

Cumulative Food Intake Curves, Dietary Restraint, and Disinhibition

Understanding the effect of Dietary Restraint and Disinhibition on the shape of cumulative food intake curves is limited by a number of factors. First, few studies have investigated the association of Dietary Restraint and Disinhibition with the shape of cumulative food intake curves. Second, earlier studies relied solely on samples of female participants. Third, only one study examined the effect of Dietary Restraint and Disinhibition on cumulative food intake curves while controlling for the other, and in combination (Westerterp, Nicolson, Boots, Mordant, & Westerterp, 1988). Thus, making specific predictions about the effects of Dietary Restraint, Disinhibition, and their interaction on the shape of cumulative food intake curves are based on limited data.

The following paragraphs review studies on the association of Dietary Restraint and Disinhibition, as well as body mass and gender, on the shape of cumulative food intake curves. In addition, the present study investigated the association of food cravings and preferences with cumulative food intake curves, yet no research has been conducted in this area.

Hypothesis #7: Cumulative Food Intake Curves and Dietary Restraint. Westerterp-Plantenga, van den Heuvel et al. (1992) and Westerterp-Plantenga, Wouters et al. (1990) examined the relationship between Dietary Restraint, as measured by the TFEQ, and cumulative food intake curves in restrained and unrestrained normal weight women and restrained obese women. They found that obese and normal weight women with high Dietary Restraint had linear cumulative food intake curves. In contrast, unrestrained normal weight women had decelerated cumulative food intake curves. Additionally, Westerterp-Plantenga, van den Heuvel et al. found that normal weight and obese restrained eaters exhibited linear cumulative food intake curves with both familiar and unfamiliar foods.

The seventh hypothesis was based on the finding that obese and normal weight women with high Dietary Restraint produced linear cumulative food intake curves compared to unrestrained women who produced decelerated cumulative food intake curves (Westerterp-Plantenga, van den Heuvel et al., 1992; Westerterp-Plantenga, Wouters et al., 1990). Based on these findings, the seventh hypothesis predicted that restrained eaters, as defined by the TFEQ, would produce linear cumulative food intake curves compared to unrestrained eaters, who were expected to produce decelerated cumulative food intake curves.

Hypothesis #8: Cumulative Food Intake Curves and Disinhibition. Westerterp-Plantenga, Westerterp et al. (1990) examined the effects of Disinhibition on the shape of cumulative food intake curves by correlating the percent change in slope with the subscales of the TFEQ. They found that Disinhibition was associated with linear cumulative food intake curves in normal weight participants. In overweight participants, the correlation was positive, indicating that Disinhibition was associated with decelerated cumulative food intake curves. Westerterp et al. (1988) obtained similar findings. Disinhibition was associated with linear cumulative food intake curves in normal weight participants, but decelerated cumulative food intake curves in overweight participants.

The eighth hypothesis was based on the finding that Disinhibition was associated with linear cumulative food intake curves in normal weight participants, but decelerated curves in obese participants. Based on these findings, the eighth hypothesis predicted that Disinhibition, as measured by the TFEQ, would be associated with linear cumulative food intake curves in non-obese participants, but decelerated cumulative food intake curves in obese participants. Also, participants who produced linear and decelerated curves were compared on test food intake, BMI, meal duration, and eating rate.

Hypothesis #9: Cumulative Food Intake Curves, Dietary Restraint, Disinhibition, Body Mass, and Food Cravings and Preferences. Only one study has examined the effects of Dietary Restraint and Disinhibition, in combination, on cumulative food intake curves. Westerterp et al. (1988) found that high Restraint, in combination with high Disinhibition, was associated with linear cumulative food intake curves in normal weight participants. Westerterp et al. did not included obese participants in their sample; therefore, the generalizability and applicability of their findings may be limited.

Studies investigating the effect of body mass on the linearity of cumulative food intake curves have produced inconsistent findings. Meyer and Pudel (1972) reported that overweight was associated with linear cumulative food intake curves. Linear cumulative food intake curves were also found in restrained obese participants, but normal weight restrained eaters also produce linear curves. Alternatively, decelerated cumulative food intake curves have been produced by obese participants scoring high on measures of Disinhibition (Westerterp et al., 1988; Westerterp-Plantenga, Westerterp et al., 1990). Thus, both linear and decelerated cumulative food intake curves have been found in samples of obese participants. In addition, Westerterp et al. found that obese and normal weight participants could not be differentiated based on cumulative food intake curves and that BMI did not affect the shape of cumulative food intake curves.

Studies have not investigated the association of food cravings and preferences with the linearity of cumulative food intake curves. Consequently, the present study did not make specific predictions about their association.

The ninth hypothesis was based on the finding that high Restraint, in combination with high Disinhibition, was associated with linear cumulative food intake curves (Westerterp et al., 1988). The ninth hypothesis predicted that Dietary Restraint and Disinhibition, in combination, would be associated with linear cumulative food intake curves. Also, the ninth hypothesis examined the association of body mass, food cravings, and food preferences with the shape of cumulative food intake curves, yet hypotheses about the nature of these interactions were not stated.

Cumulative Food Intake Curves and Gender

Evidence suggests that males initially exhibit a faster rate of consumption and experience a faster deceleration compared to females (Kissileff et al., 1982). Nonetheless, the findings by Kissileff et al. (1982) do not necessarily indicate that gender is associated with decelerated or linear cumulative food intake curves. Moreover, their data were obtained with a design that utilized a liquid meal as the dependent variable. Recent research that utilized solid food meals as dependent variables were conducted with overweight or obese female subjects, negating the possibly of investigating differences by gender. Therefore, the present study tested if gender was associated with either decelerated or linear cumulative food intake curves.

Satiety Quotient and VAS

Satiety is an important construct in food intake literature that refers to the state of inhibition over eating following a meal (Green et al., 1997). Satiety quotients were developed as an easy way to assess satiety and to quantify the level of satiety achieved per unit of food (Green et al.).

Satiety quotients may be used to investigate two aspects of food intake behavior. First, satiety quotients may be used to examine the satiating effect of different types of foods. Second, satiety quotients may be used to examine the satiating effect of the same food between groups of people. The present study utilized satiety quotients to examine the association of the amount of satiety achieved per gram of cheesecake with food cravings, food preferences, Dietary Restraint, Disinhibition, gender, and body mass.

Satiety quotients are calculated by assessing motivation or desire to eat before and after an eating episode, and measuring the amount of food eaten. Measuring desire to eat is easily accomplished with Visual Analogue Scales (VAS). Participants rate their "desire to eat" on a 100 mm line, anchored from "very weak" to "very strong." The experimenter then measures the ranking of the variable in millimeters from the left of the 100 mm line. To calculate the satiety quotient, desire to eat post-eating episode is subtracted from desire to eat pre-eating episode, all of which is divided by the total intake of the eating episode. The resulting quotient is an index of satiety per unit of food.

Because satiety quotients were recently developed, predictions about the relationship between satiety quotients and the variables assessed in the present study were not proposed. The association of food cravings and preferences, Dietary Restraint, Disinhibition, gender, and body mass with satiety quotients was examined in the present study. VAS were examined as a function of the variables, in addition.

Conclusions and Hypotheses

An ubiquitous assumption about food intake behavior is that people eat the types of foods that they crave and prefer. Despite the popularity of this assumption, few studies have directly examined the relationship between food intake behavior and food cravings and preferences. The present study investigated the association of food cravings, food preferences, Dietary Restraint, Disinhibition, gender, and body mass with food intake.

To examine the relationships between the aforementioned variables and food intake, the present study assessed food cravings and preferences with the FCI and FPQ, respectively, in a sample of non-obese and obese males and females. Also, participants were administered the TFEQ to assess Dietary Restraint, Disinhibition, and Perceived Hunger, and their heights and weights were measured to calculate BMI. Following completion of the questionnaires, participants were administered a test lunch consisting of sandwich squares and cheesecake. The amount and rate of intake of the test food (i.e., cheesecake) was assessed with a Universal Eating Monitor (UEM). Also, motivation or desire to eat was assessed with Visual Analogue Scales before and after consumption of the sandwich and test food.

Based on data from the test lunch, three categories of data were collected. First, the number of grams of test food consumed was calculated, as well as other meal characteristics such as meal duration and eating rate. Second, cumulative food intake curves were created that depicted the amount of the test food eaten as a function of time. Third, satiety quotients were calculated that represented satiety per gram of cheesecake. Also, VAS data were collected that measured hunger and desire to eat before and after consumption of the test food. The three categories of variables were utilized to investigate three aims of the present study.

The first aim of the study was to test the hypothesis that people eat the types of foods that they crave and prefer. In addition, the present study investigated the association of consumption of a high fat, sweet food (i.e., cheesecake) with Dietary Restraint, Disinhibition, gender, and body mass. The number of grams of test food eaten, as assessed by a UEM, was the dependent variable. In addition, other meal characteristics, namely the duration of the meal and eating rate were examined. The following hypotheses were tested.

1. The first hypothesis tested the assumption that people consume the types of foods that they crave, as assessed by the FCI. To test this hypothesis, the number of grams of the test food (cheesecake) consumed was correlated with the Sweets, High Fats, Carbohydrates/Starches, and Fast Food Fats subscales of the FCI, as well as the FCI Total score. Because the test food was a food that was high in fat and sweet, it was predicted that there would be a stronger positive correlation with the Sweets and High Fats subscales of the FCI with test food intake than the Carbohydrates/Starch and Fast Food Fats subscales. Also, males and females were compared on the FCI subscales, including the FCI Total score, with BMI as a covariate.

2. The second hypothesis predicted that females would consume more grams of the test food compared to males, with BMI as a covariate to control for the influence of body weight on food intake. Body Mass Index was expected to be

a significant covariate, demonstrating an association between BMI and consumption of the test food. Also, males and females were compared on meal duration and eating rate.

3. The third hypothesis tested the assumption that people eat the types of foods that they report liking, as assessed by the FPQ. To test the third hypothesis, the number of grams of test food consumed was correlated with the factor scores of the FPQ. It was predicted that the High Fats and High Simple Sugar factors of the FPQ, specifically the High Fat/High Simple Sugar cell, would be strongly correlated with test food intake compared to the Low Fat, Low Carbohydrate/High Protein, and High Carbohydrate factors. Also, males and females were compared on the subscales of the FPQ in a MANCOVA with BMI as a covariate, and the FCI and FPQ were correlated to explore their relation.

4. The fourth hypothesis predicted that Dietary Restraint and Disinhibition would predict test food intake. Also, the fourth hypothesis predicted that the low Restraint/high Disinhibition group would have significantly higher BMI and test food intake compared to the high Restraint/high Disinhibition group. The high Restraint/high Disinhibition group was expected to have significantly higher BMI and test food intake compared to the low Restraint/low Disinhibition and high Restraint/low Disinhibition groups, who were not expected to differ from each other. Also, the fourth hypothesis examined the association of Dietary Restraint and Disinhibition with meal duration and eating rate.

5. The fifth hypothesis predicted that Dietary Restraint would not be associated with food cravings, as measured by the FCI.

6. The sixth hypothesis predicted that Disinhibition would be associated with food cravings, as measured by the FCI. In addition, the sixth hypothesis examined the association of Perceived Hunger with food cravings.

The second aim of the present study was to examine the association of Dietary Restraint, Disinhibition, gender, body mass, food cravings, and food preferences with the shapes of cumulative food intake curves. Cumulative food intake curves were analyzed to determine if they were decelerated or linear. Secondary analyses assessed if either decelerated or linear cumulative food intake curves were associated with the variables listed above, as well as meal duration and eating rate.

7. The seventh hypothesis predicted that Dietary Restraint would be associated with linear cumulative food intake curves.

8. The eighth hypothesis predicted that Disinhibition would be associated with linear cumulative food intake curves in non-obese participants, but decelerated curves in obese participants. Furthermore, the eighth hypothesis investigated the association of linear and decelerated cumulative food intake curves with test food intake, BMI, meal duration, and eating rate.

9. The ninth hypothesis predicted that Dietary Restraint and Disinhibition, in combination, would be associated with linear cumulative food intake curves. Also, the ninth hypothesis examined the association of body mass, food cravings, and food preferences with the linearity of cumulative food intake curves.

The third aim of the present study was to determine if food cravings and preferences, Dietary Restraint, Disinhibition, gender, and body mass influenced satiety quotients. Because satiety quotients were recently developed (Green et al., 1997), there was no research examining how they are affected by the variables assessed in the present study. Therefore, specific hypotheses about the relationship between the variables assessed in this study and satiety quotients were not generated. In addition, hunger and desire to eat, which were assessed with Visual Analogue Scales before and after consumption of the test food, were examined as repeated measures, with variables such as gender, Restraint, and Disinhibition as grouping variables. Also, the data from VAS were analyzed as a function of these variables.

METHODS

Participants

Healthy male and female participants were recruited from the Pennington Biomedical Research Center (PBRC), faculty and staff of PBRC and Louisiana State University (LSU), LSU undergraduate students, and a health-fair named Wellness Day. Faculty and staff of PBRC and LSU, LSU undergraduate students, and participants recruited from Wellness Day were offered monetary compensation (i.e., \$15.00) for participation. Participants were adults who were $\geq$ 18 years of age and they were classified as non-obese or obese based on Body Mass Index (BMI). Participants with BMI between 20-29.9 and $\geq$ 30.0 were classified as non-obese and obese, respectively. Participants were excluded from the study if they indicated that they disliked the foods in the test lunch (i.e., chicken salad sandwiches, cheesecake).

Power was examined as a function of the primary aim of the present study. The primary aim was to use correlational analyses to examine the relationship between the number of grams of the test food consumed and the subscale scores of the FCI, as well as the factor scores of the FPQ. For example, the correlation coefficient between the Sweets subscale of the FCI and test food intake was compared to the correlation coefficient between the Carbohydrates/Starches subscale and test food intake. A similar correlational analysis was conducted for test food intake and the factor scores of the FPQ.

Cohen (1992) provides an estimate of the number of participants required in correlational analyses. According to Cohen, a large effect size for an analysis that compares correlation coefficients is .50. With an alpha level of .05 and 80% power, 66 participants are needed to find a large effect size (Cohen) when comparing correlation coefficients. The present study recruited 168 participants, providing adequate power.

Measures

Food Craving Inventory

The Food Craving Inventory (FCI; White, Whisenhunt, Williamson, Greenway, and Netemeyer, 2001) was developed to provide a reliable and valid assessment of cravings for different types of foods (Appendix A). The FCI defines cravings as, “an intense desire to consume a particular food (or food type) that is difficult to resist." The definition meets Kozlowski and Wilkinson (1987) criterion that the craved substance be intensely desired, reducing reliance on the individuals’ subjective interpretation of the term craving. When completing the FCI, individuals rate the frequency of cravings for 37 foods over the past month. Participants rate how often they experienced a craving for each of the foods over the past month using a 5-point Likert scale (A = Never, B = Rarely, C = Sometimes, D = Often, E = Always/almost every day).

Validation of the FCI revealed four conceptual factors or subscales: High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats that comprise the higher-order construct of “food craving,” represented by the FCI Total score (White et al., 2001). Twenty-eight items comprise the four subscales and are used in the calculation of subscale scores. The High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats subscales contain 8, 8, 8, and 4 items, respectively. The High Fats subscale is composed of foods such as bacon and fried fish, whereas the Sweets subscale is composed of foods such as brownies and ice cream. The Carbohydrates/Starches subscale contains foods such as sandwich bread, baked potato, and pasta. The Fast Food Fats subscale contains foods such as pizza and French fries. Refer to Appendix A for a listing of the items and their respective subscales. White et al. found support for the reliability and content, concurrent, construct, and discriminant validity of the FCI.

