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ATTENTIONAL BIAS TO FOOD WORDS IN RESTRAINED EATERS

Brandon James Hodge

59 Pages

Attentional bias has been examined as one of the cognitive vulnerability factors for various psychopathology such as disordered eating. Attentional biases are important to examine as potential targets of interventions. Past research has demonstrated mixed findings on whether or not restrained eaters show cognitive biases (e.g., attentional sensitivity) toward words related to foods (Brooks et al., 2011; Dobson & Dozois, 2004; Francis, Stewart, & Hounsell, 1997). This study examined attentional bias to foods among restrained eaters using a computer based program, Mousetracker (Freeman & Ambady, 2010), that provided various indicators (i.e., reaction time, maximum deviations, and area under the curves) of attentional bias (vs. reaction time only in traditional attentional bias research). Counter to the hypotheses, results suggested no attentional bias to food words among restrained eaters. However, it seems that females tend to have an attentional bias to food words.

KEYWORDS: Attentional Bias, Emotional Stroop Task, Food Words, MouseTracker, Restrained Eating

ATTENTIONAL BIAS TO FOOD WORDS IN RESTRAINED EATERS

BRANDON JAMES HODGE

A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

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ATTENTIONAL BIAS TO FOOD WORDS IN RESTRAINED EATERS

BRANDON JAMES HODGE

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CHAPTER I: INTRODUCTION

Restrained eating to lose weight or maintain low weight is highly prevalent in a non-clinical population. The societal shift toward preference for the thin ideal for women and a masculine body type for men has caused many people to strive for an unrealistically thin or masculine body type (Johansson, Lundh, & Andersson, 2005; Markis, 2015; Markis & McLennan, 2011; Polivy & Herman, 1987). Despite false ideations of health and beauty, restrained eating has become a highly practiced body regulation strategy in American society (Polivy & Herman, 1987). Research has shown that, in America, around 20-30% of females and about 10% of males from the ages of 18-65 engage in restrained eating and that nearly half the college student population engages in dieting patterns (Polivy & Herman, 1987; Rand & Kulda, 1990)

Although restrained eating is not an eating disorder per se, various negative consequences may arise even with subclinical levels of restrained eating (Lee & Shafran, 2004). Research shows that, within restrained eaters, increased self-consciousness about body shape can result in depression and anxiety (McCarthy, 1990). Moreover, restrained eaters share psychological characteristics such as preoccupation with foods and body shape which is similar to those with eating disorders. In addition, restrained eating can be a trigger for rebound binge eating (Polivy & Herman, 1987) and then subsequent compensatory behaviors such as more restrained eating. Thus, a vicious cycle of perpetuating and exacerbating disordered eating behaviors is created. Therefore, restrained eating might be a precursor/risk factor for developing an eating disorder (Fairburn, Cooper, Doll, & Davies, 2005; Polivy & Herman, 1987; Stice, Burton, Lowe, & Butryn, 2007; Stice, Marti, & Durant, 2011). It is important to examine what contributes to and

maintains restrained eating in a non-clinical population; such findings could inform potential prevention and intervention efforts for both clinical and subclinical disordered eating.

Among many predictors of restrained eating, cognitive preoccupation with foods due to constant hunger may be of particular concern because it could lead to emotional distress and rebound binge eating (Polivy & Herman, 1987). Such cognitive preoccupation can occur very early in the perceptual process of allocating attentional resources. Restrained eaters may show perceptual sensitivity to stimuli related to foods. Attentional bias refers to such perceptual sensitivities or the tendency to process certain information more readily over other information that one has access to (Williamson, 1999). In fact, research has shown that people with clinical levels of eating disorders (i.e., anorexia nervosa, bulimia nervosa) demonstrate attentional bias to food words (Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Dobson & Dozois, 2004). However, research findings on non-clinical restrained eaters' attentional bias have been mixed. Some studies have shown that non-clinical restrained eaters demonstrated attentional bias to food words but with a smaller effect size than found in eating disorder populations (Boon, Vogelzang, & Jansen, 2000; Brooks, Prince, Stahl, Campbell, & Treasure, 2011; Cooper et al., 1992; Dobson & Dozois, 2004; Francis, Stewart, & Hounsell, 1997). Other studies have found no such evidence of attentional bias to food words in restrained eaters (Johansson, Ghaderi, & Andersson, 2004). Although research repeatedly has shown that non-clinical restrained eaters share cognitive preoccupation with foods and body shape related stimuli (Boon, Vogelzang, & Jansen, 2000; Hollitt, Kemps, Tiggemann, Smeets, & Mills, 2010; Fairburn, Cooper, Doll, & Davies, 2005) with those with clinical levels of eating disorders, it is not clear whether non-clinical restrained eaters show attentional sensitivity at an early perceptual process like people with eating disorders.

Statement of the Problem

Thus, this study examined whether restrained eaters exhibit attentional biases toward food related words. In doing so, this study considered some of the limitations in the previous studies to provide potential explanations for the mixed findings. First, I operationally defined restrained eating as restricting or avoiding food intake to lose weight or avoid weight gain. Most previous studies used a similar definition, but the measure that was used the most widely, the Restraint Scale (Polivy, Herman, & Warsh, 1978), has been criticized as measuring the tendency to restrict eating and to overeat as a result, thereby measuring a bulimic tendency. Thus, I used the restrained eating subscale of the Dutch Eating Behavior Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) which closely fits the operational definition of restrained eating of this study. Second, I used only food-related words as stimuli for the attentional bias task. Some previous studies used a mixed list of food and body-shape related words, which may have confounded the findings (Cooper & Fairburn, 1992). Third, I used separate lists of forbidden foods and nonforbidden foods words. It is possible that restrained eaters may show differential attentional bias depending on which types of foods are presented. Fourth, I used MouseTracker to capture both the process and outcomes of attentional bias. Previous studies mostly focused on the outcomes of attentional bias and were unable to explore how participant responses unfold during the process of allocating attention.

CHAPTER II: LITERATURE REVIEW

Restrained Eating as Disordered Eating

Eating Disorders

Restrained eating itself is not an eating disorder and there are many restrained eaters in non-clinical populations who do not meet the criteria for eating disorders (Fairburn, Cooper, Doll, & Davies, 2005; Polivy & Herman, 1987). However, restrained eating can be a precursor to full-blown eating disorders and is a defining symptom of eating disorders like anorexia nervosa and bulimia nervosa (APA, 2013). The prevalence rates of anorexia nervosa and bulimia nervosa are estimated to be about .9% and 1.5% for women and .3% and .5% for men (Hudson, Hiripi, Pope Jr, & Kessler, 2007). Both restrained eaters and those with eating disorders often share the fear of gaining weight, the desire to lose weight, and a self-esteem contingent on body thinness, which motivates their restrained eating and results in a continued sense of hunger, cognitive preoccupation with thoughts about food, and perhaps rebound binge eating in some cases (i.e., binge-purge type anorexia nervosa, bulimia nervosa) (American Psychiatric Association, 2013). It is important to examine whether cognitive bias at the early perceptual stage is also shared.

One widely accepted etiological explanation for eating disorders is that internalized social messages for thinness as a beauty ideal result in dysfunctional efforts to prove self-worth by pursuing such unrealistic thinness (Johansson et al., 2005; Markis, 2015; Stice, Marti, Durant, 2011). In theory, the thin ideal can lead to body dissatisfaction which may contribute to the development of eating disorders. Women in particular seem to be subject to these effects as indicated by higher prevalence and incidence rates of anorexia nervosa and bulimia nervosa

among women. One meta-analysis found that women are becoming increasingly dissatisfied with their body image when compared with men (Feingold & Mazzella, 1998).

Although body dissatisfaction is more common in women, men still encounter issues with body dissatisfaction (Feingold & Mazzella, 1998). Men's body image issues seem to center around a muscular ideal which involves fears of gaining fat (Cafri & Thompson, 2004). That is, in order to be truly attractive, a male must have a muscular body and cannot have a high body fat percentage. Maintaining a healthy diet is a crucial part of achieving or maintaining muscular mass (Pope, Gruber, Choi, Olivardia, Philips, 1997). Some men may restrain their eating in order to maintain or achieve desired muscle mass and to keep fat off of their body.

Although ideals such as the thin ideal or muscular ideal are particularly salient to individuals with an eating disorder, it seems that these beliefs have become engrained into society as a whole. Thus, it may come as no surprise that a significant number of individuals in America exhibit dieting/ restrained eating (Polivy & Herman, 1987; Rand & Kulda, 1990).

Restrained Eating and Eating Disorders

Restrained eating in general populations is highly prevalent. Approximately 20-30% of females and 10% of males from 18-65 are considered to be restrained eaters in the United States (Rand & Kulda, 1990). Moreover, nearly half of the college students in America exhibit some sort of dieting pattern (Polivy & Herman, 1987). The more commonly used term, "dieter", is used synonymously with restrained eater in the literature. Restrained eaters refrain from, avoid, or restrict the intake of foods to serve a function such as weight loss or avoidance of weight gain and have an increased preoccupation with food and eating (Francis, Stewart, & Hounsell, 1997). Importantly, restrained eaters are distinctive from people who have particular food allergies, prefer a vegetarian or vegan lifestyle, or have an inability to digest certain foods. People in these

circumstances may have no choice in this form of restriction due to health concerns or ethical concerns.

If we view eating behavior as being on a spectrum, restrained eating would likely fall between normal eating behaviors and disordered eating behaviors. Some researchers view restrained eating as being a possible step toward procuring an eating disorder (Fairburn, Cooper, Doll, & Davies, 2005; Polivy & Herman, 1987; Stice, Burton, Lowe, & Butryn, 2007; Stice et al., 2011). As noted by Polivy and Herman (1987), restrained eaters share many of the same characteristics as the eating disorder pathologies such as preoccupation with weight, dissatisfaction with body/image, desire for perfection, and even self-induced vomiting in severe cases. Similarly for people with eating disorders, restrained eaters may be influenced by the pressure for the thin-ideal or the muscular ideal. On the other hand, restrained eaters who do not meet the full criteria for eating disorders may restrict their eating less severely and their functioning or physical health may not be impaired, compared to those with eating disorders.

Although eating disorders are obviously unhealthy, restrained eating is a grey area. There may be a systematic distinction between a healthy restrained eater and a maladaptive restrained eater and these differences may relate to different outcomes for individuals. For example, a longitudinal study demonstrated that dieters who later developed an eating disorder had more disturbed eating habits and attitudes, when recruited, than their peers (Fairburn et al., 2005). Features that differentiated future cases from non-cases of eating disorders included eating in secret, preoccupation with food, eating, shape, and weight, and a fear of losing control over eating. These findings seem to support the notion that restrained eating that is not accompanied by these characteristics could be considered non-maladaptive, or even healthy restrained eating.

Attentional Bias

Attentional Bias in Psychopathology

People with disordered eating such as restrained eating may show cognitive biases due to their preoccupation with foods and body shape. Cognitive bias occurs when human cognition creates representations that are distorted in some way (i.e. attention, memory, judgment) compared to objective reality (Haselton, Nettle, & Murray, 2015). One indicator of such cognitive biases is attentional bias to certain stimuli in the early perceptual process. Attentional bias occurs when the process of selective attention has been affected by an outside stimulus (i.e., attention is drawn toward a stimulus and away from another stimulus or vice versa) (Williamson, Muller, Reas, & Thaw, 1999). For example, slower or speeded reaction times to certain stimuli in a cognitive task can be an indicator that individuals' selective attention is affected by those stimuli.

