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Examination of the Parasympathetic Activation Hypothesis (PAH) for Arousal-Induced Eating

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EXAMINATION OF THE PARASYMPATHETIC ACTIVATION HYPOTHESIS (PAH) FOR AROUSAL-INDUCED EATING

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Title: Examination of the Parasympathetic Activation Hypothesis (PAH) for Arousal-Induced Eating

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The Parasympathetic Activation Hypothesis (PAH; LaPorte, 1986) for arousal-induced eating proposes that, at modest levels of emotional arousal, eating attenuates sympathetic nervous system activity and activates the parasympathetic nervous system to maintain physiological homeostasis. Eating does not occur at very low or high levels of arousal, thus forming an inverted U-shape function between arousal and eating. Eating activates the parasympathetic nervous system in all people, but people who become highly disinhibited when eating are more susceptible to eating as a way to cope with arousing stimuli.

This study investigated the impact of three levels of arousal (i.e., low, moderate, and high) on food consumption. Restrained and disinhibited eating was assessed through a pre-screen measure, the Three Factor Eating Questionnaire-R18. Participants were randomly assigned to one of the conditions during which they were administered anagram tasks on the computer that were created to induce the designated emotional arousal. Mood rating scales were completed at three different time points to assess for change in emotional arousal and document the impact of each arousal condition. Food was presented after the completion of a portion of the anagram tasks.

Data were analyzed using a series of MANOVAs and bivariate correlations. Overall, results suggest that the arousal manipulation was effective. Although subjects in the moderate

arousal condition ate more than those in the other two conditions as predicted, results did not reach statistical significance (p = .20). A one-way MANOVA examining the relations among restrained and disinhibited eating (IV) and chips and donut consumption (DVs) did not show that eating differed significantly between the low and high restrained and disinhibited groups. Overall, findings are interpreted as providing partial support for the hypothesis that at moderate levels of arousal eating is more likely to occur.

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CHAPTER I

LITERATURE REVIEW

Introduction

Eating is a common coping mechanism for managing emotionally arousing situations (Greeno & Wing, 1994; Herman & Polivy, 1975; Nguyen-Rodriguez, Unger, & Spruijt-Metz, 2009; Oliver, Wardle, & Gibson, 2000). LaPorte (1986) proposed a hypothesis that conceptualizes this as “arousal-induced eating” or “emotional eating.” The theory, known as the Parasympathetic Activation Hypothesis (PAH), purports to explain how emotional eating attenuates the sympathetic nervous system and activates the parasympathetic nervous system. When a stressful situation is encountered, the sympathetic nervous system becomes activated, thus creating physiological changes (e.g., increased heart rate, increased blood pressure, shut down of alimentary processes). Such changes are necessary when in a fight or flight state to ensure survival (Bray, 2000; Charmandari, Tsigos, & Chrousos, 2005). Although the digestive system is attenuated at lower levels of sympathetic arousal, eating at that point would facilitate parasympathetic arousal in order to process the ingested food. This change from sympathetic nervous system arousal to parasympathetic arousal induces temporary relief as the organism seeks physiological homeostasis. In this transition, the digestive tract will likely experience the first changes, from decreased sympathetic arousal to increased parasympathetic tonus, and the rest of the organs and body systems (e.g., sweat glands, skeletal muscles) would transition into a more parasympathetic tone shortly thereafter. The greater the sympathetic arousal, the more likely eating would not occur as the entire alimentary tract from mouth to anus effectively shuts down. Food is not desired, and there is no saliva to assist in swallowing the food; however, if food is eaten at this time, the stomach will not be able to pass food to the small intestine. This relationship between emotional (sympathetic) arousal and eating thus creates an inverted U-shape function. In other words, at very high or very low levels of arousal, eating does not occur; however, eating occurs at modest levels of arousal.

This association between emotional arousal, the autonomic nervous system (ANS), and eating is shown with how the hypothalamus influences activity of the ANS and affects drive states, such as hunger. The ventromedial hypothalamus (VMH) and the lateral hypothalamus (LH) regulate the ANS reaction to eating (Coote, Yang, Pyner, & Deering, 1998; Ribeiro, LeSauter, Dupre, & Pfaff, 2009). In periods of excessive food intake, the VMH is activated and appetite decreases (Nisbett, 1972). Lesions to the VMH or hypothalamic paraventricular nucleus result in hyperphagia, delayed satiety, and weight gain (King, 2006). On the other hand, food deprivation causes activation of the reward center of the LH, which leads to feeding and weight gain. Eating or stimulation of this region is associated with pleasure, relief, parasympathetic arousal, and inhibited stress response (Everhart & Harrison, 2002; Hoehn-Saric & McLeod, 1988). Such processes have been shown with use of anorectic agents, such as amphetamine, that increase eating when taken in moderate doses but decrease eating in higher doses (Evans & Vaccarino, 1986). The same U-shaped relationship between dose level and eating behavior exists for caffeine as well, which also serves as a sympathetic arousing agent (Westerterp-Plantenga, Legeune, & Kovacs, 2005).

Arousal increases reactivity to external stimuli and, because survival - related behaviors are inherently rewarding, they will be engaged in to activate the parasympathetic nervous system and attenuate the sympathetic arousal. Such behaviors that evoke this change include eating, mating, receiving attention, and receiving social approval (Kaplan & Kaplan, 1957). Because food is readily available in today’s society and is an inexpensive resource, it can easily be obtained and consumed to receive an immediate sense of relief from the sympathetic arousal (Bray, 2000). Early experiences involving learning how food can placate emotional arousal can then influence adult eating behaviors (Birch & Fisher, 1998). Receiving social approval or drinking alcohol, among other behaviors, is not experienced at a young age, do not have such a learning history, and are not usually the predominant response to ameliorate sympathetic arousal. Although this arousal – induced eating behavior can occur in all people and animals, the extent to which it is relied on as a coping mechanism varies. Once it becomes a coping mechanism, it is challenging to manage because of the readily available food and quick effect it has on the central nervous system, as well as the relieving effect is has on the autonomic nervous system.

Introduction to Restrained and Disinihibited Eating

Because eating has physiological effects on the autonomic nervous system, all humans experience parasympathetic activation when food is consumed; however, not everyone experiences prolonged relief and arousal reduction from eating. Cools, Schotte, and McNally (1992) found that emotional arousal, regardless of the specific nature of the emotion, may trigger overeating in restrained eaters who ignore physiological cues of hunger and satiety as a way to maintain or lose weight. Individuals who feel any sort of pressure to weigh less may severely restrict their food intake and experience persistent hunger (Nisbett, 1972). Such control over food intake is likely to be interrupted when in the presence of disinhibiting factors, such as emotional arousal. This loss of control may then cause a loss of awareness of internal feelings of satiety and hunger and lead to overeating (Polivy & Herman, 1985). This hypothesis of restrained eating presents an underlying reason for obesity since many obese people are found to be highly restrained eaters (Herman, Olmsted, & Polivy, 1983). This association between restraint and obesity is likely due to how individuals who are sensitive to weight issues or who restrain their eating may only experience temporary relief from eating. This period of relief may only last for as long as eating persists. After an eating episode, an individual's cognitions may focus on their lack of control or resulting anhedonia, which then re-activates the sympathetic nervous system. The resulting cycle of events may lead to overeating, or disinhibited eating, and ultimately weight gain (Bello & Hajnal, 2010).

Emotional Arousal and the Autonomic Nervous System

Before gaining a better understanding of how the PAH applies to different individuals, the components and function of the autonomic nervous will be reviewed. The autonomic nervous system (ANS) is responsible for maintaining homeostasis of the body's internal environment and is influenced by the brain stem, hypothalamus, cerebral cortex, and limbic system. The ANS, which is part of the limbic system, also manages emotional and motivational states in relation to environmental situations. The ANS is divided into two divisions: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). These two systems are reciprocally related so the activation of one system will attenuate the activation of the other (Fox, 2006; McCorry, 2007).

The SNS becomes activated by any arousal-inducing experience, such as feelings, noise, light, drugs, and chemicals that are beyond each individual's threshold. This activation serves as an adaptive response to protect the body and ensure survival. When the SNS becomes activated, releases of norepinephrine (NE) and epinephrine (EPI) cause an increase in heart rate, increase in blood pressure, increase of sweating, inhibition of digestive processes, dilation of the bronchii and increased breathing, and increased blood flow to the skeletal muscles. Essentially, the SNS prepares the body for "fight or flight;" however, events such as having an argument with a friend or feeling excited activate the SNS as well. The PNS is regenerative and has the opposite effects of the SNS activity. Parasympathetic activity involves a decrease in tension that the sympathetic system promotes. The PNS is mediated mostly through acetylcholine (Ach), and activation of the PNS leads to relaxed muscles, slowed heart rate, lowered blood pressure, slowed breathing, and functioning digestive processes (Fox, 2006; McCorry, 2007).

All emotions involve sympathetic arousal, and the degree to which the SNS is activated is associated with the degree of emotional arousal. Therefore, increased emotional activation is associated with increased arousal of the SNS. For example, arousal is associated with SNS activity and may manifest as increased heart rate, attenuated digestive system, and increased blood pressure. As the arousal increases, the effects of sympathetic arousal will intensify. Although each person responds to stressors differently and develops individual physiological and psychological responses to stress, reactions are uniform among all individuals when in highly stressful situations (Fisher, Granger, &Newman, 2010; Melzig, Holtz, Michalowski, & Hamm, 2011). In these highly stressful situations, the sympathetic nervous system is highly activated, and behaviors (e.g., eating, drinking) that attenuated lower sympathetic arousal and increased parasympathetic arousal are no longer effective coping mechanisms. As reviewed above, such a relationship between arousal and eating forms an inverted U-shaped function (LaPorte, 1986).

Theories of Arousal-Induced Eating

The Parasympathetic Activation Hypothesis (PAH) regarding arousal-induced eating, or emotional eating, has yet to be studied in a controlled setting and has yet to be adopted into the literature as a major theory of arousal-induced eating. Below is a review of the theories of arousal-induced eating that are currently utilized.

Greeno and Wing (1994) provide an overview of arousal-induced eating and how two models have been utilized in understanding this process. The General Effects model explains that stress creates a physiological change in every organism that will result in increased eating (Greeno & Wing, 1994). Research on this model has mostly been conducted with animals and applies the tail pinch process or electric shock stressor. Although several studies showed that these stressors induce eating in animals (Antelman, Rowland, & Fisher, 1976; Nemeroff et al., 1978; Ullman, 1951), most research on this association is inconsistent in that not all animals in the studies were found to eat in response to those stressors (Levine & Morley, 1981; Sterritt & Shemberg, 1963).

The Individual Differences Model differs from the General Effects model in that it does not argue that all organisms experience arousal-induced eating. Instead, the Individual Differences Model describes how psychological and environmental factors indicate vulnerability for arousal-induced eating (Greeno & Wing, 1994). This model purports to explain that individual differences in learning, attitudes, and biology determine how arousal affects eating behavior. Three main factors of body weight, degree of restraint, and gender are specifically considered in the model as possible indicators of eating behaviors. Based on research conducted to assess each of those factors in relation to arousal-induced eating, Greeno and Wing (1994) have found that being female (Grunberg & Straub, 1992; Pine, 1985) and restraining eating (Heatherton, Polivy, & Herman, 1991; Herman & Polivy, 1975) indicate higher susceptibility to engaging in stressed-induced eating. Although considered, Greeno and Wing (1994) indicated that obesity is likely not a reliable predictor of arousal-induced eating, as shown by how most studies do not find obesity to be related to arousal-induced eating (Reznick & Balch, 1977). Greeno and Wing’s (1994) review of arousal-induced eating includes a number of laboratory stressors, such as threat of shock, unsolvable puzzles, and giving a speech. Because all studies were conducted within a laboratory study, it is difficult to determine the extent to which these finding can be generalized to other settings. Stressors, such as having a negative interaction or being evaluated by others, may trigger eating, particularly overeating, in restrained eaters. Eating becomes a negative reinforcement in reaction to the stress (Wolff, Crosby, Roberts, & Wittrock, 2000).

Several psychosomatic hypotheses of arousal-induced eating are grounded in psychoanalytic theory, specifically Freud's drive theory, which indicates that, during the first two years of life, the main source of sexual satisfaction is the mouth. Patterns of experiences that characterize deprivation or excessive gratification during this stage of life will result in a fixation at this stage, and the primary source of satisfaction will be from the mouth. Difficulty coping with stressors will cause regression to this stage, and any distress will be ameliorated with eating or drinking (Freud, 1905/1953). Object-relations theorists modified this psychodynamic approach and specifically focused on how the relationship between child and maternal caregiver promotes arousal-induced eating.

Bruch's (1952) psychodynamic approach to understanding arousal-induced eating is based on the notion that feelings of hunger and satiety are learned during early interactions between mother and child. When the mother reacts appropriately to signs of hunger or satiety from the infant, the infant learns how to differentiate these signals from one another; however, if the mother feeds the infant or deprives the infant of food during times when the appropriate signs of hunger or satiety are not indicated, the child does not learn the differences between these cues. For example, pressure to eat or not eat certain foods as a child has been shown to result in restrained and emotional eating later in life (Birch, Fisher, & Davison, 2003). On the other hand, mothers who provide food as a way to appease a crying infant encourages the association between distress and subsequent food, and the infant does not learn how to differentiate hunger from distress (Faith et al., 2004; Farrow & Blissett, 2008; Galloway, Farrow, & Martz, 2010; Ventura & Birch, 2008). Due to early experiences, the infant comes to consider love and feeding to be the same process because both relieve the infant of stress and despair and help make the infant feel secure and safe. If love and feeding continue to be associated in this way, the infant may internalize them as two ways to feel secure and deal with distress. Over time, such learning may develop into arousal-induced eating.

While Bruch (1952) focused on interactions between mother and child as the foundation for arousal-induced eating, Kaplan and Kaplan (1957) expanded this concept by describing overeating and emotional eating as a process by which emotions become associated with hunger. In a drive-reduction process, food becomes a reward and appeases the emotional arousal. This association between emotions and food is based on learning theory, such that the response (i.e., eating food) results in a reduction of the emotional arousal, which then increases the likelihood of that response occurring again. Eating becomes a response that halts any negative affective state, such as depressive moods, and allows attention to be diverted away from the arousal.

In contrast to psychodynamic theories which are founded on early learning experiences, Adam and Epel's (2007) Reward Based Stress Eating model explains how the hypothalamic-pituitary-adrenal (HPA) axis and reward circuitry affect food consumption. Stress, including stress from restrained eating, activates the hypothalamic-pituitary-adrenal (HPA) axis, which creates higher levels of circulating glucocorticoids (Tsigos & Chrousos, 2002). These glucocorticoids then induce food intake, and those people with high cortisol reactivity eat more when under stress and tend to eat higher calorie foods to more effectively decrease the stress response. Consuming palatable, or appetizing, food attenuates the HPA axis activity and activates the brain reward system and quickly provides emotional relief. If palatable food is repeatedly consumed, the reward system activates and overeating occurs. If stress is chronic and eating becomes an effective coping strategy, consumption of palatable food seems to be an addictive behavior (Adam & Epel, 2007).

Although psychodynamic theories and physiological reasons for arousal-induced eating seem to propose valid conceptualizations of arousal-induced eating, they rarely serve as the foundation for studies that examine arousal-induce eating. Instead, cognitively focused models are widely implemented as a foundation from which studies about arousal-induced eating are based. This occurrence may be because studying cognitive processes in a laboratory study is less expensive and easier than is studying early learning experiences and physiological processes. Several widely implemented cognitively based models of arousal-induced eating are as follows.

The Affect Regulation Model of arousal-induced eating indicates that loss of control over eating is due to the belief that eating provides a distraction and relief from negative emotions, such as those associated with depression. This model introduced the "emotional eating" term and indicates that emotional eating serves as a mediator between negative emotions and loss of control. Increases in arousal trigger emotional eating and then binge eating (Burton, Stice, Bearman, & Rohde, 2007). Research that highlights this relation will be discussed in a later section.

Another cognitively based theory is escape theory (Heatherton & Baumeister, 1991), which explains that overeating episodes dissipate negative affect by focusing attention on the environment rather than on more abstract thoughts, such as those about perceived failure. Eating helps to provide escape from self-awareness, and increases in negative affect spark such periods of overeating. During periods of overeating, negative affect is attenuated. Throughout the overeating period, emotional distress emerges and raises self-awareness, which results in more eating. This process is described as binge eating.

Expectancy theory proposes that overeating is maintained by expected effects of eating (Hohlstein, Smith, & Atlas, 1998). This theory explains that people who engage in binge eating behaviors highly expect eating to reduce negative emotions. In this model, the expected consequences of eating are more salient than are the actual consequences, and those expected consequences are the reasons for the maintenance of the eating behaviors. Interestingly, eating has been shown to reduce emotional arousal for only the time in which eating occurs. After eating concludes, the negative arousal returns along with the realization that eating did not eliminate the initial unpleasant arousal (Bello & Hajnal, 2010).

The PAH explains arousal-induced eating from a physiological perspective that acknowledges the psychodynamic early learning experiences. Furthermore, this hypothesis indicates that susceptible to engaging in arousal-induced eating mainly depends on cognitive processes, such as the degree to which eating is restrained and disinhibition of consumption after the onset of eating. The next section will focus in depth about how restraint and disinhibition both relate to arousal-induced eating and how the theories described above are applied in the restraint and disinhibition literature.

Restraint and Arousal-Induced Eating

Chronic dieters, or those who restrain their eating, often ignore physiological cues of hunger and satiety with the intention of maintaining or losing weight (Polivy & Herman, 1985). Cognitive theory suggests that thinking among restrained eaters is focused on concern with weight, shape, and food related information. Attention is also biased toward food related cues and memories related to food (Cooper & Fairburn, 1992). Because restrained eaters attempt to abstain from eating when experiencing hunger cues, they instead eat in the presence of cues that are not as easy to control and avoid. This concept is explained through the original restraint hypothesis, which indicates that chronic restriction of food intake leads to overeating in the presence of factors that disinhibit eating, such as the perception of having overeaten, alcohol, or stress (Greeno & Wing, 1994; Herman & Polivy, 1975; Hibscher & Herman, 1977; Oliver et al., 2000; Polivy & Herman, 1976; Spencer & Fremouw, 1979). Furthermore, restrained eating presumably creates negative arousal, and eating often occurs to reduce the distress and provide a distraction from the unpleasant stress response (Oliver et al., 2000). People who restrain their eating may be below weight “set point” and are unable to maintain this deprivation when in the presence of disinhibitors. When faced with disinhibiting factors, highly restrained eaters tend to abandon this control and eating occurs. On the other hand, people who do not restrain their eating can maintain current weight, and there is no physiological demand to eat in the presence of external cues (Herman & Mack, 1975). Experiences with dieting and restricted eating when younger may lead to a weakening of satiety signals and a heightened attractiveness of food, which may later lead overeating and binge eating behaviors (Birch & Fisher, 1998). This original restraint theory has been extensively studied to show how restrained and unrestrained eaters behave in the presence of food when placed in situations with disinhibiting factors, such as alcohol, perception of having overeaten, or emotional arousal.

To better understand how stressors affect eating behavior in restrained and unrestrained people, Lattimore and Caswell (2004) assessed physiological reactivity among 40 females (i.e., 20 restrained eaters and 20 unrestrained eaters) throughout a process of laboratory arousal tests. Restraint was measured with the Restraint scale of the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986). In a within groups design, every participant completed three consecutive tasks (i.e., a reaction time task, a cold pressor test, and a relaxation control task), and food intake was measured after the completion of each task. Both stress tasks produced similar increases in self-reported arousal when compared to the relaxation task, but the self-reported arousal was not fully supported by the physiological measurements. Blood pressure increased from baseline to after the reaction time task was completed, but no changes occurred to heart rate after this task. The cold pressor task did not produce any changes to blood pressure or heart rate. Restrained eaters consumed significantly more after the reaction time task than after the cold pressor and relaxation tasks. Unrestrained eaters consumed less following the cold pressor and reaction time tasks than after the relaxation task. Restrained eaters consumed more food than did unrestrained eaters following the reaction time task, and unrestrained eaters consumed more food following the relaxation condition than did restrained eaters. Results from this study suggest that tasks which require focus on stimuli outside the body (e.g., reaction time task) may divert attention away from internal body processes and result in eating among restrained eaters. Tasks which require focus on internal sensations (e.g., cold pressor test) allow the dietary restraint to be maintained.

While Lattimore and Caswell (2004) examined how internally and externally focused tasks affect eating, Lattimore and Maxwell (2004) examined how ego threatening tasks lead to eating as a way to escape uncomfortable internal thoughts and feelings. This study included 119 female restrained and unrestrained eaters, who were assigned to one of four conditions in which cognitive load and ego threat were manipulated using color-naming Stroop tasks. After completion of the Stroop tasks, participants were encouraged to eat ad libitum. Restrained eaters consumed more food following cognitive tasks that were ego threatening than tasks that were just cognitively demanding. Restrained eaters also ate more than did unrestrained eaters following the ego threatening tasks, suggesting that ego threatening tasks can successfully cause restrained eaters to lose control over their eating behavior.

