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The Effects of Eating Behaviors and Exercise Patterns on the Processing of Food and Exercise Related Stimuli

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Abstract

The effectiveness of Cognitive Behavioral Therapy (CBT) for eating disorders has established a link between cognitive processes and unhealthy eating behaviors. However, the relationship between individual differences in unhealthy eating behaviors that are not related to clinical eating disorders, such as overeating and restrained eating, and the processing of food related verbal stimuli remains undetermined. Furthermore, the cognitive processes that promote unhealthy and healthy exercise patterns remain virtually unexplored by previous research. The present study compared individual differences in attitudes and behaviors around eating and exercise to responses to food and exercise-related words using a Lexical Decision Task (LDT). Participants were recruited from Colby (n = 61) and the greater Waterville community (n = 16). The results indicate the following trends in the data: Individuals who scored high in "thin ideal" responded faster to food-related words than individuals with low "thin Ideal" scores did. Regarding the exercise-related data, individuals who engage in more "low intensity exercise" responded faster to exercise-related words than individuals who engage in less "low intensity exercise" did. These findings suggest that cognitive schemata about food and exercise might mediate individual's eating and exercise patterns.

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Eating Disorders and Obesity

The prevalence of eating disorders in the United States is increasing at an alarming rate. Currently, it is estimated that eight million Americans have an eating disorder—seven million women and one million men (South Carolina Department of Mental Health, 2009). Out of all the mental illnesses, eating disorders have the highest mortality rate. Anorexia and bulimia have traditionally been viewed as the most threatening eating disorders, as they have been known to cause those afflicted to starve themselves to death [Center for Disease Control (CDC), 2009]. Anorexia Nervosa (AN) is characterized by a refusal to maintain at least 80% of the normal body weight for one's height (*Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revision [DSM-IV-TR]*, 2000). There are two types of AN: restricting type, which involves eating little to no food, and binge eating/purging type. Bulimia Nervosa (BN) is commonly confused with the binge eating/purging type of AN, as both disorders involve episodes of binge eating followed by an attempt to purge one's system through extreme exercising, vomiting, or taking laxatives. A binge could include eating an entire cheesecake, a pint of ice cream, and batch of cookies within a half hour period. However, victims of BN are able to maintain a normal body weight, while those suffering from the binge eating/purging type of AN cannot. Binge eating disorder (BED) has more recently surfaced as another serious eating pathology. People suffering from binge eating disorder feel a total loss of control over what they eat and engage in binges at least twice

a week during which they eat far beyond the point of being full. Unlike BN, BED is not characterized by purging behaviors.

Although the gravity of these disorders surely merits attention, obesity is currently the most prevalent eating problem in the United States (CDC, 2009), even though it is not recognized as an eating disorder by the DSM-IV. In 2006, 33% of adult men and 35% of adult women were classified as obese. Children and adolescents had a prevalence rate of 16% (CDC, 2009). This fact is especially noteworthy because obese children have a heightened risk of developing morbid obesity later in life. Obesity is most commonly defined as having a body mass index (BMI) equal to or greater than 30 (Kuczmarski & Flegal, 2000). BMI is a fraction used to assess the ratio of weight to height and is calculated with the formula kg/m^2. A BMI of 19.0-24.9 is considered to imply a healthy weight, while BMI's below 19 and above 25 are considered underweight and overweight respectively. However, BMI is not a completely accurate reflection of obesity, since it does not take sex or muscle mass into account. Overeating, lack of exercise, genes, and metabolism have all been shown to be contributing factors of obesity. Adults with obesity are more likely than normal weight individuals to suffer from many other health problems, including heart disease, cancers, and gynecological problems (CDC, 2009). Because the prevalent unhealthy eating patterns related to obesity fall outside the clinical definition of an eating disorder, it seems critical to examine unhealthy eating patterns that are either unrelated to eating disorders or might put individuals at risk for developing an eating disorder