Food Preference Questionnaire

The Food Preference Questionnaire (FPQ; Geiselman, Anderson, Dowdy, West, Redmann, & Smith, 1998) assesses hedonic ratings or ratings of liking for foods in a 2 (High Fat, Low Fat) by 3 (High Simple Sugar, High Complex Carbohydrate, Low Complex Carbohydrate/High Protein) design (Appendix B). The FPQ consists of 72 foods, with 12 foods in each of six cells: High Fat/High Simple Sugar (HF/HS), High Fat/High Complex Carbohydrate (HF/HC), High Fat/Low Carbohydrate/High Protein (HF/LC/HP), Low Fat/High Simple Sugar (LF/HS), Low Fat/High Complex Carbohydrate (LF/HC), and Low Fat/Low Carbohydrate/High Protein (LF/LC/HP). The HF/HS subscale is composed of foods that are similar to cheesecake, such as chocolate ice cream and fudge brownies. Participants rate each food hedonically on a 9-point Likert scale, with 1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely.

The FPQ was designed to assess preference for fatty foods by calculating the mean hedonic rating of all high fat foods divided by the mean hedonic rating of all low fat foods. Reliability of fat preference and hedonic ratings for the six cells of the FPQ over repeated trials has been found to be adequate (r = .82 - .99). Furthermore, preference for fatty foods, as measured by the FPQ, has been found to be significantly correlated with intake of fatty foods in a laboratory setting, as well as self-reported fat intake, providing evidence for the validity of the FPQ (Geiselman et al., 1998).

Three Factor Eating Questionnaire

The Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick,1985) is a 51-item self-report inventory that assesses Dietary Restraint, Disinhibition, and Perceived Hunger (Appendix C). Dietary Restraint is conceptualized as the intent and ability to restrict dietary intake, and scores on this subscale have been associated with differences in food intake (e.g., Westerterp et al., 1988). Disinhibition refers to the tendency to episodically overeat, often in response to external cues, and Perceived Hunger refers to the subjective state of hunger.

The TFEQ may be used with normal, obese, and eating disordered populations. The TFEQ has established reliability and validity and is frequently used in studies of eating attitudes or behaviors (Schlundt & Johnson, 1990; Stunkard & Messick, 1985).

Body Mass Index

Body Mass Index (BMI) is represented by weight in kilograms divided by height in $meters^2$. It is commonly used to describe body composition and has been found as a valid estimate of adiposity (Billewicz et al., 1962).

Participants in the present study had their height and weight measured at Pennington Biomedical Research Center to calculate BMI. Participants were classified as non-obese (BMI = 20-29.9) or obese (BMI $\geq$ 30.0).

Universal Eating Monitor

The Universal Eating Monitor (UEM; Kissileff, Klingsberg, & Van Itallie, 1980) consists of a scale hidden in a table, connected to a computer that registers the weight of food on a plate that rests on the scale. Each time the weight of the food changes the computer records the time and quantifies the change in weight in grams. Participants are unaware that their food intake is being monitored, as a tablecloth hides the scale. In addition, participants' meals are monitored and recorded via a closed circuit video system.

The UEM records meal characteristic data. The present study examined the following data that were gathered with a UEM. First, the number of grams of test food consumed. Second, the duration of the meal or the time that the participant spent eating. Third, an index of eating rate that was calculated by dividing the number of grams of food eaten by meal duration, resulting in an index of the number of grams of food consumed per unit of time. Finally, cumulative food intake curves were calculated from UEM data. Cumulative food intake curves were created by plotting the cumulative amount of food eaten on the y-axis against time units on the x-axis; therefore, they represent the amount of food consumed as a function of time. Plotting cumulative food intake curves is possible because the experimenter records the time of each bite of food. This data is combined with the weight change data and it is possible to determine which bite of food corresponds with any given change in weight of the food.

Cumulative food intake curves are typically analyzed by examining their linearity. Typically, the curves are categorized as either decelerated or linear. Decelerated curves indicate that food intake decreases in the latter half of the meal. Alternatively, linear cumulative food intake curves depict a steady rate of eating throughout the meal. Linear cumulative food intake curves are associated with Dietary Restraint. Accelerated curves occur infrequently in studies on food intake. However, they are known to occur in women who engage in binge eating behavior (Westerterp-Plantenga, Duijsens et al., 1992) and during the first course of a meal or during small meals when satiation is less likely to occur (M. S Westerterp-Plantenga, personal communication, February 28, 2001).

The present study analyzed cumulative food intake curve data to determine if the variables assessed in the study affected their linearity. To accomplish this aim, the cumulative food intake curves were categorized as decelerated, linear, or accelerated. In order to categorize the curves, the curves were analyzed using curve-fitting analysis. Kissileff et al. (1982) found that a quadratic equation adequately describes the characteristics of cumulative food intake curves; therefore, the curves were fit quadratically using Cricket Graph software (Computer Associates International, 1992).

The methodology for plotting cumulative food intake curves using Cricket Graph software was as follows. First, an initial data point was plotted where zero grams of the test food were consumed at zero seconds. Second, the meal was timed from ten seconds before the participant consumed the first bite of the test food, not including the sample bite. The reason for timing the meal ten seconds before the participant consumed the first bite of the test food was to allow curve-fitting using Cricket Graph software (Computer Associates International, 1992). Specifically, each participant's meal must be timed from the same start point, although the start point is arbitrary. These methods are necessary when analyzing cumulative food intake curves using Cricket Graph software and are considered acceptable (M. S. Westerterp-Plantenga, personal communication, October 23, 2000). Each time the participant consumed a bite of test food, the time in seconds from the start of the meal and the cumulative amount of test food eaten were plotted with Cricket Graph software. Data points (i.e., the bite size or weight of the bite) that were corrupted due to the participant leaving the fork on the plate were not plotted. Missing data points at the end of the meal were replaced with the average bite size for the entire sample of participants. However, if more than 3 data points were missing at the end of the meal the participant's data was excluded from the analysis. Also, participants' data was not included in the analysis if it had less than 4 data points. When all of the data had been entered, a line graph was produced in Cricket Graph that was fitted with the quadratic equation, $ax^2 + bx + c$, where *a* represents the amount of deceleration.

In the present analyses, *a* was used to define and classify decelerated, linear, and accelerated cumulative food intake curves. Specifically, decelerated cumulative food intake curves were defined as curves where $a \leq -0.001$, indicating that eating rate decreased or decelerated as the meal progressed. Linear cumulative food intake curves were defined as curves where $a = 0.000$, indicating that eating rate was stable throughout the course of the meal. Accelerated cumulative food intake curves, defined as curves where $a \geq 0.001$, were produced by a small number of participants ($n = 10$), a finding that was unexpected. Accelerated cumulative food intake curves indicate that eating rate increased during the meal. Accelerated curves occur infrequently in studies of food intake. Figures 1, 2, and 3 provide examples of decelerated, linear, and accelerated cumulative food intake curves, respectively.

Visual Analogue Scales

Visual Analogue Scales (VAS) are used to measure variables such as hunger or satiety. Participants rate the variable being assessed on a 100 mm line, anchored from “not at all” to “extremely.” Following the experiment, the experimenter measures the ranking of the variable in millimeters from the left of the 100 mm line.

Participants completed two sets of VAS (Appendix D) to rate food intake motivation. VAS Set 1 measured the following variables: hunger, fullness of stomach, desire to eat, and amount of food one could eat at this moment. VAS Set 2 measured the sensory characteristics of the foods eaten in the experiment. Specifically, the pleasantness of the taste of the food,

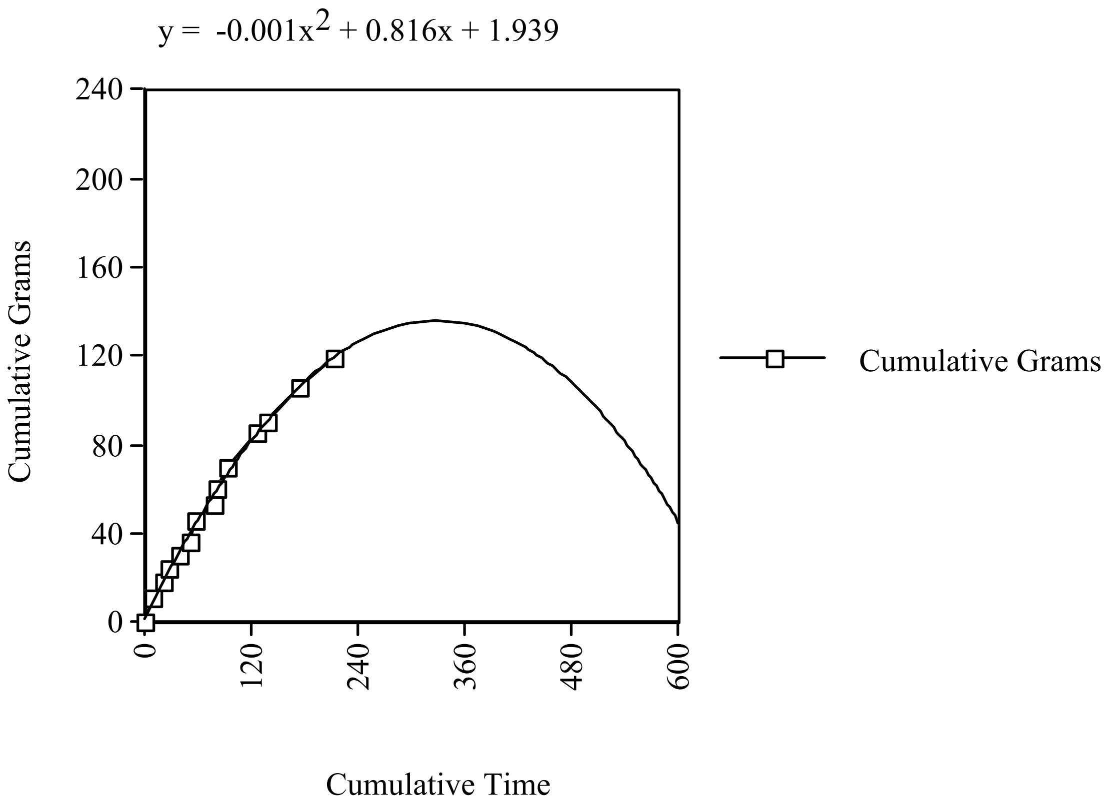

Figure 1: Example of a decelerated cumulative food intake curve.

pleasantness of the feel of food in the mouth, pleasantness of the smell of the food, desire to eat the food, how filling is the food, and fat level of the food.

The VAS in the present experiment are used commonly in studies investigating food intake (Westerterp-Plantenga, Rolland, Wilson, & Westerterp, 1999; Westerterp-Plantenga, Westerterp et al., 1999). Furthermore, their reliability and validity have been established (Flint, Raben, Blundell, & Astrup, 2000). Flint et al. (2000) found that VAS were not influenced by diet standardization the day before test meals, allowing administration of VAS when control of the participants' diet is impossible.

The present study analyzed VAS data that assessed hunger and desire to eat before and after consumption of the test food. In addition, VAS data was utilized to calculate satiety quotients that were developed as an easy way to assess satiety and to quantify the level of

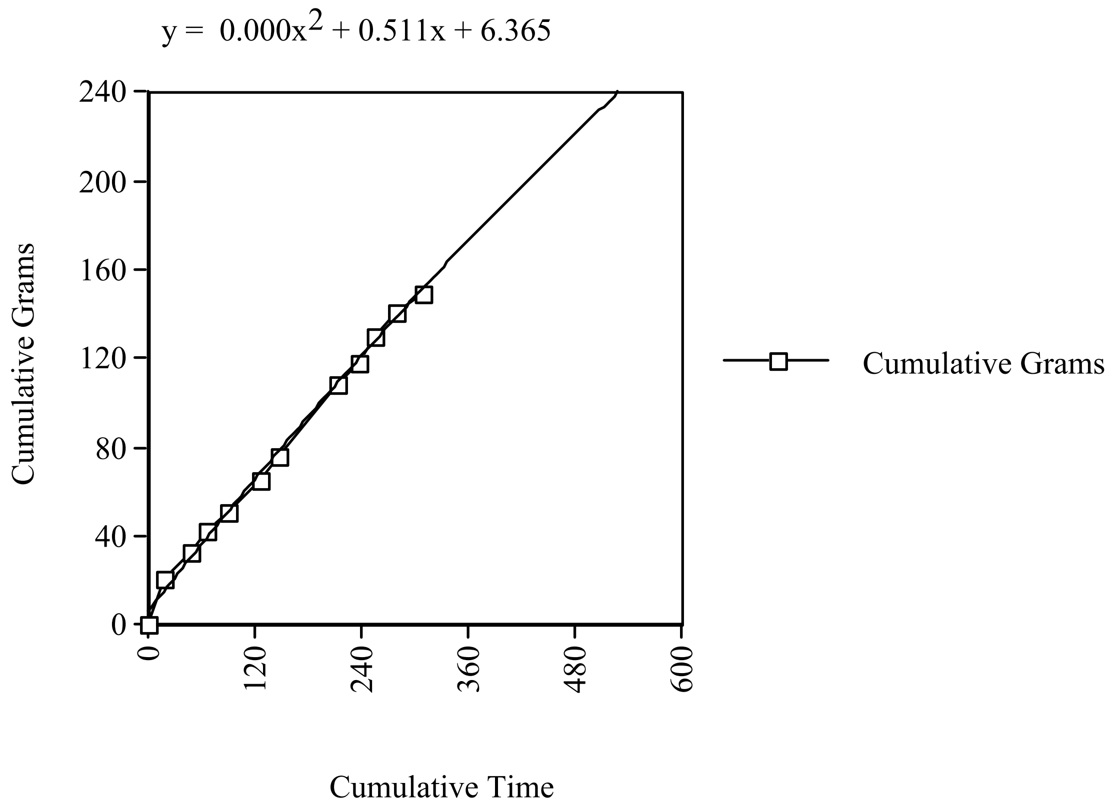

Figure 2: Example of a linear cumulative food intake curve.

satiety achieved per unit of food (Green et al., 1997). Satiety quotients were calculated with VAS ratings for motivation or desire to eat before and after a meal, and the amount of food consumed. The present study recorded the number of grams of the test food consumed with the UEM and VAS measured desire to eat before and after consumption of the test food. Therefore, satiety quotients were easily calculated with the formula:

$$\text{Satiety Quotient} = \frac{\text{desire to eat pre-eating episode - desire to eat post-eating episode}}{\text{number of grams of cheesecake consumed}}$$

As an example, lets assume that Participant A completes a pre-eating episode VAS and ranks his/her desire to eat 90 mm from the left of the VAS line. Thus, his/her desire to eat pre-eating episode is 90. Participant A’s post-eating episode VAS was 75, and he/she consumed 350 grams of test food. These figures are entered into the formula for calculating