These attentional biases can indicate the existence of and play an important role in maintaining psychopathology (Williamson et al., 1999). For example, a person with social anxiety might be particularly sensitive to stimuli that are relevant to others' negative evaluations or his/her perceived inadequacies (e.g., words such as inadequate, failure, embarrassed), because these stimuli are consistent with the person's self-schema and/or are threatening to the person (Williamson et al., 1999). Due to this sensitivity, the person may allocate more or faster attention to them in the early perceptual process (i.e., attentional bias). More attention to and processing of these stimuli would strengthen his/her negative self-schema, thereby maintaining, if not exacerbating, the social anxiety (MacLeod, Mathews, & Tata, 1986). Likewise, a person with an eating disorder or restrained eating may be sensitive to stimuli that are relevant to negative body

image or disordered eating behaviors. Attentional bias in eating disorders and restrained eating will be reviewed after measurement of attention bias is briefly described.

Measurement of Attentional Bias

Attentional bias can be measured with various tasks including word search tasks, dot probe tasks, and Stroop tasks. Word search tasks consist of participants searching for words in a matrix of words (Smeets, Roefs, Van, & Jansen, 2008). The dot probe task involves a presentation of dots and words on a computer screen and subsequent responding to the location of the dots (Macleod, Matthews, & Tata, 1986). Among others, the Stroop task (Stroop, 1935) is one of the most widely used measures of attentional bias to date (Williamson et al., 1999). This task requires participants name the color that a word is written in regardless of the meaning of the word written. An extension of the original Stroop task, the emotional Stroop task, uses emotionally relevant stimuli in place of color words (Williams, Mathews, & MacLeod, 1996). Research on attentional bias in psychopathologies using the emotional Stroop task generally concludes that people are frequently slower to name the color of a word if it was associated with their psychopathology (Williams, et al., 1996).

Earlier versions of Stroop task required participants to verbally name the color, but more recent versions incorporated computer technology such as button presses or mouse tracking (Incera, Markis, & McLennan, 2013; Markis, 2015). MouseTracker is a free computer software package which enables researchers to collect data about participants' decisions and choices in real time while completing a psychological task (e.g., Stroop task); the program obtains this information by tracking the movement of the mouse during the task (Freeman & Ambady, 2010). The assumption is that the hand motions correspond to one's underlying cognitive processing directly during the task (Freeman, Dale, & Farmer, 2011).

Before MouseTracker, the only indicators of attentional bias captured on the Stroop test were reaction time (RT; the observed time between the start and end of a trial) and percent correct (PC; the proportion of correct answers over the total number of possible questions) (Markis, 2015), which are effectively the end outcomes of the attentional bias. Mouse tracking can provide more information on the process that occurs during the Stroop task as indicated by “maximum deviation (MD)” and the “area under the curve (AUC)”. A MD is a measure of the distance between the idealized trajectory of the mouse movement for choosing the right answer (i.e., target stimuli) and the furthest point on the actual response trajectory. An AUC is a measure of the total area under a given trajectory and the idealized trajectory. Both the MD and AUC can be used as indicators of spatial attraction toward or away from a given stimulus. Freeman and Ambady (2010) note that the AUC can be a better measure of overall attraction toward the unselected response. Conversely, the MD tends to be a better measure of maximum attraction toward the unselected response.

Attentional Bias in Restrained Eating

Theoretical Background

It is conceptually reasonable to assume that restrained eaters may have attentional bias to food related stimuli. For restrained eaters, foods have important meaning because they are potential threats to their goal of restricting eating and thus they want/need to be able to avoid them to maintain their goal. Ironically, they may be cognitively preoccupied with thoughts of foods, despite their desire to avoid them, because of such threat values and relevance to their goal. At the same time, foods may be highly activated in their mind because of their constant hunger caused by restrained eating. In other words, restrained eaters would show perceptual sensitivity to foods-related stimuli because (a) foods-related schema are readily accessible and

highly activated in their mind due to cognitive preoccupation and constant hunger, and also (b) because they are potentially threatening to their goal of restricting eating and thus need to be avoided. This speculation can be supported by schema theory, boundary theory, and Wegner's (1994) Ironi Process theory, respectively.

According to Vitousek and Hollon (1990), schema are cognitive structures consisting of sets of ideas on various concepts, objects, events or people that direct our attention, perception, and information processing such that we pay more attention to information that is relevant to our existing schemas (Vitousek & Hollon, 1990; Williamson et al., 1999). Highly salient or important schemas are more easily and readily accessible/activated, thereby guiding one's information processing from the early attentional process to later meaning making and interpretations, resulting in various cognitive biases and strengthening the current schema (Vitousek & Hollon, 1990).

People with eating disorders or restrained eating may have schema regarding foods or body shape/size which are a lot more salient, important, complex, and thus readily accessible compared to people without them because of the relevance of foods/body shape to their goals of losing weight or maintaining low weight (Williams et al., 1999) Thus, highly salient and readily accessible schemas about foods among people with eating disorders or restrained eating may direct their attention selectively to stimuli that are consistent with the content of the foods schemas (i.e., attentional bias) (Vitousek & Hollon, 1990; Williamson et al., 1999).

Boundary theory suggests that restrained eaters may feel constant hunger, which may make them perceptually sensitive and tuned to foods-related stimuli (Polivy & Herman, 1983, Stewart & Samoluk, 1997). The boundary model suggests that people typically have a biological receptive signal (referred to as a boundary) for hunger and for satiety. Being hungry or full are

both states of being that are unpleasant. Therefore, staying in between these two boundaries (not hungry or full; satisfied) is the most desired state. People with disordered eating or restrained eaters may have an altered hunger/satiety signal. That is, restrained eaters have a lower hunger boundary and a higher satiety boundary. Thus, they have a larger space between their boundaries than a non-restrained eater. Additionally, restrained eaters have a “third diet boundary” which sends a psychological signal that they should stop eating before the biological satiety process activates. As such, this boundary helps to inhibit food intake so that one can lose weight or prevent weight gain (Polivy & Herman, 1983). Ironically, as a rebound, restrained eaters may end up eating more than non-restrained eaters after the diet boundary has been exceeded. It is believed that restrained eaters have certain amounts of food they would allow themselves to intake and that if they pass this diet boundary, their hunger takes over and causes them to eat (Polivy & Herman, 1983; Polivy & Herman, 1987). In less complex terms, it is as if the restrained eater unconsciously tells him or herself, “Well I’ve already eaten more than I wanted to. Now I might as well just eat as much as I want until I’m full!” As a result of restricting food intake and therefore feeling chronically hungry (Stewart & Samoluk, 1997), one might be ironically motivated to seek ways to reduce the sense of hunger, despite the desire and intention not to eat (Polivy & Herman, 1983), thereby paying more attention to food-related stimuli.

On the other hand, ironic process theory (Wegner, 1994) suggests that the thoughts that an individual wants to avoid actually receive more attention, ironically, and thus end up being thought about more because one needs to first attend to and identify the target thoughts to be able to avoid them (Wegner, 1994). According to this theory, restrained eaters may want to avoid foods/food-related thoughts since they could be potentially threatening to accomplishing their goal

of restrained eating. Due to this avoidance, they may end up paying more attention to food-related stimuli and thus show perceptual sensitivity (i.e., attentional bias) to the stimuli.

In the next section, empirical studies that found attentional bias among restrained eaters and also people with eating disorders will be reviewed. Research on attentional bias in people with eating disorders may be relevant because of shared characteristics of high accessibility of foods schemas, constant sense of hunger, and the perceived threat from foods and the need to avoid them between people with eating disorders and non-clinical restrained eaters. In fact, there are a limited number of studies on non-clinical restrained eaters' attentional biases.

Attentional Bias in Eating Disorders

A recent meta-analysis on 43 studies concluded that people with anorexia nervosa and bulimia nervosa have greater attentional bias to food stimuli (i.e., slower RTs) when compared to healthy controls in an emotional Stroop task (Brooks et al., 2011). Similarly, a study found that participants with eating disorders processed high and low calorie food pictures similarly (i.e., they did not distinguish between the foods when processing them) but still demonstrated an attentional bias for food images (demonstrated by higher brain activity as measured using an electroencephalography or EEG) (Blechert, Feige, Joos, Zeeck, & Tuschen-Caffier, 2011). This finding suggests that those with eating disorders are more predisposed to focus their attention on images of foods. On the other hand, another study on non-clinical undergraduate women with a high thin-ideal did not yield any significant results regarding attentional bias to body stimuli (Cassin, von Ranson, & Whiteford 2008).

Similarly, Dobson and Dozois (2004) completed a meta-analysis on 28 studies that used the emotional Stroop task to study anorexia nervosa, bulimia nervosa, and dieting/food restrictions. They found that participants with bulimia nervosa had attentional biases for a range

of stimuli including body/weight and food, and that participants with anorexia nervosa only displayed biases to body/weight stimuli. Cooper et al. (1992) found that participants with bulimia nervosa had slower reaction times when naming the color of words related to eating, weight, and shape compared with healthy controls. Furthermore, Davidson and Wright (2002) found similar results as the previous study but also noted that the severity of bulimia nervosa had a positive relationship with the naming of color words; a higher eating pathology typically led to a longer reaction to size and food related words. It is worth noting that, like Cooper et al. (1992), Davidson and Wright (2002) used words related to eating, weight, and shape altogether.

The only study that used MouseTracker to analyze attentional bias among people with anorexia nervosa and bulimia nervosa (Markis, 2015), to my knowledge, also showed that middle aged women with eating disorders had larger attentional bias to body-related stimuli (e.g., obese, huge, thin, fragile) compared to younger females with eating disorders as indicated by slower RTs. However, they did not include food related words. Another study using a word search task also found that people with eating disorders (i.e., anorexia nervosa and bulimia nervosa) showed speeded detection to body-related stimuli and increased distraction from food stimuli (Smeets, Roefs, Van, & Jansen, 2008).

In summary, the research seems to support the idea that people with bulimia nervosa (i.e., those who alternate between binge eating and compensation such as restrained eating) show an attentional bias to food related stimuli, body shape related stimuli, or combined sets of words when compared to those without eating disorders. On the other hand, it seems that people with anorexia nervosa only have an attentional bias to body shape related stimuli, compared to those with no eating disorders.

Attentional Bias in Restrained Eaters

A small amount of research has been conducted on non-clinical restrained eaters. The findings are mixed. Some suggest that nonclinical restrained eaters demonstrate attentional bias (in the form of slowed RTs) to food and body words (Francis et al., 1997; Green & Rogers, 1992), but to a lesser degree compared to those with eating disorders. The effect sizes of attentional biases in restrained eaters seem to fall between those of non-restrained eaters and those with eating disorders (Brooks et al., 2011; Cooper & Fairburn, 1992). Two meta-analyses compared attentional bias in people with eating disorders, nonclinical restrained eaters, and a nonclinical control group (Dobson & Dozois, 2004; Johansson et al., 2004). The Johansson et al. (2004) meta-analysis contained only women whereas the Dobson and Dozois (2004) meta-analysis contained men and women. Both of the studies suggested a larger Stroop effect to food and body stimuli (i.e., longer RT and lower PC) among women with eating disorders compared to the other two groups (i.e., restrained eaters and the control group), with upper medium effect sizes (i.e., $d = .57$ for body/weight words and $d = .59$ for food words). Notably, Johansson et al. (2004) found no significant Stroop effect to food or body words in nonclinical restrained eaters whereas Dobson and Dozois (2004) did find a significant Stroop effect for food words (but not to body words) among non-clinical dieters/restrained eaters with upper small effect size of $g = .39$. This finding is also in line with a third meta-analysis which found that the effect size for non-clinical restrained eaters to food words is $d = .36$ (Brooks et al., 2011).