To examine the effects of a different disinhibiting stressor on eating, Mills and Palandra (2008) examined the effects of perceived calories of a preload on subsequent eating among restrained and unrestrained eaters, who were categorized into one of those two categories based on scores on a revised version of the Restraint Scale (RS; Polivy, Heatherton, & Herman, 1988). In a between groups design, seventy-nine undergraduate students were assigned to the high calorie milkshake preload condition, low calorie milkshake preload condition, or the no preload condition. Unknown to the participants, the milkshakes in the first two groups included the same calories and ingredients. Following the consumption of the milkshake preload, participants were offered food ad libitum. Restrained eaters in the preload groups ate more than those in the no preload condition. Unrestrained eaters ate less in the preload conditions and most in the no preload condition. Restrained eaters reported that the high calorie milkshake made them more anxious than did the low calorie milkshake. Unrestrained eaters also rated the high calorie milkshake as more arousal provoking, but they did not increase their food intake during the test meal. This tendency for restrained eaters to increase their eating after consuming a preload is known as counterregulatory eating. Furthermore, the distinction between how restrained and unrestrained eaters responded to arousal suggests that restrained eaters have learned that eating is an effective coping mechanism when experiencing unpleasant emotional arousal.

Although Lattimore and Caswell (2004), Lattimore and Maxwell (2004), and Mills and Palandra (2008) found that disinhibiting factors do induce eating among restrained eaters, several studies have not found such results. For example, O’Connell, Larkin, Mizes, and Fremouw (2005) examined impact of dietary restraint and caloric preload on ability to suppress thoughts about food and eating. A sample of 64 college females (i.e., 32 restrained eaters and 32 unrestrained eaters), as measured by a revision of the Restraint Scale (RS; Herman & Polivy, 1980) was divided into four different conditions: preload suppression expression, preload expression expression, no preload suppression expression, or no preload expression expression. The preload condition was given a chocolate or vanilla milkshake and the no-preload condition was not given any food. After 10 minutes, all participants were told to verbalize all thoughts that came to mind in a stream of consciousness process. The suppression expression condition was told to not think about food, and the expression expression group was not given that directive. All groups then were given three different types of ice cream to taste and judge, and they were told to eat as much or as little as they would like. Results show that restrained eaters instructed to suppress food related thoughts had more food and eating related thoughts than did unrestrained eaters told to suppress such thoughts. Preloading was associated with increased thoughts about food and eating among restrained eaters. In contrast to previous research that suggests restrained eaters will eat more food than unrestrained eaters in the preload condition (Spencer & Fremouw, 1979), this study did not show such an effect. Instead, participants in the preload condition consumed less ice cream than those in the no-preload condition. This overall effect may be due to how focusing on thoughts may lead to self-awareness of dieting behaviors and thus, lead to a regain of control over eating.

Another study that did not show a significant positive association between restrained eating and food consumption following a stressor was conducted by Sheppard-Sawyer, McNally, and Fischer (2000) who examined how sadness induced by a film affects food intake among restrained and unrestrained eaters. In a within-subjects design, thirty-one female participants who were restrained or unrestrained eaters, according to Herman and Polivy's (1980) revised

Restraint Scale, all viewed a neutral film and a sad film on two consecutive days. All participants were offered popcorn to eat during the movie, and amount eaten was measured. Overall, depressed mood was endorsed following the sad film but not following the neutral film, and happy mood was endorsed following the neutral film but not following the sad film. Results showed that film-induced sadness significantly reduced food intake in the low restraint individuals, but the sad film only tended to increase food intake in restrained eaters. The relationship between sad film and food intake among restrained eaters was not significant. This result suggests that, when an emotion is induced without an accompanying ego threat (as it was in the film conditions), highly restrained eaters may not present as much disinhibited eating.

Alcohol as a Disinhibitor Among Restrained Eaters

Alcohol has been purported to successfully disinhibit subsequent eating when served as a preload (Hetherington, Cameron, Wallis, & Pirie, 2001; Yeomans & Phillips, 2002); however, Polivy and Herman (1976) have been the only researchers who found an increase in eating among restrained eaters following a preload consumption of alcohol in a laboratory setting. They gave a preload of caffeine, vitamin C, aspirin, vitamin E, saccharine, or alcohol to 40 undergraduate females. All participants who received the alcohol either were told they received alcohol or that they received a drink that was not alcohol. Also, some participants were told that they were given alcohol when in reality they were not. Results show that, when restrained eaters received alcohol which they expected to be alcohol, they ate more than when they consumed alcohol but was told that it was not alcohol. Such a study demonstrates how the belief that alcohol was consumed disrupts the restraint that some people have on eating; however, studies that attempted to recreate Polivy and Herman's (1976) findings have been unsuccessful. Ouwens, van Strien, and van der Staak (2003) found that eating did not differ between restrained and unrestrained male eaters, regardless of whether they first drank orange juice with liquor or orange juice without liquor. Yeomans (2010) studied the effects of alcohol on immediate food intake and appetite in women to better understand the extent to which eating is affected by expectations associated with alcohol consumption and by the disinhibiting effects that alcohol may have on restrained eating. As measured by the restraint scale on the Three Factor Eating Scale (TFEQ; Stunkard & Messick, 1985), 20 restrained women and 20 unrestrained women consumed one of four preloads: alcoholic beer, alcoholic juice, non-alcoholic beer, and non-alcoholic juice before a test meal. They were all told that they may consume alcohol at some point throughout the study, but no groups were specifically told that they would be drinking alcohol. Both restrained and unrestrained women consumed more food after drinking alcohol than after consuming the nonalcoholic beverages. Most food was consumed after drinking the alcoholic juice and least was eaten after the alcohol free juice drink. Although alcohol seemed to stimulate eating, there were no significant differences in response to alcohol between restrained and unrestrained eaters.

Another example of a lack of the predicted association between restrained eating behaviors and eating after consuming alcohol is shown with how Yeomans, Hails, and Nesic (1999) examined the effects of alcohol on eating. Of 22 men, 12 unrestrained eaters and 10 restrained eaters ate lunch after consuming preloads of water, alcoholic fruit juice, and non-alcoholic fruit juice. They were all told that the drink may contain alcohol, but no further information was provided. The unrestrained men ate less food after the non-alcoholic juice and ate most after consuming alcoholic fruit juice. Surprisingly, food intake did not vary among the conditions for restrained men; however, both the alcoholic juice and non-alcoholic juice caused satiety faster than did water in both the restrained and unrestrained men. Hunger, according to results on the TFEQ, also increased more in the initial stages of the test meal in the unrestrained men who had consumed alcohol than who had consumed water or the nonalcoholic juice. No variation in food intake existed for restrained men. These results as well as the findings from Yeoman's (2010) and Ouwens and colleagues (2003) studies suggest that restraint may not be the best predictor of food consumption following alcohol intake. On the other hand, this lack of an association between alcohol and eating may instead to be due to the fact that participants were not aware of whether or not they consumed alcohol. Cognitive awareness of the alcohol consumption may be necessary to induce eating, as shown with how believing that alcohol was consumed led to greater subsequent eating (Polivy & Herman, 1976). If individuals learn through experience that alcohol is associated with eating, the cognitions underlying that association may be more salient than are the physiological effects of alcohol. Without those cognitions, the association may not be present. In the studies noted above, not knowing that alcohol was consumed may have prevented restrained eaters from perceiving loss of control of their diet and, therefore, there was no significant relationship between restrained eating and food consumption post- alcohol preload.

Summary

Overall, not all stressors consistently affect eating in restrained eaters. The hypothesis that alcohol serves to disinhibit eating among restrained eaters does not seem to currently have a great deal of support. Furthermore, distress has been found to increase eating among restrained eaters, but this association is dependent on the form of distress introduced (Herman et al., 1983). Physical fear has been found to reduce eating among non-dieters but does not increase eating among dieters; however, threats to ego or self image tend to more consistently cause increased eating among dieters (Greeno & Wing, 1994). These stressors that induce self-awareness and emotional arousal supposedly encourage attention to be forced away from the self to preserve self-esteem (Heatherton, Polivy, Herman, & Baumeister, 1993). Food and eating become convenient and effective ways to cope with the self-esteem threats and the emotional arousal.

Restraint, Disinhibition, and Arousal-Induced Eating

Restraint has been shown to be important in understanding arousal-induced eating in response to disinhibiting stimuli (e.g., stress); however, a consistent link between restraint and eating seems to be lacking. As explained above, restraint is the process of restricting eating to maintain or lose weight; however, it does not account for all variation among emotional eaters. Another process of eating that is of importance to the topic of arousal-induced eating is disinhibition, or the tendency to overeat certain foods that are palatable or in response to disinhibiting signals (Greeno &Wing, 1994; Polivy & Herman, 1999). By taking this variable into account, people can either be high or low on restraint and high or low on disinhibition. Many of the measures used to assess restraint do not differentiate well between restraint and disinhibition. For example, the revised version of the Restraint Scale (RS; Polivy, Heatherton, & Herman, 1988) measures both restraint and disinhibition, but the restraint scales on the Dutch Eating Behavior Questionnaire (DEBQ; van Strien et al., 1986) and the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985) only measure restraint. High scores on the RRS will indicate high restraint and high disinhibition (i.e., unsuccessful dieting), but high scores on the TFEQ and DEBQ restraint scales indicate either high restraint and low disinhibition (i.e., successful dieting) or high restraint and high disinhibition (i.e., unsuccessful dieting). The restraint scales on the DEBQ and TFEQ do not differentiate varying levels of disinhibition, but the RRS distinguishes low disinhibitors from high disinhibitors (Savage, Hoffman, & Birch, 2009; Wardle & Beales, 1987); however, the emotional eating or disinhibition scales of the DEBQ and TFEQ identify individuals who demonstrate disinhibited eating during emotionally arousing situations. Because arousal-induced eating has been considered to be fully accounted for by measures of restraint, those disinhibition and emotional scales were not consistently used in many studies that assess eating behaviors in relation to stress or arousal. These inconsistent ways in which restraint and disinhibition have been measured in those studies has contributed to the inconsistent results about the relations among restraint, stress, and eating. Essentially, the independent effects of restraint or disinhibition are not sufficient to predict the extent to which eating is a coping mechanism during situations with disinhibiting stimuli. Instead, restraint moderating the effects of disinhibition more accurately predicts eating behaviors in situations with disinhibiting stimuli (Polivy & Herman, 1999; Westenhoefer, 1991). The following studies show how interactions between restraint and disinhibition affect eating in emotionally arousing situations.

Yeomans and Coughlan (2009) examined the association between induced emotions and eating. Ninety-six women were classified as being either high or low on both the restraint and disinhibition scales of the TFEQ, and the amount of snack foods they ate during a neutral, positive, or negative affect related film was measured. According to results on the Profile of Mood States (POMS; Lorr & McNair, 1971), anxiety was increased following the negative affect film but not after the positive or neutral affect films. Arousal, as determined by the POMS to be anxiety without fatigue and confusion, was increased following the positive and negative affect valenced films. High restraint and high disinhibition were most associated with eating during the negative film condition. Low restraint and high disinhibition were most associated with eating in the positive film condition and least in the negative film condition. Women with low disinhibition consumed the same amount of food in all three film conditions, independent of degree of restraint. Overall, restraint alone was not sufficient in predicting eating in response to stress, as shown with the inconsistencies in eating among high and low restrained eaters in different emotional conditions. This study shows that restrained women with high disinhibition tend to overeat in a negative affect condition. Women who are low restrained eaters but are high disinhibitors will overeat when exposed to stimuli that are emotionally positive.

To assess how different emotions affect eating in non-laboratory settings, Wolff and colleagues (2000) examined the associations between moods, eating, coping, and daily stress through self-report questionnaires over the course of three weeks from 40 undergraduate females (i.e., 20 binge eaters and 20 non-binge eaters) who had not been diagnosed with an eating disorder. Analyses of the self-report questionnaires revealed that binge eaters, as defined by the Questionnaire of Eating and Weight Patterns (QEWP; Spitzer et al., 1992), experienced as many stressful events as did non-binge eaters in a day, but binge eaters rated those events as more stressful than did non-binge eaters. Binge eaters experienced more negative moods and less positive moods than did non-binge eaters. Binge eaters experienced more guilt, self blame, depression, and anger on a daily basis and experienced those emotions in association with their eating more so than did non-binge eaters. Stress and negative mood were shown to be a common trigger for binge eating and, women who binge eat may experience a more pervasive negative mood on a daily basis, which may make it more likely that a binge will occur.

Overall, Wolff and colleagues (2000) found that binge eaters and non-binge eaters experienced an equal number of stressful events, but the binge eaters perceived those events to be more stressful and had more difficulty coping with those events in ways other than eating. To further examine perceived versus actual stress, Groesz and colleagues (2012) examined the relations between self-reported perceived stress, chronic stress, motivation to eat, and food intake among 457 undergraduate women. Results show that greater perceived and experienced stress was associated with a greater drive to eat, disinhibited eating, binge eating, and hunger. Greater perceived stress was associated with a greater lack of control over eating and greater likelihood of the consumption of non-nutritious food. These results support the findings of Wolff and colleagues (2000) and emphasize the need to consider disinhibition when studying how emotional eating leads to and is associated with binge eating.

As shown in the restraint literature, stressors that threaten the ego lead to eating among restrained eaters (Lattimore & Maxwell, 2004). To assess how the relation between ego threat tasks and eating is moderated by both restraint and disinhibition, Rutters, Nieuwenhuizen, Lemmens, Born, and Westerep-Plantenga (2008) assessed the impact of a stressful task of attempting to solve insolvable mathematical equations on food intake among 129 men and women. Dietary restraint and disinhibition were assessed using the TFEQ, arousal was assessed with the State-Trait Arousal Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), and mood was measured with the POMS questionnaire. After eating a test meal to guarantee the lack of hunger among all participants, the stress or control task was completed. For the following 30 minutes, participants were encouraged to relax and eat as much as they preferred of trays of chocolate, fruit-chew candy, chips, pretzels, and nuts. The POMS and STAI were administered every 10 minutes during the half hour. During that half hour, arousal in both groups decreased. Energy intake and state arousal scores were significantly higher and mood was lower in the stress condition compared to the control condition, but this effect was stronger for those participants who scored high on disinhibition. Unlike previous studies that found a significant relation between restraint and eating when in the presence of ego threat tasks (Lattimore & Maxwell, 2004), results from this study did not show a relation between energy intake, stress, and dietary restraint. Overall, psychological stress was shown to increase eating in the absence of hunger, especially among those who engaged in disinhibited eating and were more responsive to stress.

To further assess the relations among ego threatening tasks, restrained eating, and disinhibited eating, Wallis and Hetherington (2004) examined how tasks that are neutral, threaten the ego, and are cognitively demanding affect eating among restrained and emotional eaters. Restrained eating was defined as ability to control food intake to maintain or lose weight, and emotional eating was defined as disinhibited eating, or overeating, when emotionally aroused. Thirty-eight undergraduate female students were divided into four groups based on degree of restraint and emotional eating (i.e., high restraint/high emotional, high restraint/low emotional, low emotional/high restraint, low emotional/low restraint), as revealed by scores from the DEBQ. Results show that the cognitively demanding and ego threat condition (i.e., emotional Stroop task) and solely cognitively demanding condition (i.e., incongruent Stroop task) caused higher rates of hunger and more eating than did the control group tasks, and more eating was done after the ego threat task than after the cognitively demanding task. The high restraint/low emotional group consumed significantly more food in both the ego threat and cognitively demanding conditions than in the control condition. The high restraint/high emotional group consumed the most in the ego threat condition and more than did the high restraint/low emotional group during the ego threat condition. The low restraint/low emotional group consumed a similar amount of food in all conditions. Overall, this study shows that ego threatening and cognitively demanding tasks impair restrained eaters ability to monitor and control dietary restraint possibly because attention has been diverted elsewhere. After considering the association between restraint and disinhibition, ego threatening tasks are particularly more likely to trigger eating than are cognitively demanding tasks. While Rutters and colleagues (2009) did not find a significant association between restrained eating, ego threatening tasks, and ad libitum food consumption, Wallis and Hetherington (2004) did find a significant positive association between level of restraint and food consumption following an ego threatening task. Results from both studies support the notion that ego threatening tasks lead to greater food consumption among disinhibited eaters, suggesting that disinhibition may be a better indicator than is restraint of arousal-induced eating.

One study that only examined how disinhibition moderates the relation between ego threatening tasks and eating was conducted by Bekker, van de Meerendonk, and Mollerus (2004). Eighty-four female college students, categorized as emotional or non-emotional eaters based on results of the Emotional Eating scale of the DEBQ, were randomly assigned to either take a quiz which they were destined to fail or complete a neutral mood induction task (i.e., given easy questions to answer). The quiz was composed of questions that were deceivingly very difficult to complete, and the participants were told that results would be used by the Ministry of Education. Negative feedback was provided to all participants in this group following completion of the quiz. The quiz condition was found to significantly increase negative affect and eating among the highly disinhibited eaters. No other associations were significant. Although restraint was not measured in this study, this study further supports the relation between ego threatening tasks and eating that was found by Rutters and colleagues (2008).

Along with studies that examine the affect of ego threatening tasks on eating behavior, several studies focused on determining relations between food or alcohol preloads and eating behaviors. Van Strein, Cleven, and Schippers (2000) examined the relations among perceived calories in a preload, degree of restrained eating, and disinhibited eating. Two hundred females who were classified as restrained or unrestrained eaters, according to the Restraint Scale and the restraint and disinhibition scales from the TFEQ and the DEBQ, all consumed a preload strawberry milkshake. They were then told that they would be taste testing vanilla, strawberry, and chocolate ice cream. After tasting and rating the quality of the ice cream, participants were encouraged to eat as much of the ice cream as they would like because it was going to be thrown away at the conclusion of the study. Results did not show separate disinhibition or restraint effects; however, highly restrained eaters who were disinhibited when eating consumed significantly more ice cream than did other participants.

The literature examining restrained eating as a moderator between alcohol preloads and subsequent eating appears to be inconclusive. Stewart, Angelopoulos, Baker, and Boland (2000) examined the relations between dietary restraint, disinhibited eating, and patterns of alcohol use to assess how disinhibition affects such relations. Self report measures were administered to 176 female undergraduate participants that assessed eating patterns and restricted eating (e.g., Revised Restraint Scale) as well as quantity and frequency of alcohol consumed. Restraint eating was positively correlated with quantity of alcohol consumed, binge drinking, and yearly excessive drinking; however, restraint eating was not associated with frequency of drinking alcohol. Specifically, women who practice dietary restraint do not tend to drink more than do unrestrained women but, when they drink, they tend to drink significantly more alcohol, suggesting that they are disinhibited while drinking. These results emphasize the importance of considering social cues and observation when studying the effects of alcohol on eating. The other studies mentioned above that involve alcohol (Ouwens et al., 2003; Yeomans, 2010; Yeomans et al., 1999) may have produced such unexpected results because of the environment in the controlled laboratory setting as well as because of the failure to consider disinhibition as a factor.

Overall, Stewart and colleagues' (2000) study supports the van Strein and colleagues' (2000) findings in that restraint alone is not a sufficient indicator of eating but should be considered along with disinhibition when understanding individual factors that make people more susceptible to arousal-induced eating.

Summary

Dietary restraint and disinhibited eating affect eating behaviors when in the presence of food. The independent effects of restraint and disinhibition only partially account for the variance among arousal-induced eating, and greater accuracy in that prediction is present when the combination of dietary restraint and disinhibition is considered. For example, alcohol has been known as a disinhibiting stimulus that evokes eating among restrained eaters, but this conception is not well supported. Instead, research more strongly suggests that alcohol tends to be a disinhibiting factor in restrained eaters who are also highly disinhibited eaters. Although eating does not seem to effectively reduce distress, only one of the studies mentioned above assessed and recorded the level of arousal or emotional arousal experienced after the laboratory study concluded. This information would be helpful for understanding if eating actually lowered arousal in the laboratory settings and how perceived arousal at the end of the studies differed among different levels of restraint and disinhibition. Also, not all stressors equally affected restrained and disinhibited eaters. For example, tasks that challenged the ego and self-concept were more likely to lead to increased eating in people who scored higher on restraint and disinhibition than were tasks that were solely cognitively demanding or involved anticipated fear or pain.