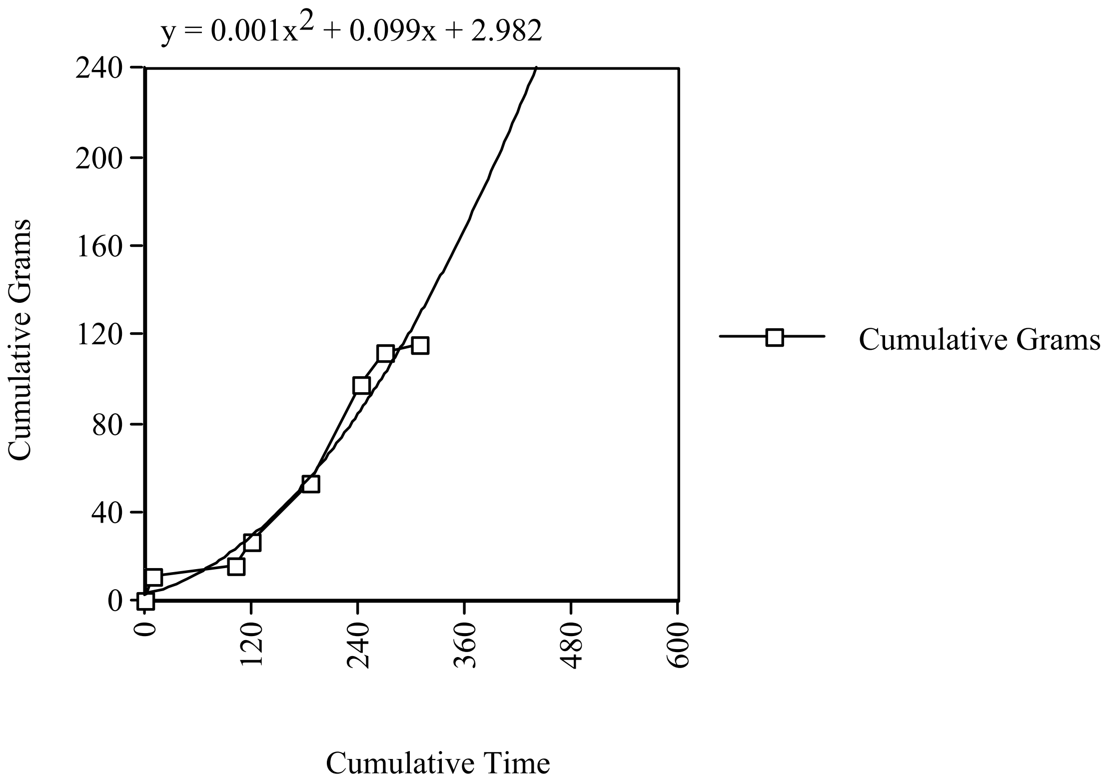

Figure 3: Example of an accelerated cumulative food intake curve.

satiety quotients:

$$\frac{90 - 75}{350} = .04$$

Participant A's satiety quotient was .04, per gram of test food. Alternatively, lets assume that Participant B's desire to eat pre-eating episode was 90 and his/her post-eating episode was 20, and he/she also consumed 350 grams of test food. These figures are entered into the formula for calculating satiety quotients:

$$\frac{90 - 20}{350} = .20$$

Participant B's satiety quotient was .20, per gram of test food, indicating that Participant B reported more satiety per gram of test food compared to Participant A.

Satiety quotients represent a new area of research. Consequently, the present study did not state hypotheses about the association of food cravings, food preferences, Dietary Restraint, Disinhibition, gender, and body mass with satiety quotients. As an alternative, the present study explored the influence of the variables assessed in this study on satiety quotients.

Materials

Sandwich Squares

In order to approximate a legitimate lunch, participants consumed chicken salad sandwich squares prior to eating cheesecake, which was the test food of interest. The sandwich squares consisted of 40% calories from fat.

Cheesecake

The present study used 1/3 of a Sara Lee French Cream Cheesecake per participant. One-third of the entire cheesecake was used to avoid a ceiling effect in the amount of test food consumed. The cheesecake consisted of 55.55% calories from fat, 64% of which was saturated fat. The cheesecake contained 38.89% calories from carbohydrates, 57% of which was simple sugar, and 5.56% calories from protein.

Procedure

The present study was conducted in the UEM laboratory at Pennington Biomedical Research Center. Participants were scheduled for the experiment, or the test lunch, between 10:00 A.M. and 12:00 P.M. Participants were instructed not to eat or drink anything but water from 10:00 P.M. the previous day. Also, they were instructed not to exercise the evening before their visit or to consume alcohol for 24 hours prior to their visit.

When participants arrived at the UEM laboratory, they were provided with informed consent (Appendix E) and their heights and weights were measured and recorded. Participants were administered a pretest questionnaire that assessed compliance with the instructions and determined if they had a cold, allergies, or nasal infection that may interfere with their ability to taste food. Participants completed the FCI, FPQ, and TFEQ.

Participants completed the experimental protocol individually. They were served chicken salad sandwich squares prior to consuming *ad libitum* cheesecake. Females received four sandwich quarters (approximately one sandwich) and males received six quarters (approximately one and one half sandwiches) on the UEM. Males were given more sandwich quarters due to their higher caloric needs (Bray, 1998). The pre-load of sandwich squares was given to make the experimental session appear like an ordinary lunch, with desert.

The UEM and the experimenter recorded the weight of the sandwich squares before being presented to the participants. Prior to tasting the sandwich quarters, participants completed VAS Set 1 that assessed hunger, fullness, desire to eat, and the amount of food they believe they could consume at that moment. Next, participants were instructed to taste a piece of the sandwich and they completed VAS Set 2, rating the pleasantness of the food on a number dimensions. Following completion of VAS Sensory Set 2, participants were told that they would be left alone to consume the rest of the sandwich quarters at their own pace, and drink as much water as they wished (a glass and pitcher of water were left on the table). They were instructed not to read or talk on their cell phone during the eating episode and to inform the experimenter via an intercom when they had completed eating the sandwich squares. The rate of food intake was measured by the UEM and the experimenter recorded the timing of bites of food and videotaped the test lunch. When participants indicated that they completed eating the sandwich squares, they completed another VAS Set 1 and were told to wait in the lobby while the experimenter set up the rest of the lunch (total duration of 10 minutes).

While the participant waited in the lobby, the experimenter weighed a large piece of cheesecake (1/3 of a cheesecake) and placed it in the UEM laboratory. Ten minutes after completion of the sandwich squares, the experimenter escorted participants back into the UEM laboratory where they completed another VAS Set 1. Participants were instructed to taste a piece of test food and they completed another VAS Set 2, rating the pleasantness of the test food on a number of scales. Participants were told that the experimenter would leave the room and they may eat as much of the test food and drink as much water as they wish, and that the experimenter would notify them when the lunch was complete. The experimenter recorded the timing of bites and the UEM recorded the amount of food intake. Participants were left in the UEM laboratory for 15 minutes. Upon completion of this portion of the experiment, participants completed VAS Set 1 and were informed that they had completed the experiment.

RESULTS

Data were collected on 168 participants (122 Caucasian, 40 African-American, 6 Asian). The present study examined differences between Caucasians and African-Americans; therefore, the six Asians were eliminated from the analyses. Twenty-six participants (16%) were non-obese, defined as BMI 20.0-29.9 and 136 (84%) participants were obese, defined as BMI $\geq$ 30.0.

The sample consisted of 139 (85.80%) females with a mean BMI 33.47 (SD = 5.70) and a mean age of 43.73 years (SD = 9.74). One hundred four of the female participants were Caucasian (74.82%) and 35 (25.18%) were African-American. The sample consisted of 23 (14.20%) males with a mean BMI 36.63 (SD = 2.95) and mean age of 45.52 years (SD = 9.81). Eighteen (78.26%) of the males were Caucasian and 5 (21.47%) were African American. The descriptive characteristics of the sample are summarized in Table 2.

Data from the present study were analyzed to test the hypotheses associated with the three aims of the study. As previously mentioned, the three aims of the study evaluated food intake (e.g., the number of grams of the test food eaten), cumulative food intake curves, and satiety quotients/VAS. Each of the three aims required a unique data analytic plan to evaluate the data. In addition, meal duration and eating rate were examined as a function of the variables assessed in the present study. The following section describes the data analytic plan and the results of the analyses for food intake, cumulative food intake curves, and satiety quotients/VAS.

Menstrual cycle and endogenous and exogenous hormones have been found to influence food intake and food cravings. Specifically, food intake and food cravings increase during the luteal phase of the menstrual cycle (e.g., Buffenstein, Poppitt, McDevitt, &

Prentice, 1995; Dye & Blundell, 1997; Dye, Warner, & Bancroft, 1995). The present study did not assess the phase of female participants' menstrual cycles at the time of the test lunch, which is a significant weakness of the study. Future research examining food intake and/or food cravings in female participants would benefit from delineation of menstrual cycle phase.

Unless otherwise specified, the significance level for correlational analyses was .01 to control for experiment-wise error. Analyses of variance (e.g., ANOVA, MANOVA, MANCOVA) utilized Wilks' Lambda criterion and a significance level of .05.

Table 2: Descriptive characteristics of the sample.

Variable				Mean	SD	N	%
Total Sample						162	100
	Age			43.98	9.74		
	BMI			33.92	5.50		
		BMI 20-29.9				26	16
		BMI $\geq$ 30				136	84
	Female					139	88.80
		Age		43.73	9.74		
		BMI		33.47	5.70		
		Ethnicity					
			Caucasian			104	74.82
			African-American			35	25.18
	Males					23	14.20
		Age		45.52	9.81		
		BMI		36.63	2.95		
		Ethnicity					
			Caucasian			18	78.26
			African-American			5	21.74

Food Intake

Food Intake, Food Cravings and Preferences, Gender, and Body Mass

Hypothesis # 1: Food Intake and Food Craving. The first hypothesis predicted that participants eat the types of foods that they report craving, as assessed by the FCI. To test the first hypothesis, the FCI subscales (Sweets, High Fats, Carbohydrates/Starches, Fast Food

Fats, FCI Total score) were correlated with the number of grams of the test food (cheesecake) consumed. It was predicted that the Pearson correlation coefficients for test food intake and the Sweets and High Fats subscales would be significantly stronger than that of the Carbohydrates/Starches and Fast Food Fats subscales, as evaluated with Fisher z-transformations (Fisher, 1921). The hypothesized pattern of correlations would reflect the tendency for participants who scored high on the Sweets and High Fats subscales to consume more of the test food than participants who scored low on those subscales or who scored high on the other subscales of the FCI. Also, males and females were compared on the FCI subscales, with BMI as a covariate.

A multivariate analysis of covariance (MANCOVA) was performed, with gender as the independent variable and the FCI subscales, including the FCI Total score, as dependent variables. Body mass index was a covariate. The main effect for gender was nonsignificant, F (5, 154) = 1.83, p = .11, and BMI was not a significant covariate, F (5, 154) = .68, p = .64. A one-way ANOVA was performed to determine if males and females differed on their ratings for individual food items on the Sweets subscale. Males and females differed significantly solely on the "chocolate" item, F (1, 160) = 7.89, p < .0063, with alpha adjusted to .0063 based on Bonferroni procedure.

An additional MANCOVA was performed where gender was the independent variable and the FCI subscale scores were the dependent variables. Body weight, expressed as kilograms, was a covariate to solely control for body weight. The results of the MANCOVA indicated a main effect for gender, F (5, 154) = 3.03, p < .05, and body weight was a significant covariate, F (5, 154) = 2.44, p < .05. Results of the univariate tests revealed that body weight was not significantly associated with any single FCI subscale and males and females did not differ significantly on any single FCI subscale.

The first correlational analysis included Caucasian and African-American males and females. Due to the number of analyses, the significance level was set at .01 to control for experiment wise error. The correlational analysis indicated that consumption of the test food was significantly correlated with the Sweets subscale, $r = .21$, $p < .01$. One-tailed Fisher z-transformations (Fisher, 1921) were performed to determine if the correlation between test food intake and the Sweets subscale differed significantly from the correlations for the Carbohydrates/Starches, High Fats, and Fast Food Fats subscales of the FCI, as well as the FCI Total score. The significance level was .05. Results of the Fisher z-transformations indicated that the correlation between intake of the test food and the Sweets subscale was significantly larger than the correlation for the Carbohydrates/Starches subscale, $z = 1.91$, $p < .05$. Table 3 summarizes the results of the correlational analysis.

Previous studies reported differences in the types of foods craved by males and females (Weingarten & Elston, 1991). However, the present study failed to find differences in craving scores between males and females. Nevertheless, it is possible that different patterns of correlations exist between craving scores and intake of the test food by genders or ethnicity. Therefore, Pearson product-moment correlation coefficients were calculated between test food intake and the FCI subscale scores for Caucasian and African-American females, separately. Also, the same correlational analysis was performed for male participants, yet both Caucasian and African-American males were included in the analysis due to the small number of males in the study sample.

The analyses indicated that the Sweets subscale was the only subscale of the FCI to significantly correlate with intake of the test food for Caucasian females, $r = .30$, $p < 01$. Fisher z-transformations revealed that the correlation between test food intake and the Sweets subscale was significantly larger than the coefficient for the High Fats subscale, $z = 2.04$, $p < .05$. None of the FCI subscales correlated significantly with consumption of the test food for African-American females. Also, none of the FCI subscales correlated significantly with test food intake for Caucasian and African-American males, who were analyzed together. Table 3 provides a summary of the findings.

Table 3: Pearson correlations between grams of the test food eaten and the subscales of the FCI (Sweets, High Fats, Carbohydrates/Starches, Fast Food Fats), including the FCI Total score.

	Carbs.	Fats	FFF	Sweets	Total
Caucasian & African-American Males & Females (n = 158-159)					
Grams Eaten	$.06^{a}$	$.10^{ab}$	$.10^{ab}$	$.21^{b}$*	$.16^{ab}$
Caucasian Females (n = 102-103)					
Grams Eaten	$.18^{ab}$	$.10^{a}$	$.17^{ab}$	$.30^{b}$*	$.25^{ab}$
African-American Females (n = 34)					
Grams Eaten	$-.07^{a}$	$.08^{a}$	$.00^{a}$	$.11^{a}$	$.04^{a}$
Caucasian & African-American Males (n = 22)					
Grams Eaten	$-.14^{a}$	$.07^{a}$	$.04^{a}$	$.16^{a}$	$.04^{a}$

Note: Due to the number of analyses, the significance level was set at .01 to control for experiment wise error. Pearson correlation coefficients significant at alpha < .01 are denoted by an asterisk (*). Within rows, correlation coefficients with different superscripts differ significantly based on one-tailed Fisher z-transformations (p <.05). The abbreviations for the FCI subscales are as follows: Carbs. = Carbohydrates/Starches, Fats = High Fats, FFF = Fast Food Fats, Total = FCI Total score.

Hypothesis #2: Food Intake, Gender, and Body Mass. The second hypothesis predicted that females would consume more grams of the test food compared to males and that BMI would be associated with test food intake. In addition, comparisons were made between males and females with respect to meal duration and eating rate. Examination of the data revealed that two participants had outliers on the eating rate variable. They were eliminated from the current and subsequent analyses that evaluated eating rate.

A multivariate analysis of covariance (MANCOVA) was performed, with gender as the independent variable and BMI as a covariate. The dependent variables were grams of the test food consumed, meal duration, and eating rate. The main effect for gender was significant, $\underline{F}$ (3, 137) = 6.28, $\underline{p} < .01$. Body mass index was not found to be a significant covariate, $\underline{F}$ (3, 137) = 1.84, $\underline{p} = .14$. The univariate tests indicated that males and females differed significantly on eating rate, $\underline{F}$ (1, 139) = 13.00, $\underline{p} < .0001$. Males and females did not differ significantly on grams consumed, $\underline{F}$ (1, 139) = 3.48, $\underline{p} = .06$ and meal duration, $\underline{F}$ (1, 139) = 1.09, $\underline{p} = .30$. Refer to Table 4 for a summary of the results.