Restrained eaters' perceptual sensitivity to food/weight related words was further indicated by studies that used other methods than emotional Stroop tasks. Boon, Vogelzang, and Jansen (2000) examined female restrained and nonrestrained eaters using a dot probe task and a word recognition task. They found that the restrained eaters typically recognized food words

faster than neutral words. Hollitt and colleagues (2010) examined non-clinical restrained eaters using a visual search task (Hollitt, Kemps, Tiggemann, Smeets, & Mills, 2010). They found that the restrained eaters were significantly faster to find the food word mixed with neutral words and the neutral word mixed with food words when compared to the neutral word amongst neutral words. Although the restrained eaters showed shorter RTs in identifying food words, their overall RTs were longer compared with non-restrained eaters. This result was interpreted as meaning that restrained eaters' attention is captured by food words more readily compared to non-restrained eaters.

Overall, it is not clear whether non-clinical restrained eaters show attentional bias/perceptual sensitivity to food words. Some suggest so, possibly to a smaller degree compared to people with eating disorders; others suggest not. In trying to better understand whether or not non-clinical restrained eaters have an attentional bias to food words, it is important to consider the role that food type might also play.

Research findings are mixed on whether food type plays any role in attentional bias among non-clinical restrained eaters. Francis, Stewart, and Hounsell (1997) compared restrained eaters with non-restrained eaters to examine if they showed differential attentional bias to forbidden (e.g., unhealthy foods such as pizza or chips) and non-forbidden (e.g., healthy foods such as carrots or celery) foods using an emotional Stroop task. It was found that the restrained eaters showed longer RTs to food words in general than to control words. However, there were no significant differences in RT between the forbidden and non-forbidden food word conditions. This finding was consistent with past research showing that attentional bias to food does not typically depend on caloric value (Blechert et al., 2011). However, another study has demonstrated that people self-report more ambivalence toward unhealthy foods (e.g.,

desserts/candies, high fats, high carbs) than healthy foods (Urland & Ito, 2005).

In summation, research findings are mixed on the emotional Stroop effect to food words in general and on any differential emotional Stroop effect to nonforbidden versus forbidden food words among non-clinical restrained eaters. Some suggest a significant attentional bias to food words among restrained eaters (Cooper & Fairburn, 1992; Francis et al., 1997), with a smaller effect size compared to that among people with eating disorders (Brooks et al., 2011; Dobson & Dozois, 2004) and that the healthiness of food could moderate how people respond to different types of foods (Urland & Ito, 2005); others suggest that attentional bias among restrained eaters is not significantly different from that among non-restrained eaters (Johansson, Ghaderi, & Andersson, 2004) or that the food type makes no difference in attentional bias among restrained eaters (Francis et al., 1997).

Present Study Rationales

Literature Gaps

This study aimed to clarify the meaning of the mixed findings by examining attentional bias to nonforbidden versus forbidden types of foods among non-clinical restrained eaters. One possible reason for the mixed findings includes inconsistencies in the samples included in the meta-analyses. Johansson et al. (2004) used females only in their analyses and referred to these individuals as “non-eating disordered but nevertheless over-concerned with eating and body weight” as opposed to restrained eaters (pp. 275). On the contrary, Dobson and Dozois’s (2004) analysis included men and women and they categorized individuals as dieting/restrained eaters but failed to provide a direct operational definition for who actually qualified for this category.

Another important reason for the mixed results could be related to the operational definition of non-clinical restrained eaters. For example, a fair amount of research has used the

Restraint Scale (RS; Polivy, Herman, & Warsh, 1978) to categorize and define restrained eaters (Blechert, Feige, Jajcak, & Tuschen-Caffier, 2010; Boon et al., 2000; Francis et al., 1997; Jansen, Huygens, Tenney, 1998; Smeets et al., 2008; Urland & Ito, 2005). The RS has been shown to measure restrained eaters with a tendency to overeat in addition to restraining their eating, which may actually measure the tendency to alternate between restrained eating and rebound binge or overeating (i.e., subclinical bulimic tendency). A small number of studies, on the other hand, used the Restrained Eating subscale of the Dutch Eating Behaviors Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) which measures intention and actual control/restriction of food due to concerns about weight (van Strien, 1996; van Strien, Breteler, & Ouwens, 2002; van Strien, Herman, Engels, Larsen, & Leeuwe, 2007). Differences in the definitions such as these may have contributed to the mixed findings. For example, Francis et al. (1997) used the RS to categorize restrained eaters and found that highly restrained eaters showed longer RTs to food words. Green and Rogers (1993) used the DEBQ (van Strien et al., 1986) to categorize restrained eaters and also found that highly restrained eaters exhibited slowed RTs to food words. Thus, while both of these studies found that highly restrained eaters have an attentional bias to food words, it is difficult to compare the study results since they could be measuring different forms of restrained eating.

In addition, it is not clear whether restrained eaters would show differential attentional bias to so called “forbidden foods—those that people rate as being unhealthy (e.g. butter, pie)” and “non-forbidden foods—those that people rate as being healthy (e.g., peas, broccoli)” (Francis et al., 1997). It is reasonable to speculate that forbidden foods are the very foods restrained eaters seek to avoid and as a result they may attend to forbidden foods differently than non-forbidden foods. In fact, Urland and Ito (2005) found that foods viewed as unhealthy (desserts, candies,

high fat, etc.) caused greater ambivalence (i.e., self-reported mixed feelings toward those foods) in participants. The only study that examined the differences in attentional bias between forbidden and non-forbidden foods found no differences (Francis et al., 1997). That is, restrained eaters exhibited attentional biases toward both categories of food words equally; there were no significant differences between the type of food word (i.e., forbidden versus nonforbidden). Unfortunately, this was the only study which directly examined this issue.

Another gap in the attentional bias literature on restrained eating is that studies have not examined what happens while attention is captured and directed (i.e. the process); rather, they focus solely on the outcomes of attentional bias (Francis et al., 1997; Green & Rogers, 1992). Typically, studying attentional bias in restrained eating has been fairly limited to using reaction times (RT; the amount of time between starting a problem and finishing the problem) and percent correct (PC; the total percentage of questions answered correctly) as outcomes.

Finally, some studies that examined the Stroop effect among people with disordered eating behaviors did not match—or did not report having done so— words based on aspects such as the number of letters, the number of syllables, the frequency, familiarity, and valence between conditions which could systematically bias the results (Black, Wilson, Labouvie, & Heffernan, 1997; Cooper et al., 1992; Cooper & Fairburn, 1992). For example, the RT may be longer for words that are not familiar to participants or with long syllables even though their attention is not being captured by the contents of the words. As such, it is recommended to use matched words between experimental and control stimuli to improve internal validity and to make comparison across studies simpler (Cassin & von Ranson, 2005).

This study addressed these conceptual and methodological issues of previous studies. First, I used the DEBQ to measure restrained eating, because the scale appears to be consistent

with the operational definition of restrained eaters in this study, i.e., those who restrict their food intake due to a weight concern and were on a spectrum of unhealthy, disordered eating. I did not use the RS, because the RS appears to also measure potential rebound overeating/binge eating.

Second, this study used the list of food words from a previous study that were matched based on length of the word and frequency in the English language (Francis et al., 1997). Using words from a previous study could also help create at least some cross-study comparability. Moreover, separate lists of forbidden foods (foods seen as unhealthy by the general population) and non-forbidden foods (foods seen as healthy by the general population) were used to examine any potential differential attentional biases to them (Francis et al., 1997).

Finally, this study aimed to examine both the processes and outcomes of attentional bias through the use of MouseTracker. Previous research on restrained eaters using the emotional Stroop task was only able to examine the outcomes of attentional bias (i.e., RT and PC) and not what happens during the process. Mouse tracking allows for additional indicators of attentional bias such as MD and AUC to indicate more about the processes occurring over time (i.e., how one's response choice [mouse dragging] unfolds over time as a result of the stimuli shown), in addition to the outcomes of RT and PC. It is possible, for example, that, although RTs toward food words may not be significantly different between restrained and nonrestrained eaters, MDs or AUCs may be larger in restrained eaters, suggesting their uncertainty or ambivalence toward food words.

Research Questions and Hypotheses

In summary, this study examined whether non-clinical restrained eaters demonstrated attentional bias to food stimuli, both as a process and outcome, and whether the attentional bias was distinct between forbidden and nonforbidden food stimuli. The emotional Stroop task was

used via mouse tracking to measure attentional bias, as indicated by RT, PC, MD, and AUC. Specifically, this study tested the following hypotheses:

Hypothesis 1-1. RTs for restrained eaters to foods words would be significantly longer than RTs of non-restrained eaters (i.e., main effect of eater type on food words RT).

Hypothesis 1-2. Among restrained eaters, RTs for food words in general (forbidden and non-forbidden words pooled together) would be longer than to neutral words. On the other hand, among non-restrained eaters, RTs for food words in general would not be different from those for neutral words.

Exploratory question 1. It is possible that forbidden foods stimuli may be more threatening and thus capture attention more. It is also possible that non-forbidden foods may be equally attention capturing because they are the ones needed to be approached for weight control purposes. Therefore, it was explored whether the RTs for forbidden versus non-forbidden food words would be different among restrained eaters versus non-restrained eaters.

Hypothesis 2-1. MDs for restrained eaters to foods would be significantly larger than MDs of non-restrained eaters (i.e., the main effect of eater type on food words MD).

Hypothesis 2-2. Among restrained eaters, MDs for food words in general (forbidden and non-forbidden words pooled together) would be larger than to neutral words. Conversely, non-restrained eater's MDs to food words in general would not be different from those for neutral words.

Exploratory Question 2. It was explored whether the MDs for forbidden versus non-forbidden food words would be different among restrained eaters versus non-restrained eaters.

Hypothesis 3-1. AUCs for restrained eaters to foods would be significantly larger than AUCs of non-restrained eaters (i.e., the main effect of eater type on food words AUC).

Hypothesis 3-2. Among restrained eaters, AUCs for food words in general (forbidden and non-forbidden words pooled together) would be larger than to neutral words. Conversely, non-restrained eater's AUCs to food words would not be different from those for neutral words. Additionally, the difference between AUCs for forbidden versus non-forbidden food words in restrained eaters and non-restrained eaters was not assumed to be significant.

Exploratory Question 3. It was explored whether the AUCs for forbidden versus non-forbidden food words would be different among restrained eaters versus non-restrained eaters.

Hypothesis 4-1. The PC for restrained eaters would be significantly lower than those for non-restrained eaters (i.e. the main effect of eater type on food words PC).