The Role of Cognition

Researchers have found that cognitive processes such as preoccupations with food, body image, and body weight are related to the development of eating disorders (Cooper & Fairburn, 1992). This finding is the basis of the cognitive theory (CT) on eating pathology, and inspired the use of Cognitive Behavioral Therapy (CBT) for treating AN, BN, and BED (Fairburn, Marcus, & Wilson, 1993). CBT works to alter the cognitions that perpetuate unhealthy behaviors, so in eating pathology, CBT targets the cognitions associated with unhealthy eating behaviors. Currently, CBT is considered to be one of the most effective means of treatment for eating disorders. The effectiveness of CBT suggests that a preoccupation with food and body image may be a key factor in the persistence of eating disorders.

Although researchers have established a strong connection between cognitive responses to food and weight and the development of eating disorders, these processes have not been shown to play as strong a role in the development of obesity (Nauta, Hospers, Jansen, & Kok, 2000). However, there is some evidence to suggest that certain higher-order cognitive processes are related to the development and persistence of obesity and propensity for weight-gain (Byrne, Cooper, & Fairburn, 2004; Byrne, Allen, Dove, Watt, & Nathan, 2008; Kubiak, Vogele, Siering, Schiel, & Weber, 2008). After an individual initially perceives a stimulus, higher-order cognitive processes can affect how they encode and recall that stimulus (Luck & Vecera, 2002). Attention plays an important role in both earlier and later cognitive processes. During the initial processing of a stimulus, attention focuses the individual on a specific stimulus and prevents sensory memory from becoming overloaded. After initial perception, however, attention also

functions to keep an individual focused on a stimulus. If an individual does not attend to a stimulus, he or she cannot engage in higher order cognitive processes, such as maintaining the stimulus in working memory or encoding it into long-term memory. Therefore, researchers also look at how individuals' attend to stimuli differently when examining higher-order cognitive processes. Previous research suggests that certain higher-order cognitive processes may be related to unhealthy eating behaviors associated with weight gain or being overweight.

One higher order cognitive process that has been linked to weight gain is dichotomous thinking, or thinking in black and white terms (Byrne et al., 2004). Byrne and colleagues (Byrne et al., 2004; Byrne et al., 2008) studied whether thinking dichotomously about weight and health issues is related to an individual's tendency to gain weight. They suggested that individuals struggling with weight gain might exhibit high levels of dichotomous thinking. This could increase their chance of "falling off of the wagon" once they break their diets, because they think that one mistake destroys their diet completely. This inability to recover from breaking their diet could cause these attempting dieters to gain a large amount of weight and put them at risk for obesity. Although the relationship between dichotomous thinking and obesity has not been firmly established, Kubiak et al. (2008) found that obesity is related to ruminating on negative thoughts, another higher order cognitive process. They examined the common pattern of "emotional eating" in response to a negative thought or event, and found that obese individuals must actively ruminate or dwell on these negative thoughts in order for them to predict eating and potential weight gain. This pattern of eating directly after engaging

in rumination further suggests that higher-order cognitive processes promote unhealthy eating behaviors.

Although previous studies have suggested a relationship between weight gain and higher-order cognitive processes, the extent to which early-level cognitive processes are associated with unhealthy eating behaviors remains unclear. Researchers have attempted to examine how early-level cognitive processes relate to propensity for weight gain by looking at individual differences in schemata around food. According to Neisser (1976), a schema is a knowledge structure that guides information processing (as cited in Soetens & Braet, 2007). Schemata group related pieces of information together and allow individuals to make inferences about schema-relevant material. For example, if an individual invites a friend to breakfast, their friend would probably assume that the meal would include bagels, eggs, or cereal, because those food items fit into their schema of what breakfast is. Their friend would be surprised, however, if lobster was served, because lobster is not included in most people's schemata about breakfast. Soetens and Braet identified a potential schema that may be particular to obese individuals as a preoccupation with weight, shape, and eating related information. If obese individuals do have such a schema, they should attend to schema-relevant material differently than normal-weight individuals do. Examining these differences in attention sheds lights on how individuals are initially processing schema-relevant material (Luck & Vecera, 2002). Furthermore, studying the early-level cognitive processes behind unhealthy eating behaviors will help researchers develop more effective means of treatment not just for clinical eating disorders, but for all eating issues.