A second MANCOVA was conducted to solely control for body weight. Gender was the independent variable and the dependent variables were grams of the test food consumed, meal duration, and eating rate. Body weight was a covariate. Controlling for body weight alone did not change the results. A significant main effect for gender was found, $\underline{F}$ (3, 137) = 4.67, $\underline{p} < .01$, and body weight was not a significant covariate, $\underline{F}$ (3, 137) = 2.02, $\underline{p} = .12$. Males and females differed significantly on eating rate, $\underline{F}$ (1, 139) = 9.77, $\underline{p} < .01$, and no other variables.

Table 4: Means and standard deviations (in parentheses) for grams of the test food consumed, meal duration, and eating rate by gender.

	Males	Females
Grams Consumed	147.64^{a} (111.28)	107.01^{a} (62.58)
Meal Duration	221.13^{a} (178.16)	277.94^{a} (179.06)
Eating Rate	$.92^{a}$ (.86)	$.48^{b}$ (.36)

Note: Within rows, means with different superscripts differ significantly ($\underline{p} < .0001$). Eating rate represents grams consumed per second.

Hypothesis #3: Food Intake and Food Preference. The third hypothesis predicted that people eat the types of foods that they report liking, as measured by the FPQ. Also, males and females were compared on the subscales of the FPQ, with BMI as a covariate, and the relation between the FPQ and FCI was explored with a correlational analysis.

A MANCOVA was conducted with gender as the independent variable and the FPQ subscale scores (High Fat/High Simple Sugar, Hi Fat/High Complex Carbohydrate, Hi Fat/Low Carbohydrate/Hi Protein, Low Fat/High Simple Sugar, Low Fat/High Complex Carbohydrate, Low Fat/Low Carbohydrate/Hi Protein, Fat Preference Index) as dependent variables. Body mass index (BMI) was a covariate and a second MANCOVA was performed with body weight as a covariate. The results of the MANCOVA indicated that the main effect of gender was significant, $\underline{F}$ (7, 148) = 2.39, $\underline{p} < .05$ and Body Mass Index was not a significant covariate, $\underline{F}$ (7, 148) = 0.66, $\underline{p} = .71$. In the second MANCOVA, similar results were found and body weight was not a significant covariate, $\underline{F}$ (7, 148) = 0.46, $\underline{p} = .86$. The univariate tests for gender indicated that males and females did not differ significantly on any single dependent variable, yet examination of the means revealed that males tended to report nonsignificantly stronger hedonic ratings or ratings of liking for high protein foods (refer to Table 5). To further explore the association of gender with liking ratings, two additional analyses were performed, a discriminant function analysis and a MANCOVA.

Gender was the grouping variable and the FPQ subscale scores, including the Fat Preference Index, were the predictor variables in the discriminant function analysis. The overall Wilk's lambda was significant, L = .89, $\underline{X}^2$ (7, $\underline{N}$ = 157) = 17.55, $\underline{p} < .05$, indicating that the seven predictors differed as a function of gender. The eigenvalue for the discriminant function was .12 and the canonical correlation was .33, indicating that gender accounted for roughly 11% of the variance in FPQ subscale scores. Table 6 presents the within-groups correlations between the predictors and the discriminant function. The discriminant function

Table 5: Means and standard deviations (in parentheses) for FPQ subscale scores by gender.

	Female	Male	F	P
HF/HS	6.30 (1.46)	5.93 (1.67)	.81	.37
HF/HC	5.86 (1.28)	5.80 (1.37)	.03	.88
HF/LC/HP	6.26 (1.26)	6.72 (.90)	2.16	.14
LF/HS	5.79 (1.60)	5.63 (1.55)	.17	.68
LF/HC	5.59 (1.36)	5.55 (1.06)	.00	.96
LF/LC/HP	6.10 (1.38)	6.49 (1.19)	1.97	.16
Fat Preference	1.09 (.23)	1.05 (.15)	.62	.43

Note: Abbreviations for the subscales of the FPQ are as follows: HF/HS (High Fat/High Simple Sugar), HF/HC (High Fat/High Complex Carbohydrate), HF/LC/HP (High Fat/Low Carbohydrate/High Protein), LF/HS (Low Fat/High Simple Sugar), LF/HC (Low Fat/High Complex Carbohydrate), and LF/LC/HP (Low Fat/Low Carbohydrate/High Protein).

Table 6: Within-groups correlations between the predictors and the discriminant function.

	Correlation Coefficients with Discriminant Function
HF/LC/HP	-.37
LF/LC/HP	-.28
HF/HS	.25
Fat Preference	.17
LF/HS	.10
HF/HC	.05
LF/HC	.03

Note: Abbreviations for the subscales of the FPQ are as follows: HF/HS (High Fat/High Simple Sugar), HF/HC (High Fat/High Complex Carbohydrate), HF/LC/HP (High Fat/Low Carbohydrate/High Protein), LF/HS (Low Fat/High Simple Sugar), LF/HC (Low Fat/High Complex Carbohydrate), LF/LC/HP (Low Fat/Low Carbohydrate/High Protein), and Fat Pref. (Fat Preference Index).

was interpreted as representing a “protein” dimension and males appear to have higher hedonic ratings for high protein foods compared to females. Eighty eight percent of participants were correctly classified as either male or female based on FPQ subscale scores.

Box's M test for homogeneity of covariances matrices for canonical discriminant function was nonsignificant, Box's M = 1.45, F Approx. (1, 11417.03) = 1.43, $p = .23$. Kappa was .26, indicating better than chance prediction. The results of the discriminant function analysis are consistent with the results of the MANCOVA, which suggested that males reported nonsignificantly stronger hedonic ratings for high protein foods compared to females.

A final analysis was conducted to explore the association of gender with hedonic ratings. Scale scores were derived from the FPQ that represented the mean of all: high fat, low fat, high sugar, high carbohydrate, and high protein items. A MANCOVA was performed that compared males and females on these five scale scores, with BMI as a covariate. The main effect for gender was significant, $F(5, 150) = 3.05$, $p < .05$, and BMI was not a significant covariate, $F(5, 150) = .08$, $p = .99$. Results of the univariate tests were nonsignificant, but males tended to have nonsignificantly higher hedonic ratings for high protein foods than females. The results are illustrated in Table 7.

Table 7: Means and standard deviations (in parentheses) for FPQ scale score by gender.

	Female	Male	F	p
High Fat	6.14 (1.16)	6.15 (1.14)	.01	.94
Low Fat	5.83 (1.29)	5.89 (1.05)	.10	.76
High Sugar	6.05 (1.27)	5.78 (1.36)	.61	.44
High Carb	5.73 (1.18)	5.68 (1.09)	.01	.91
High Protein	6.19 (1.14)	6.60 (1.00)	2.66	.11

The results of the analyses investigating gender and hedonic ratings indicate a significant, yet modest, overall difference in hedonic ratings of males and females. It appears that the strongest difference in hedonic ratings was that males preferred foods high in protein compared to females.

Pearson product-moment correlations were calculated for consumption of the test food and the factor scores of the FPQ, including the Fat Preference Index, for all participants (Caucasian and African-American males and females). To control for experiment-wise error, the significance level was set at .01. The results of the correlational analysis indicated that the High Fat/High Simple Sugar subscale correlated significantly with intake of the test food, $r = .25$, $p < .01$. No other subscales of the FPQ correlated significantly with test food intake. One-tailed Fisher z-transformations with a significance level of .05 were conducted to determine if the correlation between the High Fat/High Sugar subscale and intake of the test food was significantly stronger than correlations of the other FPQ subscales and intake of the test food. Fisher z-transformations revealed that the correlation of test food intake and the High Fat/High Simple Sugar subscale was significantly stronger than the correlations for the High Fat/Low Carbohydrate/High Protein ($z = 2.03$, $p < .05$), Low Fat/High Complex Carbohydrate ($z = 2.65$, $p < .05$), Low Fat/High Protein ($z = 2.78$, $p < .05$), and Low Fat/High Sugar ($z = 2.81$, $p < .05$) subscales. Table 8 provides a summary of the results of the correlational analysis and the Fisher z-transformations.

Pearson product-moment correlations were calculated for consumption of the test food and the subscales of the FPQ, including the Fat Preference Index, for females (Caucasian and African American, combined) and males (Caucasian and African American, combined). For females, no correlations were significant. For males the Low Fat/High Complex Carbohydrate subscale correlated significantly with test food intake, $r = .55$, $p < .01$, but the number of males in the analysis was small. No other correlations were significant. Fisher z-transformations were performed to determine if the correlation coefficients between FPQ subscale scores and intake of the test food differed significantly, within each group (females and males). Refer to Table 8 for a summary of the results of the correlational analysis and the Fisher z-transformations.

Table 8: Pearson correlations between grams of the test food eaten and subscales of the FPQ, including the Fat Preference Index.

	HF/HS	HF/HC	HF/LC /HP	LF/HS	LF/HC	LF/LC /HP	Fat Pref.
Cauc. & A.-Amer. Males & Females (n = 156-159)							
Grams Eaten	.25[a]*	.13[ab]	.09[b]	.03[b]	.04[b]	.03[b]	.14[ab]
Females (Caucasian & African-American, n = 134-137)							
Grams Eaten	.20[ac]	.08[ac]	.01[bc]	-.09[b]	-.06[bc]	-.06[bc]	.19[ac]
Males (Caucasian and African-American, n = 22)							
Grams Eaten	.48[a]	.34[ab]	.45[a]	.49[a]	.55[a]*	.36[ab]	.01[b]
Females (Caucasian, n = 101-103)							
Grams Eaten	.17[ac]	.10[ac]	-.02[bc]	-.12[b]	-.02[bc]	-.08[b]	.21[ac]
Females (African-American, n = 33-34)							
Grams Eaten	.29[a]	.02[abc]	.10[abc]	-.02[bc]	-.18[b]	.01[abc]	.13[ac]

Note: Significant Pearson correlation coefficients ($p < .01$) are denoted by an asterisk (*). Within rows, correlation coefficients with different superscripts differ significantly based on one-tailed Fisher z-transformations ($p < .05$). FPQ subscales are abbreviated as follows: HF/HS (High Fat/High Simple Sugar), HF/HC (High Fat/High Complex Carbohydrate), HF/LC/HP (High Fat/Low Carbohydrate/High Protein), LF/HS (Low Fat/High Simple Sugar), LF/HC (Low Fat/High Complex Carbohydrate), LF/LC/HP (Low Fat/Low Carbohydrate/High Protein), and Fat Pref. (Fat Preference Index).

Pearson product-moment correlations were calculated for the grams of the test food consumed and the factor scores of the FPQ, including the Fat Preference Index, for female Caucasian and female African-American participants, separately. The results indicated that no FPQ subscales correlated significantly with the intake of the test food for either group. Once again, Fisher z-transformations were conducted to determine if the correlation coefficients differed significantly, within each group. Table 8 provides a summary of the Fisher z-analyses analyses.

The subscales of the FPQ and FCI were correlated to examine their relation. Because the FPQ and FCI presumably measure different, albeit somewhat similar, constructs, the correlations were expected to be modest. As illustrated in Table 9, the results indicated that many of the FCI and FPQ subscales were correlated significantly, yet their relation appears modest. Thus, the FPQ and FCI appear to measure different constructs.

Table 9: Pearson correlations between the subscales of the FCI and FPQ.

	HF/HS	HF/HC	HF/LC/ HP	LF/HS	LF/HC	LF/LC/ HP	Fat Pref.
Fats	.08	.18	.34**	.04	.01	.09	.12
Sweets	.42**	.13	.12	-.02	-.12	-.01	.30**
Carbs	.16	.22*	.27*	.06	.13	.07	.06
FFF	.08	.25*	.19	-.17	-.08	-.10	.33**
Tot. FCI	.26*	.23*	.28**	-.01	-.01	.03	.24*

Note: Pearson correlation coefficients significant at the $\underline{p} < .01$ and $\underline{p} < .001$ levels are denoted by an asterisk (*) and double asterisk (**), respectively. FCI subscales are abbreviated as follows: Fats (High Fats), Carbs. (Carbohydrates/Starches), FFF (Fast Food Fats), and Tot. FCI (FCI Total score). FPQ subscales are abbreviated as follows: HF/HS (High Fat/High Simple Sugar), HF/HC (High Fat/High Complex Carbohydrate), HF/LC/HP (High Fat/Low Carbohydrate/High Protein), LF/HS (Low Fat/High Simple Sugar), LF/HC (Low Fat/High Complex Carbohydrate), LF/LC/HP (Low Fat/Low Carbohydrate/High Protein), and Fat Pref. (Fat Preference Index).

Food Intake, Dietary Restraint, and Disinhibition

Hypothesis #4: Food Intake, Dietary Restraint, and Disinhibition. The fourth hypothesis predicted that Dietary Restraint and Disinhibition would predict consumption of the test food. Furthermore, the fourth hypothesis made specific predictions about the influence of Dietary Restraint and Disinhibition, alone and in combination, on consumption of the test food and BMI. Meal duration and eating rate were examined as a function of Dietary Restraint and Disinhibition, as well.

In order to test the fourth hypothesis, participants were identified who scored greater than the 60th percentile and lower than the 40th percentile on the Dietary Restraint and Disinhibition subscales of the TFEQ. The 60th and 40th percentile were calculated based on scores from the entire sample of participants. Comparable cut-scores have been used in research on food intake behavior with similar participants (Smith et al., 1998). Utilizing the cut-scores allows examination of Dietary Restraint and Disinhibition alone and in combination. The 2 (High and Low Restraint) X 2 (High and Low Disinhibition) design produces four groups of participants: low Restraint/low Disinhibition, high Restraint/low Disinhibition, low Restraint/high Disinhibition, and high Restraint/high Disinhibition.

Two analyses were performed to examine Dietary Restraint and Disinhibition. First, a multiple regression analysis was performed, where the dependent variable was the number of grams of test food consumed and the independent variables were Dietary Restraint and Disinhibition. It was predicted that Dietary Restraint and Disinhibition would predict significantly the amount of the test food eaten. Four participants were eliminated from the analysis due to being outliers, defined as having standardized residual > 3.00. The results of the multiple regression analysis indicated that Dietary Restraint and Disinhibition did not predict significantly grams of test food consumed, $\underline{R}^2 = .003$, adjusted $\underline{R}^2 = -.01$, $\underline{F}$ (2, 150) = .242, $\underline{p} = .79$, failing to support the prediction. Table 10 summarized the correlations among Dietary Restraint, Disinhibition, and intake of the test food.

Second, a 2 (High and Low Dietary Restraint) X 2 (High and Low Disinhibition) multivariate analysis of variance (MANOVA) was conducted. The dependent variables were

Table 10: Pearson correlations among Dietary Restraint, Disinhibition, and grams of the test food consumed.

	Grams Eaten	Dietary Restraint	Disinhibition
Grams Eaten	-		
Dietary Restraint	-.03	-	
Disinhibition	-.04	-.18	-

Note: No Pearson correlation coefficients were significant ($p < .01$).

the grams of test food consumed, BMI, meal duration, and eating rate. Specific predictions were made about the influence of Restraint and Disinhibition on consumption of the test food and BMI, among the four groups of participants. In summary, the low Restraint/high Disinhibition group was expected to have significantly higher BMI and test food consumption compared to the high Restraint/high Disinhibition group. The high Restraint/high Disinhibition group was expected to have significantly higher BMI and test food intake compared to the low Restraint/low Disinhibition and high Restraint/low Disinhibition groups, who were not expected to differ from each other.

