Running head: ATTENTIONAL AND APPROACH

Attentional and Approach Biases for Food Cues in Normal Weight, Overweight, and Obese

Individuals

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Abstract

Few studies have examined eating behavior using the incentive-habit theory of addiction. The current study examined the relationship between eating behavior, incentive learning theory, and incentive-habit theory. A sample of undergraduate students completed two computer tasks. A matrix task was used to assess the participants' ability to attend to food-related pictorial cues, and a stimulus-response compatibility task measured the participants' tendency to approach food-related pictorial cues. Participants were also asked to complete a demographic questionnaire and the Eating Disorder Inventory (EDI). Height and weight for each participant was also measured for body mass index (BMI) calculations. Results evaluated the effect of BMI on EDI results and reaction times for an attentional task and an approach task. A general discussion considers the two competing theories as possible explanations for the increase of obesity in the United States.

Attentional and Approach Biases for Food Cues in Normal Weight, Overweight, and Obese Individuals

Obesity is rapidly becoming an epidemic across America (Desai, Miller, Staples and Bravender, 2008). Americans are known to be some of the largest people in the world, and the number of overweight individuals continues to grow. With obesity on the rise, research literature has shifted to obesity prevention and health maintenance techniques. A growing amount of research has not only addressed these issues, but has also considered compulsive eating as an addictive behavior (Orford 2001; Ozelli, 2007). In general, research suggests that there may be addictive properties in food that facilitate weight gain. The current study attempted to examine eating behavior within context of the incentive-habit theory of addiction.

Risk Factors Associated with Obesity

Compulsive eating behavior perceptions have been one topic of interest in current research literature. Desai et al. (2008) surveyed several college students about their perceptions on eating behavior. Several risk factors for being overweight were identified from this research. According to Desai et al. (2008), overweight participants (compared to participants of normal weight) had a higher fear of binge eating, as well as a preoccupation with food. Overweight individuals also had an increased desire to be thin and had exhibited dieting behavior (Desai et al., 2008). Physical inactivity was also noted as a potential risk factor for being overweight. Importantly, this research suggests that evaluating eating behavior attitudes may be utilized for prevention techniques (Desai et al., 2008).

Gender differences have been noted in other studies as potential risk factors for obesity (Hautala, Junnila, Helenius, Väänänen, Liuksila, and Räihä, 2008; Kashubeck-West, Mintz, and Weigold, 2005). For example, according to Hautala et al. (2008), females tend to have more

disordered eating patterns than males. The exact cause of the gender discrepancy is unknown. Kashubeck-West et al. (2005) suggest that females are concerned more with their body image than males. Current research also suggests that females tend to participate more in weight-loss regimens and have a stronger relationship between self-esteem and body image (Kashubeck-West et al., 2005).

Physical inactivity and diet have been identified as factors related to high-school students' eating behavior. Lowry, Lee, McKenna, Galuska, and Kann (2008) evaluated participants based on fruit and vegetable consumption, as well as weight management behaviors. According to Lowry et al. (2008), only 21-25% of the participants ate a substantial amount of fruits and vegetables. Decreased television viewing and being physically active were both correlated with healthy eating behavior (Lowry et al., 2008). Preferential behavior also may affect the types of foods a person will eat (Lowry et al., 2008). Based on the Lowry et al. (2008) findings, one begins to question the particular individual differences that cause one individual to eat healthier than another.

Eating Behavior Assessment

Two of the most common tools to assess disordered eating patterns are the Eating Attitudes Test 26 (EAT-26) and the Eating Disorder Inventory or EDI (Desai et al., 2008; Limbert, 2004; Waldherr, Favaro, Santonastaso, Van Strien, & Rathner, 2008). The EAT-26 has been commonly used to aid in the assessment of individuals with anorexia nervosa and bulimia, but not as a tool to assess overweight and obesity (Desai et al., 2008). Desai et al. (2008) used the EAT-26 to evaluate risk factors for obesity in a nonclinical sample. However, future research needs to consider the EAT-26 in nonclinical samples before reliability and validity can be determined.

The Eating Disorder Inventory (EDI) is another tool commonly used to assess eating behavior (Limbert, 2004; Waldherr et al., 2008). The EDI has been used successfully to assess bulimia and anorexia nervosa, as well as disordered eating patterns in nonclinical samples (Limbert, 2004; Waldherr et al., 2008). The EDI also evaluates several different psychological components. According to Waldherr et al. (2008), the EDI assesses feelings of inadequacy, perfectionism, distrust, body dissatisfaction, drive for thinness, interoceptive awareness, maturity fears, asceticism, impulse regulation, and social insecurity. Individuals who score high on these psychological components are more likely to display problematic eating behaviors.