Use of Cognitive Tasks

In order to study the cognitive processes related to eating disorders and other problematic eating patterns, researchers have used a myriad of cognitive tasks. Traditionally, cognitive tasks have been used to examine the processes that mediate a variety of health problems, such as depression and addiction (Hill & Paynter, 1992; Watkins, Mathews, Williamson, & Fuller, 1992). Hill and Paynter used a semantic priming task to compare the cognitive networks of alcoholics and a control group of participants. Semantic priming occurs when two words are related, so when they are presented in succession, the first word makes the second word more accessible. Therefore, participants are likely to respond faster to the second word than they normally would if it were presented alone or preceded by an unrelated word. Semantic priming is assumed to reflect the organization of meaning in semantic memory, because it reveals the strength of association between pairs of words (see McNamara, 2005; Balota & Coane, 2008, for recent reviews).

Hill and Paynter (1992) specifically used a primed lexical decision task (LDT) that included alcohol-related words. In a LDT, participants are presented with a stimulus that is a string of letters and must classify the stimulus as a word (e.g., *bread*) or a non-word (e.g., *flirp*). In the study, each target was preceded by either an alcohol-related prime or a neutral prime. Because alcohol-related terms are likely salient to alcoholics, they should have stronger cognitive networks around alcohol related words than non-alcoholics do. Hill and Paynter found that this difference in the strength of cognitive networks was manifested in performance on the primed lexical decision task, with alcoholics reacting faster than non-alcoholics to alcohol-related words preceded by

alcohol-related primes. They also included a heavily drinking college population into their study, but only the alcohol dependent participants produced the aforementioned priming effects. This finding suggests that individuals who are addicted to alcohol are more preoccupied with alcohol-related stimuli than individuals who engage in heavy drinking are. Just as Hill and Paynter found differences between participants who drink heavily and participants who are addicted to alcohol, individuals who overeat or eat unhealthily might respond to cognitive tasks differently than individuals who are definitively obese.

In addition to using cognitive tasks to examine the cognitive processes associated with health problems, researchers have also used cognitive tasks to examine the processes associated with different personality traits. Robinson, Ode, and Moeller (2007) examined how neuroticism, which is characterized by Watson (2000; as cited in Robinson, Ode, & Moeller, 2007) as involving negative affect, worry, and some somatic symptoms, affected participants' ability to recognize negative versus positive words. They found that neurotic participants were slower to recognize a negative target following a positive prime and faster to recognize a negative target following a negative prime than non-neurotic participants were. This finding suggests that neurotic individuals might have stronger associations between negative words and weaker associations between positive and negative words than non-neurotic individuals do, thus enhancing the semantic priming effect between negative words. The fact that people with neuroticism think in an overwhelmingly negative manner and exhibit strong associations between negative words suggests that individuals' attitudes are related to the way that they respond to verbal stimuli. Just as a neurotic attitude affects responses to negative words, attitudes about

food and exercise may also mediate the way the individuals respond to food and exercise related verbal stimuli. Therefore, cognitive tasks could serve as a diagnostic tool for the types of eating behaviors that put individuals at risk for developing eating disorders or obesity.

Cognitive tasks can also be used to examine how cognition influences the persistence of pathological eating behaviors, such as binging or starving oneself. For example, Channon, Hemsley, and de Silva (1988) had anorexic participants complete a Stroop task (Stroop, 1935) using neutral and food-related words. The words were written in a variety of colors, and the participants were asked to name the color of each word. The length of time it took the participants to name the color reflected how much the meaning of the word captured their attention and made it difficult for them to ignore the word's meaning and focus on its color. Anorexic participants were slower than control participants at naming all of the words, but especially slower at naming the food-related words. This suggests that food words might grab anorexic individuals' attention more than they capture the attention of the average person. Studies such as Channon et al.'s shed light on the cognitive processes that are related to eating disorders, but do not address a broader range of unhealthy eating behaviors.