The MANOVA indicated that the main effect for Dietary Restraint, F (4, 108) = .82, p = .51 was nonsignificant, but the main effect for Disinhibition, F (4, 108) = 2.74, $p < .05$ was significant. The Dietary Restraint by Disinhibition interaction was not significant, F (4, 108) = .25, p = .91. The univariate tests results revealed that participants scoring high on Disinhibition had significantly higher BMI compared to those scoring low on Disinhibition, F (1, 111) = 9.54, $p < .05$. The univariate tests comparing high and low Disinhibition on grams of test food consumed, F (1, 111) = .12, p = .73; meal duration, F (1, 111) = 1.77, p = .19; and eating rate, F (1, 111) = .08, p = .78 were nonsignificant. See Tables 11 and 12 for a summary of the means and standard deviations for intake of the test food, BMI, meal duration, and eating rate for Dietary Restraint and Disinhibition, respectively.

Table 11: Means and standard deviations for grams of the test food eaten, BMI, meal duration, and eating rate by Dietary Restraint.

	Dietary Restraint	
	Low	High
Grams Consumed	108.30^{a} (65.69)	98.18^{a} (57.66)
Body Mass Index	33.50^{a} (5.40)	32.88^{a}(5.90)
Meal Duration	282.21^{a} (186.15)	246.29^{a} (167.35)
Eating Rate	$.45^{a}$ (.21)	$.56^{a}$ (.48)

Note: Standard deviations are in parentheses. Within rows, none of the means differed significantly (p < .05).

Table 12: Means and standard deviations for grams of the test food eaten, BMI, meal duration, and eating rate by Disinhibition.

	Disinhibition	
	Low	High
Grams Consumed	103.64^{a} (52.97)	102.14^{a} (68.48)
Body Mass Index	31.44^{a} (6.58)	34.70^{b} (4.18)
Meal Duration	283.02^{a} (174.74)	244.98^{a}(177.36)
Eating Rate	$.50^{a}$ (.46)	$.51^{a}$ (.30)

Note: Standard deviations are in parentheses. Within rows, means with different superscripts differed significantly (p < .05).

Hypothesis #5: Dietary Restraint and Food Craving. The fifth hypothesis predicted that Dietary Restraint would not be associated with food cravings, as measured by the FCI. Dietary Restraint, as measured by the TFEQ, was correlated with the subscale scores of the FCI (High Fats, Sweets, Carbohydrates/Starches, Fast Food Fats, FCI Total score) for males and females, separately. It was predicted that Dietary Restraint would not be significantly correlated with the subscale scores of the FCI. The results indicated that for both males and females, Dietary Restraint did not correlate significantly with any of the subscale scores of the FCI. Tables 13 and 14 provide summaries of the correlation coefficients for females and males, respectively.

Table 13: Pearson correlation coefficients among Dietary Restraint, Disinhibition, and the subscales of the FCI for Females (n = 135-138).

	Res.	Dis.	Hunger	Fats	Sweets	Carbs.	FFF	Tot. FCI
Res.	-							
Dis.	-.22*	-						
Hunger	-.17	.68**	-					
Fats	-.04	.25*	.32**	-				
Sweets	.01	.37**	.43**	.39**	-			
Carbs.	-.09	.33**	.37**	.74**	.48**	-		
FFF	-.11	.24*	.34**	.50**	.44**	.50**	-	
Tot. FCI	-.06	.39**	.46**	.82**	.77**	.86**	.70**	-

Note: Significant Pearson correlation coefficients are denoted with an asterisk * (p <.01) and double asterisks ** (p < .001). The abbreviations are as follows: Res. = Dietary Restraint, Dis. = Disinhibition, Hunger = Perceived Hunger, Fats = High Fats, Carbs. = Carbohydrates/Starches, FFF = Fast Food Fats, Tot. FCI = FCI Total score.

Table 14: Pearson correlation coefficients among Dietary Restraint, Disinhibition, and the Subscales of the FCI for Males (n = 22-23).

	Res.	Dis.	Hunger	Fats	Sweets	Carbs.	FFF	Tot. FCI
Res.	-							
Dis.	.02	-						
Hunger	-.21	.68**	-					
Fats	.01	-.28	-.11	-				
Sweets	.05	-.06	.25	.47	-			
Carbs.	-.23	-.01	.09	.77**	.55*	-		
FFF	.04	-.06	.21	.52	.67**	.69**	-	
Tot. FCI	-.05	-.13	.12	.84**	.81**	.90**	.81**	-

Note: Significant Pearson correlation coefficients are denoted with an asterisk * (p <.01) and double asterisks ** (p < .001). The abbreviations are as follows: Res. = Dietary Restraint, Dis. = Disinhibition, Hunger = Perceived Hunger, Fats = High Fats, Carbs. = Carbohydrates/Starches, FFF = Fast Food Fats, Tot. FCI = FCI Total score.

Hypothesis #6:Disinhibition, Perceived Hunger, and Food Craving. The sixth hypothesis predicted that Disinhibition would be associated with food cravings, as measured by the FCI. Disinhibition, as measured by the TFEQ, was correlated with the subscale scores of the FCI (High Fat, Sweets, Carbohydrates/Starches, Fast Food Fats, FCI Total score) for females and males, separately. It was predicted that Disinhibition would be significantly positively correlated with the subscale scores of the FCI. For females, the Pearson product-moment correlations were significant between Disinhibition and the High Fats, Sweets, Carbohydrates/Starches, and Fast Food Fats FCI subscales, as well as the FCI Total score. For males, Disinhibition did not correlate significantly with any of the subscales of the FCI, but only a small number of males were included in the analysis. See Tables 13 and 14 for a summary of the correlation coefficients for females and males, respectively.

Specific predictions about the correlation of Perceived Hunger, as measured by the TFEQ, and the FCI subscale scores were not established. Nevertheless, Pearson correlation coefficients were calculated between Perceived Hunger and the subscales of the FCI. For females, Perceived Hunger correlated significantly with all of the subscales of the FCI, including the FCI Total score. For males, Perceived Hunger did not correlate significantly with any of the FCI subscales. Refer to Tables 13 and 14 for a summary of the correlation coefficients for males and females, respectively.

Cumulative Food Intake Curves

Ninety-five participants' data were suitable for cumulative food intake curve analysis based on the aforementioned inclusion criteria. Cumulative food intake curves were plotted and fit quadratically using Cricket Graph software (Computer Associates International, 1992). As previously outlined, the curves were categorized as either decelerated, linear, or accelerated. The analyses indicated that 48 of the curves were decelerated, 37 were linear, and 10 were accelerated. Because accelerated curves are rare and were not of primary interest to the present study, they were eliminated from the analyses, resulting in 85 curves viable for analysis.

Cumulative Food Intake Curves, Dietary Restraint, and Disinhibition

Hypothesis #7: Cumulative Food Intake Curves and Dietary Restraint. The seventh hypothesis predicted that restrained eaters, as defined by the TFEQ, would produce linear cumulative food intake curves compared to unrestrained eaters, who were expected to produce decelerated cumulative food intake curves.

To test the seventh hypothesis, a Pearson Chi square analysis was conducted to determine if restrained and unrestrained eaters had different proportions of decelerated and linear curves. The Chi square was nonsignificant, $\underline{X}^2$ (1, $\underline{N}$ = 75) = 2.07, $\underline{p}$ = .15, indicating that Dietary Restraint was not associated with linear cumulative food intake curves.

Hypothesis #8: Cumulative Food Intake Curves and Disinhibition. The eighth hypothesis predicted that Disinhibition, as measured by the TFEQ, would be associated with linear cumulative food intake curves in non-obese participants, but decelerated cumulative food intake curves in obese participants. Also, participants who produced linear and decelerated curves were compared on test food intake, BMI, meal duration, and eating rate.

Very few ($\underline{n}$ = 9) non-obese participants were eligible for the analysis. Therefore, to test the eighth hypothesis, 3 analyses were performed. First, a Chi square analysis was conducted with all participants (obese and non-obese) to determine if participants scoring high and low on Disinhibition had different proportions of decelerated and linear curves. The Chi square was significant, $\underline{X}^2$ (1, $\underline{N}$ = 69) = 5.83, $\underline{p}$ < .05. Examination of the proportions revealed that the hypothesis was supported. Low Disinhibition was associated with linear curves, whereas high Disinhibition was associated with decelerated curves.

Second, a Chi square was performed for non-obese participants, followed by an additional Chi square for obese participants. The Chi square for non-obese participants was nonsignificant, $\underline{X}^2$ (1, $\underline{N}$ = 8) = .18, $\underline{p}$ = .67, but the Chi square for obese participants was significant, $\underline{X}^2$ (1, $\underline{N}$ = 61) = 4.87, $\underline{p} < .05$. The results of the Chi squares and examination of the proportions of linear and decelerated curves by high and low Disinhibition suggests that Disinhibition was associated with decelerated curves in obese, but in not non-obese participants. However, the results should be viewed with caution due to the small number of participants in the Chi square for non-obese participants.

Participants who produced linear and decelerated curves were compared on the following variables: grams of the test food eaten, BMI, meal duration, and eating rate in a one-way ANOVA. The significance level of the ANOVA was adjusted to alpha < .0125 based on Bonferroni procedure (.05/4 = .0125). The results revealed that participants who produced linear vs. decelerated curves differed significantly on eating rate, $\underline{F}$ (1, 81) = 7.84, $\underline{p} < .0125$, where decelerated curves were associated with eating significantly more grams of the test food per second. The groups did not differ on the grams of the test food consumed, $\underline{F}$ (1, 83) = .004, $\underline{p}$ = .95; meal duration, $\underline{F}$ (1, 81) = 4.86, $\underline{p}$ = .03; or BMI, $\underline{F}$ (1, 83) = 6.20, $\underline{p}$ = .02. Refer to Table 15 for a summary of the means and standard deviations for participants who produced decelerated vs. linear curves.

Table 15: Means and standard deviations for grams of test food consumed, BMI, meal duration, and eating rate by decelerated vs. linear cumulative food intake curves.

	Decelerated	Linear
Grams Consumed	120.84^a (82.08)	119.84^a (58.96)
Body Mass Index	35.14^a (4.65)	32.74^a(4.08)
Meal Duration	252.59^a (160.79)	335.68^a (182.36)
Eating Rate	.52 $(.21)^a$	$.40^b$ (.18)

Note: Within rows, means with different superscripts differ significantly at $\underline{p} < .0125$. The significance level was adjusted based on the Bonferroni procedure. Standard deviations are in parentheses.

Hypothesis #9: Cumulative Food Intake Curves, Dietary Restraint, Disinhibition, Body Mass, and Food Cravings and Preferences. The ninth hypothesis was two fold. First, the ninth hypothesis predicted that high Dietary Restraint and high Disinhibition, in combination, would be associated with linear cumulative food intake curves. Second, the ninth hypothesis explored the association between the other variables assessed in the present study and the linearity of cumulative food intake curves.

A one-sample Pearson Chi square was conducted with participants scoring high on both Dietary Restraint and Disinhibition to determine if the proportion of decelerated and linear curves differed from that of the hypothesized proportion (i.e., .50). The results of the Chi square were nonsignificant, $\underline{X}^2$ (1, $\underline{N}$ = 18) = 0.89, $\underline{p}$ = .35, failing to support the hypothesis.

To examine the second aim of the ninth hypothesis, a hierarchical logistic regression analysis was performed. The logistic regression analysis was conducted to determine if decelerated and linear cumulative food intake curves could be predicted by the variables assessed in the study. Dietary Restraint, Disinhibition, and BMI were entered at Step 1, the FCI subscales were entered at Step 2, and the FPQ subscales were entered at Step 3. The effects of these variables on the linearity of cumulative food intake curves has not been extensively studied and hypotheses were not generated in the present study. Step 1 of the logistic regression was significant, $\underline{X}^2$ (3, $\underline{N}$ = 82) = 9.64, $\underline{p} < .05$, with BMI predicting curve linearity, $\underline{B}$ = -.11, $\underline{\text{S.E.}}$, = .06, $\underline{\text{Wald}}$ = 3.95, $\underline{p} < .05$, $\underline{r}$ = -.13 (OR = .89; C.I. .80 - 1.00). Higher BMI was associated with decelerated curves.

Cumulative Food Intake Curves and Gender

The present study originally proposed to examine the association of gender with the linearity of cumulative food intake curves. However, the influence of gender on cumulative food intake curves could not be thoroughly examined, as only 6 of 85 participants with viable curve data were male. Nevertheless, a Chi square analysis was conducted to determine if males and females differed on the proportion of decelerated vs. linear curves. The Chi square was nonsignificant, $\underline{X}^2$ (1, $\underline{N}$ = 85) = 1.90, $\underline{p}$ = .17, yet examination of the proportions indicated that males almost exclusively produced linear curves, as 5 of the 6 males had linear curves (83.3%). Roughly half of the females (43 of 79 or 54.4%) produced linear curves.

Satiety Quotient and VAS

The satiety quotient was developed as an easy way to assess satiety and to quantify the level of satiety achieved per unit of food (Green et al., 1997). Satiety quotients were calculated by assessing desire to eat before and after an eating episode and measuring the amount of food eaten. A series of analyses were conducted to investigate VAS (hunger and desire to eat), followed by analyses investigating satiety quotients.

Visual Analogue Scales were used to measure hunger and desire to eat before and after consumption of the test food. Three repeated measures analyses of variances were performed to examine the association of hunger and desire to eat with 1) gender and weight status (obese vs. non-obese), 2) Dietary Restraint and Disinhibition, and 3) linear vs. decelerated cumulative food intake curves. Conducting separate analyses was not ideal; it was necessary to achieve an adequate number of participants per analysis, as cases were deleted list-wise that had missing data.

A repeated measures analysis of variance was performed with hunger and desire to eat as the within subject variables. Gender and obesity status (obese vs. non-obese) were the grouping variables. The results indicated that both hunger, $F(1, 154) = 10.73$, $p < .01$ and desire to eat, $F(1, 154) = 85.08$, $p < .0001$ decreased significantly after consumption of the test food. The interactions for hunger and gender, $F(1, 154) = .19$, $p = .67$ and hunger and obesity status, $F(1, 154) = .22$, $p = .64$ were nonsignificant. The interactions for desire to eat and gender, $F(1, 154) = .09$, $p = .77$ and desire to eat and obesity status, $F(1, 154) = .04$, $p = .84$ were nonsignificant.

A repeated measures analysis of variance was performed with hunger and desire to eat as the within subject variables. Dietary Restraint (high and low) and Disinhibition (high and low) were grouping variables. The main effects for hunger and desire to eat will not be reviewed, as they were significant in all analyses, indicating that both hunger and desire decreased following consumption of the test food. The interactions for hunger and Restraint, $F(1, 124) = 3.07$, $p = .08$ and desire to eat and Restraint, $F(1, 124) = .04$, $p = .85$ were nonsignificant. Also, the interactions for hunger and Disinhibition, $F(1, 124) = 1.22$, $p = .27$, and desire to eat and Disinhibition, $F(1, 124) = .16$, $p = .69$ were nonsignificant.