Many of the studies presented above attributed their findings to cognitive theories of arousal-induced eating; however, with the exception of one study, none of the studies examined cognitive processes, such as the degree to which participants were attending to the tasks, attending to the food, experiencing food and weight related thoughts, and focusing on their emotional arousal. Cognitive theories of arousal-induced eating consider all of those factors, but the studies above were flawed because they failed to address these processes, suggesting that these theories of arousal-induced eating do not have empirical support in the literature on restrained and disinhibited eating; however, the cognitive theories continue to be utilized in the literature when drawing conclusions about findings. Furthermore, psychodynamic theories of arousal-induced eating are not even referenced in the literature on restraint and disinhibited eating, but these theories are also maintained as current theories of arousal-induced eating in the absence of significant empirical support. Overall, none of the current theories of arousal-induced eating have adequate empirical support. Studies that claim their findings support the current theories do not clearly and consistently operationalize the constructs of arousal, anxiety, and stress. Stressors are incorporated in the methodologies but the processes by which these stressors create effects on eating are not examined. Although associations among various factors of eating behaviors, stressors, emotional arousal, and food intake are well-studied, the underlying reasons for these associations are lacking considerably.

Food Preferences in Emotionally Arousing Situations

When people engage in eating to attenuate arousal, different foods are chosen based on conceptions about the degree to which the food will be satisfying and effective at reducing such arousal (Mennella, 1995). Palatable, energy dense foods that are innately prepotent are usually preferred when experiencing emotional arousal, and this way of coping with the arousal likely is attributed to learned associations between eating energy dense foods and immediate feelings of pleasure or relief (Gibson & Desmond, 1999). Preferences for food are largely influenced by early feeding experiences. Infants have an innate preference for sweet and salty tastes and reject sour and bitter tastes. Although research on this topic is limited, Mennella (1995) showed that flavors of breast milk influenced an infant's preference for certain foods. As humans grow older, acceptance of new foods usually occurs after five to ten attempts of trying the new food and, the greater the variety of foods available, the higher the likelihood different foods will be preferred. Children innately know that high energy foods maintain satiety for longer periods of time, and repeated exposure to those options can enhance preferences for those types of food (Birch & Fisher, 1998).

Markus and colleagues (1998) found that easily anxious, or neurotic, people in psychologically stressful situations will experience decreased emotional arousal and cortisol levels after eating high carbohydrate and low protein meals. Dieting tends to lower plasma tryptophan levels and sensitizes serotonergic function. Restrained and emotional eaters who diet find much pleasure in high fat and energy dense foods, and highly disinhibited eaters have difficulty controlling the intake of these palatable foods (Cowen, Clifford, Walsh, Williams, & Fairburn, 1996). Furthermore, fat is also less satiating than is protein or carbohydrates, which further contributes to the overconsumption of high fat foods. These foods may be preferred during arousal-inducing situations because small energy dense foods are more easily digested when gut activity is suppressed by the sympathetic arousal. Furthermore, low levels of brain serotonin result in dysphoric moods. Negative moods can be attenuated with foods that are high in carbohydrates and low in protein. These foods then initiate release of endogenous opioids (Fox, 2006), as well as increase the ratio of plasma tryptophan to large neutral amino acids, which leads to increased brain tryptophan, serotonin synthesis, satiety, and better mood. People feel calmer after meals high in carbohydrates and low in protein than meals higher in protein and low in carbohydrates (Benton, 2002). Highly stressed people may be sensitive to these dietary effects of tryptophan on the brain, and they learn that eating is an effective way to cope with the arousal. Furthermore, palatable foods and drugs seem to activate the same mesolimbic dopamine reward system circuitry in the brain (Berthoud, 2002), further showing the rewarding aspects of consuming food when emotionally aroused. For example, sugar and fat target the brain in a similar way as do opiates and are often sought during times of stress (Cota, Tschöp, Horvath, & Levine, 2006).

Because studies above show that highly restrained and disinhibited eaters find comfort in eating during emotionally arousing situations, the following studies further indicate the types of food that people prefer when coping with the emotions associated with stressful situations. Oliver and colleagues (2000) assessed the associations between stress and appetite for salty, sweet, and bland foods. Among 68 men and women, half were assigned to prepare a four minute speech that would be filmed and assessed, and the other half listened to an emotionally neutral excerpt from a film. Appetite ratings of different pictures of food were presented and completed, and all participants were then offered a meal of sweet, salty, and bland foods, each of low and high fat content. Physiological and psychological measures were administered to assess eating behaviors (i.e., restraint, emotional, and external scales from the DEBQ), arousal (i.e., STAI), as well as measures to assess blood pressure and heart rate. Participants in the speech group rated their experience as being significantly more stressful than did participants in the film group, and the physiological measurements confirmed these results. The highly emotional, or disinhibited, eaters in the speech condition ate significantly more high fat and energy dense foods than did the low emotional eaters in the speech condition as well as more than did the participants in the film condition. Restraint was found not to be significantly associated with food consumption, but there was a trend toward greater consumption of sweet foods by highly restrained people in the speech condition. Rated desire to eat different foods depicted in the pictures was less affected by stress, but desire to consume salty foods was greatest among emotional eaters in the speech condition.

As Oliver and colleagues (2000) found a positive association between consumption of high fat and energy dense foods following ego threatening tasks, Wallis and Hetherington (2009) also examined how ego threatening and neutral Stroop color naming tasks affect consumption of high and low fat foods. Twenty-six females completed the restraint and emotional eating scales on the DEBQ and completed measurements that assess for arousal, hunger, and mood (i.e., visual analogue scale (VAS; Stubbs et al., 2000) and the Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988) at baseline, after the task, and after the snack. In a within subjects design, all participants completed an ego threatening Stroop task and a neutral Stroop task in counterbalanced order. Negative moods were found to increase after both conditions but decreased after consuming the snacks. Positive affect was found to decrease after the ego threat task and then increase to a level similar to that at baseline after eating the snacks. BMI and emotional eating, according to scores on the DEBQ did not influence intake; however, restraint was related to differences in intake between the conditions. Similar amounts of chocolate and dried fruit were eaten by restrained and emotional eaters in both conditions. Interestingly, highly restrained eaters restricted their intake of chocolate and restricted their intake of dried food more following the ego threat task than following the neutral task; however, increased hunger was greater following the ego threat task than the neutral task. These results differ from those of Oliver and colleagues (2000), and the authors suggest that these unexpected results may be due to how only one high fat and low fat food was offered. The low fat food may have served as a reminder to restrain eating; however, this result has not been shown in other studies with few food options.

As explained in the "Restraint, Disinhibition, and Stress – Induced Eating" section above, Groesz and colleagues (2012) found that perceived and experienced stress was associated with a greater drive to eat and disinhibited eating. Those people found to have higher restraint and high disinhibition when eating were found to also consume more non-nutritious food, such as chips, hamburgers, and soda. Perceived stress was also associated with a decrease in consumption of nutritious food low in fat, such as fruits, whole grain foods, and vegetables.

To examine how inducing specific emotions affect food preferences among people who engage in arousal-induced eating, LeBel, Lu, and Dubé (2008) examined the associations among comfort food preferences, restrained eating, and emotional eating within 196 women. Women were classified as being low or high "schematic" depending on if they fell above or below the medians on the restraint, emotional, and external scales of the DEBQ. Participants also identified their favorite comfort foods as well as their hunger and different feelings prior to eating such foods. High "schematic" women were found to prefer high calorie foods when experiencing negative emotions significantly more than were low "schematic" women. Also, consumption of these high calorie foods tended to produce greater feelings of guilt among the high "schematic" women. Low "schematic" women favored high and low calorie food options equally. Furthermore, high "schematics" focused more on the negative aspects of eating comfort foods, such as the emotional triggers and emotional consequences of eating comfort foods. Low "schematics" focused more the food itself, such as the food's hedonic and sensory attributes. Low "schematics" also associated comfort food consumption with positive effects and less guilt following consumption. The high "schematic" eaters viewed the comfort food as being pleasurable and a convenient way to decrease emotional arousal and, by suppressing any contradictory thoughts, they ultimately lost cognitive restraint and engaged in overconsumption of the comfort foods.

LeBel and colleagues (2008) found that people high in restraint and disinhibition consumed high calorie foods with the intention of decreasing emotional arousal. Wallis and Hetherington (2009) further examined these associations among stress, eating behaviors, and snack food consumption. Eighty-nine females completed the three scales on the DEBQ as well as a self report measure that assessed how emotional arousal causes changes in eating behaviors. Emotional eaters reported overeating potato chips, biscuits, and chocolate; however, an equal amount of non-emotional eaters reported overconsuming and underconsuming all three of these foods when in stressful situations. No differences in eating were found for restrained eaters. Because self-report measures were used, these results may be due to personal biased views of how to define overconsumption. On the other hand, results may suggest that non-emotional eaters occasionally disinhibit intake but do so less than do emotional eaters.

Summary

The types of food that an individual is most often exposed to are likely to be preferred; however, emotional arousal and the resulting sympathetic arousal are most effectively attenuated through the intake of high carbohydrate, high fat foods, and low protein foods. These types of food are easier to consume when the digestive system’s activity decreases, and they increase the release of tryptophan as well as endogenous opioids, which produce a calming effect and increased mood. These studies above indicate that restrained and disinhibited eaters are not only likely to eat more than are people low in restraint and disinhibition, but they are more likely to choose the high fat and high carbohydrate options when experiencing emotional arousal.

Consuming this sort of palatable food also tends to produce feelings of guilt and shame, which may then reactivate the sympathetic nervous system and continue the cycle of emotional arousal and eating.

Summary and Current Study

Research shows that eating serves as a coping mechanism for managing emotional arousal. With regard to this arousal-induced eating, the PAH proposes that, as sympathetic arousal increases, food consumption will increase as a way to attenuate sympathetic arousal and activate the parasympathetic nervous system; however, at a certain point, one which is different among individuals, sympathetic arousal no longer allows for the consumption and digestion of food. This inverted U-shaped function between arousal and eating serves as the foundation for the parasympathetic activation hypothesis. Eating activates the parasympathetic nervous system in all people, but not all people resort to eating as a coping mechanism for managing emotional arousal. Instead, people who highly restrain their eating and become highly disinhibited eaters when eating tend to rely on eating as a way to cope with arousing stimuli.

The literature on arousal-induced eating is not very comprehensive and includes methodological problems, such as poor construct operationalization and stressor manipulation, which persist in the literature and compromise the external validity of the findings. Furthermore, this field has yet to clearly identify which stressor most effectively leads to emotional arousal and subsequent eating. All stressors (e.g., threat of electric shock, cold pressor tests, ego threatening tasks) that have been applied vary in effectiveness across studies. Overall, ego threatening tasks seemed to more consistently create sufficient emotional arousal and most often lead to the most eating among participants, especially those who were highly restrained and disinhibited eaters. Studies hypothesize that ego threatening tasks cause negative internal self-awareness, and eating instead focuses attention on the external environment. This challenge to an individual's self-concept seems to be a more potent stressor than are others.

The current literature on arousal-induced eating examines how different stressors affect eating, as well as how low arousal tasks and high arousal tasks relate to subsequent food consumption. This study will be the first assessment of how three varying degrees of emotional arousal affect subsequent eating. Specifically, the study will examine how low, moderate, and highly stressful ego threatening tasks affect arousal and eating behavior. Furthermore, highly restrained and disinhibitied eaters have been found to consider eating to be an effective coping mechanism and are more likely to engage in eating when emotionally aroused than are people who are not highly restrained and disinhibited eaters. All people eat more when aroused, but the effect seems to be greater for those people who are highly restrained and disinhibited eaters. Therefore, this study will also examine how restrained eating and disinhibited eating are associated with arousal, as well as food consumption following the induction of emotional arousal.

The main hypothesis of the study is that participants who are administered moderately stressful tasks will consume more food than will participants who are administered minimally stressful or highly stressful tasks (Hypothesis 1). Because no studies within this field have examined varying levels of stress with regard to restrained and disinhibited eating, no hypotheses are generated to connect these concepts; however, these associations will be examined to determine how restraint and disinhibition influence the relations among arousal and food consumption within the scope of the PAH model.

CHAPTER II

METHODS AND PROCEDURES

Participants

Participants included 60 male and 90 female undergraduate students at Indiana University of Pennsylvania (IUP) who were randomly selected from the psychology department's research subject pool to participate in this study. Participants were enrolled in Introductory Psychology (PSYC 101) and received research credit for their participation. All participants were native English speakers. Participants ranged in age from 18 to 44 years (*M* = 19.26, *SD* = 2.412). Participant height ranged from 54 to 76 inches (*M* = 40.23, *SD* = 7.097), and participant weight ranged from 86 to 320 pounds (*M* = 154.56, *SD* = 38.889). The length of time between when each participant last ate and the start of his/her study session ranged from five minutes to 22 hours (*M* = 200.06 minutes, *SD* = 210.976 minutes).

A total of 160 IUP undergraduate students consented to participate in this study. The individual sessions with each of the first ten participants were used as pilot study sessions to assess feasibility and effectiveness. The data from these 10 participants were not used in the analyses. Minor adjustments (e.g., amount of food offered) were made to the study procedure based on those first ten sessions. Data from the remaining 150 participants was used to test the study hypotheses.

Measures

Restraint and Disinhibition

Degree of restrained eating and disinhibition when eating was measured using the Cognitive Restraint, Uncontrolled Eating, and Emotional Eating scales from the Three Factor Eating Questionnaire-R18 (TFEQ-R18; Karlsson, Persson, Sjöström, & Sullivan, 2000)

(Appendix D). The TFEQ-R18 is based on the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985), which was developed using adult participants who varied in their eating behaviors and weight. The TFEQ measures cognitions and behaviors related to eating and includes three factors entitled Cognitive Restraint of Eating, Disinhibition of Eating Control, and Susceptibility to Hunger. Few studies have reported the psychometric properties of the instrument, although the measure is widely used.

Karlsson and colleagues (2000) assessed the construct validity of the TFEQ in a study with 4377 Swedish adult male and female obese participants. The TFEQ's internal consistency reliability coefficients for each of the three scales were above .70; however, item-scale correlations showed weak internal consistency for the cognitive restraint and disinhibition scales. Overall, construct validity was obtained for the cognitive restraint scale, but many of the items in both the hunger and disinhibition scales formed one factor of uncontrolled eating. Another factor of emotional eating was also identified. To improve internal consistency and discriminate validity of the scales, a revised 18-item version of the TFEQ was developed. The measure includes three scales of Cognitive Restraint (6 items), Uncontrolled Eating (9 items), and Emotional Eating (3 items). Each item has a Likert scale response format. Total scores on this measure range from 18 to 76, and higher scores on the scales are associated with greater cognitive restraint, uncontrolled eating, and emotional eating.

De Lauzon and colleagues (2004) examined the psychometric properties of the TFEQ – R18 on 587 Swedish adolescents and adults and found satisfactory internal consistency of the TFEQ – R18 with all coefficients for each of the three scales above .70. Anglé and colleagues (2009) found the same results when analyzing TFEQ-R18 scores from 2997 Finnish females, aged 17 to 20. The measure was also able to distinguish among different eating patterns as assessed by reported food intake (Anglé et al., 2009; Karlsson et al., 2000; de Lauzon et al., 2004). This measure has not been compared to other well-known eating behavior measures and thus, information about convergent and concurrent validity is not available. This measure is short, easy to administer, and has shown to be a psychometrically sound instrument for measuring the eating behaviors of restraint and disinhibition. The TFEQ-R18 was administered as a pre-test. During the first of two school semesters of data collection, only participants who scored at or above one standard deviation above the mean of all scores, as well as at or below one standard deviation below the mean of all scores, were included in the sample as a way to have two distinct groups of people who are low or high in restraint and disinhibition with regard to eating. Because few people above one standard deviation above the mean agreed to participate the first semester, all research participants who completed this pre-screening measure the second semester were allowed to participate in the study, regardless of scores on the TFEQ-R18. Overall, scores from the prescreen measure (TFEQ, R – 18) ranged from 22 to 62 (M = 40.23, SD = 7.097).

Arousal

The Mood Rating Scale (Appendix E) that assesses hunger, happiness, anger, anxiety, and boredom on scales of 0 (very low) to 100 (very high) was administered at three different time points throughout the study session: before the arousal task administration, after the arousal task administration, and 20 minutes after the conclusion of the arousal task during which time the participants were offered donuts and Pringle chips. At each time point, participants were asked to indicate how they currently were experiencing each feeling on the (10 cm) scale of 0 to 100 by drawing a line on each scale. The examiner explained the directions and demonstrated the task by indicating the degree to which she felt tired on the scale of 0 to 100. This measure of emotional arousal, which was created for the purpose of the study, was completed as a way to determine if each task created the expected arousal in participants. All variables were incorporated into the analyses to better understand the PAH.

The first ten piloted sessions revealed that some participants' mood ratings did not coincide with their observable behaviors. Thus, an additional observation variable, in which all observable behaviors (e.g., fidgeting, sighing) from the participant while they completed the second mood rating scale were considered. These behaviors were then scored as 1 (not negatively emotionally aroused) or 2 (negatively emotionally aroused).

Food Intake

To assess the extent to which participants eat to cope with emotional arousal, 24 donut holes and 48 Pringles chips were provided to each participant after the arousal task. Each donut hole was 55 calories, and each Pringle chip was 10 calories. The first ten participants in the pilot study received 12 donut holes and 24 Pringle chips but, after one participant ate all of the provided food, the amount offered was doubled to account for all variability in food consumption. The amount eaten was measured by determining the difference between numbers of Pringles chips and donut holes present before and after the eating period. The total calories of Pringles and donut holes eaten were then summed for each participant. To mask the true intentions of the provided food, participants were asked to taste each food and complete a Taste Test Rating Scale (Appendix F). This scale asked participants to rate on a Likert scale of 1 (not at all) to 4 (to a great extent) how sweet, salty, and savory each food item was. They also were asked to rate their overall preference of each food item on a Likert scale of 1 (strongly dislike) to 4 (strongly like).

Demographic Questionnaire

Participants completed a five item demographic questionnaire (Appendix G) that included questions about age, gender, height, and weight. In addition, one item asked participants what time they ate their last bite of food prior to entering the session. This measure was completed at the conclusion of the session.

Procedure

This study was conducted through the use of the psychology department subject pool. During the first week of classes, all students consenting to participate in research completed a pre-test form (TFEQ-R18) to assess eating behaviors. During the first semester of data collection, those students who scored at least one standard deviation above and one standard deviation below the mean met inclusion criteria for the study. During the second semester of data collection, all students who completed the TFEQ-R18 were eligible for the study. Of those who were eligible, a randomly selected sample was invited to participate. Those students who agreed to participate were scheduled for one individual administration session to occur that same semester. Each participant in the sample was then randomly assigned to receive the low arousal, moderate arousal, or high arousal task. Aside from the arousal task, all other variables were constant across testing sessions in all groups. Each participant completed the testing session individually. To maintain confidentiality, testing data was placed in a separate manila folder for each participant. The folders were labeled with a participant number (1 to 160) and a group number (1, 2, or 3) depending on the random assignment into each group: low arousal (1), moderate arousal (2), or high arousal (3).

A script for each of the three conditions is included in Appendix A, and one of two examiners administered each study session. Each participant was asked to not eat an hour before the study as a way to control each participant's baseline hunger. During the testing session, all participants signed the informed consent form (Appendix B) and were told that the study examines cognitive abilities and taste preferences. They also were asked to provide their four letter IUP e-mail addresses so that the data from the study session could be connected with the data from the pre-screening measure. This four letter identification number was written on a sticky note and was later shredded after the session when the two sets of data were connected for each participant.

Participants then completed the Mood Rating Scale (Appendix E) to assess baseline feelings of hunger, happiness, anger, anxiety, and boredom. The researcher or research assistant then administered the arousal task via the computer (Appendix C). Based on which of the three groups each participant was randomly assigned to, a low, moderate, or high arousal task was administered. Each task involved completing 30 anagrams through a computer program, and participants received feedback throughout the administration. After each item was answered, the computer program provided visual and auditory feedback to the participant. For example, in the low arousal condition, correct answers received feedback of "Great job!" and incorrect responses caused feedback of "That was not correct, but keep up the good work." In the moderate arousal group, feedback for correct answers was "Correct," and feedback for incorrect answers was "That was not correct. Try harder next time." In the high arousal group, feedback for correct answers was "Correct," and feedback for incorrect responses was "Wrong. Try harder next time, and please work faster." After completion of the anagram items in the high arousal condition only, the examiner left her seat and grabbed a travel container of blood draw equipment (e.g., syringes (without needles), gauze, tape, scissors, waste container, latex gloves) that had been concealed from the participant's view. The examiner brought the medical equipment to a table adjacent to the desk at which the participant sat and set up several of the materials to indicate the preparation of a blood draw. During this process, the examiner asked the participant, "When is the last time you had your blood drawn?" and did not respond to any questions or comments from the participants, unless they could be answered with a "this is for later."