Eating Behavior as an Addiction

Orford (2001) suggested that eating behavior may be considered an addiction. According to Orford (2001), addiction can be defined as “[A]n attachment to an appetitive activity, so strong that a person finds it difficult to moderate the activity despite the fact that it is causing harm” (p. 18). Obesity and eating disorders (such as bulimia and anorexia nervosa) can be classified under this very basic definition (Orford, 2001). In other words, eating behavior that is not controlled can lead to a greater risk of becoming overweight or obese. The same uncontrolled eating behaviors may also be considered addictive if they are persistent.

Research conducted by Pisetsky, Chao, Dierker, May, and Striegel-Moore (2008) offers additional support that eating behavior may be related to addictive behavior. Pisetsky et al. (2008) evaluated the relationship between disordered eating and substance abuse in nearly 14,000 high school students. Results from this study suggest that disordered eating is significantly correlated with substance use of the following substances: cigarettes, alcohol, marijuana, cocaine, inhalants, heroin, methamphetamines, ecstasy, steroids, and hallucinogens (Pisetsky et al., 2008). Gender differences were also noted within this study, in that the strongest

associations for females were smoking, binge drinking, and inhalants (Pisetsky et al., 2008). Male participants had the strongest associations with marijuana, steroids, and inhalants (Pisetsky et al., 2008). Overall, this study concluded that disordered eating is correlated with a higher risk of substance abuse (Pisetsky et al., 2008). This behavioral conclusion corresponds with Orford's (2001) theory, which considers eating behavior as a possible addiction.

Neuroimaging Studies

Ozelli (2007) has also found similarities between eating behaviors and other addictive behaviors. According to neuroimaging studies, compulsive eating is linked to the same brain circuits as drug addiction (Ozelli, 2007). The brain circuitry is activated at the sight of the addictive substance or by environmental cues related to the addictive substance (Ozelli, 2007). Interestingly, Orford (2001) notes that if the fundamental differences between compulsive eating and drug abuse are put aside, research within both areas may be used to develop treatment techniques. This is in direct agreement with Ozelli (2007). Ozelli (2007) also states that both obese individuals and drug addicts may have developed these addictions based on an incorrect response to dopamine, which is responsible for reward-seeking behavior.

Reward-seeking is a communal aspect of both eating behaviors and drug use (Ozelli, 2007). According to Ozelli (2007), the brain circuitry that is activated by both food and drug is also the same network that rewards survival behavior. Both food and drugs alike are recognized by the brain for their rewarding properties (Ozelli, 2007). As individuals increase food intake (or drug intake) the dopamine which is released into the striatum allows the individual to experience the pleasurable side effects, thus conditioning the individual to associate the reward with the intake of the food or the drug (Ozelli, 2007). In particular, foods with high caloric values are more rewarding than foods of lower caloric value. From an evolutionary standpoint, high caloric

foods have historically been of greater value because food sources were not readily available (Ozelli, 2007). This form of conditioning could be the underlying process that establishes compulsive eating behaviors (Ozelli, 2007).

Several studies have indicated that the striatum and the dopamine pathways affect outward behavior concerning both drug and food addictions. According to McClernon, Kozink, Lutz and Rose (2009), there is greater brain activity in the dorsal striatum after a smoker has been abstinent. This neural activation is triggered by the site of smoking cues (McClernon et al., 2009). Volkow, Wang, and Fowler (2002) discovered that dopamine within the dorsal striatum plays a significant role in reward regulation concerning food consumption. Geiger, Haburcak, Avena, Moyer, Hoebel, and Pothos (2009) researched the interaction between dietary behavior and dopamine release. Results from this study concluded that when dopamine release is depressed, obese animals (in this case rats) will compensate by eating high caloric foods to release more dopamine (Geiger et al., 2009). In contrast, Stice, Spoor, Bohon, et al. (2008) found that obese females showed great activation on an fMRI in somatosensory regions when presented a milkshake over a tasteless solution; however striatum activation during food intake itself was relatively weak. The weak association was hypothesized to be contingent upon depleted dopamine receptors in obese individuals (Stice et al., 2008).