Finally, a repeated measures analysis of variance was performed with hunger and desire to eat as the within subject variables. The grouping variable was linearity of the cumulative food intake curves (decelerated or linear). The main effects for hunger and desire to eat were significant. The interactions for hunger and curve linearity, $F(1, 85) = .77$, $p = .38$ and desire to eat and curve linearity, $F(1, 85) = 1.04$, $p = .31$ were nonsignificant.

Three analyses were conducted to analyze satiety quotients. One participant's data were eliminated from the analyses investigating satiety quotients for being an outlier. The first analysis utilized the cut-scores reviewed earlier for Dietary Restraint and Disinhibition. As previously mentioned, utilizing the cut-scores allows for a 2 (high and low Restraint) X 2 (high and low Disinhibition) design. To test for differences in satiety quotients as a function of Dietary Restraint, Disinhibition, or their interaction, a 2 (High Restraint, Low Restraint) X 2 (High Disinhibition, Low Disinhibition) ANOVA was conducted, with satiety quotients as the dependent variable. Results of the ANOVA indicated that the main effects for Restraint, F (1, 125) = .32, p = .57, Disinhibition, F (1, 125) = .06, p = .81, and their interaction, F (1, 125) = .06, p = .81 were nonsignificant.

The second analysis, a one-way analysis of variance (ANOVA), was performed to determine if males and females differed significantly on satiety quotients. The one-way ANOVA indicated that males and females did not differ significantly on satiety quotients, F (1, 156) = .19, p = .67. The mean satiety quotient for males was .24 (SD = .24) compared to .32 (SD = .81) for females.

The third analysis was a hierarchical multiple regression analysis to determine if satiety quotients, the dependent variable, could be predicted by the independent variables of food cravings, food preferences, body mass, Dietary Restraint, and Disinhibition. Body mass index was entered at Step 1, Dietary Restraint and Disinhibition were entered at Step 2, the FCI subscales were entered at Step 3, and the FPQ subscale scores were entered at Step 4. Five participants data were eliminated from the analysis due to having standardized residuals > 3.00. None of the variables at any of the steps significantly predicted satiety quotients.

DISCUSSION

The three aims of the present study investigated food intake (i.e., grams of the test food consumed, meal duration, and eating rate), cumulative food intake curves, and satiety quotients/VAS. The results of the analyses are discussed as they relate to each aim of the study. As previously mentioned, a significant liability of the present study was not ascertaining the phase of female participants' menstrual cycles at the time of the test lunch. Failing to do so might account for the many of the nonsignificant findings, particularly those that relate to food intake, food cravings, Dietary Restraint, and Disinhibition.

Food Intake

Food Intake, Food Cravings and Preferences, Gender, and Body Mass

Hypothesis # 1: Food Intake and Food Craving. The first hypothesis predicted that participants eat the types of foods that they report craving. The correlation coefficients for intake of the test food and the Sweets and High Fats subscales of the FCI were expected to be significantly stronger than that of the Carbohydrates/Starches and Fast Food Fats subscales. Also, males and females were compared on the FCI subscales, including the FCI Total score, with BMI as a covariate.

Males and females did not differ significantly on the FCI subscale scores and body mass was not a significant covariate. The findings were surprising, as previous studies concluded that females craved foods such as chocolate more frequently than males (Gendall et al., 1997; Weingarten & Elston, 1991). The use of the FCI to assess food cravings might have influenced the finding that males and females did not differ on food craving scores. The FCI assesses cravings for a number of foods on each subscale and the Sweets subscale contains eight items. Therefore, it is possible that females crave specific types of sweets (e.g., chocolate) more frequently than males, but males and females may not differ on cravings for sweets as a food category. A comparison of males and females on the items of the Sweets subscale supported this conclusion. Males and females differed significantly solely on the item assessing craving for chocolate, with females reporting higher cravings for chocolate compared to males.

The results of the present study do not provide strong support for the common assumption that people eat the types of foods that they crave. Researchers have concluded that food cravings frequently lead to food intake, particularly of the craved or similar food (Hill & Heaton-Brown, 1994; Weingarten & Elston, 1991). Therefore, strong correlations between food cravings and food intake are expected, yet the present study did not find strong correlations between the FCI and intake of a single test food (i.e., cheesecake). A significant correlation was found between the Sweets subscale and intake of the test food for all of the participants, yet the correlation was relatively small (r = .21) and primarily restricted to Caucasian females. The results were unexpected and inconsistent with conclusions from previous studies (Hill & Heaton-Brown, 1994; Weingarten & Elston, 1991).

For the entire sample of participants, the correlation between test food intake and the Sweets subscale was significantly stronger than the correlation between test food intake and the Carbohydrates/Starches subscale. The correlation between the High Fats subscale and test food intake did not differ significantly from any of the other subscales. Therefore, the prediction that the High Fats and Sweets subscales would be significantly more highly correlated with intake of the test food compared to the Carbohydrates/Starches and Fast Food Fast subscales was not supported in its entirety. One reason for the finding may be due to the fact that the High Fats subscale contains items that are high in fat, but not particularly sweet (e.g., sausage). The findings of the present study suggest that food cravings are not necessarily associated with food intake.

The results of the present study may be inconsistent with prior research due to methodological differences. Researchers have concluded that food cravings frequently lead to consumption of the craved or similar food, yet the conclusions were based on studies that suffered from two limitations. First, the studies relied on unvalidated methods for assessing food cravings. Second, food intake was assessed via self-report (Hill & Heaton-Brown, 1994; Weingarten & Elston, 1991), which has been found to have questionable validity (Block, 1982). The present study utilized a validated questionnaire to assess food cravings, in addition to objective assessment of food intake in the laboratory.

The present study may have failed to find strong correlations between the FCI and intake of the test food, but the findings do not eliminate the possibility that people consume foods that they crave. It is possible that people eat the types of foods that they crave, but they may not necessarily consume a large amount of the food, a conclusion that is consistent with prior research. For instance, authors have argued for a strong association between food cravings and eating in the majority of the population (Wiengarten & Elston, 1991), yet not all food cravings lead to consumption of a large amount of food or binge-eating behavior (Gendall et al., 1998), except in bulimics (Mitchell, Hatsukami, & Eckert, 1985). The results of the present study suggest that food cravings may be associated with intake of a moderate amount of the craved food, where participants who reported strong cravings consumed only slightly more than those who did not report strong cravings.

Hypothesis #2: Food Intake, Gender, and Body Mass. The second hypothesis predicted that females would consume more of the test food compared to males, when BMI was a covariate to control for body mass. Also, body mass was expected to be significantly associated with test food intake, and males and females were compared on meal duration and eating rate.

Males and females did not differ significantly on either grams of the test food consumed or meal duration, and BMI was not significantly related to intake of the test food. Males had significantly faster eating rate compared to females.

The failure to find a significant difference between males and females on the amount of the test food eaten was unexpected. Because females typically report more frequent cravings for foods similar to the test food, it was assumed that they would consume more of the test food compared to males (Gendall et al., 1997; Weingarten & Elston, 1991). The failure to support the hypothesis may be due to a number of reasons. First, males and females did not differ significantly on the FCI, suggesting that males and females may not differ on the types of foods craved when validated questionnaires are used to assess food cravings. Second, the results of the present study suggest that food cravings do not necessarily lead to consumption of a large amount of the craved food. Third, males consumed a larger preload (six sandwich squares) compared to females (four sandwich squares). Males were administered a larger preload to compensate for their higher metabolic requirements compared to females. In other words, males consumed a larger preload in an effort to equate the effect of the preload on satiety and hunger between genders. However, the difference in the size of the preloads was not empirically derived; consequently, males may have been more satiated from the preload compared to females, reducing their intake of the test food. The likelihood that males were more satiated than females prior to test food intake appears small, as significant differences were not found between the genders on pre-test food ratings of hunger and desire to eat. Nonetheless, the finding that males did not consume significantly more of the test food compared to females is interesting, as males typically consume more food compared to females.

Males ate more food per unit of time compared to females. The finding is consistent with anecdotal reports and Kissileff et al. (1982) reported that males had increased rates of intake compared to females, yet their test food was a liquid shake not solid food. It should be noted that males not only ate the test food at a faster rate than females, but males almost exclusively produced linear cumulative food intake curves. It is possible that the faster eating rate in males may be associated with linear curves. One study examined cumulative food intake curves in males, yet comparisons were not made between the linearity of curves produced by males and females (Westerterp-Plantenga & Verwegen, 1999).

The finding that BMI was unrelated to food intake was unexpected. Although body mass is typically positively associated with food intake (Bray, 1998), the present study found that BMI was not a significant covariate. It is possible that the laboratory setting of the experiment influenced food intake behavior, yet Kissileff et al. (1982) concluded that laboratory assessment of food intake is similar to food intake in the natural environment. Alternatively, the availability of a single test food may have influenced eating behavior, where different results may have been obtained in an experimental design where more than one food was available. Williamson, Geiseleman, Greenway, Mickley, and Martin (2000) reported that people tend to eat more food when 3 foods are available for consumption compared to one food.

Hypothesis #3: Food Intake and Food Preference. The third hypothesis predicted that people eat the types of foods that they report liking, as measured by the FPQ.

Specifically, the High Fat/High Simple Sugar cell of the FPQ was expected to be strongly correlated with consumption of the test food. In addition, males and females were compared on the subscales of the FPQ, using BMI as a covariate, and the FPQ and FCI were correlated to examine their relation.

Body mass index was not associated with hedonic ratings. Overall, there was a significant, but modest, difference in hedonic ratings between males and females. The strongest difference was that males had higher hedonic ratings for foods high in protein compared to females, yet the difference was not statistically different when tested in isolation. The finding is consistent with anecdotal reports of males' food preferences and research that found that both white and black males prefer high protein foods such as steak more frequently than females (Wyant & Meiselman, 1984). Other researchers report similar results. For example, Drewnowski, Kurth, Holden-Wiltse, and Sarri (1992) found that obese men preferred "protein/fats" (e.g., meats) and women preferred carbohydrates/fats (e.g., cake, cookies).

The High Fat/High Simple Sugar subscale was the only subscale to correlate significantly with test food intake ($r = .25$) for the entire sample of participants (i.e., Caucasian and African-American males and females). Also, the correlation between the High Fat/High Simple Sugar subscale and intake of the test food was significantly stronger than that of the High Fat/High Protein, Low Fat/High Sugar, Low Fat/High Complex Carbohydrate, and Low Fat/High Protein subscales. The finding is consistent with the expectation that people eat the foods that they report liking, as the High Fat/High Simple Sugar subscale contains foods similar to cheesecake.

Although the correlation between the High Fat/High Sugar subscale and test food intake was significant, the correlation coefficient of .25 is not as large as might have been expected. For example, Geiselman et al. (1998) found a correlation of .86 between preferences for fat and overall percentage of fat kilocalorie intake in a food self-selection paradigm. However, other researchers have argued that the correlation between food preference and food selection may not necessarily be strong, particularly concerning the variables that affect food selection such as physical/emotional state, quality of the available food, style of preparation of the food, and eating history (Wyant & Meiselman, 1984). Wyant and Meiselman conclude that there is only a low to moderate probability of a high correlation between food preference and selection.

The results of the present study are consistent with Wyant and Meiselman's (1984) conclusion that food preferences are not necessarily highly correlated with food intake. However, the difference in the results between the present study and those of Geiselman et al. (i.e., the difference in the strength of the correlation coefficients) are striking, especially considering that similar methodology was used (e.g., FPQ, laboratory assessment of food intake). One reason for the disparate results might be Geiselman et al.'s assessment of food intake in a buffet-style meal. Geiselman et al. measured food intake in a buffet-style meal comprised of many different types of foods that varied in macronutrient content. Alternatively, the present study evaluated intake of a single test food, where the only food available was the test food. It is possible that food intake would have been more highly correlated with food preference if other foods were available. Researchers have found that food intake increases when more than one food is available (Williamson et al., 2000).

Many of the FPQ and FCI subscales were found to correlate significantly, yet the correlation coefficients were modest. The results support the argument that food preferences and food cravings are separate constructs.

Food Intake, Dietary Restraint, and Disinhibition

Hypothesis #4: Food Intake, Dietary Restraint, and Disinhibition. The fourth hypothesis predicted that Dietary Restraint and Disinhibition would predict consumption of the test food. Furthermore, the fourth hypothesis made specific predictions about consumption of the test food and BMI among four groups of participants (i.e., low Restraint/low Disinhibition, high Restraint/low Disinhibition, low Restraint/high Disinhibition, high Restraint/high Disinhibition). Specifically, the low Restraint/high Disinhibition group was expected to have significantly higher BMI and test food intake compared to the high Restraint/high Disinhibition group. The high Restraint/high Disinhibition group was expected to have significantly higher BMI and test food intake compared to the low Restraint/low Disinhibition and high Restraint/low Disinhibition groups, who were not expected to differ from each other. Meal duration and eating rate were examined as a function of Dietary Restraint and Disinhibition, as well.

Dietary Restraint and Disinhibition did not predict intake of the test food and neither Restraint nor Disinhibition were correlated significantly with intake of the test food. Also, the specific predictions about food intake and BMI among the four groups of participants were not supported. However, the main effect for Disinhibition was significant and univariate tests revealed that participants scoring high on Disinhibition had significantly higher BMI compared to those scoring low on Disinhibition. The finding provides partial, albeit incomplete, support for the fourth hypothesis, as Disinhibition was associated with higher body mass index. Dietary Restraint and Disinhibition did not have a significant affect on meal duration or eating rate.

The finding that Disinhibition was positively associated with body mass is consistent with previous studies. Smith et al. (1998) and Lawson et al. (1995) found that Disinhibition was highly associated with body mass and food intake, and they argued that Dietary Restraint moderated the relation. The present study failed to find an association between Disinhibition and food intake, and it did not detect a moderating role of Dietary Restraint. Nonetheless, the significant association between BMI and Disinhibition, and the failure to find an association between Dietary Restraint and BMI, supports previous studies that concluded that Disinhibition is more highly associated with BMI compared to Dietary Restraint (Lawson et al.; Smith et al.; Westenhoefer et al., 1990).

Hypothesis #5: Dietary Restraint and Food Craving. The fifth hypothesis predicted that Dietary Restraint would not be significantly correlated with food cravings, as measured by the FCI.

For both males and females Dietary Restraint was not correlated significantly with any of the subscale scores of the FCI, including the FCI Total score. The finding is consistent with previous studies that concluded that Restraint is not highly associated with food cravings (Hill et al., 1991; Rodin, Mancuso, Granger, & Nelbach, 1991; Weingarten & Elston, 1991). The implications of the finding will be discussed in detail at the end of the next section that reviews the results of Hypothesis #6, which examined the associations of Disinhibition and Perceived Hunger with food cravings.

Hypothesis #6: Disinhibition, Perceived Hunger, and Food Craving. The sixth hypothesis predicted that Disinhibition would be associated with food cravings, as measured by the FCI. Predictions about the association of Perceived Hunger with food cravings were not established.

Disinhibition and Perceived Hunger were correlated with the subscale scores of the FCI for females and males, separately. For females, the correlations were significant between Disinhibition and all of the FCI subscales, including the FCI Total score. For males, Disinhibition was not significantly correlated with the FCI, yet the analysis contained only a small number of males (n = 22-23). Similarly, for females, Perceived Hunger correlated significant with all of the FCI subscales, including the FCI Total score. For males, Perceived Hunger was not significantly correlated with the FCI, yet the analysis contained only a small number of males, as previously mentioned.