Soetens and Braet (2007) compared obese and normal weight participants' preoccupation with food-related words using an imbedded word task (IWT). The IWT is a word-search task, in which individuals must identify words that are concealed by surrounding letters. The task was designed to reflect which words grab an individual's immediate attention, thus examining their early level processing of the word. If a word grabs an individual's attention, they should be able to locate it in the word search,

however, if a word does not grab their attention, they might struggle to find it in the word search, or not be able to find it at all. Both food-related words and neutral words were included in the IWT. According to CT, obese participants' immediate attention might be grabbed by food-related words. However, obese participants did not report feeling more distracted by food words than neutral words, suggesting that their attention was not immediately directed towards the food words.

Although results from the IWT do not support applying CT to obesity, the results from a recall task that the participants completed following the IWT suggest that CT may apply to eating pathology (Soetens & Braet, 2007). After completing the IWT, the participants were asked to recall all words that they remembered from the task. Soetens and Braet found that obese participants recalled more food words than normal weight participants did. This finding suggests that the food words were more salient to obese individuals than normal weight individuals, which could be due to a difference in their cognitive schemas. The conflicting results of IWT and recall task suggest that obese individuals may differ from normal weight individuals in terms of their schemata around food related information, but the existence of such schemata should be studied with paradigms that more sensitively measure responses to verbal stimuli than the IWT.

One concern with Soetens and Braet's (2007) study is that the IWT is not a sensitive measurement of early processing of stimuli, because it relies on self-report. Although the IWT was designed to assess which words grab participants' immediate attention, having participants self-report how distracted they were by certain words may confound higher order cognitive processes with earlier ones. It is possible that a participant's immediate attention is directed toward the food words, but they themselves

are unaware of the focus of their attention, so they later do not report feeling distracted by food-related words. Using participants' implicit, or unconscious, reactions to stimuli as a dependent measure is a more accurate method of assessing earlier levels of processing (Luck & Vecera, 2002). One of the most common methods of measuring implicit reactions is by recording a participant's response time (RT) to a stimulus during a LDT. Participants' RTs to the stimuli reflect their familiarity with certain stimuli and how frequently they are exposed to the stimuli. A fast RT implies that the stimulus is very accessible, and a slow RT implies that the stimulus is not accessible, making it difficult for the participant to recognize it as a word. Studies measuring individuals' implicit responses to food related words are necessary in order to examine individuals' schemata around food.

Although there is strong evidence to suggest that individuals' eating behavior may correlate with their responses to food-related verbal stimuli, researchers have not precisely defined this correlation. Francis, Stewart, and Hounsell (1997) found that restrained eaters, individuals who frequently engage in dieting behaviors, demonstrated a greater level of interference from general food related words during a Stroop task than non-restrained eaters did. This suggests that individuals who are attempting to diet are very focused on food, and therefore are highly distracted by food related stimuli. This finding might imply that restrained eaters would be especially distracted by "forbidden foods," or foods that went against their diets. However, the restrained eaters did not exhibit a greater level of interference for "forbidden foods" than they did for "nonforbidden" or healthy foods; they were equally distracted by food stimuli from both groups. Studies such as Francis et al.'s could be expanded to look at many different types

of eating behaviors, not just restrained eating. For example, individuals who overeat might be distracted by food related stimuli during a word task. Furthermore, different types of foods might yield greater or lesser interference. In order to examine the relationship between eating behavior and the processing of food-related verbal stimuli, a task that incorporates both healthy and unhealthy foods must be administered to individuals with a variety of eating patterns.