Classical Conditioning

The underlying classical conditioning concepts mentioned by Ozelli (2007) are supported by other associative learning models such as flavor-nutrient learning, flavor-flavor learning and conditioned satiety (Brunstrom, 2007; Havermans & Jansen, 2007; Myers & Sclafani, 2006). Myers & Sclafani (2006) state that individuals learn to prefer or reject certain foods based on the positive and negative ingestive and postingestive consequences, which is the basis for flavor-

nutrient learning. According to Brunstrom (2007) and Havermans and Jansen (2007), flavor-flavor learning is based on the association of two previously unrelated flavors. When one flavor (CS) is paired several times with another food (US) that has either positive or aversive properties, the CS eventually takes on the property of the US (Brunstrom, 2007; Havermans & Jansen, 2007). Conditioned satiety is yet another way humans can be classically conditioned based on food stimuli. Conditioning through satiety occurs when the sensory properties of the food are linked to the internal states caused by the food (Brunstrom, 2007). According to Ozelli (2007), each of these classical conditioning paradigms can also be supported through neuroimaging.

Addiction Theories

In addition to the neuroimaging studies, there are two theoretical viewpoints that may also support disordered eating behaviors as an addiction in terms of conditioning. The incentive learning theory is based on the concept that incentives associated with the drug become more salient through repetition (Mogg, Field, & Bradley, 2005, p. 333). In other words, as individuals become classically conditioned to prefer a particular substance, it will take more of that substance to fulfill their needs. This theory is illustrated in a number of different food consumption studies. According to Epstein, Robinson, Temple et al. (2008), overweight children habituate more slowly to food than children of normal weight. In this case, the overweight children need more of the food than the children of normal weight, which is an example of incentive learning theory. Incentive-habit theory is derived from incentive learning concepts. Incentive-habit theory states that addictions are habitual, but they may be derived from incentives (Mogg et al, 2005). According to this theory, individuals are classically conditioned through incentives. However, once the incentives become addictive, then the individual's

behavior becomes habitual. This changes the relative *want* into a *need*, allowing the individual to become dependent on the food or substance.

To bridge the gap between research on food addiction and drug addiction, the current study used a paradigm that has been utilized by several studies evaluating nicotine addiction. Both attentional bias and approach bias tasks have been used to evaluate differences in nicotine dependence (Mogg et al., 2005; Thewissen, Havermans, & Geschwind et al., 2007). Participants were stratified as either high-dependent smokers or low-dependent smokers (Mogg et al., 2005; Thewissen et al., 2005). Each participant was asked to complete both an attention bias task and an approach bias task with smoking-related cues vs. a control picture. Results of these studies concluded that low-dependent smokers tend to fixate and approach smoking cues more readily than high-dependent smokers (Mogg, et al., 2005; Thewissen et al., 2007). This supports the incentive-habit theory of addiction. According to Mogg et al. (2005), the high-dependent smokers have habituated to the smoking-related cues, whereas the low-dependent smokers have not.

Overview of the Current Study

Currently, there is no research examining disordered eating within an incentive-habit framework. By using a similar paradigm to the Mogg et al. (2005) study, the current study evaluated the incentive-habit theory in three different weight classifications: normal weight, overweight, and obese. Considering previous articles stating that normal weight, overweight, and obese individuals perceive food differently (Desai et al., 2008; Lowry et al., 2008), the incentive-habit theory may be a possible explanation for varying perceptions of food cues. Similar to the Mogg et al. (2005) study, participants in this study were evaluated based on their reaction times to food cues in an attentional task and in an approach bias task.

Hypotheses for the current study are also based on the results of the Mogg et al. (2005) and Thewissen et al. (2007) studies. The hypotheses were derived from theoretical beliefs that food can be considered addictive (Orford, 2001), which is also illustrated by neuroimaging studies (Ozelli, 2007). In particular, neuroimaging studies suggest the same brain circuitry is activated in both drug addicts and obese individuals when drug cues or food cues are present, suggesting a link between addiction and food (Ozelli, 2007). In particular, the hypotheses are framed to support the incentive habit theory of addiction (Mogg et al., 2005; Thewissen et al., 2007). In hypotheses 1, 2, and 3 the term sensitization refers to faster reaction time to food cues in the attention task, and faster approach time and slower departure time to food cues in the approach task.

H1: Individuals who are overweight exhibit greater sensitization towards food cues on attentional and approach tasks than obese individuals.

H2: Dieters exhibit greater sensitization towards food-related cues than non-dieters within their stratified group.