Hypothesis 4-2. Among restrained eaters, PCs for food words in general (forbidden and non-forbidden words pooled together) would be smaller than to neutral words. Conversely, non-restrained eater's PCs to food words in general would not be different from those for neutral words.

Exploratory Question 4. It was explored whether the PCs for forbidden versus non-forbidden food words would be different among restrained eaters versus non-restrained eaters.

CHAPTER III: METHODS

Participants and Screening Procedure

Participants included 158 (37 males, 23.42%; 120 females, 75.95%) undergraduate students enrolled at a Midwestern university in America. A total of 24 (4 males, 20 females) participants (age $M = 19.68$, $SD = 2.52$) were restrained eaters in this study. Participants were classified as a restrained eater if they scored one standard deviation above the sample mean ($M = 2.54$, $SD = .87$) (van Strien, Frijters, Bergers, & Defares, 1986). The other 134 of the participants were considered non-restrained eaters (age $M = 18.82$, $SD = .88$). In the sample, 105 (66.50%) participants identified as European American, 18 (11.40%) as African American, 11 (7.00%) as Latino/Latina, 2 (1.30%) as Asian American, 3 (1.90%) as Native American, 1 (.60%) as Arab American, 5 (5.70%) as Bi- or Multi-racial, and 9 as other. Regarding educational status, 61 (38.60%) participants identified as a Freshman, 38 (24.10%) as a Sophomore, 40 (25.30%) as a Junior, 17 (10.80%) as a Senior, and 1 (.60%) as a Graduate Student. They participated via the psychology department research participant pool for research credits.

Stroop Task Materials

Apparatus

Each session of the experiment was conducted on a standard Windows desktop computer. The software, MouseTracker (Freeman & Ambady, 2010), was used to track the mouse trajectories of each participant. In each trial, the mouse trajectories were sampled 60-75 times per second. Recording hand movements using mouse tracking software allowed for measurements of several dependent variables including RT, MD, AUC, and PC.

Word Stimuli

The food word list provided by Francis and colleagues (1997) was used because they were matched on the frequency and word length (refer to Appendix A for the lists of forbidden food words, non-forbidden food words, and control words used in this study).

To measure the emotional Stroop effect of words relating to food, three different categories were created. The words included 15 forbidden food words (ex. icing, pastry), 15 non-forbidden food words (ex. celery, carrots), and 30 animal words (ex. camel, ponies) which served as a control. In line with Green and Rogers (1993), the control words were chosen from the same semantic category to avoid procedural error in the results. Using word lists matched on frequency and word length was intended to increase the internal validity of the study (Cassin & von Ranson, 2005; Green & Rogers, 1993).

Prior to beginning the actual problem blocks, participants completed a practice block containing 8 trials. Practice trials were included to help ensure the participants were familiar with the task before moving on. Like Markis (2015), these blocks were made of four X's or O's (XXXX, OOOO) in one of the four various colors (red, yellow, blue, green). Throughout the experiment it was the participant's job to choose the appropriate color response button in the left or right corner of the screen. After completing the first practice block, participants moved onto Block 1. Before blocks 2, 3, and 4, the participants completed a similar practice block containing just 4 trials (one for each color) so that they could readjust for the next set of problems. Four main blocks of problems were included in the study so that each word was appropriately color balanced. Of the four main blocks, each block contained 60 problems for a total of 240 mouse trajectories per participant to be analyzed. Overall, each word was shown once in every color throughout the duration of the whole experiment. Therefore, a given block contained 15

forbidden food words, 15 non-forbidden food words, and 30 neutral words (all of which were randomized).

Self-report Measures.

Restrained Eating

The Restrained Eating subscale of the Dutch Eating Behaviors Questionnaire (DEBQ; van Strien, Frijters, Bergers, & Defares, 1986) was used to measure restrained eating (refer to Appendix B for items on the DEBQ).

The 33-item DEBQ (van Strien et al., 1986) consists of Restrained Eating (10 items, e.g., “Do you deliberately eat less in order not to become heavier?”), Emotional Eating (13 items, e.g., “Do you have the desire to eat when you are irritated?”), and External Eating (10 items, e.g., “If you see others eating, do you also have the desire to eat?”) subscales. See appendix B for the full questionnaire. Each question is rated on a Likert scale of 1-5 from never to very often. Higher scores on these inventories reflect higher tendencies to use restrained, emotional, or external eating. The internal consistency reliability Cronbach’s alpha ranges from .80 to .95 depending on the scale (van Strien et al., 1986) based upon the original study. The DEBQ has shown moderate factorial validity with factor loadings that are typically between .65 and .88 (van Strien et al., 1986). In this study, the Cronbach’s alpha was .93 for the questionnaire as a whole, .92 for the restrained eating subscale, .95 for the emotional eating subscale, and .82 for the external eating subscale.

Perceived Forbiddenness of Food Words.

A modified version of the Food Evaluation Questionnaire (FEQ; Knight & Boland, 1989) was used to examine how forbidden each food word was perceived as for each participant to make sure that the food words used in this study were perceived forbidden versus nonforbidden

as intended. On this inventory, participants were asked to rate each food presented in the emotional Stroop task on a scale of 1 (*dietarily permitted*) to 9 (*dietarily forbidden*) based on the definition that forbidden meant “foods which you avoid in an effort to control body weight” (Francis et al., 1997). Refer to Appendix C to view the FEQ in survey form.

Demographics Form

Questions regarding the age, sex, ethnic background, educational status, and whether he or she has problems seeing colors (i.e. color blindness) were asked.

Design and Analysis

The experiment consisted of a 2 (Eater Type: restrained, non-restrained) x 3 (Word Type: forbidden foods, non-forbidden foods, and animal as control) mixed design. Eater Type was a quasi-independent between-subject variable whereas the word type was considered a within-subject variable. Like Markis (2015), participants completed a total of 240 trials on MouseTracker (Freeman & Ambady, 2010). The 15 forbidden food words, 15 non-forbidden food words, and 30 control words were presented once in every color throughout the experiment. Dependent variables included RT, MD, AUC, and PC. Mixed ANOVAs were conducted on each dependent variable. In addition, to examine attentional bias to food words in general (vs. forbidden/nonforbidden food words distinctions), 2 (eating type) x 2 (word type: foods and animal as control) mixed ANOVAs were also conducted on each dependent variable.

Procedure

Upon arriving at the research lab for the scheduled study, participants were greeted by the researcher and were asked to take a seat while they went over the informed consent form. Afterward, the participants were directed to sit at the computer to complete the mouse tracking

task. Once the researcher gave the signal to begin the computer task, participants read the instructions on the screen in front of them.

Participants were instructed to click on the buttons at the top-left (“BLUE – GREEN”) and top-right (“RED – YELLOW”) of the computer screen that matched the color of the word that appeared directly in the middle of the screen. They were informed that they should focus on only the color of the word and ignore the content of the words so that they could answer as fast as possible. When they were ready to begin the initial practice trials they clicked the “START” button at the bottom-center of the screen. After clicking the button, an “XXXX” appeared in one of the four colors and participants clicked the button that matched the color. If participants did not initiate mouse movement by 500 ms, a message appeared prompting them to go faster and their data for these trials became void. After the practice trials, a message appeared on the screen reminding participants to remember to focus on the color of the words and not their contents. Upon clicking the start button, the participants began Block 1 of the experiment where the actual food and control words appeared randomly in various colors. After completing the first block of problems a message appeared letting them know that they could take a short break if needed and to move on when ready. This same message, along with a shorter practice block of trials, ensued every block of problems.

Once finished with the mouse tracking task, participants were asked to fill out the online survey. The order of the survey was the DEBQ, the FEQ, and the demographics sheet. Questionnaires were not completed until after the mouse tracking task to ensure they did not bias the task. After filling out the questionnaires, participants were debriefed and thanked for their time. Each participant received a total of one credit for their half an hour of participation in the study.

CHAPTER IV: RESULTS

Preliminary Analyses

Participants were classified as a restrained eater when they scored one standard deviation above the sample mean ($M = 2.54$, $SD = .87$).

To ensure that participants viewed forbidden and nonforbidden words as distinctly different from one another, an Eater Type (2; restrained, nonrestrained) x Food Type (2, forbidden, nonforbidden) mixed ANOVA was utilized. A significant main effect of Food Type was found, $F(1,156) = 436.52$, $p < .001$, $\eta^2 = .74$. Participants rated forbidden foods significantly higher than nonforbidden foods, $t(157) = -4.52$, $p = .01$, $d = 3.38$. The interaction effect was also marginally significant, $F(1,156) = 2.90$, $p = .09$, $\eta^2 = .02$. Restrained eaters rated forbidden foods as being more highly forbidden than nonrestrained eaters with marginal significance. For information on the means and standard deviations of each individual food word, see Table A-1 in Appendix D.

Descriptive statistics of the study variables (Restrained Eating, RT, MD, AUC, and PC) are presented in Table 1. The first set of analyses treated each word type as distinct (neutral, forbidden food, and nonforbidden food words). The second set of analyses treated nonforbidden and forbidden foods as one category of foods. Table 1 combines each of these analyses and displays the means, standard deviations, range, kurtosis, and skewness for the dependent variables with forbidden and nonforbidden foods as distinct from one another *and* for foods in general. The distinction between the variable “food” and the variables “nonforbidden food” and “forbidden food” was necessary to test the aforementioned hypotheses that food type could play a role in attentional differences.

Table 1

Mean, Standard Deviation, Range, Skewness, and Kurtosis of Variables

Variables	M	SD	Range	Skewness	Kurtosis
DEBQ					
Restrained Eating	2.54	.87	3.80	.08	-.56
RT					
Neutral RT	1014.54	258.36	2975.24	6.75	67.17
Nonforbidden RT	1020.36	252.28	2703.02	5.38	48.00
Forbidden RT	1020.16	246.60	2686.37	5.54	50.45
Food RT	1020.26	248.20	2690.07	5.53	50.21
MD					
Neutral MD	.41	.19	1.03	.43	.04
Nonforbidden MD	.41	.19	.98	.56	.23
Forbidden MD	.42	.20	1.05	.46	.08
Food MD	.41	.19	1.02	.48	.13
AUC					
Neutral AUC	1.12	.97	9.66	5.02	40.13
Nonforbidden AUC	1.11	.87	8.12	4.14	28.71
Forbidden AUC	1.14	.99	9.82	4.83	38.29
Food AUC	1.12	.92	8.97	4.62	35.06
PC					
Neutral PC	.24	.39	2	1.74	3.01
Nonforbidden PC	.32	.70	3	2.23	4.17
Forbidden PC	.27	.63	3	2.43	5.49
Food PC	.29	.52	2.5	1.91	3.27

As shown in Table 1 above, the kurtosis and skewness of the RT, MD, and PC indicated that these variables were not normally distributed (i.e., skewness and kurtosis were over 2). To meet the normality assumption required for performing the mixed ANOVAs to test the main hypotheses, the RT, AUC, and PC scores were transformed. RT and AUC required cosine transformations and PC required a square root transformation to become normally distributed. Table A-2 in Appendix D displays the transformed values of the dependent variables.

Correlation coefficients among the study variables are presented in Table 2. MD, AUC, and PC were related to each other. MD and AUC were moderately to strongly negatively

correlated ($r = -.76 \sim .65$). This was expected because the process through which they are obtained is based upon similar measurements. PC had a weak to low positive relationship with MD ($r = .13 \sim .33$). Conversely, PC had a weak to low negative relationship with AUC ($r = -.27 \sim -.20$).