The Present Study

The present study examined how individuals' with varying behaviors and attitudes around eating and exercise respond to food and exercise related words during a LDT. Individuals' behaviors and attitudes were measured using a battery of new and previously developed questionnaires. Although previous studies have looked mostly at behaviors, attitudes can also imply an obsession with eating or exercise, which might put people at risk for developing a disorder. Furthermore, exercise was incorporated into the present study, because previous research has not focused looked at cognitive processes associated with unhealthy exercise patterns. Exercise is an important aspect of eating pathology, since lack of exercise can lead to obesity, and excessive exercise can be related to AN and BN (Fairburn, Cooper, Doll, & Welch, 1999).

Rather than focusing on a clinical sample, the present study included participants who have not been diagnosed with a clinical eating disorder in an attempt to examine a wide range of attitudes and behaviors around eating and exercise. Participants were drawn from a small liberal arts college and a community in Maine, since members of these populations likely eat and exercise very differently. It was expected that college students might eat more high calorie foods than community members, since they eat most

of their meals in cafeterias, and that college students would exercise more regularly than community members. It is difficult to predict how individuals' attitudes and behaviors around eating and exercise might correlate with their responses to food and exercise related words, because restrained eating could yield a preoccupation with food in general, or specifically with high calorie or low calorie words. Similarly, attitudes and behaviors around exercise might be related to individuals' processing of active and inactive words. Therefore, individual differences in attitudes and behaviors around eating and exercise were expected to interact with responses to different types of stimuli in the LDT, but the direction of this interaction was undetermined.

Method

Participants

Sixty-one participants (42 women) were recruited from the Colby College community using Experimetrix. The participants were all undergraduate students taking courses in psychology, ages 18 through 22, and they received course credit for their participation. Sixteen participants (10 women) were also recruited from the greater Waterville community using flyers and newspaper advertisements. Community participants received ten dollars to compensate their participation. Their ages ranged from 18 to 61, and they had a mean age of 41.7. These two populations were chosen because it was expected that the college students and community participants would vary greatly in their eating and exercise patterns. One participant from Colby College was excluded from the study as an outlier because his/her average reaction time on the LDT exceeded the group average by 2.5 standard deviations.

Materials

The lexical decision task (LDT), in which participants classified a string of letters as a real (English) word or a non-word, was administered on computers using E-Prime software (Schneider, Eschman, & Zuccolotto, 2002). The stimuli in the LDT were food-related, activity-related, or control words. The food and activity words were divided into four distinct categories: high calorie foods (e.g., *bacon, pastry*), low calorie foods (e.g., *carrot, cereal*), active words (e.g., *exercise, jog*), and inactive words (e.g., *drive, sleep).* See Appendix A for the critical targets. To control for the fact that the semantic relationship between words from the same category might result in a within-category priming effect, the control words also were selected from four categories (animals, furniture, tools, and vehicles). Twenty-one words from each critical and filler category were included, for a total of 168 words. The words were all matched as closely as possible on length, accuracy, frequency of use in the English language, orthographic neighborhood—the number of words that can be created by changing one letter of the original stimulus (Coltheart, Davelaar, Jonasson, & Besner, 1977), and mean reaction time based on the English Lexicon Project (Balota et al., 2007). However, words in the food and filler categories did differ significantly on means of orthographic neighbors, $t(100.7) = 2.73$, $p < .01$[1], and frequency, $t(119) = 2.44$, $p < .02$. See Table 1 for stimulus characteristics. Because most lexical properties were statistically similar across the categories, especially mean reaction time, individual differences in reaction times to words were attributed to individual differences in responses to the word category. One hundred and sixty-eight pseudo-homophones (e.g., *brane*) were also included in the LDT.

Pseudohomophones were selected because they have been found to increase the magnitude of priming effects (Joordens & Becker, 1997).