H3: Females exhibit greater sensitization towards food-cues than males within their stratified group.

H4: EDI scores are correlated with food-cue reaction time, BMI category and gender.

Method

Participants

Seventy-five participants were recruited primarily through undergraduate psychology courses. One participant was dropped from the study due to a computer malfunction during testing. Another participant was dropped from the study because her BMI was below the normal

weight range. The remaining 73 participants (44 female, 29 male) completed all aspects of the study. Participants' age ranged from 18-30 years ($M = 20.20$, $SD = 2.18$). Ninety-five percent of the participants were Caucasian. Participants were placed in three distinct categories: normal weight (NW), overweight (OW), and obese (O). Classifications for each category were determined by BMI scores. The distribution of BMI scores were as follows: 27 normal weight, 32 overweight, and 14 obese.

Materials

Computer Tasks. The attentional task and approach task were both designed using the psychological software Inquisit (Inquisit 3.0.3.2, 2009). Each task was designed to model similar computer programs utilized in previous paradigms which assessed the relationship between attentional and approach biases and smoking behavior (Thewissen et al., 2007; Mogg et al., 2005). The software was loaded onto two Gateway computers with 18.1 and 17 inch monitors. Each computer was located in a separate room to lessen distraction.

A 4x4 matrix task was designed to elicit attentional biases towards pictorial food cues. All pictorial cues were found using an online web search. Food images consisted of fruits, vegetables, meats, grains, dairy, junk food, and various plates of food. Control images were images of athletes such as: football, basketball, tennis, soccer, and hockey players, as well as gymnasts, golfers, runners, and bikers. Both pictorial control cues and experimental cues were displayed at random within a 4x4 matrix with fifteen neutral images (Daneneau & Baldwin, 2004). Pictorial cues were also used for the approach task or stimulus response compatibility (SRC) task to assess the avoidance bias in each participant. Each task was randomized to eliminate any sort of practice effects. The presentation of the food images were also randomly selected by the computer program for each participant.

Questionnaires and BMI calculations. A demographic questionnaire was given to acquire basic information about the participants. The EDI was used to assess dieting behavior (Limbert, 2004; Waldherr et al., 2008) and weight belief discrepancy, which is defined as the difference between actual weight and ideal weight. In addition to the EDI, BMI was assessed based on weight and height measurements:

$$\text{BMI} = \left(\frac{\text{Weight in Pounds}}{(\text{Height in inches}) \times (\text{Height in inches})} \right) \times 703$$

Participants were assigned to BMI categories based on a range of BMI scores (Flegal, Carroll, Ogden, & Curtin, 2010). A BMI score of 18.4 or below is considered underweight. A BMI score of 18.5 - 24.9 is within the normal weight range, 25.0 - 29.9 is overweight, and 30.0+ is obese.

Procedure

All participants were tested in the evening in a quiet research lab. Each participant was asked to refrain from eating, drinking, smoking and exercising two hours prior to the beginning of each session. Eighty-six percent of participants complied with this requirement. The remaining 14% ranged from eating a small snack to eating a complete meal before the study. At the beginning of each session, each participant was given a consent form, which was signed before continuing with the experiment. After the introductory material had been gathered, participants were told to sit at a desk in front of a computer monitor approximately 1.1 m distance from the screen (Mogg et al., 2005).

Next, each participant completed either the attentional task or the SRC (or approach bias) task. For the attentional task, a 4x4 matrix was presented for a total of 120 experimental trials. The experimental trials were preceded by 10 practice trials for both the food cues and the athletic cues. Each participant was asked to locate either a pictorial food cue or a picture of an athlete in

each matrix. Sixty trials were designated to both the control image and the experimental image. Each attentional task was broken down into blocks of 20, where each participant alternated between searching for the food cue or the athletic cue. Each matrix was presented until the participant clicked on the appropriate cue using the computer cursor. Once the food cue or athletic cue was found, the next 4x4 matrix was presented. Participants were given the opportunity to take a brief break after each experimental block to eliminate any sort of fatigue caused by the computer program.