The finding that Dietary Restraint was not associated with food cravings is consistent with previous literature (Hill et al., 1991; Rodin et al., 1991; Weingarten & Elston, 1991). Also, the association of Disinhibition and Perceived Hunger with food cravings supports previous research (Cepeda-Benito et al., 2000). Cepeda-Benito et al. note that the association of food cravings with Disinhibition is expected given the association of food cravings with bingeing in bulimics (Mitchell et al., 1985). The findings of the present study, in conjunction with those of other studies, provide a preliminary theoretical framework for the development of food cravings and their association with Dietary Restraint, Perceived Hunger, and caloric deprivation.

The failure to find an association between Dietary Restraint and food cravings has been used as evidence against a physiological or homeostatic theory of food cravings, which posits that food cravings are the result of a bodily need for a substance or mineral (e.g., Weingarten & Elston, 1990). Gendall et al. (1997) argued that an association between Dietary

Restraint and food cravings might not have been found due to the dissociation between cognitive Restraint and actual caloric deprivation. However, caloric deprivation in very-low-calorie-diet (VLCD) weight loss programs decreases cravings for foods that are both restricted and allowed on the diet (Harvey et al., 1993), and Hill et al. (1991) conclude that food deprivation is not a necessary condition for food cravings. Also, Perceived Hunger decreases on VLCDs (Lappalainen, Sjoden, Hursti, & Vesa, 1990; Wadden, Stunkard, Day, Gould, & Rubin, 1987). The results suggest that both food cravings and Perceived Hunger are negatively associated with caloric deprivation in VLCDs.

The results reviewed above appear inconsistent with Cepeda-Benito et al.'s (2000) conclusion that the intensity of food cravings increases with caloric deprivation or hunger. However, in actuality, that finding, in addition to the findings that food cravings and hunger decrease on VLCDs and that food cravings are associated with hunger, provide evidence for a parsimonious explanation of the origin of food cravings. Specifically, there is a consensus that food cravings are highly associated with hunger, as hunger precedes food cravings and food cravings diminish after eating (Cepeda-Benito et al.; Hill & Heaton-Brown, 1994). In fact, food cravings have been conceptualized as an expression of appetite for a particular food in response to hunger, where food cravings are acquired by conditioning or consuming the food while hungry, thus food craving may be referred to as "conditioned hunger" (Gibson & Desmond, 1999).

Gibson and Desmond's position deserves merit and further research. It is likely that food cravings decrease on VLCDs for at least two reasons. First, the variety of foods available for consumption on VLCDs is dramatically reduced, decreasing the chances of conditioning foods with hunger. Second, hunger decreases on VLCDs and food cravings are conceptualized as an expression of hunger (Gibson & Desmond, 1999) or a motivational state associated with and similar to hunger (Cepeda-Benito et al.). However, when people are not on a VLCD, they experience hunger and the associated phenomenon of food cravings. Particularly, the onset of craving occurs shortly after the onset of hunger, cravings increase with caloric deprivation, and cravings are reduced following eating. In summary, food cravings are highly associated with and very similar to the construct of hunger, and future research should be aimed at clarifying the association.

Cumulative Food Intake Curves

A number of predictions were proposed concerning the association of the variables assessed in the study with cumulative food intake curves. However, as previously mentioned, cumulative food intake curves could not be analyzed for a number of participants. Therefore, many of the analyses and results should be viewed as largely exploratory.

Cumulative Food Intake Curves, Dietary Restraint, and Disinhibition

Hypothesis #7: Cumulative Food Intake Curves and Dietary Restraint. The seventh hypothesis predicted that restrained eaters would produce linear cumulative food intake curves compared to unrestrained eaters, who were expected to produce decelerated cumulative food intake curves.

The proportion of linear and decelerated curves between restrained and unrestrained eaters did not differ significantly. The results do not support previous research that found a significant association between Dietary Restraint and linear cumulative food intake curves in non-obese and obese restrained eaters (Westerterp-Plantenga, van den Heuvel et al., 1992; Westerterp-Plantenga, Wouters et al., 1990). Linear curves have been interpreted as a consequence of cognitively mediated eating styles, where a conscious decision is made to terminate eating when satiety reached its highest level (Westerterp-Plantenga, 2000; Westerterp et al., 1988).

One reason for the failure to replicate earlier findings may be the presence of males in the present study's sample. However, males produced only 6 of the 85 curves, suggesting that the influence of gender was minimal. Alternatively, the type of analysis may have affected the results. Studies that found an association between Dietary Restraint and linear curves relied on correlational analyses (e.g., Westerterp-Plantenga, Wouters et al., 1990). The present study categorized both the type of curve (i.e., linear vs. decelerated) and participants (i.e., high and low Restraint and Disinhibition) and utilized Chi square analysis. Finally, previous studies did not contain samples obese unrestrained eaters (Westerterp-Plantenga, van den Heuvel et al.; Westerterp-Plantenga, Wouters et al.), negating the possibility to fully explore the association of restraint and obesity on the linearity of cumulative food intake curves.

Hypothesis #8: Cumulative Food Intake Curves and Disinhibition. The eighth hypothesis predicted that Disinhibition would be associated with linear cumulative food intake curves in non-obese participants, but decelerated curves in obese participants. Due to the small number of non-obese participants with eligible curves for the analysis, examination of the eighth hypothesis was neither thorough nor conclusive. Also, participants who produced linear and decelerated curves were compared on test food intake, BMI, meal duration, and eating rate. Decelerated curves were associated with faster intake of the test food compared to linear curves, with no differences on the amount of the test food consumed, meal duration, or BMI.

For the entire sample of participants (obese and non-obese), Disinhibition was associated with decelerated curves. Obese participants were analyzed separately and

Disinhibition was associated with decelerated curves. Alternatively, for non-obese participants, Disinhibition was not associated with decelerated or linear curves. The results partially support the eighth hypothesis. Disinhibition was associated with decelerated curves in obese participants, but not in non-obese participants. However, the conclusion that Disinhibition was not associated with linear curves in non-obese participants is tentative, as a small number of participants were included in the analysis.

The results are supportive of previous research that found that Disinhibition in obese participants was associated with decelerated curves (Westerterp-Plantenga. Westerterp et al., 1990). Decelerated curves have been interpreted as indicative of internal mediation of food intake (Westerterp et al., 1988). Therefore, decelerated curves imply “natural” cues to terminate eating, such as satiety, whereas linear curves imply cognitive and conscious mediation of eating. However, Westerterp-Plantenga (2000) concluded that decelerated curves in dietary unrestrained females were the result of continuing to eat for 1-2 minutes after satiety reached its highest level. Therefore, it appears that obese disinhibited participants who produced decelerated curves may have continued to eat following satiation, which was associated with curve deceleration and may be associated with higher body mass. Alternatively, restrained eaters terminate eating when satiety reaches its highest level, controlling food intake consciously.

Hypothesis #9: Cumulative Food Intake Curves, Dietary Restraint, Disinhibition, Body Mass, and Food Cravings and Preferences. The ninth hypothesis predicted that high Dietary Restraint and high Disinhibition, in combination, would be associated with linear cumulative food intake curves. Also, the association between the other variables assessed in the present study and the linearity of cumulative food intake curves was examined.

Dietary Restraint and Disinhibition, in combination, were not associated with the linearity of cumulative food intake curves. The finding is inconsistent with the results of Westerterp et al. (1988) who found that high Restraint/high Disinhibition was associated with linear curves in non-obese women. The present study may have failed to replicate the findings of Westerterp et al. due to the predominance of obese participants in the sample. Westerterp et al. found the association of high Dietary Restraint/high Disinhibition with linear curves in non-obese females. In addition, the present study used curve-fitting analysis to evaluate the linearity of cumulative food intake curves, where Westerterp et al. used less advanced statistics. Finally, Westerterp et al. categorized curves as either decelerated or linear, yet they failed to differentiate linear curves from accelerated curves. Therefore, they may have mistakenly categorized curves as linear that were actually accelerated. Accelerated curves were eliminated from the present study's analyses.

Regression analysis revealed that the shape of the cumulative food intake curves was predicted by BMI, where BMI was associated with decelerated curves. The finding is inconsistent with Westerterp et al. (1988) who concluded that body mass was not associated with the shape of cumulative food intake curves, yet their analyses suffered from the limitations that were mentioned in the previous paragraph. However, in the present study, both body mass and Disinhibition were associated with decelerated curves, and body mass was associated with Disinhibition. Therefore, it is impossible to ascertain if body mass, Disinhibition, or both are associated with decelerated curves. Future study is needed to explicate the relation between Disinhibition, body mass, and decelerated curves.

Cumulative Food Intake Curves and Gender

The association of gender on cumulative food intake curves has not been thoroughly examined. The present study attempted to examine the association of gender with cumulative food intake curves, yet a very small number of male participants' data was available for curve analysis. Although significant results were not obtained, males almost exclusively produced linear curves, whereas females produced relatively equal proportions of linear and decelerate curves. The results suggest that male gender is associated with linear curves. However, firm conclusions about the association of gender with the linearity of cumulative food intake curves could not be reached for a number of reasons. First, males and females were not found to differ significantly on the proportion of decelerated and linear curves and the small number of males in the sample negatively affected power. Second, males had a faster eating rate and had smaller satiety quotients compared to females, which may either influence the shape of the curves, or be associated with linear curves. Future research is needed to explore the relationship between gender and the linearity of cumulative food intake curves.

Satiety Quotient and VAS

The results of the present study suggest that VAS were sensitive to changes in hunger and desire to eat as a consequence of food intake. Additionally, VAS did not demonstrate interaction effects with gender, weight status (obese vs. non-obese), Dietary Restraint, Disinhibition, and curve linearity (linear vs. decelerated).

The findings support previous research that VAS are a valid assessment tool for measuring appetite related phenomena (Flint et al., 2000). Additional support for the validity of VAS was found by Westerterp-Plantenga and Verwegen (1999) who reported that VAS ratings for hunger, desire to eat, and satiety were sensitive to changes induced by ingestion of preloads that differed on macronutrient content.

Satiety quotients are quick and easy to calculate and provide and index of satiety per unit of food. Since the inception of satiety quotients, there are no published reports of their use in food intake literature. Satiety quotients were examined as a function of Dietary Restraint, Disinhibition, gender, food cravings, food preferences, and BMI, but they were not found to be associated with any of the variables. Based on the lack of significant findings and the dearth of literature on satiety quotients, their utility remains to be proven. Satiety quotients may be useful as a descriptor of satiety, but their ability to detect differences between groups appears lacking.

Summary

The present study offers support for the concurrent and discriminant validity of the Food Craving Inventory (White et al., 2001). Similar to the results found by White et al., the FCI had moderate correlations with Perceived Hunger, supporting the concurrent validity of the inventory. The discriminant validity of the FCI was supported, as the FCI did not correlate significantly with Dietary Restraint, and the FCI had small correlations with Disinhibition. The FCI's correlations with the FPQ were small to modest, providing additional support for the FCI's discriminant validity. Also, the present study demonstrated that food cravings are not necessarily associated with eating, particularly overeating. However, the results are in need of replication with study designs that utilize multiple foods and employ a more naturalistic environment. The study also demonstrated that males and females do not differ on cravings for different food categories, but they differ on cravings of specific foods, particularly chocolate.

Based on the results of the present study and the existing literature on food cravings, it appears that food cravings are a nonbehavioral, cohesive, multidimensional construct that is psychological in nature (e.g., Cepeda-Benito et al., 2000; White et al., 2001). The strong association of food cravings with hunger speaks to the phenomenology of food cravings. Food cravings appear to be a motivational state that is highly associated with or similar to hunger (Cepeda-Benito et al.). The etiology of food cravings deserves exploration, particularly the role of conditioning foods with hunger as a means of establishing food cravings (Gibson & Desmond, 1999).

Previous studies found that Disinhibition was associated with food intake and body mass, with Dietary Restraint moderating the relation (Lawson et al., 1995; Smith et al., 1998). The present study only partially replicated these findings, as Disinhibition was associated with body mass. Also, studies reported an association between Dietary Restraint and linear cumulative food intake curves in obese and non-obese participants (Westerterp-Plantenga, van den Heuvel et al., 1992; Westerterp-Plantenga, Wouters et al., 1990), yet the results of the present study failed to replicate these findings. The linearity of cumulative food intake curves was found to vary as a function of Disinhibition and body mass, where decelerated curves were associated with elevated Disinhibition and body mass. However, based on the findings of this study, it was impossible to determine the unique contribution of body mass and Disinhibition to decelerated curves. Other meal parameters (e.g., meal duration, test food intake) did not vary as a function of Dietary Restraint or Disinhibition; therefore, cumulative food intake curves contribute valuable data about meal characteristics that may not be provided by less sophisticated measurement of meal parameters. Cumulative food intake curves appear to be a promising area of future research.

In conclusion, the present study produced many interesting results. However, predicted relations among psychological variables (e.g., Disinhibition) and eating behavior were elusive. One reason for the lack of significant findings may reside in the nature of food intake behavior. Research on food intake behavior conducted in the laboratory has demonstrated that individuals' food intake is stable and consistent from meal to meal (Barkeling, Rossner, & Sjoberg, 1995; Williamson et al., 2000). It appears that individuals demonstrate stable patterns of food intake and that psychological variables have less influence on eating behavior. Should this hypothesis be supported, it facilitates investigation of agents hypothesized to affect food intake behavior (e.g., drugs, peptides, hormones) in within subjects designs, or designs where the same participants complete test meals while they are on and off the agent.

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APPENDIX A

Food Craving Inventory

Directions: For each of the foods listed below (Items 1-37), please circle the appropriate letter using the following scale.

A craving is defined as an intense desire to consume a particular food (or food type) that is difficult to resist.

Over the past month, how often have you experienced a craving for the food?

A = Never
B = Rarely (once or twice)
C = Sometimes
D = Often
E = Always/almost every day

1. Cake	A B C D E
2. Pizza	A B C D E
3. Fried Chicken	A B C D E
4. Gravy	A B C D E
5. Sandwich Bread	A B C D E
6. Sausage	A B C D E
7. Pudding	A B C D E
8. French Fries	A B C D E
9. Cinnamon Roles	A B C D E
10. Rice	A B C D E
11. Hot dog	A B C D E
12. Peanut butter	A B C D E
13. Hamburger	A B C D E
14. Biscuits	A B C D E
15. Ice cream	A B C D E
16. Pasta	A B C D E
17. Fried fish	A B C D E
18. Whole milk	A B C D E
19. Cookies	A B C D E
20. Chocolate	A B C D E
21. Pancakes or waffles	A B C D E
22. Corn bread	A B C D E
23. Chips	A B C D E
24. Butter or margarine	A B C D E
25. Rolls	A B C D E
26. Cereal	A B C D E
27. Donuts	A B C D E
28. Candy	A B C D E

29. Brownies	A B C D E
30. Bacon	A B C D E
31. Croissant	A B C D E
32. Steak	A B C D E
33. Pie	A B C D E
34. Baked potato	A B C D E
35. Barbecued ribs	A B C D E
36. Mashed potatoes	A B C D E
37. Bagel	A B C D E

Factor loadings for the FCI are as follows:

High Fats: Fried chicken, Gravy, Sausage, Hot dog, Fried fish, Corn bread, Bacon, Steak

Sweets: Cake, Cinnamon Rolls, Ice cream, Cookies, Chocolate, Donuts, Candy, Brownies

Carbohydrates/Starches: Sandwich bread, Rice, Biscuits, Pasta, Pancakes or waffles, Rolls, Cereal, Baked potato

Fast Food Fats: Pizza, French fries, Hamburger, Chips

APPENDIX B

Food Preference Questionnaire

Please mark the box which indicates how much you like each of the following foods AT THIS MOMENT.