Table 2

Correlations Between Transformed Dependent Variables and Restrained Eating

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Level of Restrained Eating	---												
2. Neutral RT	.01	---											
3. Nonforbidden RT	-.09	.07	---										
4. Forbidden RT	.00	.13	-.01	---									
5. Neutral MD	-.01	-.12	-.00	-.03	---								

6. Nonforbidden MD	.03	-.12	.03	.02	.94	---							
					***	***							
7. Forbidden MD	.01	-.12	.04	-.01	.94	.92	---						
					***	***	***						
8. Neutral AUC	-.04	.06	.04	.01	-.72	-.66	-.68	---					
					***	***	***	***					
9. Nonforbidden AUC	-.05	.05	.00	-.05	-.66	-.71	-.65	.93	---				
					***	***	***	***	***				
10. Forbidden AUC	-.08	.07	.02	-.03	-.70	-.68	-.76	.94	.90	---			
					**	**	***	**	**	**			
11. Neutral PC	-.06	-.13	.07	-.02	.25	.24	.30	-.22	-.21	-.25	---		
					***	***	***	**	**	**	***		
12. Nonforbidden PC	.05	.03	-.08	.14	.33	.28	.27	-.27	-.22	-.23	.30	---	
					***	*		**	**	*		**	
13. Forbidden PC	-.06	-.08	-.04	.05	.19	.17	.13	-.24	-.23	-.20	.14	.24	---

* $p < .05$, ** $p < .01$, *** $p < .001$. All tests were two-tailed.

Since research in the past has been mixed in using males and females in studies with restrained eaters (Dobson & Dozois., 2004), a 2 (male, female) x 3 (neutral, nonforbidden, and forbidden) MANOVA was completed for the dependent variables (RT, MD, AUC, and PC). No significant results were found, $F(12, 144) = .492, p = .92$. Thus, the MANOVA revealed no significant effect of sex on the dependent variables.

However, given that many studies in this area of research solely used females and that males' data had a much higher kurtosis and skewness on the dependent variables compared to females, a supplementary exploratory analysis with females was conducted despite the non-significant MANOVA (Cooper & Fairburn, 1992; Green & Rogers, 1993; Francis et al., 1997). It enabled the use of the original RT data without transforming it in female only analyses since the skewness and kurtosis were within the allowed thresholds in females (see Table A-3 and Table A-4 in Appendix D).

Main Analyses

Hypothesis 1: Reaction Time

Hypothesis 1-1, that RTs for restrained eaters to foods words would be significantly longer than RTs of non-restrained eaters, was not supported. Hypothesis 1-2, that RTs for food words in general (forbidden and non-forbidden words pooled together) would be longer than to neutral words among restrained eaters whereas RTs for food words in general would not be different from those for neutral words among non-restrained eaters, was also not supported. In an Eater Type (2: restrained, non-restrained) x Word Type (3: neutral, nonforbidden, forbidden) mixed ANOVA, the interaction effect between eater type and word type on RT was not significant, $F(2,155) = .33, p = .72, \eta^2 = .01$ (Table 3). That is, restrained eaters did not significantly differ from non-restrained eaters on RTs based upon the word type (neutral,

nonforbidden, and forbidden). Main effects of Eater Type or Word Type on RT were not significant either, $F(2,155) = .61, p = .54, \eta^2 = .01$.

To address exploratory question 1, forbidden and nonforbidden word conditions were combined and an Eater Type (2: restrained, non-restrained) x Word Type (2: neutral, food) mixed ANOVA was conducted. No significant interaction effect, $F(1,156) = .002, p = .96, \eta^2 = .001, d = .07$, or main effect of word type, $F(1,156) = .17, p = .68, \eta^2 < .001$, was found.

Hypothesis 2: Maximum Deviation

Hypothesis 2-1 was that MDs for restrained eaters to foods words would be significantly larger than MDs of non-restrained eaters and hypothesis 2-2 was that MDs for food words in general (forbidden and non-forbidden words pooled together) would be larger than to neutral words among restrained eaters whereas MDs for food words in general would not be different from those for neutral words among non-restrained eaters. Neither of these hypotheses were supported. In an Eater Type (2: restrained, non-restrained) x Word Type (3: neutral, nonforbidden, forbidden) mixed ANOVA, the interaction effect between eater type and word type on MD was not significant, $F(2,155) = .91, p = .40, \eta^2 = .01$ (Table 3). That is, restrained eaters did not significantly differ from non-restrained eaters on MDs to the various word types (neutral, nonforbidden, and forbidden). Main effects of Eater Type or Word Type on MD were not significant either, $F(2,155) = 1.7, p = .19, \eta^2 = .02$.

To address exploratory question 2, forbidden and nonforbidden word conditions were combined and an Eater Type (2: restrained, non-restrained) x Word Type (2: neutral, food) mixed ANOVA was conducted. No significant interaction effect, $F(1,156) = 1.50, p = .22, \eta^2 = .01, d = .06$, or main effect of word type, $F(1,156) = 1.51, p = .22, \eta^2 = .01$, was found.

Hypothesis 3: Area Under the Curve

Both Hypothesis 3-1 that AUCs for restrained eaters to foods words would be significantly larger than AUCs of non-restrained eaters and hypothesis 3-2 that AUCs for food words in general [forbidden and non-forbidden words pooled together] would be larger than to neutral words among restrained eaters whereas AUCs for food words in general would not be different from those for neutral words among non-restrained eaters were not supported. In an Eater Type (2: restrained, non-restrained) x Word Type (3: neutral, nonforbidden, forbidden) mixed ANOVA, the interaction effect between eater type and word type on AUC was not significant, $F(2,155) = 1.54, p = .22, \eta^2 = .02$ (Table 3). That is, restrained eaters did not significantly differ from non-restrained eaters on AUCs to various word types (neutral, nonforbidden, and forbidden). The main effect of Word Type on AUC was marginally significant, $F(2,155) = 2.89, p = .06, \eta^2 = .04$. A post-hoc test revealed that AUC for nonforbidden words was marginally significantly larger than AUC for forbidden words, although AUC for neutral words was not significantly different from that for either forbidden or nonforbidden words, $p = .03$ (neutral words: $M = .44, SD = .49$; nonforbidden words: $M = .44, SD = .49$; forbidden words; $M = .40, SD = .54$).

To address exploratory question 3, forbidden and nonforbidden word conditions were combined and an Eater Type (2: restrained, non-restrained) x Word Type (2: neutral, food) mixed ANOVA was conducted. No significant interaction effect, $F(1,156) = .36, p = .55, \eta^2 = .002, d = .06$, or main effect of Word Type, $F(1,156) = .50, p = .48, \eta^2 = .003$, was found.

Hypothesis 4: Percent Correct

Hypothesis 4-1, that PC for restrained eaters to foods words would be significantly lower than PCs of non-restrained eaters, was not supported. Hypothesis 4-2, that restrained eaters

would have smaller PCs to food words compared to neutral words and that nonrestrained eaters' PCs would not differ depending on the word type, was not supported. In an Eater Type (2: restrained, non-restrained) x Word Type (3: neutral, nonforbidden, forbidden) mixed ANOVA, the interaction effect between eater type and word type on PC was not significant, $F(2,155) = 1.09, p = .34, \eta^2 = .01$ (Table 3). That is, restrained eaters did not significantly differ from non-restrained eaters on PC to the different word types. The main effect of Word Type on PC was not significant, $F(2,155) = .90, p = .41, \eta^2 = .01$.

To address exploratory question 4, forbidden and nonforbidden word conditions were combined and an Eater Type (2: restrained, non-restrained) x Word Type (2: neutral, food) mixed ANOVA was conducted. No significant interaction effect of PC, $F(1,156) = .97, p = .33, \eta^2 = .01, d = .29$, or main effect of word type, $F(1,156) = .84, p = .36, \eta^2 = .01$, was revealed.

Table 3

Mixed ANOVA Results for Hypotheses Testing

Test	<i>df</i>	<i>F</i>	<i>p</i>	η^2	Power
Main Effects (Neutral x Forbidden x Nonforbidden Words)					
RT	2, 155	.61	.54	.01	.15
MD	2, 155	1.68	.19	.02	.35
AUC	2, 155	2.89	.06 [†]	.04	.56
PC	2, 155	.90	.41	.01	.20
Interaction Effects (Neutral x Forbidden x Nonforbidden Words)					
RT	2, 155	.33	.72	.01	.10
MD	2, 155	.91	.40	.01	.21
AUC	2, 155	1.54	.22	.02	.32
PC	2, 155	1.06	.35	.01	.23
Main Effects (Neutral x Food Words)					
RT	1, 156	.17	.68	<.001	.07
MD	1, 156	1.51	.22	.01	.23
AUC	1, 156	.50	.48	.003	.11
PC	1, 156	.84	.36	.01	.15
Interaction Effects (Neutral x Food Words)					
RT	1, 156	.002	.96	.001	.05
MD	1, 156	1.50	.22	.01	.23
AUC	1, 156	.36	.55	.002	.09
PC	1, 156	.97	.33	.01	.16

Note: “Food Words” refers to analyses which combined forbidden and nonforbidden food words into one category.

[†] $p < .10$

Exploratory Analyses with Females Only

The same analyses were repeated with females only. The first set of analyses utilized an Eater Type (2: restrained, non-restrained) x Word Type (3: neutral, nonforbidden, forbidden) mixed ANOVA for each of the dependent variables (i.e. RT, MD, AUC, and PC). The second set of analyses utilized an Eater Type (2: restrained, non-restrained) x Word Type (2: neutral, food) mixed ANOVA for the same dependent variables. In both sets of analyses, no significant interaction effects amongst any of the dependent variables were found. Thus, the level of restrained eating played no role in how female participants responded (RT, MD, AUC, PC) to the

various word types (regardless of whether forbidden foods and nonforbidden foods were analyzed together or as separate categories). Nevertheless, several main effects were found.

A 2 x 3 mixed ANOVA revealed a marginally significant main effect of word types on RT, $F(2,117) = 2.66, p = .07, \eta^2 = .04$. A post-hoc test revealed no significant differences in RT between word types. When forbidden and nonforbidden food words were combined into food words, the 2 x 2 mixed ANOVA revealed a significant main effect of word types on RT, $F(2,118) = 5.30, p = .02, \eta^2 = .04, d = .07$. A planned comparison revealed that female participants showed longer RTs to food words than to neutral words, $t(119) = -8.69, p = .02$.

A 2 x 3 mixed ANOVA revealed a marginally significant main effect of word types on MD, $F(2,117) = 2.38, p = .10, \eta^2 = .04$. A post-hoc test revealed larger MDs for forbidden words compared with neutral words. This difference was marginally significant. There were no significant differences between MD for nonforbidden words and that for the other two word conditions, $p = .03$ (neutral words: $M = .40, SD = .18$; nonforbidden words: $M = .40, SD = .17$; forbidden words: $M = .41, SD = .19$). No main effect of MD was found when food words were pooled together.