The SRC task was adapted from the Mogg et al. (2005) and Thewissen et al. (2007) studies. Each task consisted of a picture cue at the right side of the screen. The pictures that were presented in the SRC task were either food cues or neutral cues. A manikin image was also presented with the pictorial cue in the middle of the screen. The SRC task was divided into two different segments with different stimulus-response assignments, which were randomized across participants (Mogg et al., 2005). Each segment consisted of 80 trials. In one segment participants were asked to respond to the pictures by moving the manikin towards the pictorial food cues and away from the neutral pictures. In the other segment, participants moved the manikin *away* from the food-related pictures and *towards* the neutral images. To move the manikin the participants used the “f” and “j” keys located on the computer keyboard. Once the manikin reached the picture or the edge of the screen the image faded from the screen and the next trial began, this was accomplished by pressing either key 5 times (Mogg et al., 2005).

The participants were presented with the demographic questionnaire and the EDI after both the attentional and approach bias tasks were completed. Participants’ height and weight were measured for BMI classifications. Height and weight were collected at the conclusion of the study. This was to ensure that the weigh-ins themselves did not lead to confounds during

testing. After height and weight were recorded, participants were informed that they would receive a debriefing email as soon as all the data had been collected.

Results

Descriptive Statistics

Before evaluating the results of the two computer tasks, preliminary analyses were conducted to examine potential outliers and descriptive statistics for this sample. Outliers were defined by 2 standard deviations above or below the mean. Outliers were considered for both the attentional task and the approach task, however the small amount of outliers did not make a significant difference in the results, therefore all data was analyzed.

Table 1 illustrates the mean and standard deviation for age, BMI, actual weight, ideal weight, and weight-belief discrepancy. The average BMI for this sample was 27.19; according to the Centers for Disease Control and Prevention this number falls in the overweight category (Flegal et al., 2010). Interestingly, 64 participants reported a lower ideal weight than their actual weight ($M = 19.46$, $SD = 29.38$). This finding was found across normal weight, overweight, and obese categories. Six participants reported no difference between their actual weight and ideal weight. Only three participants reported a higher ideal weight. All three participants who reported a higher ideal weight were within the normal weight BMI category.

Analysis of Variance

A 3 (BMI category) x 2 (picture type) x 2 (dieting) x 2 (gender) factorial ANOVA was conducted used to analyze hypotheses 1-3. *H1* predicted that overweight individuals would show greater sensitization towards food cues in both computer tasks. Overall, BMI category showed no main effect on the attentional and approach tasks, $F(2, 71) = 1.043$, $p = 0.415$, $\eta^2 = .096$. Thus, no differences found within any BMI category. Dieting alone showed no effect on

either the approach task or the attentional task, $F(1, 72) = .392, p = 0.882, \eta^2 = .039$. There were also no interactions between BMI and dieting on all computer blocks except for the matrix athlete task, $F(2, 71) = 3.945, p = 0.024, \eta^2 = .111$. Non-dieting normal weight participants found the picture of the athlete quicker than normal weight dieters. Also, dieting obese individuals had a faster reaction time than non-dieters within the obese category. *H3* predicted that gender differences would affect food-cue reaction time. In particular, females were predicted to exhibit greater sensitivity towards food-cues than males within each BMI category. Overall, gender had no main effect on reaction time in either computer task, $F(1, 72) = .567, p = 0.755, \eta^2 = .055$. There were also no interactions between gender and BMI category, $F(2, 71) = .680, p = 0.768, \eta^2 = .055$, therefore *H3* was not supported.

General Trends

Although no significant effects or interactions were discovered to support *H1*, *H2*, or *H3*, there were some general trends that partially support the predictions. Means and standard deviations for each computer task can be found in Table 2, and are illustrated in Figures 1-3. Figure 1 illustrates that overweight participants took longer to find the food cue in the matrix task than normal weight and obese individuals ($M = 1735.59$ ms, $SD = 308.87$). However, Figure 1 also illustrates that overweight participants have the quickest react time for the athletic cues ($M = 1656.39$ ms, $SD = 242.29$). Normal weight and obese individuals had similar reaction times to both the matrix food and the matrix athlete task. Figure 2 shows that each BMI category approached food more quickly than they avoided a neutral cue. Interestingly, each BMI category had approximately the same reaction time for the approach food task, as well as the avoid neutral task. Figure 3 illustrates the SRC avoid food task. In the SRC avoid food task normal weight ($M = 1220.51$ ms, $SD = 283.93$) and obese participants ($M = 1324.66$ ms, $SD = 208.27$) approached

neutral pictures more quickly than they avoided food pictures ($M = 1298.58$ ms, $SD = 207.71$; $M = 1397.19$ ms, $SD = 269.28$). Overweight individuals had nearly the same reaction time for approaching the neutral cue and avoiding the food cue, which is interesting considering the reaction time discrepancy in Figure 1.