The following questionnaires were also administered: a basic health questionnaire, a demographics sheet, the eating attitudes test (Garfinkel & Newman, 2001), the three-factor eating questionnaire[2] (Lauzon et al., 2004), an eating behavior questionnaire, an exercise attitudes test, and an exercise behavior questionnaire. The eating attitudes test and the three-factor eating questionnaire were developed by previous researchers and tested for validity and reliability; all other questionnaires were developed by the current researcher and first used in the present study. All questionnaires are presented in Appendix B. The health questionnaire asked participants for their height and weight so BMI could be computed and included many diseases that could be associated with unhealthy eating patterns, such as diabetes and cancer. The eating attitudes test assessed how preoccupied participants were with being thin, while the eating behavior questionnaire measured what they ate on a daily basis and how often. The exercise attitudes questionnaire measured what motivated participants to exercise and general feelings about exercise. Finally, the amount and type of exercise participants engaged in was reported in the exercise behavior questionnaire. Participants were told they could leave blank any questions that they did not feel comfortable answering.

Procedure

Participants were randomly assigned to one of two groups. Group 1 (n = 37) completed the questionnaires before the LDT whereas Group 2 (n = 39) completed the questionnaires after the LDT to test if exposure to the questionnaires affected performance on the LDT, since the questionnaires contained many of the words that were

used in the LDT. Furthermore, it is possible that priming participants to think about their own eating and exercise behaviors with the questionnaires could affect the way they responded to food and exercise related words. Up to three participants completed the experiment at once, each at their own computer. Each participant was given an informed consent. After signing the consent form, members of Group 1 were given the questionnaire packet to fill out. This was collected by the experimenter once they were finished. They were then guided through computerized instructions about for the LDT, and were told that they would be presented with a series of stimuli on a screen and that their job was to decide if the stimuli were real words or non-words. They were also told that the non-words would be pseudo-homophones and given an example. If the stimulus was a real word, they were to press to "L" key on the keyboard as quickly and as accurately as possible. If it was a non-word, they were to press the "A" key on the keyboard as quickly and as accurately as possible. They completed a practice trial that included 16 stimuli (8 words, 8 non-words). After the practice trials, participants were asked if they had any further questions. The experimenter then left the room and the participants began the experimental trials. The first four trials were buffer trials that were not included in the final analysis. Participants completed 336 experimental (168 words, 168 non-words). Once they finished the LDT, participants were instructed to use the blank sheet of paper and pen provided by the experimenter to recall as many words they remembered from the LDT. After completing the surprise free recall task, they were debriefed by the experimenter and released from the study. Participants from Group 1 completed the questionnaires prior to debriefing instead of before the LDT.

Data Analysis

Because the questionnaires assessed a wide variety of attitudes and behaviors around eating and exercise, an exploratory factor analysis was conducted using participants' questionnaire responses. The Three-Factor Eating Questionnaire was not included in the factor analysis since not all participants responded to it, and it has already been analyzed by previous researchers (Lauzon et al., 2004). Three factors emerged from the Eating Attitudes Test: thin ideal, feeling thin, and avoidance of food. For the eating behaviors questionnaire, four factors emerged: dieting behaviors, binging behaviors, healthy eating behaviors, and eating regular meals. Three factors emerged from the exercise attitudes questionnaire: having an emotional response to exercising, exercising to improve fitness, and exercising to lose weight. Items from the exercise behaviors questionnaire fell along two factors: high intensity activities (e.g. running and playing a competitive sport) and low intensity activities (e.g. walking and biking). Appendices C-F describe which questionnaire items were included in each factor.