A significant main effect of word types on AUC was found through the use of a 2 x 3 mixed ANOVA, $F(2,117) = 3.69, p = .03, \eta^2 = .06$. A post-hoc test revealed that AUC was largest for nonforbidden food words, followed by neutral and then forbidden words. AUC for nonforbidden food words was not significantly different from that for neutral words but was from that for forbidden words, $p = .01$ (neutral words: $M = .40, SD = .52$; nonforbidden words: $M = .42, SD = .49$; forbidden words: $M = .35, SD = .54$). Thus, female participants showed the most distraction to the nonforbidden food words, followed by the neutral words. The forbidden foods

were the least distracting stimuli type. No main effect of AUC was observed when food words were combined.

Table 4

<i>Mixed ANOVA Results for Hypotheses Testing (Females Only)</i>					
	<i>df</i>	<i>F</i>	<i>p</i>	η^2	Power
Main Effects (Neutral x Forbidden x Nonforbidden Words)					
RT	2, 117	2.66	.07 [†]	.04	.52
MD	2, 117	2.38	.10 [†]	.04	.47
AUC	2, 117	3.69	.03*	.06	.67
PC	2, 117	1.09	.34	.02	.24
Interaction Effects (Neutral x Forbidden x Nonforbidden Words)					
RT	2, 117	.12	.89	.01	.07
MD	2, 117	1.22	.30	.02	.26
AUC	2, 117	2.06	.13	.03	.42
PC	2, 117	2.17	.12	.04	.44
Main Effects (Neutral x Food Words)					
RT	1, 118	5.30	.02*	.04	.63
MD	1, 118	2.48	.12	.02	.35
AUC	1, 118	.64	.42	.01	.13
PC	1, 118	.54	.46	.01	.11
Interaction Effects (Neutral x Food Words)					
RT	1, 118	.14	.71	.001	.07
MD	1, 118	2.20	.14	.02	.31
AUC	1, 118	.27	.60	.002	.08
PC	1, 118	.57	.45	.01	.12

Note: "Food Words" refers to analyses which combined forbidden and nonforbidden food words into one category.

[†] $p < .10$

* $p < .05$

CHAPTER V: DISCUSSION

This study examined attentional bias to foods words among non-clinical restrained eaters using an emotional Stroop task. Specifically, I hypothesized that restrained eaters, compared to non-restrained eaters, would show attentional bias to food words than to neutral words, as indicated by slower RT, larger MD and AUC, and lower PC. I also explored whether such attentional bias would be larger for forbidden (i.e., so-called unhealthy) foods than for nonforbidden (i.e., healthy) foods. The study hypotheses were not supported. In fact, restrained eaters demonstrated no attentional biases to food words. However, there were some meaningful findings: Participants in general and female participants responded to forbidden versus nonforbidden food words differently, and female participants, regardless of their restrained eating level, demonstrated attentional biases to food words.

Restrained Eaters and Attentional Bias to Foods

The results revealed no significant interaction effects between the word conditions and restrained eating on any of the attentional bias indicators. The results suggest the lack of attentional bias to food words in nonclinical restrained eaters. This study, unlike others, utilized mousetracking technology to analyze more about the process happening as restrained eaters' responses unfolded overtime. Despite the ability to obtain additional information in addition to the traditional RT and PC about attentional bias from each participant, the effect still was not found.

Further, this study examined food words alone and did not include other words that might be potentially relevant to restrained eaters such as body, weight, or shape words. This was particularly important given that some studies in the past (both for restrained eaters and those with eating disorders) used word sets that included food, body, weight, and shape words (e.g. Cooper et al., 1992; Davidson & Wright, 2002). For example, Cooper et al. (1992) found that

those with bulimia nervosa had an attentional bias to body and food words but that dieters (i.e., nonclinical restrained eaters) were no different than control groups. Since words were combined and thus potentially confounding, it was incumbent to analyze each word type separately and this study examined the latter (i.e., foods). Furthering Cooper et al.'s (1992) observation that restrained eaters do not have an attentional bias to food and body words, it seems that food words, when examined alone, do not affect restrained eaters at an early perceptual level.

The lack of significant results may also relate to previous research on attentional bias in eating disorders. Similarly to Cooper et al.'s (1992) findings, Dobson and Dozois's (2004) meta-analysis supported the idea that people with bulimia nervosa demonstrate attentional biases to body, weight, and food words and added the observation that people with anorexia only have attentional biases to body and weight stimuli. This meta-analysis found an attentional bias to food words in nonclinical restrained eaters, whereas another meta-analysis did not (Johansson et al., 2004). Taken together, it is possible that restrained eaters may have an attentional bias to foods only when they also exhibit the tendency to subsequently overeat (i.e., bulimic tendency). Perhaps, restrained eaters with no overeating tendency may show attentional bias only to body/weight related stimuli (i.e., anorexic tendency). This potential subclinical bulimic tendency (i.e., restrained eating and the tendency to also overeat) is better measured by the RS (Polivy, Herman, & Warsh, 1978), whereas the restrained eating subscale of the DEBQ (van Strien, Frijters, Bergers, & Defares, 1986) better measures pure restrained eating. Thus, this study's results support the notion that pure restrained eating may not lead to attentional biases to food words. Future research should further explore this speculation.

Attentional Bias in Females

When analyzing data only with females only, the mean differences in the dependent variables between word type (neutral, forbidden, and nonforbidden) were more pronounced within female participants than within male and female participants pooled together. More specifically, females in general showed more bias towards food words. For instance, their AUCs to nonforbidden words were larger than other word types, their MDs to forbidden words were larger than to neutral words (but not different from nonforbidden words), and their RTs to food words in general (forbidden and nonforbidden words pooled together) were slower than to neutral words. Overall, it seems that females in general, whether they engage in restrained eating or not, may be perceptually sensitive to nonforbidden foods. Perhaps, due to the pervasive thin-ideal, many women, regardless of whether they diet or not, might have developed perceptual sensitivity to nonforbidden foods to accomplish their goals of becoming thin. Then, endorsement of a thin-body ideal could be a predictor of attentional bias to food related stimuli. This speculation should be tested in future research.

In addition, although we could not compare men and women due to a small sample size of men, future studies should address potential gender differences in attentional bias to different food types, particularly given that men and women may differ in which foods are perceived beneficial to achieve their body ideals (i.e., thin ideal for women vs. muscular ideal for men).

Clinical Implications

Although this study examined a nonclinical population, the study findings might provide some clinical implications given that restrained eating has been considered a risk factor for eating disorders. The current results did not support a perceptual sensitivity to food words among nonclinical restrained eaters. At least at an early perceptual level, such cognitive vulnerability

was not observed among the nonclinical restrained eaters, unlike people with eating disorders (Channon, Hemsley, & de Silva, 1988; Cooper, Anastasiades, & Fairburn, 1992; Davidson & Wright, 2002; Dobson & Dozois, 2004). If any secondary prevention efforts were to be made for restrained eaters, the focus would need to be on factors other than attentional bias to food-related stimuli.

Although restrained eating played no role in attentional bias to food words, females were observed to have various attentional biases to the food words. This might suggest the prevalence of pressure to meet certain body ideals or healthy eating preoccupation among females. This speculation should be tested in future research to examine whether primary or secondary prevention efforts would be warranted to focus on preoccupation with eating nonforbidden foods among females.

Limitations/Future Research Suggestions

As with any study, there are several limitations to be considered. One limitation that warrants discussion was the use of animal words as neutral words in this study. The word stimuli used were taken from Francis et al. (1997) in an attempt to allow for better cross-study comparisons and because the words were matched based on word length and frequency. Nevertheless, it is important to acknowledge that the animal words, which served as the neutral words, may have contributed to differences across participants. One way this could have affected participants' responses might be that some of the animal words might have still signaled a food. For instance, the words "cow" and "hen" might have been seen as foods as opposed to animals. Another important consideration is that, while animal words were used as neutral words, animal words are not necessarily neutral by nature. Perhaps certain participants were vast animal lovers and thus had schema dedicated toward animals which would theoretically affect their responses

to the “neutral” words. This effect was not strong enough to be picked up in any of the analyses. Nevertheless, it is important to consider the neutrality of these words.

Another limitation of the study was the use of words which are actually colored in reality. When doing an emotional Stroop task, one thing researchers must bear in mind is the complex associations that objects and ideas have. If the word “broccoli” appears in the color blue and a participant is asked to name the color of this word, it is entirely possible that the participant may experience cognitive dissonance since broccoli is actually green. If participants have this sort of difficulty, the higher cognitive load associated with the task could certainly lead to increased RTS, MDs, AUCs, and/or PCs.

The lack of a diverse participant pool is an additional limitation of this study. Originally, both male and female participants were included in the study. Unfortunately, the number of men who agreed to participate in this study was not large enough to do gender comparisons. Further, the pool of participants was predominantly white and thus may not have captured differences that exist across various ethnicities.

Overall, the number of participants in this experiment must be taken into account. Although some meta-analyses (e.g., Brooks et al., 2011; Dobson & Dozois, 2004) have found that restrained eaters have an upper small effect size ($d = .36$, $g = .39$) when naming the color of food words, none of these studies utilized mousetracking. In fact, when comparing the effect sizes of the above meta-analyses, the present study found nowhere near these effect sizes on any of the dependent variables (Cohen’s d tended to fall in the .06-.07 range). One thing to consider is that mousetracking (versus traditional methodology utilizing the emotional Stroop task) may differ in the number of participants required to detect these effects with sufficient power. Thus, it is important to consider the possibility that more participants may have been needed in order to

detect the upper small effect size reported in the literature. With a power increase like this, it is possible the effect could have been found.

A final limitation of this study stems from the response button mappings utilized in this study. In typical studies utilizing the Stroop or emotional Stroop task, participants are asked to verbally state the color of a word or to press a corresponding button. When utilizing Mousetracker, it was necessary to map two responses to each of the two buttons at the top left and right of the computer screen. This is important because it is possible that participants may have had a more difficult time choosing a response since each button stood for two different answers. It would technically have been possible to utilize four buttons, but this would have made analyses more complex (e.g. more responses, downward motions are different than upward motions, etc.). Further, this study did not control for the various configurations that could have been used for the response button mappings (e.g., “BLUE – GREEN” versus “BLUE – RED” or “GREEN – BLUE”) and instead followed Markis’s (2015) response button layout of “BLUE – GREEN” (left side) and “RED – YELLOW” (right side) for all trials. With this in mind, it is worth noting that previous research which has utilized different button configurations has not reported any differences (Yamamoto, Incera, & McLennan, 2016).

Several future avenues of research could shed more light on attentional bias within restrained eaters. For example, results from this study support the idea that we should look at other potential factors which may moderate a restrained eater’s attention to food words. In this study, there were differences in results when female participants were examined alone versus when men and women were examined together. Future research could examine differences between male and female restrained eaters. Given the differences in ideals (muscular vs thin), it is important to note that differences in attention may vary. Researchers could also examine other

potential moderators (e.g., body ideal internalization, body dissatisfaction, need for perfection external eating, etc.) which may better explain the mixed findings of previous research. Future research should also specifically look at whether or not pure restrained eating (as measured by the DEBQ) versus restrained eating with a tendency to overeat (as measured by the RS) affects the level of attentional bias to food words.

Conclusion

This study did not find attentional bias to food words among non-clinical restrained eaters. Thus, if restrained eating is indeed a potential risk factor for later development of an eating disorder, a perceptual sensitivity to food-related stimuli may not be the shared factor. Future researchers could examine attentional bias to other relevant stimuli (e.g. body, weight, or shape words) among restrained eaters or identify moderators (e.g., gender, endorsement of thin or muscular body ideals).