Figures 4-6 illustrate gender differences for each of the computer task. As previously mentioned, no significant results were found. The two biggest discrepancies that were found were in the matrix task and the avoid food task. In the matrix task, females ($M = 1660.96$ ms, $SD = 233.68$) found the food cue quicker than males ($M = 1793.57$ ms, $SD = 353.41$), which is consistent with *H3*. Females also approached the neutral cue quicker than males in the avoid food task ($M = 1244.60$, $SD = 198.61$; $M = 1338.21$, $SD = 312.97$).

Correlations

Pearson product-moment correlations were used to examine the relationship between reaction time, gender, and BMI category with the body dissatisfaction subscale of the EDI. *H4* predicted that EDI scores would correlate with reaction time, BMI category, and gender. Results from this study concluded that there were no correlations between reaction time in either computer task and scores on the body dissatisfaction subscale. However, scores on the body dissatisfaction subscale were negatively correlated with gender, $r = -.49$, $p < 0.01$, and positively correlated with BMI category, $r = .33$, $p < 0.01$. Thus, females reported greater body dissatisfaction than males, and individuals who weighed more tended to report greater body dissatisfaction.

Discussion

The basis of this research was to question whether being overweight and obese could be related to food addiction. There are two theories linked to addictive behavior. The incentive

learning theory considers addictive behavior to be based on tolerance (Mogg et al., 2005). Thus, the more an individual eats, the more it will take to satisfy his or her cravings. This will also increase the desire to obtain more food. The incentive-habit theory states that individuals eventually habituate to the addictive stimuli (Mogg et al., 2005). Thus, changing *wanting* the stimuli into *needing* the stimuli. When individuals reach this point their behaviors are often out of conscious control and become more automatic. Therefore, these individuals are not as responsive to stimulus cues that were once salient.

This research considered eating behavior as a possible addiction related to incentive-habit theory concepts. Hypotheses for this study were developed on the basis that the more a person weighs; the more likely they are to have habituated to food-related cues. For example, according to the incentive-habit theory individuals who are obese should have a slower reaction time to food-related pictorial cues than overweight individuals. It was hypothesized that overweight individuals would find and approach food cues quicker than obese individuals. However, this finding was not supported. In fact, overweight individuals were slower to find food cues than normal weight and obese participants; although this finding was not significant. Also, according to the incentive-habit theory, overweight individuals should have a slower reaction time when moving away from a food cue than obese individuals. However, results indicated that there were no significant differences between BMI category and reaction time to food cues. Interestingly, both the incentive-habit theory and incentive learning theory were not supported based on this research. This comes as a surprise because the incentive learning theory in particular has been supported in previous research studies examining food intake (Epstein et al., 2008).

Although no support was found for the hypotheses, there was an interaction between dieting and BMI category on the matrix athlete task (see Figure 7). Non-dieting normal weight

participants had a quicker reaction time to the athletic cues in the matrix athlete task than normal weight dieters. Interestingly, the opposite trend was found for obese individuals. Dieting obese individuals had a faster reaction time to athletic cues than obese non-dieters. One possible explanation for this finding is that non-dieting normal weight individuals may be more likely to play sports or engage in athletic activities. This may make athletic cues more salient for normal weight non-dieters. The same sort of explanation may explain why obese dieters had quicker reaction times than obese non-dieters. Obese individuals who are dieting may be more physically active than obese non-dieters, which may make athletic cues more salient. Although there was a significant interaction between BMI and dieting, these results were only based on 7 dieters within the sample. Therefore, results may not be representative of a larger dieting population.

General trends suggested that overweight individuals reacted differently in the attentional task and the approach task. Figure 1 illustrates that overweight individuals had a slower reaction time towards food cues, however Figure 3 illustrates that overweight participants approached the neutral cue, and avoided the food cue at approximately the same time. In other words, implicitly overweight individuals take longer to react to food cues than a control, explicitly overweight individuals reaction times are about the same for the avoid food task. This is analogous to the framework of the incentive habit theory. The argument could be made that overweight individuals may have already habituated to food cues due to the implicit nature of the attentional task.

Several limitations to this study may have contributed to the lack of significant results. There are several methodological shortcomings that can be improved upon in future research. First, the food-cue tasks were done on a computer. A computer simulation of finding,

approaching, and avoiding a food pictorial cue is fundamentally different than actually seeing and seeking real food. Overall, the results suggested basic trends in finding, approaching, and avoid food cues, however none of these results were significant. This may be partially due to the fact that computer simulation may not be an accurate measurement of food-related behaviors.