A median split was conducted on participants' scores along each of the factors, creating a "high" and "low" group for each factor. The participant populations were also split to include an equal number of community and Colby participants in each "high" and "low" group, since the community population included older participants, who typically have slower reaction times to stimuli. See Table 2 for mean responses of the "high" and "low" groups for each factor. Mixed Analyses of Variance (ANOVA) were conducted with factor group (high, low) as a between subjects factors and stimulus type in the LDT (e.g., food vs. filler words, active vs. inactive words) as a within subjects factor to assess the relationship between participants' attitudes and behaviors around eating and exercise

and their responses to food and exercise related verbal stimuli. Because eating patterns were predicted to mediate responses to food stimuli, the eating-related factors were used to analyze responses to all food stimuli, and specifically responses to the high calorie food words and the low calorie food words. The exercise-related factors were used in analyses of participants' responses to the active and inactive words. However, the two activity-related categories were only analyzed in opposition to one another, and were not analyzed as a general activity-related group similarly to how the high calorie and low calorie food stimuli were analyzed both separately and as a larger food group. This was because the active and inactive words referred to physical activities (such as running) and non-physically taxing activities (such as driving) respectively, and did not have a larger, cohesive theme (i.e., high calorie and low calorie words were united under the larger theme of "food."

The following analyses were conducted using only female participants. This was due to the fact that male and female participants responded to the questionnaires differently, especially the eating attitudes test. All participants' responses to the items of the eating attitudes test were totaled and a median split was conducted on the composite scores, creating a "High Eating Attitudes" group and a "Low Eating Attitudes Group." Although there were about an equal number of men and women in the low group, the high group was predominantly women, $\chi^2(1) = 16.56$, $p < .001$. This suggests that men and women responded differently to the questionnaire and should therefore be analyzed separately. Because the present study had a majority of female participants, analyses were conducted using only the women's data.

Results

Initially, a mixed ANOVA with participant group (completed questionnaires before LDT, completed questionnaires after LDT) as a between subjects factor and stimulus type in the LDT (food word, filler word, activity word) was conduced to assess whether completing the questionnaires first mediated responses in the LDT. The ANOVA did not show a significant main effect or interaction involving the variable participant group (all p values > .05), suggesting that the questionnaires did not selectively orient women's attention to the food or activity words. Therefore, data were collapsed across group type for the following analyses. Data were also collapsed across population (Colby versus community), because the community sample size was too small to analyze separately.

Eating Attitudes and Behaviors and the LDT

A mixed ANOVA with the factor thin ideal (high score on thin ideal, low score on thin ideal) as a between subjects factor and stimulus type in the LDT (food word, filler word) was conducted to evaluate the effect of attitudes about food on the processing of food-related words (see Table 2). The ANOVA showed a significant interaction of thin ideal and stimulus type, $F(1, 48) = 5.12$, $p < .05$. As can be seen in Figure 1, participants with high thin ideal responded slightly faster to the food related words than participants with low thin ideal did, $t(48) = .71$, $p > .05$, however, the two groups responded similarly to the filler words, $t(48) = .29$, $p > .05$. This trend suggests that food related words grab the attention of women with high thin ideal. No other effects were significant (all p values > .05).

A mixed ANOVA with the factor eating regular meals (high score on eating meals, low score on eating meals) as a between subjects factor and stimulus type in the LDT (food word, filler word) also yielded a significant interaction of eating meals and stimulus type, $F(1, 46) = 4.70$, $p < .05$. Participants who had a high score on eating meals responded faster than participants with a low score to food words (708 ms versus 786 ms), and to filler words (718 ms versus 782 ms). Because participants with higher scores were faster on both food and filler words, this is likely a spurious difference that cannot be attributed to individual differences in eating meals. This underscores the importance of comparing responses to the critical targets with responses to the filler targets, because this comparison revealed that one group of participants was responding faster to all of the words, not just the critical words. No other effects involving the factor eating regular meals were significant (all p values > .05).

A Mixed ANOVA with the factor BMI (high BMI, low BMI) as a between subjects factor and stimulus type in the LDT (food word, filler word) was conducted to examine the relationship between body mass index and participants' cognitive processing of food-words. Women's BMI ranged from 17.37 to 58.52, but their mean BMI was 24.15. The "low BMI" group had a mean BMI of 21.73 and the high BMI group had a mean BMI of 26.57. Therefore, although the ANOVA yielded no significant results (all p values > .05), this is could due to the small range in mean BMI's of the low and high groups.