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC. 329.
- Black, C. M. D., Wilson, G. T., Labouvie, E., & Heffernan, K. (1997). Selective processing of eating disorder relevant stimuli: Does the Stroop test provide an objective measure of bulimia nervosa? *International Journal of Eating Disorders*, 22, 329–333.
- Blechert, J., Feige, B., Hajcak, G., & Tuschen-Caffier, B. (2010). To eat or not to eat? Availability of food modulates the electrocortical response to food pictures in restrained eaters. *Appetite*, 54, 262–268.
- Blechert, J., Feige, B., Joos, A., Zeeck, A., & Tuschen-Caffier, B. (2011). Electrocortical processing of food and emotional pictures in anorexia nervosa and bulimia nervosa. *Psychosomatic Medicine*, 73, 415–421.
- Boon, B., Vogelzang, L., & Jansen, A. (2000). Do restrained eaters show attention toward or away from food, shape, and weight stimuli? *European Eating Disorders Review*, 8, 51–58.
- Brooks, S., Prince, A., Stahl, D., Campbell, I. C., & Treasure, J. (2011). A systematic review and meta-analysis of cognitive bias to food stimuli in people with disordered eating behavior. *Clinical Psychology Review*, 31, 37–151.
- Cafri, G., & Thompson, J. K. (2004). Measuring male body image: A review of the current methodology. *Psychology of Men and Masculinity*, 5(1), 18–29.
- Cassin, S. E., & von Ranson, K. M. (2005). Word lists for testing cognitive biases in eating disorders. *European Eating Disorders Review*, 13, 216–220.

- Cassin, S. E., von Ranson, K. M., & Whiteford, S. (2008). Cognitive processing of body and appearance words as a function of thin-ideal internalization and schematic activation. *Body Image, 5*, 271–278.
- Channon, S., Hemsley, D., & de Silva, P. (1988). Selective processing of food words in anorexia nervosa. *British Journal of Clinical Psychology, 27*, 259–60.
- Cooper, M. J., Anastasiades, P., & Fairburn, C. G. (1992). Selective processing of eating-, shape-, and weight-related words in persons with bulimia nervosa. *Journal of Abnormal Psychology, 101*, 352–355.
- Cooper, M. J., & Fairburn, C. G. (1992). Selective processing of eating, weight and shape related words in patients with eating disorders and dieters. *British Journal of Clinical Psychology, 31*, 363–365.
- Davidson, E. J., & Wright, P. (2002). Selective processing of weight- and shape- related words in bulimia nervosa: Use of a computerized Stroop test. *Eating Behaviors, 3*, 261–273.
- Dobson, K. S., & Dozois, D. J. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. *Clinical Psychology Review, 23*(8), 1001–1022.
- Fairburn, C. G., Cooper, Z., Doll, H. A., & Davies, B. A. (2005). Identifying dieters who will develop an eating disorder: A prospective, population-based study. *American Journal of Psychiatry, 162*(12), 2249–2255.
- Fallon, A. E., & Rozin, P. (1985). Sex differences in perceptions of desirable body shape. *Journal of Abnormal Psychology, 94*(1), 102–105.
- Feingold, A., & Mazella, R. (1998). Gender differences in body image are increasing. *Psychological Science, 9*(3), 190–195.

- Franics, J. A., Stewart, S. H., & Hounsell, S. (1997). Dietary restraint and the selective processing of forbidden and nonforbidden food words. *Cognitive Therapy and Research*, 21(6), 633-646.
- Freeman, J. B., & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods*, 42, 226–241.
- Freeman, J. B., Dale, R., & Farmer, T. A. (2011). Hand in motion reveals mind in motion. *Frontiers in Psychology*, 2, 1–6.
- Green, M. W., & Rogers, P. J. (1993). Selective attention to food and body shape words in dieters and restrained non-dieters. *International Journal of Eating Disorders*, 14, 515–517.
- Haselton, M. G., Nettle, D. & Murray, D. R. (2015). The evolution of cognitive bias. In D. Buss (2nd Ed.), *The handbook of evolutionary psychology*, 2, 724–746.
- Hollitt, S., Kemps, E., Tiggemann, M., Smeets, E., & Mills, J.S. (2010). Components of attentional bias among restrained eaters. *Appetite*, 54, 309–313.
- Hudson, J. I., Hiripi, E., Pope Jr, H. G., & Kessler, R. C. (2007). The prevalence and correlates of eating disorders in the national comorbidity survey replication. *Biological Psychiatry*, 61(3), 348–358.
- Incera, S., Markis, T. A., & McLennan, C. T. (2013) Mouse-tracking reveals when the stroop effect happens. *Psychology Faculty Publications*. Paper 17.
- Jansen, A., Huygens, K., & Tenney, N. (1997). No evidence for a selective processing of subliminally presented body words in restrained eaters. *International Journal of Eating Disorders*, 24(4), 435–438.

- Johansson, L., Ghaderi, A., & Andersson, G. (2004). Stroop interference for food- and body-related words: A meta-analysis. *Eating Behaviors*, 6, 271–281.
- Johansson, L., Lundh, L. G., & Andersson, G. (2005). Attentional bias for negative self- words in young women: The role of thin ideal priming and body shape dissatisfaction. *Personality and Individual Differences*, 38, 723–733.
- Knight, L. J., & Boland, F. J. (1989). AN experimental disentanglement of the disinhibiting variables of perceived calories and food type. *Journal of Abnormal Psychology*, 98(4), 412–420.
- Lee, M., & Shafran, R. (2004). Information processing biases in eating disorders. *Clinical Psychology Review*, 24(2), 215–238.
- Macleod, C., Matthews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, 95(1), 15–20.
- Markis, T. A., & McLennan, C. T. (2011). The effect of priming a thin ideal on the subsequent perception of conceptually related body image words. *Body Image*, 8, 423–426.
- Markis, T. A. (2015). *Attentional Bias to Body-Related Stimuli in Younger and Middle-Aged Females: The Role of Eating Disorders and Thin Ideal Priming* (Doctoral dissertation, Cleveland State University).
- McCarthy, M. (1990). The thin ideal, depression, and eating disorders in women. *Behaviour Research and Therapy*, 29 (3), 205–215.
- Polivy, J., & Herman, C. P. (1983). A boundary model for the regulation of eating. *Psychiatric Annals*, 13(12), 918–927.
- Polivy, J., & Herman, C. P. (1987). Diagnosis and treatment of normal eating. *Journal of Consulting and Clinical Psychology*, 55(5), 635–644.

- Polivy, J., Herman, C. P., & Warsh, S. (1978). Internal and external components of emotionality in restrained and unrestrained eaters. *Journal of Abnormal Psychology*, 87, 100–114.
- Pope, G. P. Jr., Gruber, A. J., Choi, P., Olivardia, R., & Phillips, K. A. (1997). Muscle dysmorphia: An underrecognized form of body dysmorphic disorder. *Psychosomatics*, 38, 548–557.
- Rand, C. S. W., & Kulda, J. M. (1990) Restrained eating (weight concerns) in the general population and among students. *International Journal of Eating Disorders*, 10(6), 699–708.
- Smeets, E., Roefs, A., Van, F. E., & Jansen, A. (2008). Attentional bias for body and food in eating disorders: Increased distraction, speeded detection, or both? *Behaviour Research and Therapy*, 46(2), 229–238.
- Stewart, S. H., Samoluk, S. B. (1997). Effects of short-term food deprivation and chronic dietary restraint on the selective processing of appetitive-related cues. *International Journal of Eating Disorders*, 21(2), 129–135.
- Stice, E., Burton, E., Lowe, M., & Butryn, M. (2007) Relation of dieting to eating pathology. In Tony & Jaffa Brett McDermott, *Eating Disorders in Children and Adolescents* (45–56).
- Stice, E., Marti, C. N., & Durant, S. (2011). Risk factors for onset of eating disorders: Evidence of multiple risk pathways from an 8-year prospective study. *Behaviour Research and Therapy*, 49(10), 622–627.
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18, 643–662.
- Urland, G. R., & Ito, T. A. (2005). Have your cake and hate it, too: Ambivalent food attitudes are associated with dietary restraint. *Basic and Applied Social Psychology*, 27(4), 353–360.

- Van Strien, T. (1996). On the relationship between dieting and obese and bulimic eating patterns. *International Journal of Eating Disorders*, 19, 83–93.
- Van Strien, T., Breteler, M. H. M., & Ouwens, M. A. (2002). Restraint Scale, its sub-scales concern for dieting and weight fluctuation. *Personality and Individual Differences*, 33, 791–802.
- Van Strien, T., Frijters, J. E., Bergers, G. P., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders*, 5, 295–315.
- Van Strien, T., Herman, C. P., Engels, R. C. M. E., Larsen, J. K., & Van Leeuwe, J. F. J. (2007). Construct validation of the Restraint Scale in normal-weight and overweight females. *Appetite*, 49, 109–121.
- Vitousek, K. B., & Hollon, S. D. (1990). The investigation of schematic content and processing in eating disorders. *Cognitive Therapy and Research*, 14, 191–214.
- Wegner, D. M. (1994). Ironic processes of mental control. *Psychological Review*, 101(1), 34–52.
- Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin*, 120, 3–24.
- Williamson, D. A., Muller, S. L., Reas, D. L., & Thaw, J. M. (1999). Cognitive bias in eating disorders: Implications for theory and treatment. *Behavior Modification*, 23(4), 556–577.
- Yamamoto, N., Incera, S., McLennan, C. T. (2016). A Reverse Stroop Task with Mouse Tracking. *Frontiers in Psychology*, 7(670), 1–12.