The characteristics of the participant sample may also have contributed to some methodological shortcomings. The majority of the participants were Caucasian undergraduate students. Therefore, this research cannot be generalized to a broader population. According to the Center of Disease Control and Prevention (2009), African-Americans have a prevalence of obesity that is 51% greater than Caucasians, and the prevalence of obesity in Hispanics is 21% greater. The prevalence of obesity in different ethnic groups suggests that there may be some fundamental differences between groups that the current study could not evaluate. Results of this study may have been different with a more heterogeneous group.

Another possible methodological issue to consider is sample size. The overall distribution of BMI categories for the sample size was fairly accurate. However, the number of participants in each group was relatively small. If a similar study were to be conducted for further research, more participants in each group may yield differences between groups. The same can be said for the sample of individuals who were dieting. Only 7 participants reported that they were dieting, which makes it difficult to report any sort of main effects or interactions concerning dieting and the two computer tasks.

Another possible limitation to this study is the very fact that food in general may not be considered an addictive stimulus. Unlike the Mogg et al. (2005) and Thewissen et al. (2007) studies, food is an essential part of our survival. It is difficult to say that food is addictive when we need it every day. Mogg et al (2005) and Thewissen et al (2007) evaluated cigarette smoking

and dependence on nicotine. Nicotine is a substance that it is not necessary for survival, and it is an addictive substance, therefore it fits neatly under the incentive-habit theory framework. Davis and Carter (2009) stated that the act of eating itself is not necessary addicting but that overeating shares similarities with drug addiction. A potentially better way to assess eating behavior within the incentive-habit framework would be evaluate the frequency in overeating in comparison to BMI. It may also be more beneficial to consider normal weight individuals as the “low dependent” group and overweight and obese individuals as the “high dependent” group. This sort of restructuring takes into account the fact that everyone needs food for survival, but those who eat in excess may be addicted to the rewarding properties of food. This also would be in agreement with the overweight trends illustrated in Figure 1 and Figure 3 that were mentioned previously.

Another important factor to consider in further research would be the kind of food that may be considered addictive. Some foods have more physiological rewarding qualities than others. According to Taylor, Curtis, and Davis (2010), and Ozelli (2007) foods that are calorie-dense and high in fat are more physiologically rewarding than more healthy foods. In the current study, a wide variety of food images were used and all main food groups were represented. Significant results may be obtained by comparing BMI categories with finding, approaching, and avoiding food cues that are high in fat and caloric value.

In summary, the current research attempted to bridge the gap between obesity and addiction. Many research articles consider overeating an addictive process (Orford, 2001; Ozelli, 2007; Taylor et al., 2010). The incentive-learning theory and incentive habit theory may be two possible ways of explaining how this process begins and how it is maintained (Mogg et al., 2005). The current study did not find any significant differences between BMI categories

and food cue reaction time. Future research should take into consideration the possible limitations mentioned above, as well as other literature concerning food addiction and obesity. It is important to understand that the nature of obesity is multifaceted. In order to tease out individual differences between each BMI category, and the possible causes of obesity, further research should consider complex interactions between cognitive, neurological, and behavioral variables.

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Table 1

Descriptive Statistics

Measures	<i>M</i>	<i>SD</i>
Age	20.20	2.18
BMI	27.19	6.29
Actual Weight	167.84	44.79
Ideal Weight	148.38	32.21
Weight-Belief Discrepancy	19.46	29.38

Table 2

Means (Standard Deviations) for Attentional and Approach tasks

BMI Category	Attentional Task Means (SD)		Approach task Means (SD)			
	Food Cue	Athletic Cue	Approach Neutral	Avoid Food	Approach Food	Avoid Neutral
Normal Weight	1684.24 (283.93)	1662.67 (376.26)	1220.51 (267.80)	1298.58 (207.71)	1095.40 (186.35)	1262.94 (191.80)
Overweight	1735.59 (308.87)	1656.39 (242.29)	1315.49 (251.78)	1303.06 (287.03)	1143.49 (211.62)	1300.34 (217.72)
Obese	1691.72 (268.74)	1697.26 (338.92)	1324.66 (208.27)	1397.19 (269.28)	1094.12 (150.78)	1267.97 (360.71)

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

Figure 1. Average reaction times for the attentional task based on BMI category.