Following the conclusion of the arousal task for all three groups, the participants were told that they would be completing more anagrams (with the intention of maintaining the current arousal levels and so that any change in arousal at this point would more likely be due to the food) but were first going to engage in other tasks. The participants then completed the same Mood Rating Scale (Appendix E) as a manipulation check. Participants were then given a bowl of 48 Pringle chips and a bowl of 24 donut holes. Participants were told that the examiner would be leaving the room for 20 minutes and were given directions as to what should be done in the examiner's absence. First, they tasted each food item and completed the Taste Rating Scale (Appendix F). After completing that scale, they clicked on "Part 2" of the computer anagram program. More anagrams appeared, and that data were combined with the data from the previous set of completed anagrams. Each group received anagrams that reflected the difficulty levels of those provided during the first administration of anagram tasks. Participants were also told that, "all food will be thrown out after the session so, as you complete the anagrams, feel free to help yourself to as much food as you want." The examiner then left the room for 20 minutes and recorded the participants' behaviors and signs of negative emotional arousal as they completed the second Mood Rating Scale (Appendix H). After this 20 minute period, the examiner re-entered the room, moved the food aside, and had the participant fill out the Mood Rating Scale (Appendix E). The participants also were asked to fill out a demographic questionnaire (Appendix G). Following completion of the measures, participants were given the debriefing form (Appendix I), and they were allowed time to talk about the experience and any discomfort the process may have created. Each participant received an hour of participation towards their research requirement. Following the session, the examiner counted the remaining donuts and Pringle chips to determine how many of each food type was consumed and recorded this information (Appendix H).

CHAPTER III

RESULTS

Preliminary Analyses

Means and standard deviations of all mood variables (i.e., happiness, hunger, anger, anxiety, and boredom) are presented in Table 1, and correlations among those variables are presented in Table 2. Bivariate correlations showed that, as expected, the amount of time between the last bite of food and the start of the session was correlated with hunger at Time 1 ($r = .27$, $p < .001$) and hunger at Time 2 ($r = .29$, $p < .001$). Interestingly, scores on the prescreen (TFEQ-R18) measure were positively correlated with anger ($r = .21$, $p = .01$) and boredom scores at Time 2 ($r = .20$, $p = .01$), as well as boredom at Time 3 ($r = .19$, $p = 02$). Essentially, higher levels of reported restrained and disinhibited eating were associated with increased anger and boredom after the arousal task (Time 2) and higher levels of boredom at the end of the study.

Table 1

Emotions at Different Time Points

Emotion Variable	Range of Scores	Mean(SD)
Happiness		
Time 1	19 to 100	65.85 (17.07)
Time 2	0 to 100	52.93 (22.59)
Time 3	0 to 100	53.37 (23.04)
Hunger		
Time 1	0 to 100	36.97 (23.03)
Time 2	0 to 100	37.73 (24.95)
Time 3	0 to 92	27.88 (21.54)
Anger		

Time 1	0 to 90	11.53 (16.46)
Time 2	0 to 91	21.83 (22.37)
Time 3	0 to 100	19.19 (22.29)
Anxiety		
Time 1	0 to 96	22.57 (23.15)
Time 2	0 to 100	29.66 (27.02)
Time 3	0 to 100	21.85 (23.37)
Boredom		
Time 1	0 to 93	22.87 (20.76)
Time 2	0 to 100	25.21 (23.50)
Time 3	0 to 100	29.67 (25.26)

Table 2

Correlations Among All Study Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.	Prescreen Measure	-																			
2.	Weight	.06	-																		
3.	Time Between Last Bite of Food and Study	-.12	.13	-																	
4.	Hunger T1	.02	.02	**.27****	-																
5.	Hunger T2	.11	-.03	**.29****	**.86****	-															
6.	Hunger T3	.02	-.08	.12	**.60****	**.62****	-														
7.	Happiness T1	-.06	.12	.09	**.22****	**.20***	.09	-													
8.	Happiness T2	-.10	.09	.05	**.24****	**.17***	.14	**.61****	-												
9.	Happiness T3	-.07	.12	.05	**.25****	**.17***	**.17***	**.52****	**.82****	-											
10.	Anger T1	.11	.05	-.04	.02	-.01	-.01	**-.40****	**-.29****	**-.26****	--										
11.	Anger T2	**.21***	-.12	.02	.00	.03	-.05	**-.19***	**-.59****	**-.53****	**.49****	-									
12.	Anger T3	.07	-.02	.05	-.04	-.05	-.13	-.09	**-.44****	**-.43****	**.45****	**.67****	-								
13.	Anxiety T1	.13	.04	.03	-.02	-.04	-.07	**-.19***	**-.24****	**-.22****	**.46****	**.30****	**.23****	-							
14.	Anxiety T2	.15	-.05	.03	-.01	-.00	.01	-.08	**-.38****	**-.38****	**.29****	**.57****	**.41****	**.64****	-						
15.	Anxiety T3	.13	-.04	-.03	-.13	-.08	-.10	-.13	**-.33****	**-.39****	**.40****	**.47****	**.47****	**.55****	**.84****	-					
16.	Boredom T1	.15	.06	-.03	.06	.04	.04	-.14	-.14	-.11	**.39****	**.29****	**.22****	**.32****	**.21****	**.28****	-				
17.	Boredom T2	**.20***	.03	.04	.08	.14	.08	-.10	**-.21****	**-.19***	**.28****	**.34****	**.39****	**.28****	**.29****	**.28****	**.63****	-			
18.	Boredom T3	**.19***	-.03	.10	.05	.16	.03	-.10	**-.29****	**-.31****	**.31****	**.42****	**.50****	**.23****	**.29****	**.30****	**.57****	**.77****	-		
19.	Donut Calories	.04	**.20***	.14	**.22***	**.26****	.06	.06	.06	.14	.00	-.04	-.04	.05	.06	.08	-.05	-.06	-.04	-	
20.	Chip Calories	-.04	**.19***	.16	**.22***	**.28****	.09	.10	.14	**.19***	-.12	-.06	-.09	-.03	-.02	-.03	**-.18***	-.13	-.08	**.56****	-

Note. $^{*}p < .05$, $^{**}p < .01$.

Interestingly, hunger and happiness were positively correlated at Time 1 ($r = .22$, $p = .01$), Time 2 ($r = .17$, $p = .04$), and Time 3 ($r = .17$, $p = .04$). As expected, participants who approached the session (Time 1) feeling happy tended to not be angry ($r = -.40$, $p < .001$) or anxious ($r = -.19$, $p = .02$). They also were more likely to stay happy at Time 2 ($r = .61$, $p < .001$) and at Time 3 ($r = .52$, $p < .001$). As expected, at Time 2, happiness was negatively associated with anger ($r = -.59$, $p < .001$), anxiety ($r = -.38$, $p < .001$), and boredom ($r = -.34$, $p < .001$). Again, as expected, happiness was negatively associated with anger ($r = -.43$, $p < .001$), anxiety ($r = -.39$, $p < .001$), and boredom ($r = -.31$, $p < .001$) at Time 3. Anger at Time 1 was positively associated with anger at Time 2 ($r = .49$, $p < .001$) and anger at Time 3 ($r = .45$, $p < .001$). Anger was positively associated with anxiety ($r = .45$, $p < .001$) and boredom ($r = .39$, $p < .001$) at Time 1, anxiety ($r = .57$, $p < .001$) and boredom ($r = .34$, $p < .001$) at Time 2, as well as anxiety ($r = .47$, $p < .001$) and boredom ($r = .50$, $p < .001$) at Time 3.

As expected, participants who were hungrier at Time 1 before the arousal task consumed more donuts ($r = .22$, $p = .01$) and chips ($r = .22$, $p = .01$), as did participants who were hungrier at Time 2 ($r = .26$, $p < .001$; $r = .28$, $p < .001$; donuts and chips, respectively). As expected, weight was positively correlated with chip consumption ($r = .19$, $p = .02$) and donut consumption ($r = .20$, $p = .01$). Participants who ate more chips also tended to be happier at the end of the session ($r = .19$, $p = .02$). There was not a significant relation between prescreen measure score and donut consumption ($r = .04$, $p = .62$) or chip consumption ($r = -.04$, $p = .66$). This association was expected because, although people high in restraint and disinhibition with regard to eating usually are able to exercise resistance when presented with food, that control is easily challenged when in an emotionally arousing situation (Greeno & Wing, 1994; Herman & Polivy, 1975). As expected, happiness, anger, anxiety, and boredom at Time 2 were not significantly correlated with chip and donut consumption because the PAH does not indicate a linear relationship between emotional arousal and food consumption.

Randomization Check

A MANOVA was conducted to determine if there were any significant differences among the three experimental groups (i.e., low arousal, moderate arousal, and high arousal) at baseline. Baseline items included prescreen measure scores, age, gender, height, weight, time between last bite of food and start of session, baseline hunger, baseline happiness, baseline anger, baseline anxiety, and baseline boredom. Results did not reveal any significant differences among the three groups on any of those factors. These findings suggest that the groups were equal and that any subsequent differences among the groups after the experimental manipulations can be attributed to the manipulation and not pre-existing group differences, $F(22,274) = .53$, $p = .96$, Wilk's $\Lambda = .92$, partial $\eta 2 = .04$.

Manipulation Check

A repeated measures MANOVA was conducted to determine if the manipulation of the arousal tasks created the expected changes in experience (i.e., hunger, happiness, anger, anxiety, boredom) across the three time points: from baseline (Time 1) to post-arousal task (Time 2), as well as from post-arousal task (Time 2) to post-food time point (Time 3), for each of the experimental groups. Results revealed that the test failed to fulfill homogeneity of covariance matrices due to significant results on the Levene's Test of Equality of Error Variances.

To satisfy the assumptions of a MANOVA, the data were transformed using the square root transformation. Results showed a significant multivariate effect for between-subjects (of the hunger, happiness, anger, anxiety, and boredom scores) among the experimental groups (low arousal, moderate arousal, high arousal): $F(10, 286) = 4.40$, $p < .001$; Wilk's $\Lambda = .75$, partial $\eta 2$

= .13, power = 1. These results suggest that significant differences exist among the mood scores from the different groups, regardless of time point. There is also a significant multivariate effect across within-subjects time points (regardless of experimental group): $F(10, 138) = 17.52$, $p < .001$; Wilk's $\Lambda = .44$, partial $\eta 2 = .55$, power = 1, which suggests that mood ratings were significantly different across time points, regardless of the group from which the ratings were reported. There also is a significant multivariate effect across the interaction between experimental group and time point: $F(20, 276) = 3.25$, $p < .001$; Wilk's $\Lambda = .66$, partial $\eta 2 = .19$, power = 1, suggesting that the effect of arousal tasks on the mood ratings depends on the time at which those ratings were completed. Further examination of these significant associations is presented below.

Possible main effects for experimental group (while holding time constant) were examined and are presented in Table 3 and Figure 1. The three experimental groups differed significantly on scores of happiness: $F(2, 147) = 8.41$, $p < .001$, partial $\eta 2 = .10$, power = .96. Specifically, pairwise comparisons show that happiness scores for the low arousal group were significantly higher than happiness scores for the moderate and high arousal groups ($p = .00$); however, happiness scores were not significantly different between the moderate arousal group and the high arousal group ($p = 1$). This may be due to the lack of a precise measure of happiness.

Table 3

Emotions Within Groups

Emotion Variable	Range of Scores	Mean (SD)
Group 1		
Hunger	0 to 100	33.38 (2.95)
Happiness	21 to 100	65.80 (2.49)
Anger	0 to 80	8.08 (2.24)
Anxiety	0 to 96	15.59 (2.92)
Boredom	0 to 88	21.73 (2.87)
Group 2		
Hunger	0 to 93	34.93 (2.95)
Happiness	0 to 100	53.01 (2.49)
Anger	0 to 100	22.47 (2.24)
Anxiety	0 to 94	25.07 (2.92)
Boredom	0 to 84	28.09 (2.87)
Group 3		
Hunger	0 to 100	34.28 (2.95)
Happiness	0 to 96	53.35 (2.49)
Anger	0 to 100	22.01 (2.24)
Anxiety	0 to 100	33.43 (2.92)
Boredom	0 to 100	27.95 (2.87)

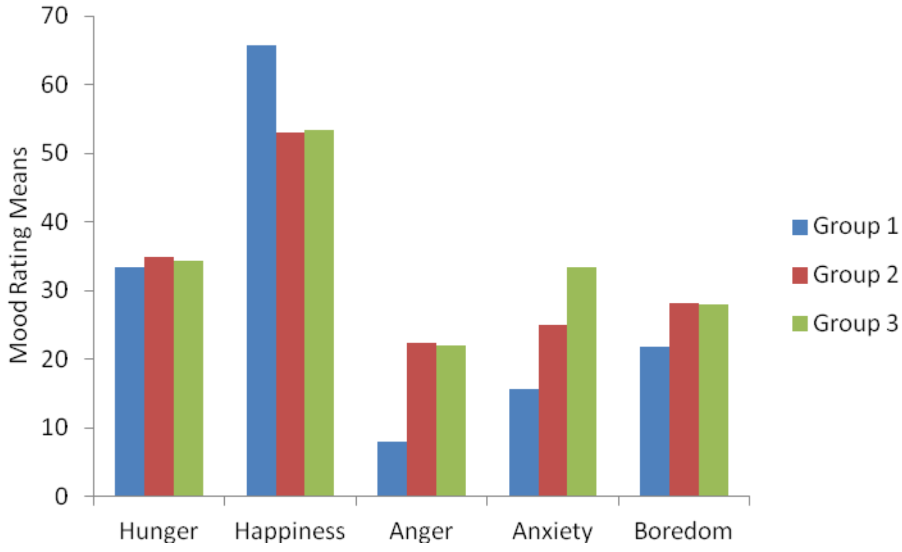

Figure 1. Manipulation check: Main effect for group.

The three experimental groups differed significantly on scores of anger: $F(2, 147) = 16.62$, $p < .001$; partial $\eta 2 = .18$, power = 1. Pairwise comparisons (Figure 1) show that anger scores in the moderate and high arousal groups were significantly higher than anger scores in the low arousal group ($p < .001$) Anger scores for the moderate arousal group tended to be higher than anger scores for the high arousal group, but this difference was not significant ($p = .84$).

The three experimental groups also differed significantly on scores of anxiety: $F(2, 147) = 9.23$, $p < .001$, partial $\eta 2 = .11$, power = .98. Pairwise comparisons (Figure 1) show that anxiety scores in the low arousal group were significantly lower than anxiety scores in the moderate ($p = .01$) and high arousal groups ($p < .001$). Anxiety scores for the high arousal group were also higher than anxiety scores for the moderate arousal group, but this difference was not significant ($p = .09$); however, the relation does suggest that the experimental manipulation was achieving the intended impact on participants.

Possible main effects for Time points while holding Group constant were examined and presented in Table 1 and Figure 2. Hunger scores were significantly different among the three time points: $F(2, 294) = 31.44$, $p < .001$, partial $\eta 2 = .18$, power = 1. Pairwise comparisons show that hunger scores were significantly lower at Time 3 than they were at both Time 1 ($p < .001$) and Time 2 ($p < .001$); however, hunger scores did not significantly differ between Time 1 and Time 2 ($p = .69$). Results suggest hunger was fairly constant for the first part of the session but decreased after the time interval in which the participants were provided with food.

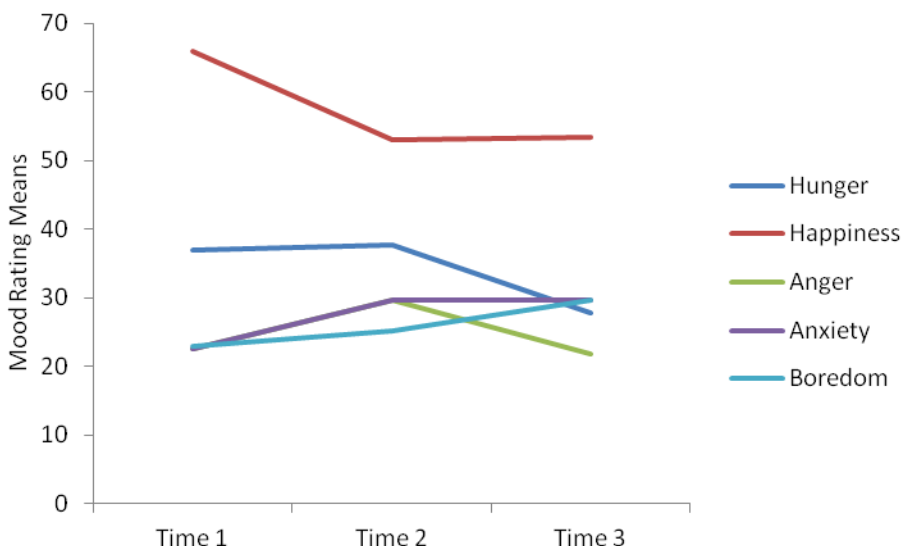

Figure 2. Manipulation check: Main effect for time.

Happiness scores were significantly different among the three time points: $F(2, 294) = 50.72$, $p < .001$, partial $\eta 2 = .26$, power = 1. Pairwise comparisons (Figure 2) show that happiness scores were higher at Time 1 than at Time 2 ($p < .001$) and Time 3 ($p < .001$). Happiness scores at Time 3 were higher than at Time 2, but this difference was not significant ($p = .89$). These results suggest that the arousal tasks contributed to the decrease in overall happiness, but the period of eating tended to increase reported happiness.

Anger scores were significantly different among the three time points: $F(2, 294) = 30.06$, $p < .001$, partial $\eta 2 = .17$, power = 1. Pairwise comparisons (Figure 2) show that anger scores at Time 2 were higher than anger scores at Time 1 ($p < .001$) and at Time 3 ($p < .001$). Anger scores at Time 3 were higher than anger scores at Time 1 ($p < .001$). Results suggest that the arousal tasks overall created anger, but the period of eating contributed to the dissipation of anger; however, the eating period did not sufficiently return anger scores to baseline levels.

Anxiety scores were significantly different among the three time points: $F(2, 294) = 14.35$, $p < .001$, partial $\eta 2 = .09$, power = 1. Pairwise comparisons (Figure 2) show that anxiety scores at Time 2 were significantly higher than anxiety scores at Time 1 ($p < .001$) and at Time 3 ($p < .001$). Anxiety scores at Time 1 were higher than they were at Time 3, but this difference was not significant ($p = .47$). These results suggest that the arousal tasks raised reported anxiety, and the eating period helped to reduce anxiety. Although not a significant difference, the higher anxiety at baseline may be due to anticipation of the study session.

Boredom scores were significantly different among the three time points: $F(2, 294) = 10.90$, $p < .001$, partial $\eta 2 = .07$, power = .99. Pairwise comparisons (Figure 2) show that boredom scores were significantly higher at Time 3 than at Time 1 ($p < .001$) and at Time 2 ($p < .001$). Boredom scores at Time 2 were higher than boredom scores at Time 1, but this difference was not significant ($p = .27$). These results suggest an increase in boredom, regardless of experimental group, as the testing session progressed.

To examine the significant interactions between experimental group and mood scores, post hoc ANOVA tests were conducted. There was a significant interaction between time and experimental groups for happiness (see Figure 3): $F(4, 294) = 10.38$, $p < .001$, partial $\eta 2 = .12$, power = 1.

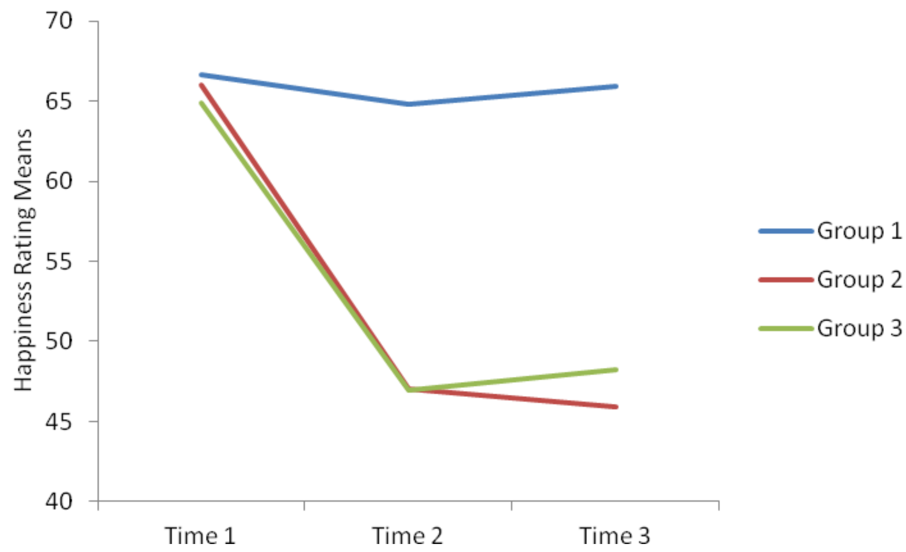

Figure 3. Manipulation check: Interaction between group and time for happiness.