1=Dislike Extremely 5=Neutral, Neither Like nor Dislike 9=Like Extremely

	Don't know/ Never tasted before	1	2	3	4	5	6	7	8	9
chocolate layer cake										
pasta with alfredo sauce										
American cheese										
canned pears										
cream of wheat										
vanilla pudding										
roasted skinless chicken breast										
Snickers										
crescent rolls										
BBQ chicken wings										
canned apricots										
pita bread										
fat free string cheese										
pecan pie										
cream of celery soup										
mozzarella cheese										
banana, fresh										
long grain rice										
canned shrimp in water										
apple spice cake										
pizza rolls										
fried chicken leg										
dates, dried										
dill pickle										
stewed chicken breast										
vanilla ice cream										
onion rings										
pot roast										
bagel, plain										
ground turkey										

1=Dislike Extremely 5=Neutral, Neither Like nor Dislike 9=Like Extremely

	Don't know/ Never tasted	1	2	3	4	5	6	7	8	9
chocolate ice cream										
potato sticks										
hamburger patty										
prunes, dried										
white rice										
fat-free cheddar cheese										
Mounds coconut candy bar										
tortilla chips										
prime rib										
popsicle, fruit flavored										
French bread										
roasted skinless turkey breast										
cheesecake, plain										
fast-food biscuit										
sirloin steak										
cantaloupe, fresh										
baked potato, plain										
turkey breast canned in water										
fudge brownie										
Stove-Top stuffing										
fried egg										
apple, raw										
sweet potato, baked, plain										
boiled crawfish										
chocolate cupcake with chocolate icing										
cheese straws										
peanut butter										
jelly, any flavor										
corn, whole kernel										
boiled shrimp										
M&M plain candies										
French fries										
fried catfish fillets										
watermelon, fresh										
leeks										

1=Dislike Extremely 5=Neutral, Neither Like nor Dislike 9=Like Extremely

	Don't know/ Never tasted	1	2	3	4	5	6	7	8	9
broiled red snapper										
M&M peanut candies										
potato salad (mayonnaise type)										
scrambled eggs										
honeydew melon, fresh										
parsnips, cooked										
spinach										
chocolate pudding										

APPENDIX C

Three Factor Eating Questionnaire

For items 1-36, please respond using the scale: **A = True B = False**

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.
2. I usually eat too much at social occasions, like parties and picnics.
3. I am usually so hungry that I eat more than three times a day.
4. When I have eaten my quota of calories, I am usually good about not eating anymore.
5. Dieting is so hard for me because I just get too hungry.
6. I deliberately take small helpings as a means of controlling my weight.
7. Sometimes things just taste so good that I keep on eating even when I am no longer hungry.
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.
9. When I feel anxious, I find myself eating.
10. Life is too short to worry about dieting.
11. Since my weight goes up and down, I have gone on reducing diets more than once.
12. I often feel so hungry that I just have to eat something
13. When I am with someone who is overeating, I usually overeat too.
14. I have a pretty good idea of the number of calories in common food.
15. Sometimes when I start eating, I just can't seem to stop.
16. It is not difficult for me to leave something on my plate.
17. At certain times of the day, I get hungry because I have gotten used to eating then.
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.
19. Being with someone who is eating often makes me hungry to eat also.
20. When I feel blue, I often overeat.
21. I enjoy eating too much to spoil it by counting calories or watching my weight.
22. When I see a real delicacy, I often get so hungry that I have to eat right away.
23. I often stop eating when I am not really full as a conscious means of limiting the amount I eat.
24. I get so hungry that my stomach often seems like a bottomless pit.

25. My weight has hardly changed at all in the last ten years.
26. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.
27. When I feel lonely, I console myself by eating.
28. I consciously hold back at meals in order not to gain weight.
29. I sometimes get very hungry late in the evening or at night.
30. I eat anything I want, any time I want.
31. Without even thinking about it, I take a long time to eat.
32. I count calories as a conscious means of controlling my weight.
33. I do not eat some foods because they make me fat.
34. I am always hungry enough to eat at any time.
35. I pay a great deal of attention to changes in my figure.
36. While on a diet, if I eat a food that is not allowed, I often splurge and eat other high calorie foods.

> Please answer the following questions by filling in the circle on your answer sheet corresponding to the letter of the response that is appropriate to you.

37. How often are you dieting in a conscious effort to control your weight?
A = rarely B = sometimes C = usually D = always
38. Would a weight fluctuation of 5 lbs. affect the way you live your life?
A = rarely B = sometimes C = usually D = always
39. How often do you feel hungry?
A = rarely B = sometimes C = usually D = always
40. Do your feelings of guilt about overeating help you to control your food intake?
A = rarely B = sometimes C = usually D = always
41. How difficult would it be for you to stop eating halfway through dinner and not eat for the next four hours?
A = easy B = slightly difficult C = moderately difficult D = very difficult
42. How conscious are you of what you are eating?
A = not at all B = slightly C = moderately D = extremely
43. How frequently do you avoid "stocking up" on tempting foods?
A = almost never B = seldom C = usually D = almost always
44. How likely are you to shop for low calorie foods?
A = unlikely B = slightly likely C = moderately likely D = very likely

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

A = never B = rarely C = often D = always

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

A = unlikely B = slightly likely C = moderately likely D = very likely

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

A = almost never B = seldom C = at least once a week D = almost every day

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

A = unlikely B = slightly likely C = moderately likely D = very likely

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

A = never B = rarely C = sometimes D = at least once a week

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

A = usually or always eat whatever you want, whenever you want it

B = often eat whatever you want, whenever you want it

C = often limit food intake, but often "give in"

D = usually limit food intake, rarely "give in"

E = 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."

A = not like me

B = little like me

C = pretty good description of me

D = describes me perfectly

APPENDIX D

Visual Analogue Scales (VAS)

Note. Participants rate each item on the 100 mm line with a hash mark.

Set 1

How hungry do you feel at this moment?

Not at all hungry	____________________	Extremely hungry

How full does your stomach feel at this moment?

Not at all full	____________________	Extremely full

How strong is your desire to eat at this moment?

Very weak	____________________	Very strong

How much food do you think you could eat at this moment?

Nothing at all	____________________	A very large amount

Set 2

How pleasant is the taste of this food?

Not at all pleasant	______________________________	Extremely pleasant

How pleasant does this food feel in your mouth?

Not at all Pleasant	______________________________	Extremely pleasant

How pleasant is the smell of this food?

Not at all Pleasant	______________________________	Extremely pleasant

How strong is your desire to eat this food?

Very weak	______________________________	Very strong

How filling is this food?

Not at all Filling	______________________________	Extremely filling

How high in fat does this food taste?

Not at all high in fat	______________________________	Extremely high in fat

APPENDIX E

Consent to Participate in a Research Study

Title of Study: The association of food cravings and preferences with food intake.

What you should know about a research study

- We give you this consent form so that you may read about the purpose, risks and benefits of this research study.
- The main goal of research studies is to gain knowledge that may help future patients.
- You have the right to refuse to take part, or agree to take part now and change your mind later on.
- Please review this consent form carefully and ask any questions before you make a decision.
- Your participation is voluntary.
- By signing this consent form, you agree to participate in the study as it is described.

1- Who is doing the study?

Principal Investigator:	Donald Williamson, Ph.D. Phone: (225) 763 3122
Medical Investigator:	Frank Greenway, M.D. Day Phone: (225) 763 2663 24-hr. Emergency Phone Nos.: (225) 763 2576 (Weekdays 8:00a.m.-5:00 p.m.) (225) 765 4644 (After 5:00 p.m. and Weekends)
Co-Investigators:	Paula Geiselman, Ph.D. Corby Martin, M.S.

Dr. Williamson directs this study, which is under the medical supervision of Dr. Greenway. We expect about 200 people from the Pennington Biomedical Research Center will be in this study. Additionally, roughly 30 people from undergraduate psychology courses at Louisiana State University (L.S.U.) and faculty and staff from Pennington Biomedical Research Center will complete this study. The study will take place over a period of two years. If you are being screened for inclusion in a study investigating medications to treat obesity, your expected total time in this ancillary study is two visits within a six month period. If you were recruited from undergraduate psychology courses at L.S.U., or if you are a faculty or staff from PBRC, you will only complete one visit. You will come in for a food intake test which may or may not include a body image assessment. Participants who are included in studies on medications to treat obesity, will come in once again during the treatment phase of the study for a second food intake session which may or may not include a body image assessment. During the food intake test you will also fill out some questionnaires about eating behavior and attitude. The duration of the food intake test is about one hour. The body image assessment takes approximately 15 minutes. Thus, the duration of the combined body image/food intake test will be 1.25 hours. Consequently, the total time you will spend in this ancillary study is 2.5 hours, only if you are being screened for a study on weight loss medications. This is a PBRC study.

2- Where is the study being conducted?
This ancillary study takes place in the eating monitor laboratory at Pennington Biomedical Research Center.

3- What is the purpose of this study?
The primary purpose of this study is to test the effects of weight loss medication on food intake, food intake motivation, and body image. This study also aims to investigate the association of food cravings and preferences with food intake.

4- Who is eligible to participate in the study? Who is ineligible?
Subjects meeting the entry criteria for placebo controlled trials of medications to treat obesity conducted at the Pennington Center are eligible to participate in this study. These participants are healthy adults, who are $\geq$ 18 years of age and have a body mass index of $\geq$ 27.5 kg/m². Additionally, people enrolled in undergraduate psychology courses at L.S.U. and faculty and staff of PBRC are eligible to participate in this study. These participants are healthy adults, who are $\geq$ 18 years of age, and have a body mass index of 20-30 kg/m². Females may not be pregnant or get pregnant while on the study. Subjects who do not give their consent to participate in this ancillary, are ineligible to participate in this study.

5- What will happen to you if you take part in the study?
You will come to the PBRC for a food intake test. During the food intake test, you will be provided with a lunch consisting of freshly prepared sandwich quarters with chicken salad, a dessert and water. Prior to eating, you will fill out several questionnaires about eating behavior and eating attitudes.

<u>The food intake test:</u>
Before coming in for the food intake test, you are expected to eat and drink nothing besides water for 12 hours prior to the time of testing. You are not supposed to exercise on the evening before the test and you are expected to abstain from alcohol for 24 hours prior to testing. Before starting the lunch, you will complete a questionnaire to assess whether you have any allergies, a cold, etc. on that particular day. In addition, if you are female, you will be asked several questions concerning the date of your latest menstrual period and the current phase of birth control pills, if applicable. You will be served a small portion of sandwiches and water in our eating monitor laboratory. At different times throughout your lunch you will fill out several questions on a computer about your feelings of Perceived Hunger and fullness, and about the taste qualities of the food in front of you. After eating the sandwich, you will wait for 10 minutes in the waiting room. You will then be served a dessert in the eating laboratory. During lunch your food intake may be monitored. The total duration of the entire session will be about one hour.

The body image assessment:
Prior to the lunch, you may be given a body image assessment where you will be instructed to select from a range of body silhouettes a silhouette that matches most closely your current body size. Which body size to select depends on the instructions you receive.

For participants who are enrolled in a study of weight loss medications, you will come in again for a follow-up food intake test after you have been on the weight loss medication for at least one month. The procedure for this test lunch is similar to the one described above. This test may or may not include a body image assessment. The second test will take one or 1.25 hours depending upon whether or not a body image assessment is included.

6- What are the possible risks and discomforts?
There are no notable discomforts associated with this study. The study only involves eating sandwiches and dessert for lunch. Sandwiches and desserts will be freshly prepared and no secret ingredients have been added to them. During lunch, subjects may be watched on a TV monitor and recorded on videotape, which may make some subjects feel slightly uncomfortable. There are no notable discomforts to filling out questionnaires about eating behavior and eating attitude, or to completing body image assessments.

7- What are the possible benefits?
Participants who are recruited through undergraduate psychology courses at L.S.U. will receive course credit for participating in the study. Participants recruited through the PBRC will not receive benefits. However, by participating in this study you are contributing to our understanding of food intake behavior and body image.

8- If you do not want to take part in the study, are there other choices?
You have the choice at any time not to participate in this research study.

9- If you have any questions or problems, whom can you call?
If you have any questions about your rights as a research volunteer, you should call the Institutional Review Board Office at 225/763-2693 or Dr. Claude Bouchard, Executive Director of PBRC at 225/763-2513. If you have any questions about the research study, contact Dr. Donald Williamson (PI) at (225) 763 3122. If you think you have a research-related injury or medical illness, you should call Dr. Frank Greenway at (225) 763 2576 during regular working hours. After working hours and on weekends you should call the answering service at (225) 765-4644. The on-call physician will respond to your call.

10- What information will be kept private?
Every effort will be made to maintain the confidentiality of your study records. However, someone from the Food and Drug Administration, the Pennington Biomedical Research Center, and United States Department of Agriculture may inspect and/or copy the medical records related to the study. Results of the study may be published; however, we will keep your name and other identifying information private. Recorded video sessions will be watched only by the investigators involved in the study. Other than as set forth above, your identity will remain confidential unless disclosure is required by law.

11- Can your taking part in the study end early?
Yes. Dr. Williamson can withdraw you from the study for any reason or for no reason. You may withdraw from the study at any time without penalty. Possible reasons for withdrawal include problems with compliance to the study procedures. If you decide to leave the study early please contact Dr. Donald Williamson at 763-3122.

12- What if information becomes available that might affect your decision to stay in the study?
During the course of this study there may be new findings from this or other research which may affect your willingness to continue participation. Information concerning any such new findings will be provided to you.

13- What charges will you have to pay?
None.

14- What payment will you receive?
None.

15- Will you be compensated for a study-related injury or medical illness?
The Pennington Center is a research facility and does not provide medical care. In the event of injury or medical illness resulting from the research procedures in which you participate, you will be referred to a treatment facility. No form of compensation for medical treatment is available. Medical treatment may be provided at your expense or at the expense of your health care insurer (e.g., Medicare, Medicaid, Blue Cross-Blue Shield, etc.) which may or may not provide coverage.

16- Signatures
The study has been discussed with me and all my questions have been answered. I understand that additional questions regarding the study should be directed to the study investigators. I agree with the terms above and acknowledge that I have been given a copy of the consent form.

_________________________________ _____________
Signature of Volunteer Date

____
Social Security No. of Volunteer

_________________________________ _____________
Signature of Witness Date

_________________________________ _____________
Investigator, Donald Williamson, Ph.D. Date

_________________________________ _____________
Medical Investigator, Frank Greenway, M.D. Date

VITA

Corby Kyle Martin was born and raised in Havre, Montana. He attended Eastern Washington University where he received his Bachelor of Arts degree in psychology in June 1994. In 1996, under the direction of Philip C. Watkins, Ph.D., he received his Master of Science degree in clinical psychology from Eastern Washington University. In August 1996, he began his doctoral training in clinical psychology under the supervision of Donald A. Williamson, Ph.D., at Louisiana State University. He attended the Medical University of South Carolina from July 2000 to July 2001, where he completed his pre-doctoral internship under the direction of Patrick M. O'Neil, Ph.D. In August 2001, he began a post-doctoral fellowship at the Medical University of South Carolina under the supervision of Patrick M. O'Neil, Ph.D. He will receive the degree of Doctor of Philosophy in Clinical Psychology in December 2001. His primary research interests are the treatment and prevention of obesity.