APPENDIX A: MATCHED FOOD AND NEUTRAL WORDS

Forbidden Foods	Frequency	Word Length	Control Words	Frequency	Word Length
Icing	1	5	Camel	1	5
Pastry	4	6	Ponies	6	6
Chips	3	5	Geese	3	5
Cake	13	4	Deer	13	4
Candies	2	7	Peacock	2	7
Pizza	3	5	Mules	3	5
Bacon	10	5	Mouse	10	5
Pie	14	3	Hen	22	3
Chocolate	9	9	Elephants	10	9
Sugar	34	5	Bears	1	5
Butter	27	6	Snakes	26	6
Cream	20	5	Sheep	23	5
Cookie	1	6	Coyote	1	6
Cereal	17	6	Insect	14	6
Puddings	1	8	Crocodile	1	9
Mean (<i>SD</i>)	10.60 (10.27)	5.67 (1.50)		9.07 (8.80)	5.73 (1.62)
Nonforbidden Foods	Frequency	Word Length	Control Words	Frequency	Word Length
Celery	4	6	Falcon	4	6
Carrots	4	7	Dolphins	4	8
Asparagus	1	9	Anteater	1	8
Tomatoes	3	8	Cricket	3	7
Mushroom	2	8	Armadillo	2	9
Cantaloupe	1	10	Butterfly	2	9
Rice	33	4	Bird	31	4
Onions	4	6	Wolves	4	6
Salad	9	5	Seals	4	5
Broccoli	1	8	Squirrel	1	8
Peas	24	4	Cat	23	3
Egg	12	3	Hawk	14	4
Soup	16	4	Cows	16	4
Cherry	6	6	Chicks	1	6
Potato	15	6	Buffalo	16	7
Mean (<i>SD</i>)	9.00 (9.47)	6.27 (2.05)		8.40 (9.35)	6.27 (1.62)

APPENDIX B: DUTCH EATING BEHAVIORS QUESTIONNAIRE

Please answer each question using the response scale:

1-----2-----3-----4-----5

Never Seldom Sometimes Often Very often

Restrained Eating Subscale of DEBQ

1. If you have put on weight, do you eat less than you usually do?1-----2-----3-----4-----5
2. Do you try to eat less at mealtimes than you would like to eat?1-----2-----3-----4-----5
3. How often do you refuse food or drink offered because you are concerned about your weight?1-----2-----3-----4-----5
4. Do you watch exactly what you eat?1-----2-----3-----4-----5
5. Do you deliberately eat foods that are slimming?1-----2-----3-----4-----5
6. When you have eaten too much, do you eat less than usual the following days?1-----2-----3-----4-----5
7. Do you deliberately eat less in order not to become heavier?1-----2-----3-----4-----5
8. How often do you try not to eat between meals because you are watching your weight1-----2-----3-----4-----5
9. How often in the evening do you try not to eat because you are watching your weight?1-----2-----3-----4-----5
10. Do you take into account your weight with what you eat?1-----2-----3-----4-----5

Please answer each question using the response scale:

1-----2-----3-----4-----5

Never Seldom Sometimes Often Very often

Emotional Eating Subscale of DEBQ

11. Do you have the desire to eat when you are irritated?	1-----2-----3-----4-----5
12. Do you have a desire to eat when you have nothing to do?	1-----2-----3-----4-----5
13. Do you have a desire to eat when you are depressed or discouraged?	1-----2-----3-----4-----5
14. Do you have a desire to eat when you are feeling lonely?	1-----2-----3-----4-----5
15. Do you have a desire to eat when somebody lets you down?	1-----2-----3-----4-----5
16. Do you have a desire to eat when you are cross?	1-----2-----3-----4-----5
17. Do you have a desire to eat when you are approaching something unpleasant to happen?	1-----2-----3-----4-----5
18. Do you get the desire to eat when you are anxious, worried, or tense?	1-----2-----3-----4-----5
19. Do you have a desire to eat when things are going against you or when things have gone wrong?	1-----2-----3-----4-----5
20. Do you have a desire to eat when you are frightened?	1-----2-----3-----4-----5
21. Do you have a desire to eat when you are disappointed?	1-----2-----3-----4-----5
22. Do you have a desire to eat when you are emotionally upset?	1-----2-----3-----4-----5
23. Do you have a desire to eat when you are bored or restless?	1-----2-----3-----4-----5
24. If food tastes good to you, do you eat more than usual?	1-----2-----3-----4-----5

Please answer each question using the response scale:

1-----2-----3-----4-----5

Never Seldom Sometimes Often Very often

External Eating Subscale of DEBQ

25. If food smells and looks good, do you eat more than usual?	1-----2-----3-----4-----5
26. If you see or smell something delicious, do you have a desire to eat it?	1-----2-----3-----4-----5
27. If you have something delicious to eat, do you eat it straight away?	1-----2-----3-----4-----5
28. If you walk past the baker do you have the desire to buy something delicious?	1-----2-----3-----4-----5
29. If you walk past a snackbar or a café, do you have the desire to buy something delicious?	1-----2-----3-----4-----5
30. If you see other eating, do you also have the desire to eat?	1-----2-----3-----4-----5
31. Can you resist eating delicious foods?	1-----2-----3-----4-----5
32. Do you eat more than usual when you see others eating?	1-----2-----3-----4-----5
33. When preparing a meal are you inclined to eat something?	1-----2-----3-----4-----5

APPENDIX C: FOOD EVALUATIONS QUESTIONNAIRE

Please rate each item below on a scale of 1 (*dietarily permitted*) to 9 (*dietarily forbidden*).

Icing	1-----2-----3-----4-----5-----6-----7-----8-----9
Pastry	1-----2-----3-----4-----5-----6-----7-----8-----9
Celery	1-----2-----3-----4-----5-----6-----7-----8-----9
Chips	1-----2-----3-----4-----5-----6-----7-----8-----9
Carrots	1-----2-----3-----4-----5-----6-----7-----8-----9
Asparagus	1-----2-----3-----4-----5-----6-----7-----8-----9
Tomatoes	1-----2-----3-----4-----5-----6-----7-----8-----9
Cake	1-----2-----3-----4-----5-----6-----7-----8-----9
Mushroom	1-----2-----3-----4-----5-----6-----7-----8-----9
Candies	1-----2-----3-----4-----5-----6-----7-----8-----9
Pizza	1-----2-----3-----4-----5-----6-----7-----8-----9
Cantaloupe	1-----2-----3-----4-----5-----6-----7-----8-----9
Bacon	1-----2-----3-----4-----5-----6-----7-----8-----9
Rice	1-----2-----3-----4-----5-----6-----7-----8-----9
Onions	1-----2-----3-----4-----5-----6-----7-----8-----9
Pie	1-----2-----3-----4-----5-----6-----7-----8-----9
Salad	1-----2-----3-----4-----5-----6-----7-----8-----9
Chocolate	1-----2-----3-----4-----5-----6-----7-----8-----9
Sugar	1-----2-----3-----4-----5-----6-----7-----8-----9
Broccoli	1-----2-----3-----4-----5-----6-----7-----8-----9
Peas	1-----2-----3-----4-----5-----6-----7-----8-----9
Butter	1-----2-----3-----4-----5-----6-----7-----8-----9
Egg	1-----2-----3-----4-----5-----6-----7-----8-----9
Cream	1-----2-----3-----4-----5-----6-----7-----8-----9
Cookie	1-----2-----3-----4-----5-----6-----7-----8-----9
Soup	1-----2-----3-----4-----5-----6-----7-----8-----9
Cereal	1-----2-----3-----4-----5-----6-----7-----8-----9
Cherry	1-----2-----3-----4-----5-----6-----7-----8-----9
Puddings	1-----2-----3-----4-----5-----6-----7-----8-----9
Potato	1-----2-----3-----4-----5-----6-----7-----8-----9

APPENDIX D: SUPPLEMENTARY TABLES

Table A-1

Means and Standard Deviations of Food Words as Rated on the Food Evaluations Questionnaire

	<i>Mean</i>	<i>SD</i>
Nonforbidden Foods		
Celery	1.69	1.70
Carrots	1.55	1.35
Asparagus	1.53	1.35
Tomatoes	1.64	1.51
Mushroom	2.25	1.97
Cantaloupe	1.76	1.46
Rice	3.14	1.91
Onions	2.38	1.77
Salad	1.61	1.35
Broccoli	1.46	1.34
Peas	1.57	1.42
Egg	2.47	1.70
Soup	3.18	1.67
Cherry	2.33	1.70
Potato	3.33	1.77
<u>Total:</u>	<u>2.13</u>	<u>1.12</u>
Forbidden Foods		
Icing	7.39	1.68
Pastry	6.77	1.76
Chips	6.31	1.88
Cake	7.23	1.89
Candies	7.05	1.96
Pizza	6.20	2.08
Bacon	6.34	2.16
Pie	7.13	1.76
Chocolate	6.03	2.06
Sugar	6.34	2.07
Butter	5.81	2.11
Cream	6.01	2.01
Cookie	6.88	2.02
Cereal	4.22	1.99
Puddings	6.30	2.11
<u>Total:</u>	<u>6.39</u>	<u>1.38</u>

Table A-2

Mean, Standard Deviation, Range, Kurtosis, and Skewness of Transformed Dependent Variables

Dependent Variable	M	SD	Range	Kurtosis	Skewness
RT					
Neutral RT	-.02	.72	2.00	-1.55	.03
Nonforbidden RT	-.06	.69	2.00	-1.39	.17
Forbidden RT	-.01	.72	2.00	-1.55	-.05
Food RT	-.06	.69	2.00	-1.46	.18
AUC					
Neutral AUC	.44	.52	1.99	.65	-1.26
Nonforbidden AUC	.45	.49	1.99	.90	-1.24
Forbidden AUC	.42	.54	1.99	.29	-1.11
Food AUC	.43	.51	2.00	.79	-1.23
PC					
Neutral PC	.28	.41	1.41	-.74	.92
Nonforbidden PC	.25	.51	1.73	1.23	1.70
Forbidden PC	.22	.47	1.73	1.66	1.08
Food PC	.30	.46	1.58	-.30	1.11

*RT and AUC received cosign transformations whereas PC received a square root transformation

Table A-3

Kurtosis and Skewness of Untransformed Dependent Variables Amongst Genders

Dependent Variable	Males		Females	
	Skewness	Kurtosis	Skewness	Kurtosis
RT				
Neutral RT	4.66	25.36	.61	-.10
Nonforbidden RT	4.09	20.61	.63	.12
Forbidden RT	4.26	22.21	.67	.02
Food RT	4.20	21.58	.66	.03
MD				
Neutral MD	.66	.50	.24	-.51
Nonforbidden MD	.79	.18	.30	-.29
Forbidden MD	.78	.77	.25	-.48
Food MD	.81	.61	.22	-.54
AUC				
Neutral AUC	4.70	24.98	1.48	3.40
Nonforbidden AUC	4.50	23.30	1.51	3.38
Forbidden AUC	4.53	23.43	1.15	1.46
Food AUC	4.59	23.98	1.35	2.55
PC				
Neutral PC	1.85	3.43	1.74	3.00
Nonforbidden PC	2.01	3.00	2.30	4.76
Forbidden PC	2.50	5.53	2.40	5.25
Food PC	2.03	3.43	1.87	3.34

Table A-4

<i>Mean, Standard Deviation, Range, Kurtosis, and Skewness of Variables Amongst Females</i>					
Variables	M	SD	Range	Kurtosis	Skewness
DEBQ					
Restrained Eating	2.66	.83	3.80	-.28	.08
Emotional Eating	2.60	.94	3.92	-.63	.18
External Eating	3.27	.66	3.50	.10	.17
RT					
Neutral RT	1005.37	137.03	643.83	.61	-.10
Nonforbidden RT	1012.61	148.58	707.92	.63	.12
Forbidden RT	1013.60	147.88	675.09	.67	.02
Food RT	1013.11	146.49	680.42	.66	.03
MD					
Neutral MD	.40	.18	.85	.24	-.51
Nonforbidden MD	.40	.17	.79	.30	-.29
Forbidden MD	.41	.19	.84	.25	-.48
Food MD	.40	.18	.74	.22	-.54
AUC					
Neutral AUC	.43	.52	1.98	1.48	3.40
Nonforbidden AUC	.44	.50	1.99	1.51	3.38
Forbidden AUC	.41	.54	1.99	1.15	1.46
Food AUC	.42	.51	2.00	.42	-1.09
PC					
Neutral PC	.40	.58	2.00	1.74	3.00
Nonforbidden PC	.24	.49	1.73	2.30	4.76
Forbidden PC	.24	.49	1.73	2.40	5.25
Food PC	.30	.46	1.58	-.43	1.06

Note: Both AUC received a cosign transformation and PC received a square root transformation on order to be normally distributed.