Tukey's HSD post hoc comparisons showed no significant differences in happiness scores among the three groups at Time 1; however, at Time 2, happiness scores for the low arousal group were significantly higher than happiness scores for the moderate arousal group ($p < .001$) and the high arousal group ($p < .001$). At this same time point, the moderate arousal group reported higher happiness scores than did the high arousal group, but the difference was not significant ($p = .91$). At Time 3, happiness scores for the low arousal group were significantly higher than happiness scores for the moderate arousal group ($p < .001$) and the high arousal group ($p < .001$). Also at Time 3, the high arousal group reported higher happiness scores than did the moderate arousal group, but the difference was not significant ($p = .84$). These results suggest that the arousal task effectively reduced reported happiness in the moderate and high arousal groups and, although happiness scores from the moderate arousal group after the task were higher than the scores in the high arousal group at this time, the difference is not significant. In addition, repeated measures ANOVA analyses were conducted to assess how happiness changed over the course of the study for each group. Happiness was significantly different across the three time points for Group 2 (see Table 4 and Figure 3): $F(2,48) = 30.58$, $p < .001$, Wilk's $\Lambda = .44$, partial $\eta 2 = .56$, power = 1. Specifically, pairwise comparisons revealed that happiness scores decreased significantly from Time 1 to Time 2 ($p < .001$) and stayed fairly constant from Time 2 to Time 3 ($p = .58$). Happiness was significantly different across the three time points for Group 3 (see Table 4 and Figure 3): $F(2,48)=21.75$, $p < .001$, Wilk's $\Lambda = .53$, partial $\eta 2 = .48$, power = 1. Specifically, happiness scores decreased significantly from Time 1 to Time 2 ($p < .001$) and then slightly increased at Time 3 ($p =.54$).

Table 4

Happiness Ratings Over Time for Each Group

Emotion Variable	Range of Scores	Mean (SD)
Group 1		
Time 1	21 to 100	66.64 (16.67)
Time 2	21 to 100	64.82 (20.12)
Time 3	22 to 100	65.94 (19.78)
Group 2		
Time 1	19 to 100	66.02 (18.40)
Time 2	6 to 100	47.06 (20.18)
Time 3	0 to 100	45.94 (22.73)
Group 3		
Time 1	25 to 93	64.90 (16.38)
Time 2	0 to 92	46.92 (22.89)
Time 3	0 to 96	48.24 (21.51)

There is also a significant interaction between time and groups for anger (see Figure 4): $F(4, 294) = 9.06$, $p < .001$, partial $\eta 2 = .11$, power = 1.

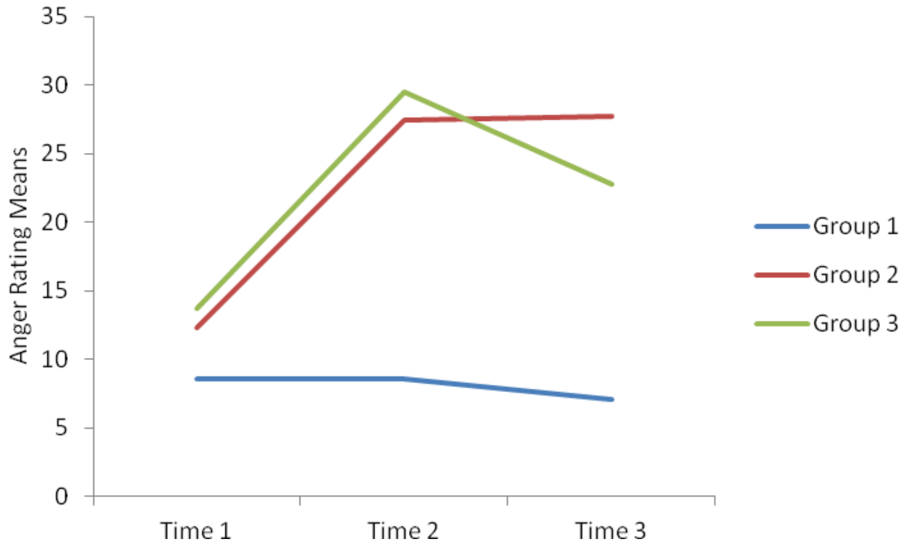

Figure 4. Manipulation check: Interaction between group and time for anger.

Tukey's HSD post hoc tests revealed that anger scores did not differ significantly among groups at Time 1. At Time 2, the moderate and high arousal groups reported significantly higher anger scores than did the low arousal group ($p < .001$). Although the high arousal group reported higher anger scores than did the moderate arousal group at Time 2, the difference was not significant ($p = .94$). At Time 3, the anger scores for the low arousal group were significantly lower than were the anger scores for the moderate arousal group ($p < .001$) and the high arousal group ($p < .001$). The moderate arousal group reported higher anger scores than the high arousal group, but the difference is not significant ($p = .55$). The low arousal group experienced less anger than did the moderate arousal and high arousal groups after the arousal task, as expected; however, the high and moderate arousal groups did not differ significantly after the arousal task.

Repeated measures ANOVA analyses were computed to determine how anger ratings changed over the course of the study sessions for each group (see Table 5 and Figure 4).

Table 5

Anger Ratings Over Time for Each Group

Emotion Variable	Range of Scores	Mean (SD)
Group 1		
Time 1	0 to 80	8.58 (15.47)
Time 2	0 to 55	8.54 (12.89)
Time 3	0 to 39	7.12 (10.88)
Group 2		
Time 1	0 to 50	12.28 (14.26)
Time 2	0 to 85	27.46 (20.29)
Time 3	0 to 100	27.68 (25.32)
Group 3		
Time 1	0 to 90	13.74 (19.16)
Time 2	0 to 91	29.50 (25.89)
Time 3	0 to 100	22.78 (22.72)

Results revealed that anger ratings were significantly different over the course of the study sessions for Group 2: $F(2, 48)= 17.70$, $p < .001$, Wilk's $\Lambda = .58$, partial $\eta 2 = .42$, power = 1. Specifically, pairwise comparisons indicated that anger ratings significantly increased from Time 1 to Time 2 ($p < .001$) and stayed fairly constant from Time 2 to Time 3 ($p = .94$). Anger ratings also were significantly different over the course of the study sessions for Group 3: $F(2, 48)= 10.04$, $p < .001$, Wilk's $\Lambda = .71$, partial $\eta 2 = .30$, power = .98. Pairwise comparisons revealed that anger significantly increased from Time 1 to Time 2 ($p < .001$) and significantly decreased from Time 2 to Time 3 ($p = .02$).

There is a significant interaction between time and groups for anxiety (see Figure 5): $F(4, 294) = 5.51$, $p < .001$, partial $\eta 2 = .07$, power = .98.

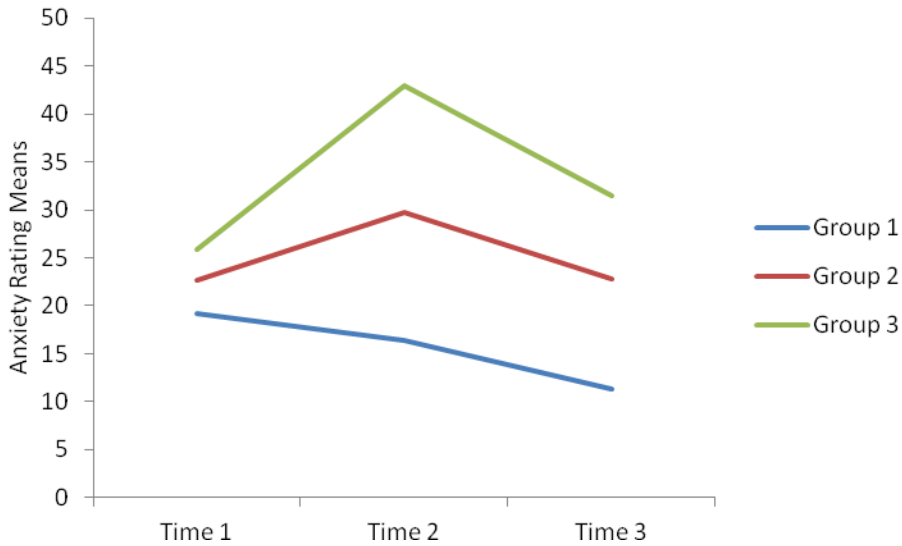

Figure 5. Manipulation check: Interaction between group and time for anxiety.

Tukey's HSD post hoc comparisons show that anger scores did not differ significantly among groups at Time 1. At Time 2, the low arousal group reported significantly lower anxiety scores than did the moderate arousal group ($p = .02$) and the high arousal group ($p < .001$). The high arousal group reported higher anxiety scores than did the moderate arousal group, but the results were just short of being significant ($p = .06$). At Time 3, the low arousal group reported significantly lower anxiety scores than did the moderate arousal group ($p = .01$) and the high arousal group ($p < .001$). The high arousal group reported higher anxiety scores than did the moderate arousal group, but the results were not significant ($p = .24$). Results suggest that the high arousal group experienced more anxiety than did the moderate arousal group after the manipulation task, and the moderate arousal group experienced more anxiety than did the low arousal group at this same time point. In addition, repeated measures ANOVA analyses were computed to determine how anxiety ratings changed over the course of the study sessions for each experimental group (see Table 6 and Figure 5).

Table 6

Anxiety Ratings Over Time for Each Group

Emotion Variable	Range of Scores	Mean (SD)
Group 1		
Time 1	0 to 96	19.16 (23.54)
Time 2	0 to 73	16.34 (17.83)
Time 3	0 to 54	11.26 (13.55)
Group 2		
Time 1	0 to 94	22.70 (22.42)
Time 2	0 to 81	29.70 (24.84)
Time 3	0 to 78	22.80 (22.22)
Group 3		
Time 1	0 to 94	25.86 (23.46)
Time 2	0 to 100	42.94 (30.41)
Time 3	0 to 100	31.48 (27.82)

Results revealed that anxiety ratings significantly changed over the course of the session for Group 2: $F(2,48)=.78$, $p < .001$, Wilk's $\Lambda = .78$, partial $\eta2 = .22$, power = .90. Specifically, anxiety increased significantly from Time 1 to Time 2 ($p = .01$) and decreased significantly from Time 2 to Time 3 ($p < .001$). Anxiety ratings also significantly changed over the course of the study for Group 3: $F(2,48)= 16.88$, $p < .001$, Wilk's $\Lambda = .59$, partial $\eta2 = .41$, power = 1. Specifically, pairwise comparisons revealed that anxiety significantly increased from Time 1 to

Time 2 ($p < .001$) and then significantly decreased from Time 2 to Time 3 ($p < .001$). Results suggest that the arousal tasks elevated anxiety in both the moderate and high arousal groups, and the eating period contributed to the alleviation of that emotional arousal.

There was not a significant interaction between time and experimental groups for hunger scores (see Figure 6): $F(4, 294) = 3.04$, $p = .06$, partial $\eta 2 = .04$, power = .80. As expected, however, hunger decreased for all groups between Time 2 and Time 3.

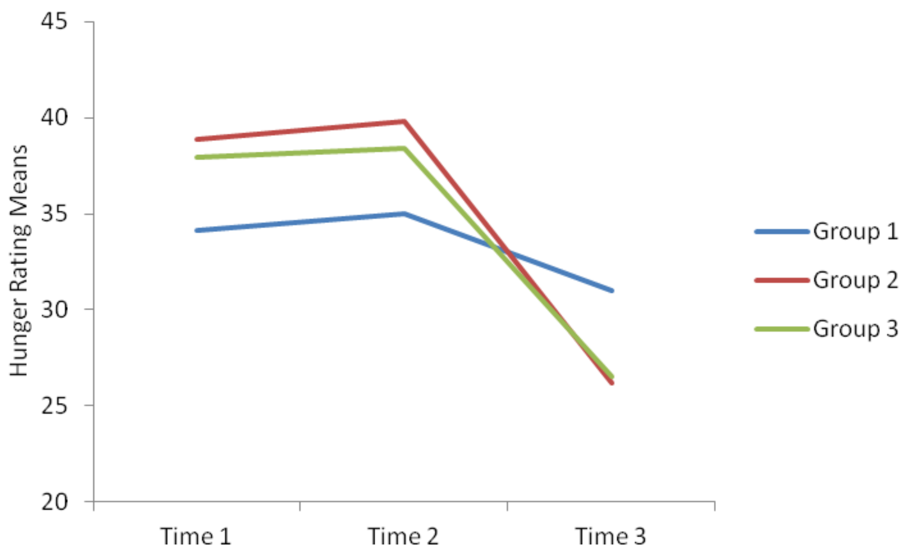

Figure 6. Manipulation check: Interaction between group and time for hunger.

There also was not a significant interaction between time and experimental groups for boredom (see Figure 7): $F(4, 294) = 1.32$, $p = .26$, partial $\eta 2 = .02$, power = .41.

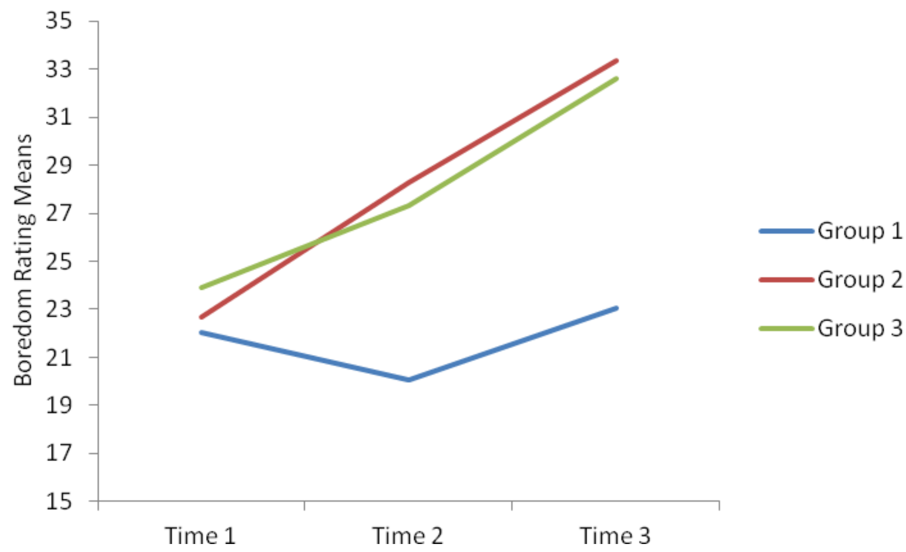

Figure 7. Manipulation check: Interaction between group and time for boredom.

Overall, examination of the interactions between group and time point for the ratings of happiness, anger, and anxiety suggest that the manipulation was effective in producing the desired changes in mood between the low arousal group and the other two groups. The discrepancies in reported moods between the moderate and high arousal groups were in the expected direction but were not significant.

The repeated measures MANOVA was followed up with discriminant analysis at Time 2 to better understand the relation between group and mood (i.e., hunger, happiness, anger, anxiety, and boredom) at this time point (see Figure 8). The analysis at Time 2 revealed two discriminant functions that underlie all five of the dependent mood variables. The first function explained 89.8% of the variance, canonical $r^2 = .50$, whereas the second explained only 10.2%, canonical $r^2 = .19$. In combination, these discriminant functions significantly differentiated the treatment groups, Wilk's $\Lambda = .72$, $X^2(10) = 47.86$, $p < .001$, but removing the first function indicated that the second function did not significantly differentiate the treatment groups, Wilk's

$\Lambda = 0.96$, $X^2(4) = 5.49$, $p > .05$. The correlations between outcomes and the discriminant functions revealed that anger loaded more highly on the first function (r = .90) than the second function (r = -.30); anxiety loaded fairly evenly on both functions (r = .68 for the first function and r = .64 for the second function); happiness loaded more highly on the first function (r = -.65) than the second function (r = .14); boredom loaded more highly on the first function (r = .30) than the second function (r = -.19); hunger loaded more highly on the first function (r = .16) than the second function (r = -.03). The discriminant function plot showed that the first function discriminated the low arousal group from both the moderate and high arousal groups, and the second function differentiated the moderate arousal group from both the low and high arousal groups.

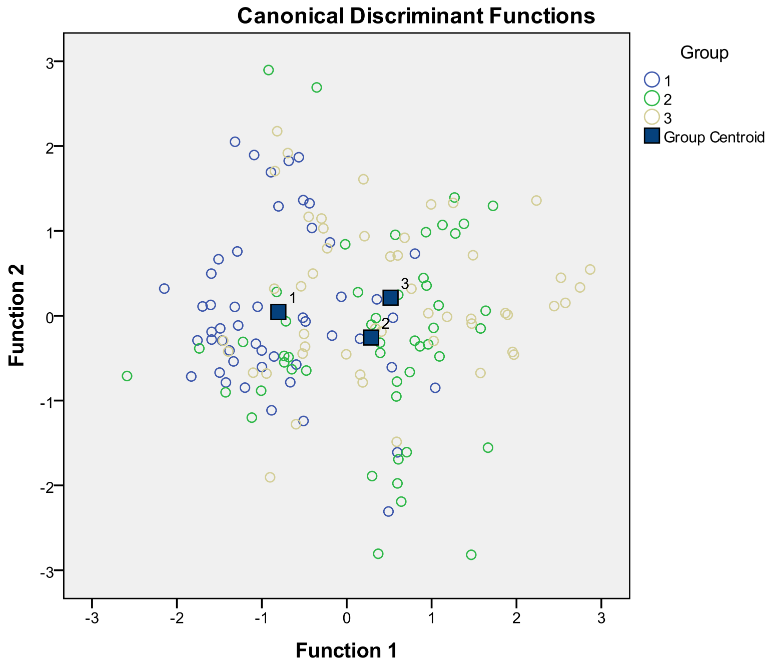

Figure 8: Discriminant analysis.

Manipulation Check With Observation Variable

To determine the relation between each participant's reported moods after the arousal task and the examiner's observations of the participant's moods at that time, an observation variable was included. The examiner rated each participant as being "negatively emotionally aroused" (Score=1) or "not negatively emotionally aroused" (Score=0) depending on observations of the participants' nonverbal and verbal behaviors at the time they completed the Time 2 mood rating scale. Bivariate correlations were conducted to examine the relation between this observation variable and the self-reported mood ratings at Time 2 (post-manipulation task). Results show that, as expected, observation of negative emotional arousal was positively correlated with anxiety (r = .57, p < .001), anger (r = .57, p < .001), and boredom (r = .29, p < .001) from the mood rating scale. Observation of negative emotional arousal also was negatively correlated with happiness (r = -.38, p < .001), and it was not significantly correlated with hunger (r = -.001, p = .20). Essentially, the examiners' observations of participants' negative emotional arousal at Time 2 were consistent with self-reported mood at that time.

To further assess the consistency between the self-reported moods and examiners' observations of negative emotional arousal, a one-way ANOVA was conducted to determine if the three experimental groups (low arousal, moderate arousal, and high arousal) differed on this observation variable (see Figure 9). Results show significant differences: $F(2, 149) = 37.44$, p < .001. Tukey HSD post hoc comparisons reveal that the low arousal group was significantly less negatively aroused than was the high arousal group (p < .001) and the moderate arousal group (p < .001). The high arousal group only tended to be more negatively aroused than the moderate arousal group (p = .45). These results mirror those main effects described above when groups were compared to the anxiety and anger variables on the Mood Rating Scale post-manipulation task.

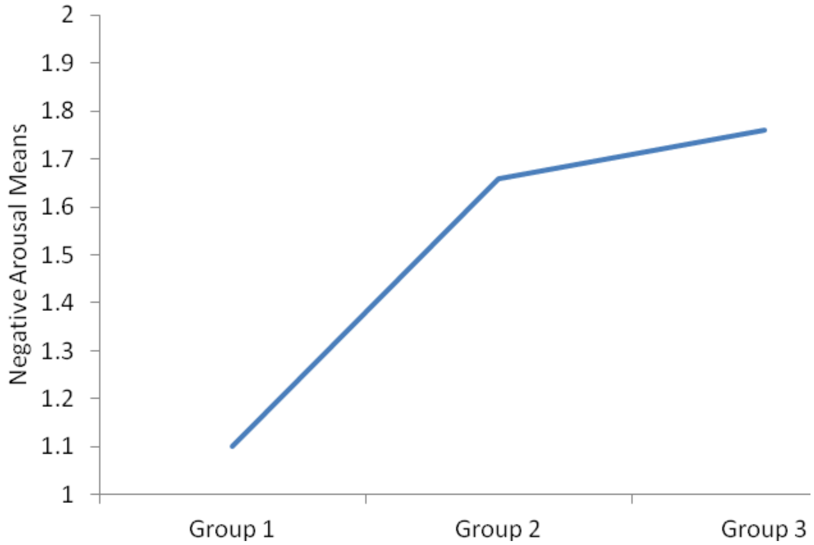

Figure 9. Manipulation check with observation variable and experimental groups.