Figure 2. Average reaction times for the SRC approach food task based on BMI category.

Figure 3. Average reaction times for the SRC avoid food task based on BMI category.

Figure 4. Average reaction times for males and females on the attentional task.

Figure 5. Average reaction times for males and females on the SRC approach food task.

Figure 6. Average reaction times for males and females on the SRC avoid food task.

Figure 7. Interaction between non-dieters and BMI category on the matrix athlete task.

Appendix A

ID #: _____

Demographic Questionnaire

Please answer each question as honest as possible.

1. What is your age? _____
2. Are you male or female? _____
3. My current year in college is:
 - a. Freshman
 - b. Sophomore
 - c. Junior
 - d. Senior
4. I consider myself a member of the following racial/ethnic group:
 - a. African-American
 - b. Asian-American
 - c. Caucasian
 - d. Hispanic-American
 - e. Native American/American Indian
 - f. Other (specify): _____
5. How much has your body weight fluctuated in the last year?
 - a. over 15 lbs
 - b. 10-15 lbs
 - c. 5-9 lbs
 - d. not much fluctuation (+/- 4lbs or less)
 - e. - 5-9 lbs
 - f. - 10-15 lbs
 - g. - more than 15 lbs
6. How many hours of sleep do you typically get on a given night?
 - a. 2-4
 - b. 5-6
 - c. 7-8
 - d. 8+

7. How often do you smoke?
 - a. Never
 - b. Occasionally
 - c. Daily, less than one pack a day
 - d. Daily, more than one pack a day

8. How often do you exercise?
 - a. Never
 - b. Occasionally
 - c. Once a week
 - d. Several times a week
 - e. Daily

9. How many meal (including snacks) do you typically eat in one day?
 - a. 1
 - b. 2-3
 - c. 4-5
 - d. 5+

10. Overall, I would rate my healthy **habits** as:
 - a. Excellent
 - b. Good
 - c. Average
 - d. Below average
 - e. Poor

11. Overall, I would rate my general health as:
 - a. Excellent
 - b. Good
 - c. Average
 - d. Below average
 - e. Poor

12. Did you eat, drink, or smoke within two hours of your designated study time?
 - a. Yes
 - b. No

13. If yes, please specify how much you ate, drank, and/or smoked.

14. Are you currently participating in any sort of diet regimen?
 - a. Yes
 - b. No

Appendix A

EDI

ID# _____ Date _____

Highest past weight (excluding pregnancy) _____ (lbs)

How long ago? _____ (months)

How long did you weigh this weight? _____ (months)

What do you consider your ideal weight? _____ (lbs)

Completed by researcher:

Height _____	appRT _____
Weight _____	
EDI Score _____	attRT _____

Appendix C

PSYCHOLOGICAL RESEARCH INFORMED CONSENT**Healthy Habits: How Individuals React to Health-Related Pictorial Cues****Principle Investigator:** Lisa Siegfried

Purpose: The purpose of this study is to evaluate gender differences concerning health behaviors and reaction time to health-related pictorial cues. Gender differences will be evaluated by a demographic questionnaire, Eating Inventory (EI), two computer tasks, and BMI (which includes height measurements and weigh-in at the end of the study).

Possible Risks/Benefits: Working with the computer software may cause minor eye irritation. In order to minimize this potential risk participants will be allowed a one minute break between each computer task. Also, participants may be slightly apprehensive about the weight-in at the conclusion of the study. The risks of this study are perceived to be minimal with no long-term effects. However, the participant has the right to withdrawal from the study at any point in time without penalty. Possible benefits of this study would be gaining participation credit for an introductory psychology course, as well as the satisfaction of participating in a study that expands psychological literature.

Privacy: All participant information will be kept confidential. The information that is gathered will be used for this study only. Participant names will be kept separate from all data collected to ensure confidentiality. Participants will also be fully debriefed at the end of the study.

Agreement: I have read the Informed Consent Form in its entirety and agree to participate in the study based on the information provided. I have asked any questions that I may have about the study at this time, and have received adequate answers to my questions. I have also been informed that I may contact principle investigator Lisa Siegfried (las002@marietta.edu) with any further questions that I may have regarding this research study. For any questions regarding your rights as a participant, please contact the Human Subjects Committee.

Participant Printed Name_____
Participant Signature_____
Date_____
Participant E-mail Address_____
Investigator Signature