Overall, results from these analyses suggest that the examiners' observations of negative emotional arousal were relatively consistent with participant self-report ratings of mood.

Arousal and Food Intake

Calories of donuts consumed ranged from 0 to 1045 (M = 255.93, SD = 188.92), and calories of Pringle chips consumed ranged from 0 to 480 (M = 108.27, SD = 105.01). Each Pringle chip was 10 calories, and each donut was 55 calories. Calories consumed by each experimental group are included in Table 7.

Table 7

Calories Consumed by Group

Group	Chips Mean (SD)	Donuts Mean (SD)	Total Mean (SD)
Group 1	100.40(87.11)	243.10(209.98)	343.50(267.86)
Group 2	139.20(129.86)	278.30(174.78)	417.50(281.87)
Group 3	85.20(86.60)	246.40(181.99)	331.60(232.79)

A one-way MANOVA was conducted to determine how food consumption (donuts and Pringle chips) differed among the three experimental groups (low arousal, moderate arousal, high arousal). Results revealed that the test failed to fulfill homogeneity of covariance matrices due to significant results on the Levene's Test of Equality of Error Variances. To satisfy the assumptions of a MANOVA, the data were transformed using the square root transformation. Results did not reveal significant differences: $F(4, 292) = 1.52$, $p = .20$, Wilk's $\Lambda = .96$, partial $\eta 2 = .02$, power = .47. Although this overall association among experimental groups and food consumption is not significant, the moderately aroused group ate more chips (see Figure 10) and donuts (see Figure 11) than did the other two groups, consistent with predictions.

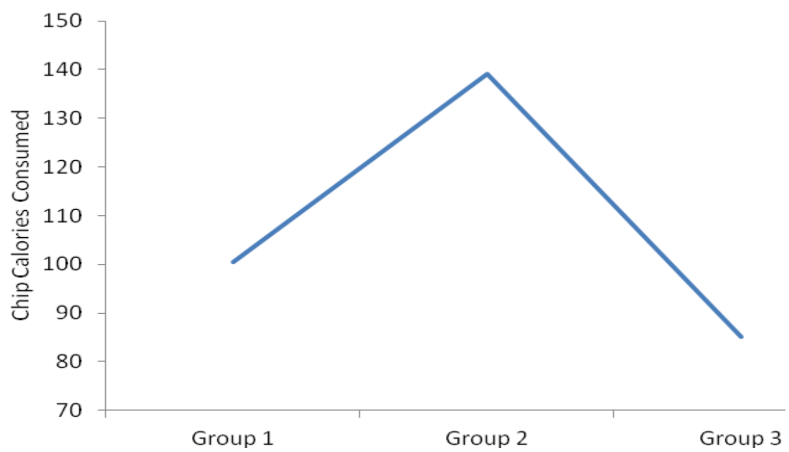

Figure 10. Emotional arousal and chip consumption.

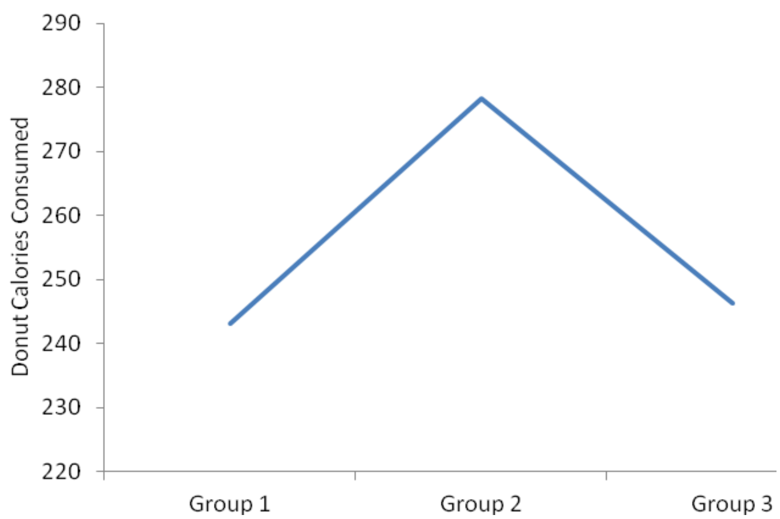

Figure 11. Emotional arousal and donut consumption.

Although the overall MANOVA results were not significant, post-hoc tests were conducted to better understand the relation among groups for chip and donut consumption. Results did not reveal a significant between-subjects effect for consumption of chips, $F(2, 147) = 2.68$, $p = .07$, partial $\eta 2 = .04$, power = .53 (see Figure 10). Specifically, the moderately aroused group ($M = 139.20$, $SD = 129.86$) ate more chips than did the high arousal group ($M = 85.20$, $SD = 86. 60$), ($p = .06$) and the low arousal group ($M = 100.40$, $SD = 87.11$), ($p = .37$). The low arousal group ate more chips than did the high arousal group ($p = .61$).

Post-hoc tests to examine differences in donut consumption among the groups also revealed non-significant results: $F(2, 147) = .85$, $p = .43$, partial $\eta 2 = .01$, power = .19 (see Figure 11). Regarding donuts, the low arousal group ($M = 243.10$, $SD = 209.98$) ate less donuts than both the moderate ($M = 278.30$, $SD = 174.78$), ($p = .44$) and high arousal groups ($M = 246.40$, $SD = 181.99$), ($p = .97$). The moderate arousal group ate the most donuts, but again the difference in consumption between the moderate and high arousal groups was not significant (*p* = .59).

These results suggest that participants exposed to moderately arousal tasks ate more in the presence of food than did participants experiencing low arousal or high arousal tasks; however, the differences among the three groups lacked significance.

Restraint, Disinhibition, Arousal, and Food Intake

After gaining an understanding how food consumption differed among the three experimental groups, the relation between eating behavior, as reported on the TFEQ-R18, and food consumption was examined. All of the scores from the TFEQ-R18 that were above the mean of 40.23 were designated as "high restraint and disinhibition," and all of the scores below the mean were considered "low restraint and disinhibition." The low restraint and disinhibition participants consumed fewer calories from donuts (*M* = 236.74, *SD* = 188.48) than did the high restraint and disinhibition participants (*M* = 272.28, *SD* = 188.91). The difference in consumption between the two groups is greater for chips. Again, the low restraint and disinhibition group consumed fewer chip calories (*M* = 103.19, *SD* = 90.77) than did the high restraint and disinhibition group (*M* = 112.59, *SD* = 116.17).

To further examine the association between restraint and disinhibition (IV) and chips and donut consumption (DVs), a one-way MANOVA was completed. Results do not show that food consumption differed significantly between the high and low restraint and disinhibition groups: $F(2, 147) = 1.06$, $p = .35$; Wilk's $\Lambda = .99$, partial η2 = .01, power = .23. Although people high in restraint and disinhibition consumed more donuts (see Figure 12) and chips (see Figure 13), the consumption was not significantly different between the low and high restraint and disinhibition groups.

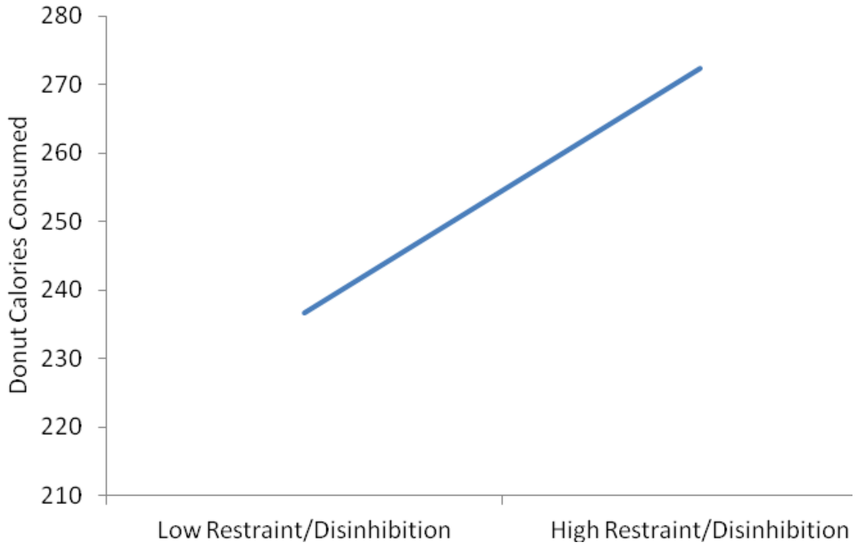

Figure 12. Restraint, disinhibition, and donut consumption.

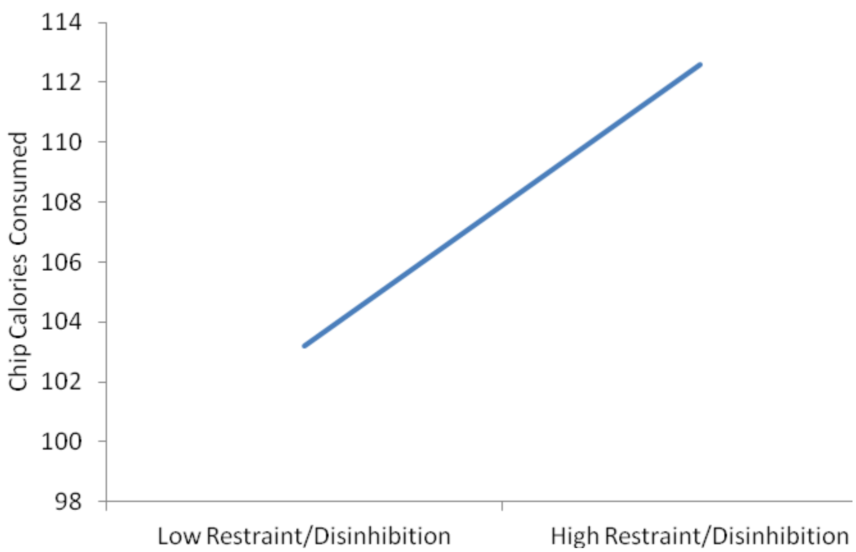

Figure 13. Restraint, disinhibition, and chip consumption.

To examine the association among restraint and disinhibition (IV), experimental group (IV), and chips and donut consumption (DVs), a MANOVA was completed. Results do not show that food consumption differed significantly among the groups when eating behaviors were considered: $F(4,286) = 1.36$, $p = .25$; Wilk's $\Lambda = .96$, partial $\eta2 = .02$, power = .42. Specifically, the degree to which restraint and disinhibition was exercised when eating was neither related to donut (see Figure 14) nor chip (see Figure 15) consumption in varying arousal conditions.

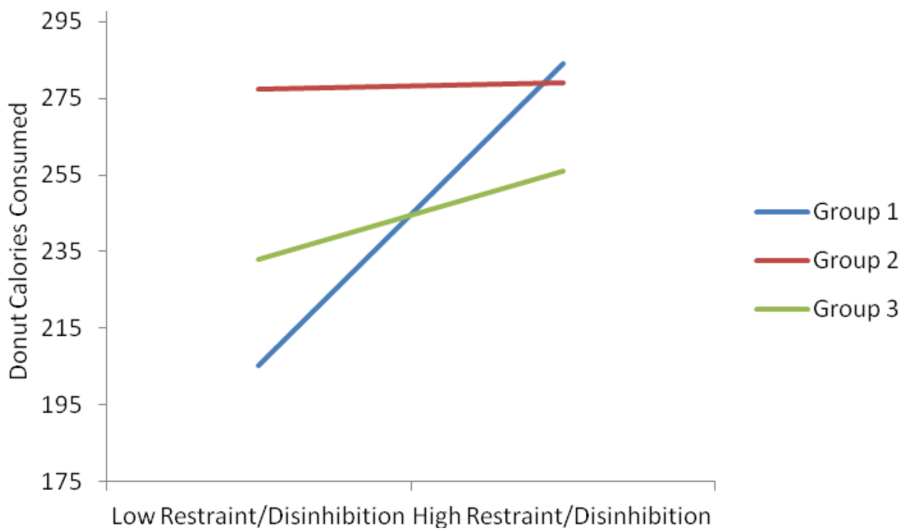

Figure 14. Restraint, disinhibition, group, and donut consumption.

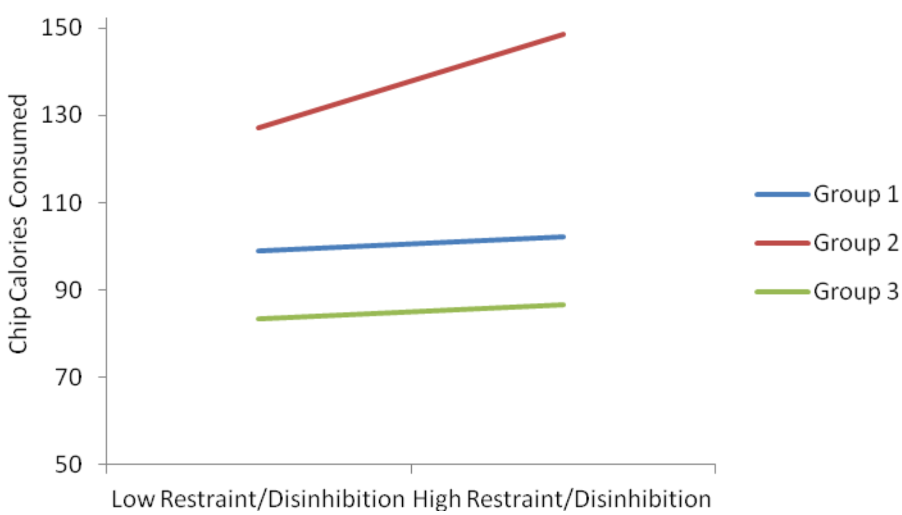

Figure 15. Restraint, disinhibition, group, and chip consumption.

CHAPTER IV

DISCUSSION

The present study tested David LaPorte's parasympathetic activation hypothesis (PAH) concerning arousal-induced eating. The study aimed to induce varying (i.e., low, moderate, high) degrees of emotional arousal within college students and examine eating behaviors. It was hypothesized that eating occurs in greater amounts when individuals are in moderately aroused environments than when they are in low or high arousal situations. This study also purported to examine how restraint and disinhibition, as measured by the TFEQ-R18, is associated with eating when in the varying emotional arousal situations.

Regarding the main hypothesis– that people in moderately arousal situations would consume more food than people in low or high arousal conditions– the results indicate that the moderately aroused group consumed more calories than did the low and high arousal groups. Specifically, the moderately aroused group ate more chips (M = 139.20, SD = 129.864) than did the high (M = 85.20, SD = 86. 60) and the low arousal groups (M = 100.40, SD = 87.11). The moderately aroused group also ate more donuts (M = 278.30, SD = 174.78) than did the low (M = 243.10, SD = 209.98) and high (M = 246.40, SD = 181.99) arousal groups; however, the differences were not significant. Further information about these associations will be explained after a discussion of how emotional arousal changed over the course of the study for the three experimental groups.

Experimental Manipulation Check on Mood Ratings

First, we review the significant bivariate associations among the study variables and quality of the experimental manipulation. Regardless of experimental group, participants who began the study session happy tended to remain happy for the duration of the session. Also, participants who began the session angry tended to remain angry throughout the session. These results were interesting because it was expected that no emotion would be constant throughout the entire testing session due to the introduction of the arousal task manipulation. These significant associations, therefore, may indicate that the arousal task did not manipulate moods appropriately, or feelings of happiness and anger may be orthogonal to the arousal conditions created by the study. As expected, happiness was negatively correlated with anger, anxiety, and boredom. Anger was positively associated with boredom and anxiety throughout the session.

The experiment was designed to induce varying levels of emotional arousal among the three experimental groups. Regardless of time point, ratings of happiness, anger, and anxiety were significantly different among the three experimental groups (i.e., low, medium, and high arousal). The three groups did not differ significantly on ratings of hunger and boredom. As expected, the low arousal group rated significantly higher levels of happiness and significantly lower levels of anger and anxiety than did the moderate and high arousal groups. Although the moderately aroused group was happier, less angry, and less anxious than the high arousal group as expected, those differences were not significant. These results indicate that the experimental task successfully manipulated arousal to produce the expected changes between the mood of the low arousal group and the moods of the other groups; however, tasks for the moderately and highly aroused groups did not produce a significant mood discrepancy between these groups. This lack of significance in the mood ratings between the moderate and high arousal groups is likely due to the experiment's inability to induce very high levels of emotional arousal given the limitations of conducting ethical research on humans. Such a limitation within the study will be discussed in greater detail later.

Manipulation check results also indicated that, regardless of experimental group, ratings of emotional arousal were significantly different among the three different time points (baseline, after the arousal task, and after the eating period). Hunger was reported to be fairly consistent until after the eating period, in which participants rated significantly less hunger, as was expected. The arousal tasks decreased ratings of happiness and increased ratings of anger and anxiety from Time 1 to Time 2, but participants were happier, as well as less angry and anxious after eating (Time 3). These overall changes in happiness, anger, and anxiety support the notion that eating helps to ameliorate emotional arousal in attempts to return arousal to homeostasis (Bray, 2000). Overall, boredom increased among all experimental groups as the testing session progressed, which potentially is due to participants' increased lack of interest in the study as the session progressed.

The effect of the experimental task on happiness, anger, and anxiety ratings within each group was found to be contingent on the time at which the ratings were completed. Boredom and hunger were not significantly different among the groups at different time points. Specifically, as expected, the low arousal group was significantly happier, less angry, and less anxious than the moderate and high arousal groups at both Time 2 and Time 3. Although the moderately aroused group was happier, less angry, and less anxious than the highly aroused group at both time points, these differences were not significant. Again, this lack of significance between the mood ratings in the moderate and high arousal groups indicates that the manipulation was not effective in inducing significantly different levels of emotional arousal between the moderate and high arousal groups presumably due to a ceiling effect based on the limited arousal-inducing procedure utilized.

The observation variable that identified each participant as “negatively emotionally aroused” or “not negatively emotionally aroused” at Time 2 was consistent with the self-reported negative emotional arousal. Specifically, an increase in observed negative emotional arousal by the examiner was associated with participants’ self-reported anxiety, anger, and boredom, as well as negatively correlated with happiness. As expected, the low arousal group was significantly less negatively aroused than was the moderate and high arousal groups. It was expected that the high arousal group would appear significantly more negatively aroused than did the moderately aroused group, and this difference was present but not significant.

The manipulation checks overall revealed that the experimental manipulation differentiated the low arousal group from the moderate and high arousal groups. The high arousal group experienced more arousal than did the moderate arousal group, but the differences in ratings were not significant. The standard deviations of each group’s mood ratings also were similar suggesting that associations among the three groups’ moods were not due to significant variability within the ratings for a given group. With that said, the lack of significance regarding food consumption between the moderate and high arousal groups could be due to the fact that the high arousal group did not experience significantly greater emotional arousal than did the moderate arousal group. This relationship will be explored below, and possible reasons for lack of significant discrepancy will be discuss in the limitations section.

Emotional Arousal and Food Consumption

Results do support that the moderately aroused group consumed more food than did the low or high arousal groups, and variability within each group’s food consumption was generally consistent. This association supports the PAH’s contention that, at moderate levels of sympathetic nervous system arousal, eating would occur more than it would at low or high levels of arousal. Eating in response to elevated levels of emotional arousal would be done to facilitate the parasympathetic nervous system and return the body to homeostasis. The moderate and high arousal groups experienced a significant decrease in anxiety from Time 2 to Time 3, and only the high arousal group experienced a significant decrease in anger in that time frame. Eating helped to facilitate a reduction in emotional arousal. Perhaps the continuation of anagram tasks during the eating period would have led to a continued increase of emotional arousal, but food consumption contributed to the maintenance or decrease of several reported moods.

Emotional arousal increases reactivity to external rewarding stimuli, and the presentation of food may have served as that rewarding behavior to attenuate sympathetic arousal induced by the arousal task (Bray, 2000). Sight and smell of food elicits an increase in hunger, desire to eat, salivation, heart rate, and emotional arousal (Fedoroff, Polivy, & Herman, 1997; Hardman, Scott, Field, & Jones, 2014; Weingarten, 1985). People who experience high chronic arousal present greater activity in brain regions (e.g., anterior cingulate and medial orbitofrontal cortex) thought to contribute to motivated behavior. This has been demonstrated in studies in which participants are presented with pictures of high calorie foods (Grabenhorst & Rolls, 2011; Hinton et al., 2004). Presentation of palatable foods when experiencing emotional arousal also may lead to eating based on the emergence of memories about the immediate arousal reducing effects when consuming food (Dallman et al., 2003; Tyron, Carter, DeCant, & Laugero 2013). Eating will then occur to reduce sympathetic arousal and return the body to homeostasis.

Perhaps, approach and avoidance motivation was at play in explaining participants' eating behaviors in reaction to varying levels of emotional arousal. This sort of motivation arises from a combination of external input (e.g., the anagram task) and internal input (e.g., memories of the effects of consuming food when experiencing varying levels of emotional arousal) (Carver

& Harmon-Jones, 2009; Eder, Elliot, & Harmon-Jones, 2013; Elliot, Eder, & Harmon-Jones, 2013). Each participant's interpretation of their emotional experience dictated whether they chose to engage in food consumption or avoid the food. Participants who are restrained eaters may have perceived the presentation of food to be negative and chose to avoid it, whereas other participants may have perceived the food to be a source of comfort and chose to engage in consumption (Schmeichel, Harmon-Jones, & Harmon-Jones, 2010). While the low arousal group experienced low levels of anger after the administration of the anagram tasks (Time 2), anger peaked in both the moderate and high arousal groups at this time point, which may have created approach motivation to consume more food. On the other hand, both the moderate and high arousal groups experienced higher levels of anxiety, which would be associated with avoidance motivation. Furthermore, the low arousal group experienced higher levels of happiness than did the moderate and high arousal groups, which would indicate an approach motivation force, but the low stress group did not consume more food than did the moderate or high arousal groups. Overall, the groups experienced various degrees of emotional arousal states associated with both avoidance and approach motivation. Therefore, it is unclear the extent to which each individual emotion contributed to food consumption. The emotional arousal levels experienced by the moderate arousal group led to the most approach motivation in comparison to the other two groups, as evidenced by greater amounts of food consumption by the moderate arousal group.

Although hunger was positively correlated with the amount of food consumed, it did not differ significantly among the groups. Therefore, the moderately aroused group did not eat more than the other two groups solely due to hunger. This association between food consumption and experimental group instead can be due to the fact that the moderately aroused group presumably experienced sympathetic nervous system arousal that led them to eat in this absence of hunger.

Essentially, sympathetic arousal easily gets confused as being an indicator of hunger (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Kaplan & Kaplan, 1957), and this poor distinction stems from early learning experiences that lead people to realize that eating palatable and energy dense (i.e., high fat and high carbohydrate) food reduces emotional arousal (Gibson & Desmond, 1999). Eating then does not occur because of hunger and a physiological need to fuel the body; rather, it occurs as a way to reduce sympathetic arousal. Eating in this situation serves as a prepotent response to the presentation of palatable foods. Antelman and Szechtman (1975) found that painful stimuli, such as tail pinch, induce eating in rats when food is present. In the present study, the manipulation tasks induced varying degrees of emotional arousal, and eating served as a way to receive the immediate reinforcement of sympathetic arousal relief. Overtime, eating high fat and high carbohydrate food in the absence of hunger may lead to obesity. Essentially, the food reward system overrules homeostatic control, and this imbalance occurs more so in overweight or obese people than it does in normal weight people (Block et al., 2009; Lemmens, Rutters, Born, Westerterp-Plantenga, 2011). As more and more palatable food is consumed, the rewarding value of it becomes less potent, which leads to overeating of palatable foods in attempts to achieve the reward benefit (Parylak, Koob, & Zorrilla, 2011; Stice, Spoor, Bohon, & Small, 2008).

Restraint and Disinhibition

Regarding restraint and disinhibition, as assessed with the TFEQ-R18, participants who scored as being low restrained and disinhibited eaters consumed fewer donuts and chips than did highly restrained and disinhibited eaters; however, these differences were not significant. They do, however, support Polivy and Herman's (1985) research that people who are highly restrained when eating and inclined to become disinhibited when eating may lose control and awareness of feelings of satiety and overeat when presented with food. These people are less responsive to internal feeding cues, such as satiety and hunger (Stunkard & Messick, 1985). Because they are more reactive to arousal and the presentation of food, they are more likely to find food rewarding and overeat in situations when it is available (Birch & Fisher, 1998). Further analyses of how restrained/disinhibited eating influenced food consumption when in the three emotionally arousing situations did not reveal significant results. Rather, it appears that people high in restraint and disinhibition consumed more food than did participants low in restraint and disinhibition, regardless of the group in which they were placed. This lack of significant discrepancy in food consumption when both experimental arousal group and eating behavior (i.e., restraint and disinhibition) are considered may be due to the experiment's attempts to manipulate acute arousal and examine a trait like response in the form of eating behaviors that instead stems from a history of chronic arousal. The arousal tasks aimed to examine changes in state-like behavior and are perhaps not the appropriate approaches for assessing restraint and disinhibition, which are trait-like behaviors.

Participants who scored as being high restrained and disinihibited eaters also tended to be angrier and more bored after the arousal task and more bored at the end of the study than were participants who scored as being low in restraint and disinhibition. These results are consistent with prior research indicating that restrained and disinhibited eaters interpret situations as more emotionally arousing than do people low in restraint and disinhibition (Wolff et al., 2000). Higher perceived arousal indicates elevated sympathetic arousal, which may lead to food consumption as a way to return physiological processes to homeostasis.

Study Strengths and Limitations

The present study had several strengths. First, it examined the association between food intake and three levels of emotional arousal. To our knowledge, this is the first study to examine three levels of emotional arousal, as opposed to comparing a non-arousal condition to a condition that induces emotional arousal. This study is also the first study to test the PAH in a controlled setting. The hypothesis was not significantly supported in this study, likely because the manipulation was not entirely effective at differentiating the groups; however, the moderate arousal group did eat more food than the other two groups. This association suggests that moderate sympathetic nervous system activation did indeed increase eating, albeit not at significant levels.

Second, none of the current theories of arousal-induced eating have adequate empirical support. Most studies about arousal-induced eating in the literature claim to test psychodynamic or physiological hypotheses but in reality use cognitively based models as the foundation for the experiments. This study proposed a physiologically oriented hypothesis and also used it as the foundation for the experimental format.

Third, the structure of the experiment also included many strengths. The mood rating scale was quick to fill out and appeared to capture the emotions in those given moments adequately. Results on this measure were also consistent with the observation variable scores. With this scale, emotional arousal was also assessed at three points throughout the session, which would have been more complicated to do with a longer measure. Examining moods at three different time points throughout the session also allowed us to get a baseline understanding of mood, an assessment of the manipulation, as well as an assessment of the effects of eating on emotional arousal. To our knowledge, there is only one other study about arousal-induced eating that examined level of arousal after the conclusion of the laboratory study (Rutters et al., 2009). The current study also examined restraint and disinhibition with the Three Factor Eating Questionnaire – R18 (TFEQ – R18) which is short, easy to administer, and is psychometrically sound. The study sessions also occurred at various times between 8am and 8pm and during various times in the semesters; therefore, time of day and time in semester did not influence the results. Most sessions were conducted by the same examiner so there was limited variability in delivery of the study session.

The study included several limitations as well. First, there were limitations within the structure of the experiments. The methodology employed did not result in significantly different levels of emotional arousal among the groups, which may have contributed to the lack of significance in eating between the moderate and high arousal groups. The high arousal group essentially did not experience sufficiently high enough levels of sympathetic arousal in response to the manipulation, and such levels of arousal may not be possible to create in a structured laboratory setting within an ethical framework. Although the study purported to examine the autonomic nervous systems response to arousal, it relied on self-report and did not examine physiological processes of sympathetic and parasympathetic arousal, such as blood pressure and heart rate, in combination with the self-reported mood scales. Although the mood rating scales could be filled out quickly, the participants may have interpreted each mood variable differently. It was assumed that each participant had a working understanding of each mood, but that may not have been true for each participant. Also, it may be possible that participants did not consume as much food as they normally would in similar emotionally arousing situations that are not in a controlled laboratory setting. Herman, Polivy, and Silver (1979) found that people high in restraint and disinhibition were able to maintain such restraint in the presence of food when they were observed by an examiner. Although the examiner was not present while the participants ate during the current study, participants may have been able to maintain restraint from eating as much as they normally would knowing that the examiner would return after the 20 minute break.

Second, there were several limitations regarding the sample of participants. Only a few students who scored higher than one standard deviation above the mean of the TFEQ-R18 agreed to participate in the study. It is possible that many students truly high in restraint and disinhibition did not sign up for this study because it was titled Taste Test Study, which indicates that food is involved. People high in restraint may have decided to not sign up due to fear of having to eat various foods that may interfere with their diets for the day. Furthermore, disinhibited eaters may not have signed up either because of awareness that they may essentially lose control of their eating when they start eating. Also, participants who committed to the study received extra credit for their attendance and did not receive any reward for their performance throughout the session. They therefore may not have put forth adequate effort throughout the anagram tasks and thus, not feel the effects of such an ego-threatening task. Also, only Pringles chips and donuts were offered. If participants did not like either food choice and therefore chose to eat none or only a limited amount of the food, their eating behaviors when in that emotionally arousing situation could not be determined accurately. Furthermore, participants were asked to refrain from eating one hour before the study to prevent high levels of satiety or hunger; however, many participants endorsed eating within that hour before the study. Future studies should provide a test meal at the beginning of the session, as Rutters and colleagues (2009) did, to guarantee everyone begins the session with similar baseline satiety levels.

Future Directions and Conclusion

The current study examined associations between acute emotional arousal, presumed sympathetic nervous system arousal, and food consumption finding that people consume more food in moderately arousing situations than they do in low or high arousal situations, consistent with predictions but not statistically significantly so. Because achieving a very high level of autonomic arousal is rare, eating often occurs when people experience moderate levels of emotional arousal. Chronic elevated emotional arousal, therefore, may be associated with frequent overconsumption of palatable and energy dense foods and ultimately, weight gain and obesity. Ozier and colleagues (2008) found that adults who ate in response to emotional arousal were 13 times more likely to be overweight or obese than adults who did not eat in response to emotional arousal. Furthermore, an abundance of palatable foods, as well as a decrease in physical activity, encourages positive balance and weight gain.

This current study suggests it is important to understand the associations between emotional arousal and food consumption to understand how to prevent and treat obesity. Future research should focus on further examining the contribution of sympathetic arousal to food consumption with the use of physiological measurements (e.g., heart rate, blood pressure, etc.). Further support for the PAH will indicate that learning how to better manage emotional arousal is as important in weight management interventions as is learning about healthy food choices and physical activity. Future studies should also focus on weight management interventions that target maladaptive eating behaviors, such as restraint and disinhibition, due to the strong associations between those eating behaviors and weight gain (Hays & Roberts, 2008). Weight loss also may be facilitated with the addition of self-awareness of what is being consumed. Polivy, Herman, Hackett, and Kuleshnyk (1986) found that being observed by an examiner or being made aware of the calories of the presented food suppresses eating. Such awareness allows eaters to monitor their behaviors and maintain control over their eating, despite other environmental factors (e.g., emotionally arousing tasks). In this way, further examination of self-monitoring, emotional arousal, and food consumption would be helpful in better understanding ways to manage weight.

Future research should also further explore the associations among restraint, disinhibition, emotional arousal, and food consumption. Restraint is done with the intention of preventing weight gain, but restricting food is challenging to maintain when in the presence of disinhibitors. Experiences with dieting and restricted eating when younger may lead to a weakening of satiety signals and a heightened attractiveness of food, which may later lead overeating and binge eating behaviors (Birch & Fisher, 1998). The current study only looked at eating among college aged students, but it is important that future studies examine these eating behaviors in children and families so that research can inform families about other ways to cope with emotional arousal, as well as about the long-term effects of eating as a way to manage emotional arousal. Attempts to prevent the development of maladaptive eating behaviors at a young age will limit the potential for the development of obesity and associated health problems later in life.

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Appendix A

Detailed Script for Each Condition

The examiner greeted participants in the basement of Uhler Hall at IUP and escorted them to a testing room where they were told the following, depending on the condition to which each was randomly assigned:

<u>Low Stressor Condition</u>

"Thanks so much for agreeing to participate in this study. The goal of this study is to look at performance on cognitive tasks and taste preferences. We will be meeting for about 30 to 45 minutes, and the session will involve completing some questionnaires as well as completing an activity on the computer. All of your information will be kept confidential, and only the consent form will have your name on it. The consent form, however, will be placed in a separate folder to protect privacy. I do need your four letter e-mail address, but your data will be saved with a different and random ID number." The two identical consent forms will be given and explained to the participant. Any questions from the participant will be answered before the participants signs both forms and keeps one.

"First, I would like for you to complete this short measure. For each of the items, please indicate on a scale of 0 to 100 how much you are currently experiencing each of those feelings. Zero means that you are not currently experiencing that feeling at all, and 100 means that you are very highly experiencing that feeling right now. You can indicate your feeling by drawing a line through the scale like this." Demonstrate how to answer the items by drawing a line through the scale of the practice item on the Mood Rating Scale.

After completing the Mood Rating Scale, "Now you can come take a seat over here at this computer. You will spend some time doing an activity on the computer. Some of these tasks may be tricky, but don't worry if you have some difficulty with the items. There will be no time limit, and your performance will not affect anything. There also will be a brief tutorial lesson in the beginning so that you have an idea of how to complete the items." Do not have them proceed to the test until they master the practice items. Explain the practice items if necessary. Also, explain that they will have three attempts to get each item correct before they automatically will be moved to the next item. Throughout the activity, the examiner will be sitting across the table from the participant and will be working on other work. Following the conclusion of this activity, the examiner will say, "Thanks so much for your participation on this task. You did really well."

Following the completion of the anagram task, the participant will be given the same Mood Rating Scale, as well as the Taste Rating Scale. "I would like for you to complete these items again using the same scale as before." Have them fill out the form. "Now, I'm going to be leaving the room for 20 minutes and while I'm gone, I would like for you to taste each of these types of food and complete this test testing rating scale. After completing that measure, I would like for you to complete more anagrams on the computer. You just need to press the button “second test” and the set of anagrams will appear.” Press that button to show them how it works, and then exit out of the screen. “All food will be thrown out after the session so, as you are completing these measures, feel free to help yourself to as much food as you want.” Give the participants the bowls of Pringles and donut holes. The examiner will then leave the room for 20 minutes.

Once the examiner returns to the room, the examiner will move the remaining food to the side and out of the participant’s view (do not allow them to bring any food home because you need to count how much they ate while they ate before finishing the anagram task). The participant will then be asked to complete the same mood rating scale and a demographics questionnaire. The participants will then be given the debriefing form, and they will be allowed time to talk about the experiment and any discomfort they may have felt throughout the session. Each participant will receive an hour of participation towards their research requirement.

<u>Moderate Stressor Condition</u>

“Thanks so much for agreeing to participate in this study. The goal of this study is to look at performance on cognitive tasks and taste preferences. We will be meeting for about 30 to 45 minutes, and the session will involve completing some questionnaires as well as completing an activity on the computer. All of your information will be kept confidential, and only the consent form will have your name on it. The consent forms, however, will be placed in a separate folder to protect privacy. I do need your four letter e-mail address, but your data will be saved with a different and random ID number.” The two identical consent forms will be given and explained to the participant. Any questions from the participant will be answered before the participants signs both forms and keeps one.

“First, I would like for you to complete this short measure. For each of the items, please indicate on a scale of 0 to 100 how much you are currently experiencing each of those feelings. Zero means that you are not currently experiencing that feeling at all, and 100 means that you are very highly experiencing that feeling. You can indicate your feeling by drawing a line through the scale like this.” Demonstrate how to answer the items by drawing a line through the scale of the practice item.

After completing the mood rating scale, “Now you can come take a seat over here at this computer. You will spend some time doing an activity on the computer. The tasks may be challenging, but most people your age are able to solve them. There is a 20 minute time limit and the tasks will get more difficult as you progress through the activity. There also will be a brief tutorial lesson in the beginning so that you have an idea of how to complete the items.” Do not have them proceed to the test until they master the practice items. Explain the practice items if necessary. Also, explain that they will have three attempts to get each item correct before they automatically will be moved to the next item. Throughout the activity, the examiner will be sitting adjacent to the participant at the table so that the examiner is in view, but the examiner will be working on other work so as to not pay too close attention to the participant. Following the conclusion of this activity, the examiner will say, “That seemed to be a bit harder than expected, but thanks for putting the effort into the activity. We are going to move onto another activity, but you will be completing more anagrams on the computer after this break." Following the completion of the anagram task, the participant will be given the same mood rating scale, as well as the taste rating scale. "I would like for you to complete these items again using the same scale as before." Have them fill out the form. "Now, I'm going to be leaving the room for 20 minutes and while I'm gone, I would like for you to taste each of these types of food and complete this test testing rating scale. After completing that measure, I would like for you to complete more anagrams on the computer. You just need to press the button "second test" and the set of anagrams will appear." Press that button to show them how it works, and then exit out of the screen. "All food will be thrown out after the session so, as you are completing these measures, feel free to help yourself to as much food as you want." Give the participants the bowls of Pringles and donut holes. The examiner will then leave the room for 20 minutes.

Once the examiner returns to the room, the examiner will move the remaining food to the side and out of the participant's view (do not allow them to bring any food home because you need to count how much they ate while they ate before finishing the anagram task). The participant will then be asked to complete the same mood rating scale and a demographics questionnaire. The participants will then be given the debriefing form, and they will be allowed time to talk about the experiment and any discomfort they may have felt throughout the session. Each participant will receive an hour of participation towards their research requirement.

High Stressor Condition

"Thanks so much for agreeing to participate in this study. The goal of this study is to look at performance on cognitive tasks and taste preferences. We will be meeting for about 30 to 45 minutes, and the session will involve completing some questionnaires as well as completing an activity on the computer. All of your information will be kept confidential, and only the consent form will have your name on it. The consent forms, however, will be placed in a separate folder to protect privacy. I do need your four letter e-mail address, but your data will be saved with a different and random ID number." The two identical consent forms will be given and explained to the participant. Any questions from the participant will be answered before the participants signs both forms and keeps one.

"First, I would like for you to complete this short measure. For each of the items, please indicate on a scale of 0 to 100 how much you are currently experiencing each of those feelings. Zero means that you are not currently experiencing that feeling at all, and 100 means that you are very highly experiencing that feeling. You can indicate your feeling by drawing a line through the scale like this." Demonstrate how to answer the items by drawing a line through the scale of the practice item.

After completing the mood rating scale, "Now you can come take a seat over here at this computer. You will spend some time doing an activity on the computer. 90% of people your age are able to answer these questions, and about 10% have challenges with the assignment. There will be a time limit of 10 minutes, but you will be able to complete the items within that time limit. The tasks will also become more difficult as you progress through the activity. There also will be a brief tutorial lesson in the beginning so that you have an idea of how to complete the items." Do not have them proceed to the test until they master the practice items. Explain the practice items if necessary. Also, explain that they will have three attempts to get each item correct before they automatically will be moved to the next item. Throughout the activity, the examiner will be sitting behind the participant so that the examiner can view the computer screen and the participant's responses. After the ten minutes of the activity, the examiner will say, "That seemed to be much harder than expected, but thanks for putting the effort into the activity. We are going to move onto another activity, but you will be completing more anagrams after this break."

Then grab the medical equipment (syringe, alcohol swab, tourniquet, syringe that does not contain a needle) and start to set up the materials on another table that is in the participant's view. Ask, "when is the last time you had your blood drawn?" and do not respond to any questions or comments from the participant, unless they can be answered with a "this is for later."

At this point, the participant will be given the same mood rating scale, as well as the taste rating scale. "I would like for you to complete these items again using the same scale as before." Have them fill out the form. "Now, I'm going to be leaving the room for 20 minutes and while I'm gone, I would like for you to taste each of these types of food and complete this test testing rating scale. After completing that measure, I would like for you to complete more anagrams on the computer. You just need to press the button "second test" and the set of anagrams will appear." Press that button to show them how it works, and then exit out of the screen. "All food will be thrown out after the session so, as you are completing these measures, feel free to help yourself to as much food as you want." Give the participants the bowls of Pringles and donut holes. The examiner will then leave the room for 20 minutes.

Once the examiner returns to the room, the examiner will move the remaining food to the side and out of the participant's view (do not allow them to bring any food home because you need to count how much they ate while they ate before finishing the anagram task). The participant will then be asked to complete the same mood rating scale and a demographics questionnaire. The participants will then be given the debriefing form, and they will be allowed time to talk about the experiment and any discomfort they may have felt throughout the session. Each participant will receive an hour of participation towards their research requirement.

Appendix B

Informed Consent

You are invited to participate in this research study. The following information is provided in order to help you to make an informed decision about whether or not to participate. If you have any questions, please do not hesitate to ask. You are eligible to participate because you are a student in the General Psychology course at Indiana University of Pennsylvania.

The purpose of this study is to examine factors associated with effective interviewing techniques. Participation will take approximately 30 – 45 minutes and will require the completion of a several short questionnaires and an activity on the computer.

Participation in this study is voluntary, and you are free to decide not to participate or to withdraw from this study at any time without it adversely affecting your relationship with the investigators or IUP. Choosing not to participate will also have no effects on the evaluation of your performance in General Psychology. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, you may withdraw at any time by notifying the Project Director or informing the research assistant. Upon your request to withdraw, all information pertaining to you will be destroyed. If you choose to participate, all information will be held in strict confidence and will have no bearing on your academic standing or services you receive from the University. Your responses to the interview questions will be confidential, with the exception of threatening to harm yourself or another individual. In addition, your name will be removed from your answers, so please answer as honestly as possible to ensure accurate results. The information you provide to us will be considered only in combination with that of other participants. The information obtained in the study may be published in scientific journals or presented at scientific meetings, but your identity will be kept confidential.

When you complete the study, you will be given an information sheet that will provide a more detailed description of the study's purpose, as well as contact information if you wish to receive the results of the study.

If you are willing to participate in this study, please sign the statement below and return it to the research assistant. Take the extra unsigned copy with you. If you choose not to participate, please give the unsigned copies to the research assistant.

Student Researcher:
Ms. Stephanie M. Terracciano, M.A.
Clinical Psychology Doctoral Student
Psychology Department
Uhler Hall, 1020 Oakland Ave.
Indiana, PA 15705

Faculty Sponsor:
Dr. David LaPorte, Ph.D.
Director of Doctoral Studies
Psychology Department
Uhler Hall, 1020 Oakland Ave.
Indiana, PA 1570

VOLUNTARY CONSENT FORM:

I have read and understand the information on the form and I consent to volunteer to be a subject in this study. I understand that my responses are completely confidential and that I have the right to withdraw at any time. I have received an unsigned copy of this informed Consent Form to keep in my possession.

Name (PLEASE PRINT): ____

Signature: ____

Date: _________________

Phone number or location where you can be reached: ______________________________

Best days and times to reach you: ____

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

_________________ ____

Date Investigator's Signature

Appendix C

Anagram Computer Activity

Participants in all three conditions completed a very brief tutorial on the computer before the start of the task administration. This tutorial explained what an anagram is and the directions for completing the activity. Each participant also completed two practice questions that must be answered correctly before moving on to the test. If a participant was unable to complete the easy anagrams, their data would have been discarded; however, all participants were able to pass the sample items.

The low stress condition received 30 relatively easy anagrams to solve. Each item also included a clue to lessen any difficulty. A small timer was present at the top of the screen, but there was no time limit. After each item was answered, the computer program provided visual and auditory feedback to the participant. For example, if the anagram was completed correctly, the words, "Great job!" appeared on the screen. If the anagram was completed incorrectly, feedback was, "That was not correct, but keep up the good work." A voice system also provided that feedback.

The moderate stress condition received 30 anagrams of increasing difficulty. Each item also included a clue that varied in degree of helpfulness and was vaguer than those clues provided for the low stress group. A small timer was present on the top of the screen, and there was a time limit of 20 minutes. After each item was answered, the computer program provided visual and auditory feedback to the participant. For example, if the anagram was completed correctly, the words, "Correct" appeared on the screen. If the anagram was completed incorrectly, feedback was, "That was not correct. Try harder next time." A voice system also provided that feedback.

The high stress group received 30 anagrams of varying difficulty, and most were not solvable. Each item also included a clue that was vague and intended to not be helpful. A small timer was present at the top of the screen, and there was a time limit of 10 minutes. The timer was accompanied by a ticking noise to indicate each second passing. After each item was answered, the computer program provided visual and auditory feedback to the participant. For example, if the anagram was completed correctly, the words, "Correct" appeared on the screen. If the anagram was completed incorrectly, feedback was, "Wrong. Try harder next time, and please work faster." A voice system also provided that feedback.

Table 8

Anagrams for Each Experimental Group

Condition	Anagram	Answer	Clues
Low Arousal (30 items)	GOD	DOG	Woof woof
	RARIBLY	LIBRARY	Room containing books
	ARE	EAR	What you listen with
	MALSL	SMALL	Opposite of "big"
	APE	PEA	Small, green vegetable
	ACT	CAT	Meow
	KEEN	KNEE	Between the thigh and lower leg
	UCTRIPE	PICTURE	Painting or drawing
	FIRES	FRIES	Side dish
	DORA	ROAD	Another name for "street"
	TAB	BAT	"blind as a …"
	PLAC	CLAP	To applaud
	INCH	CHIN	Below your mouth
	NAIPT	PAINT	Colored substance
	CHEAP	PEACH	Round fruit with pink-yellow skin
	NAP	PAN	Used to cook food in
	LAST	SALT	Goes with pepper
	IANL	NAIL	Covering on tip of finger
	TAR	RAT	rodent
	CEILS	SLICE	…of pizza
	LACENECK	NECKLACE	Jewelry worn around the neck
	BEAK	BAKE	How to make cookies
	HSRIT	SHIRT	Article of clothing worn on the torso
	GISN	SIGN	An indication or signal
	BARE	BEAR	Mammal with big paws
	DIARY	DAIRY	Butter, cheese, yogurt, milk
	ELSTY	STYLE	Fashion
	NEKCICH	CHICKEN	Cluck cluck
	MITE	TIME	Information that a clock provides
	EARTH	HEART	Beats faster when scared
Low Arousal (during eating period)	FLOW	WOLF	An animal that howls
	LOIN	LION	Males of this animal have

			manes
	SALT	LAST	Opposite of first
	LEPLS	SPELL	To write the letters in a word
	FACE	CAFÉ	A place that serves coffee
	FINDER	FRIEND	A companion
	SINK	SKIN	Sunscreen protects this
	CKOCL	CLOCK	Device that measures time
	GETFOR	FORGET	Opposite of "remember"
	FIRED	FRIED	Way to prepare food
	REAP	PEAR	Round fruit
	TEAM	MEAT	What vegetarians do not eat
	ANT	TAN	Yellow-Brown color
	COULD	CLOUD	Condensed water vapor
	FRINGES	FINGERS	You have ten of them
	ESAUC	SAUCE	Pour it on pasta
	BALM	LAMB	…chops
	RAM	ARM	Between shoulder and hand
	TRESMATS	MATTRESS	One a bed frame for comfort
	REPAP	PAPER	Write on this
	VOTES	STOVE	Used for cooking
	LUMP	PLUM	Small fruit
	LAMP	PALM	On your hand
	EARTH	HEART	Shape of Valentine's Day
	PONCOU	COUPON	Gives a discount
	LOHEL	HELLO	A common greeting
	ROYRS	SORRY	Feeling remorse
	SUPER	PURSE	Another name for a bag
	ICHAN	CHAIN	Connected links
	UMPJ	JUMO	To push oneself off a surface
	ONMEL	LEMON	Fruit
	MEIT	TIME	Shown on a clock
	CILPEN	PENCIL	Used to write
	NEP	PEN	Used to write
	EINN	NINE	Number
	CKAJET	JACKET	Clothing
	TEWRI	WRITE	Verb
	TCHWA	WATCH	Wear on wrist
	KYS	SKY	Clouds are in this
	RDBI	BIRD	Animal that flies
	FULWONDER	WONDERFUL	Adjective
	WITERN	WINTER	Seaso
	TOPLAP	LAPTOP	Portable computer
	AGB	BAG	Purse
	PERAP	PAPER	Used to write on

	ONEPH	PHONE	Used for talking
	RYC	CRY	Action when sad
	OTSBO	BOOTS	Wear on feet
	NDFRIE	FRIEND	Companion
	EYK	KEY	Used to open something
	LACENECK	NECKLACE	Wear around neck
	NUR	RUN	Verb
	NNISTE	TENNIS	Sport
	UEBL	BLUE	Color
	LETBRACE	BRACELET	Jewelry
	THMA	MATH	Subject
	SKOOB	BOOKS	Read them
	AIRCH	CHAIR	Furniture
	CHEAB	BEACH	Vacation spot
	FUNGRUS	SURFING	Activity
	VELO	LOVE	Feeling
	VT	TV	Entertainment
	WARDAWK	AWKWARD	Adjective
	SEHOU	HOUSE	Shelter
	EETSTR	STREET	Road
	SICMU	MUSIC	Listen to it
	SSESGLA	GLASSES	Improves vision
	SHBRU	BRUSH	Hair product
	GHLAU	LAUGH	Verb
	DALSSAN	SANDALS	Wear on feet
	VELO	LOVE	Feeling
	LMAC	CALM	Feeling
	EM	ME	Pronoun
	LOGYOPA	APOLOGY	Expression
	TETAL	LATTE	Drink
	YAD	DAY	24 hours
	KINPMUP	PUMPKIN	Spice
	PUC	CUP	Drink out of
	KERSNEAS	SNEAKERS	Clothing
	STOC	COST	Price
	BLEAT	TABLE	Furniture
	LALM	MALL	Place with stores
	HICELVE	VEHICLE	Car
	KEIB	BIKE	For transportation
	RAMLECA	CARAMEL	Syrup
	KOOCSIE	COOKIES	Food
	RESOT	STORE	Establishment
	RYRWO	WORRY	Fret
	INGKLAT	TALKING	Action

	MEGA	GAME	Form of play
	TARTS	START	To begin
	GETEVBALES	VEGETABLES	Food
	RECU	CURE	Relieve
	DICEEMIN	MEDICINE	Remedy
Moderate Arousal (36 items)	LUMP	PLUM	Fruit
	UNTEFOR	FORTUNE	Chance or luck
	ELLMS	SMELL	What your nose does
	LURES	RULES	Standards for activities
	WONK	KNOW	To be aware
	NERVE	NEVER	Opposite of "always"
	DAIRY	DIARY	Food item
	SESNIPAHP	HAPPINESS	A state of being
	POINTER	PROTEIN	Food group
	EAGER	AGREE	Verb
	HOCKS	SHOCK	State of being
	KINGWREC	WRECKING	To destruct
	MARCH	CHARM	Type of quality
	UNTIED	UNITED	Come together
	RIBCONTUET	CONTRIBUTE	To give
	NERTINET	INTERNET	Computer network
	SOMDIW	WISDOM	Good judgment
	VOWELS	WOLVES	Animal
	REPLAYS	PARSLEY	Spice
	TABLET	BATTLE	An encounter
	DISEASE	SEASIDE	Location
	CEDVAAND	ADVANCED	Ahead
	SWORD	WORDS	What sentences are composed of
	DIVORCES	DISCOVER	Find something
	BELLDOOR	DOORBELL	On door
	ISEPODE	EPISODE	Of a show
	GATERORUS	SURROGATE	Substitute
	URTISCITUF	FUTURISTIC	Ahead
	EALDITIISC	IDEALISTIC	Utopian
	QUATOLSUOI	LOQUATIOUS	Talkative
Moderate Arousal (during eating period)	RINGYC	CRYING	Action when sad
	INFESTS	FITNESS	Activity
	MOBBING	BOMBING	An attack

	NORMING	MORNING	Time of day
	TEENS	TENSE	Strained
	FUSIONCON	CONFUSION	Lack of understanding
	LAFNEL	FALLEN	To drop
	TAVERNS	SERVANT	Person who performs duties
	SHOT	HOST	Entertains people
	SAYPLID	DISPLAY	To show
	NAINMOUT	MOUNTAIN	Peak
	SLIGHT	LIGHTS	Needed to see in the dark
	CLOUD	COULD	Indicates ability in the past
	RECITAL	ARTICLE	Particular item or object
	RENTALS	ANTLERS	Animal's body part
	SALTING	LASTING	Adjective
	SECTION	NOTICES	Attention
	GOMKIND	KINGDOM	Unit ruled by sovereign
	GROARMP	PROGRAM	Schedule
	SILENCE	LICENSE	Personal document
	OWAMEVRIC	MICROWAVE	Kitchen appliance
	FEEFOC	COFFEE	Beverage
	SISTERS	RESISTS	Action
	TERRAIN	TRAINER	Occupation
	TREASON	SENATOR	Occupation
	WREATHE	WEATHER	State of the atmosphere
	IRANCLET	CLARINET	Musical instrument
	CYNAF	FANCY	Elaborate
	CHEATING	TEACHING	Action
	MUTILATE	ULTIMATE	Adjective
	FUSOBATEC	OBFUSCATE	Unclear
	LINTEEAED	DELINEATE	Describe
	TENTPREIOUS	PRETENTIOUS	Showy
	RINGRAJ	JARRING	Clashing
	GARSUOIREG	GREGARIOUS	Sociable
	CORK	ROCK	Large stone
	FADE	DEAF	Can't hear
	RECITAL	ARTICLE	…of clothing
	CLOUD	COULD	Past of "can"
	SUPER	PURSE	Bag
	THENT	TENTH	Placement
	DEPLUD	PUDDLE	Small pool of water
	PEYSCON	SYNCOPE	Faint
	CRESEN	SCREEN	In a window
	INFESTS	FITNESS	Good health
	CYFAN	FANCY	Elaborate
	POSPROA	APROPOS	Concerning

	REPLAYS	PARSLEY	Spice
	GLIOROBMI	IMBROGLIO	Confused
	CEAPRIC	CAPRICE	Whim
	FEEFOC	COFFEE	Beverage
	CLAAB	CABAL	Group
High Arousal (30 items)	CORK	ROCK	Large stone
	FADE	DEAF	Can't hear
	RECITAL	ARTICLE	…of clothing
	NOEXHPLOY	XYLOPHONE	Instrument
	GILUPSIT	PUGILIST	Fighter
	FLOG	GOLF	Sport
	SILENCE	LICENSE	A permit
	SASSICH	CHASSIS	Skeleton
	STEMBASOIU	ABSTEMIOUS	Moderate
	HATE	HEAT	Temperature
	NEEDSEM	DEMESNE	Land
	EBE	BEE	Insect
	SEIRSCH	----	Clothing
	LOIN	LION	Animal
	PEYSCON	SYNCOPE	Faint
	RINUWESN	----	Happiness
	CRESEN	SCREEN	In a window
	INFESTS	FITNESS	Good health
	CYFAN	FANCY	Elaborate
	POSPROA	APROPOS	Concerning
	REPLAYS	PARSLEY	Spice
	GLIOROBMI	IMBROGLIO	Confused
	CEAPRIC	CAPRICE	Whim
	FEEFOC	COFFEE	Beverage
	ARENTAION	----	Noun
	MUTILATE	ULTIMATE	Extreme
	CLAAB	CABAL	Group
	SECTION	NOTICES	Notifications or warnings
	SANIE	ANISE	Plant
	STURA	----	Nature
High Arousal (during the eating period)	TENTEED	DÉTENTE	Easing
	ESOMEAW	AWESOME	Adjective
	TEDSWOR	WORSTED	Yam
	RULEVINT	VIRULENT	Harmful
	TRAEX	EXTRA	More

	SCARED	SACRED	Blessed
	BREAD	BEARD	Facial hair
	DECAAF	FAÇADE	Exterior
	GUENIREM	MERINGUE	Dessert
	PEDRUDAUQ	QUADRUPED	Animal
	FRIES	FIRES	Combustion or burning
	VOWELS	WOLVES	Animals
	GLOBELUV	----	Equipment
	SIMOACH	CHAMOIS	Animal
	SERVE	VERSE	Poetic form
	TEACHING	CHEATING	To act dishonestly
	TARTS	START	To begin
	TAN	ANT	Insect
	TENTEPRSIOU	PRETENTIOUS	Superfluous
	RUPES	SUPER	Adjective
	TASANFCIT	FANTASTIC	Adjective
	CYNAF	FANCY	Adjective
	CLOUD	COULD	Past of "can"
	SUPER	PURSE	Bag
	THENT	TENTH	Placement
	ADVANT	----	Electronic
	IRRIDATE	----	Employment
	DEPLUD	PUDDLE	Small pool of water
	MATAINION	ANIMATION	Liveliness
	CHEAP	PEACH	Fruit

Appendix D

Three Factor Eating Questionnaire – Revised 18 (TFEQ – R18)

Please consider the following statements carefully. Please answer the following questions by choosing the number that is appropriate for you.

1. When I smell a sizzling steak or juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

2. I deliberately take small helpings as a means of controlling my weight.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

3. When I feel anxious, I find myself eating.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

4. Sometimes when I start eating, I just can't seem to stop.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

5. Being with someone who is eating often makes me hungry enough to eat also.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

6. When I feel blue, I often overeat.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

7. When I see a real delicacy, I often get so hungry that I have to eat right away.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

8. I get so hungry that my stomach often seems like a bottomless pit.

4	3	2	1

Definitely True	Mostly True	Mostly False	Definitely False

9. I am always hungry so it is hard for me to stop eating before I finish the food on my plate.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

10. When I feel lonely, I console myself by eating.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

11. I consciously hold back at meals in order not to weight gain.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

12. I do not eat some foods because they make me fat.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

13. I am always hungry enough to eat at any time.

4	3	2	1
Definitely True	Mostly True	Mostly False	Definitely False

14. How often do you feel hungry?

1	2	3	4
Only at meal times	Sometimes between meals	Often between meals	Almost always

15. How frequently do you avoid "stocking up" on tempting foods?

1	2	3	4
Almost never	Seldom	Usually	Almost always

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

1	2	3	4
Unlikely	Slightly likely	Moderately likely	Very likely

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

1	2	3	4
Never	Rarely	Sometimes	At least once a week

18. On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never “giving in”), what number would you give yourself? ______________________

Appendix E

Mood Rating Scale

Please indicate your current feelings using the 0-100 scale below. Put a line through each scale to describe your current mood.

Instruction Example: **Tired**

0 — 100

Not at all tired — Extremely tired

1. Hunger

0 — 100

Completely full — Extremely hungry

2. Happiness

0 — 100

Very unhappy — Extremely happy

3. Anger

0 — 100

Not at all angry — Extremely angry

4. Nervous/anxiety

0 — 100

Completely calm — Extremely nervous

5. Boredom

0 — 100

Not at all bored — Extremely bored

Appendix F

Taste Test Rating Scale

1. Please taste each food and, using the scale below, please rate each food item according to the categories in the table.

1	2	3	4
Not at all	Very Little	Somewhat	To a Great Extent

	Pringles Chips	**Donut Holes**
Sweet		
Salty		
Savory		

2. Please rate your overall preference for each food item using the scale below.

1	2	3	4
Strongly dislike	Mostly dislike	Mostly like	Strongly like

	Pringles Chips	**Donut Holes**
Overall Preference		

Appendix G

Demographic Questionnaire

Please circle your answers to the following questions.

1. What is your age?
   a. 18
   b. 19
   c. 20
   d. 21
   e. Other________

2. What is your gender?
   a. Male
   b. Female
   c. Transgender
   d. Not specified

3. What is your current height? _______ feet ______ inches

4. What is your current weight? _________ pounds

5. When was the last time you ate a bite of food prior to arriving at this session. (Please provide a specific time).

   _____________.

Session Time: ____________

Appendix H

Food Eaten Form

Pringles: 48
Donut holes: 24

Number of Donut Holes eaten _________________

Number of Pringle chips eaten _________________

Observations of participant behavior:

Appendix I

Debriefing Form

Dear Participant:

The purpose of the study was to examine the Parasympathetic Activation Hypothesis (PAH) of arousal-induced eating (or emotional eating) that was proposed by the faculty sponsor for this study, Dr. David LaPorte. This hypothesis explains how eating helps to calm down sympathetic nervous system activation from emotions as well as activate the parasympathetic nervous system to induce relief. The PAH indicates that low and very high stress leads to less eating than does moderate stress, thus forming an inverted U-shaped function between emotional (sympathetic arousal) and eating. This current study specifically looked at that function.

You are reminded that your original consent document included the following information: Participation in this study is voluntary, and you are free to decide not to participate or to withdraw from this study at any time without it adversely affecting your relationship with the investigators or IUP, or on the evaluation of your performance in General Psychology. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose not to participate, you may withdraw at any time by notifying the Project Director or informing the research assistant. Upon your request to withdraw, all information pertaining to you will be destroyed. Your responses to the interview questions will be confidential, with the exception of threatening to harm yourself or another individual. In addition, your name will be removed from your answers, and the results of the questionnaires assessing your perceptions of the interview will be confidential. If you have any concerns about your participation or the data you provided in light of this disclosure, please discuss this with us. We will be happy to provide any information we can to help answer questions you have about this study.

If your concerns are such that you would now like to have your data withdrawn, please inform the Project Director or the research assistant and we will do so.

If you have questions about your participation in the study, please contact me at s.m.terracciano@iup.edu, or my faculty advisor, Dr. David LaPorte, at laporte@iup.edu.

If you have questions about your rights as a research participant, you may contact Indiana University of Pennsylvania's Institutional Review Board at irb-research@iup.edu.

If you experienced distress as a result of your participation in this study, a referral list of mental health providers is attached to this document for your use. If you would like to speak to someone immediately, please tell the research assistant, and either I or my faculty advisor will be more than happy to speak with you.

Please again accept our appreciation for your participation in this study.

Stephanie Terracciano, M.A.
Student Researcher
Clinical Psychology Doctoral Student

Dr. David LaPorte, Ph.D.
Faculty Sponsor
Professor