Mixed ANOVAs with the factors avoidance of food, feeling thin, dieting behaviors, binging behaviors, and healthy eating behaviors (high score on factor, low score on factor) as between subjects factors and stimulus type in the LDT (food word,

filler word) were also conducted, but no significant effects were found (all *p* values > .05).

Exercise and Fitness Attitudes and Behaviors and the LDT

A mixed ANOVA with the factor low intensity exercise (high score on low intensity exercise, low score on low intensity exercise) as a between subjects factor and stimulus type in the LDT (active word, inactive word) was conducted to examine the effect of exercise behaviors on the processing of activity-related words. The ANOVA showed a significant interaction of low intensity exercise and stimulus type, $F(1, 46) = 9.35$, $p < .05$. As can be seen in Figure 2, participants who engage in more low intensity exercise responded slightly faster to the active words than participants who engage in less low intensity exercise did, $t(48) = 1.41$, $p > .05$. Interestingly, when a within subjects ANOVA was conducted to assess how all participants, regardless of exercise behaviors, responded to the active and inactive words, no significant differences were found (all *p* values > .05), suggesting that the between group differences in RTs can be attributed to individual differences in the group members. This suggests that the active words might have captured the attention of participants who engage in more low intensity exercise because these exercise-related stimuli are more relevant to their lives. This seems especially likely since the active words were predominantly low intensity exercises (e.g., *yoga*, *walking*). No other effects involving the factor low intensity exercise were significant (all *p* values > .05).

A mixed ANOVA with the factor high intensity exercise (high score on high intensity exercise, low score on high intensity exercise) as a between subjects factor and stimulus type in the LDT (active word, inactive word) yielded a significant interaction of

high intensity exercise and stimulus type, $F(1, 46) = 6.00$, $p < .05$. Surprisingly, participants who engage in more high intensity exercise responded slightly slower to the active words than participants who engage in less high intensity exercise did, $t(48) = .92$, $p > .05$ (see Figure 3). This suggests that the active words did not capture the attention of participants who engage in high intensity exercise. This could be due to the fact that the active words were predominantly low intensity exercises, so they were less relevant to individuals who engage in mostly high intensity exercise. No other effects were significant (all p values > .05).

Mixed ANOVAs with the factors having an emotional response to exercising, exercising to improve fitness, and exercising to lose weight (high rate of factor, low rate of factor) as between subjects factors and stimulus type in the LDT (active word, inactive word) were also conducted, but no significant effects were found (all p values > .05).

Discussion

The present results suggest that individuals' attitudes and behaviors around eating and exercise mediate their responses to food and exercise-related words in a LDT. Specifically, women who scored higher on the items that composed the factor "thin ideal" responded faster to food-related words than women with lower scores. This suggests that food-related words captured the attention of women who have a strong desire to be thin. This could be due to the fact that women who are preoccupied with maintaining or achieving a thin body are likely preoccupied with food as well, because they carefully monitor what they eat. Interestingly, women high in thin ideal did not respond differently to high calorie and low calorie food words, suggesting that both types of food-related words grab their attention equally. This effect is similar to Channon et al.'s (1988)

finding that anorexics are slower at naming food-related words during a Stroop task than normal individuals are, because during a Stroop task, slower responses indicate that the word's meaning is grabbing the individual's attention.

The fact that women high in "thin ideal" are showing similar responses to anorexics suggests that being high in thin ideal may be a risk factor for developing anorexia. Although this is a strong inference, the eating attitudes test is commonly used to assess how likely it is that an individual will develop an eating disorder (Garfinkel & Newman, 2001). It is possible that the subset of items from the EAT that form the factor "thin ideal" might more accurately predict the development of an eating disorder, especially anorexia. Since the media often glorifies models with extremely thin body types, researchers have found that the persistence of anorexia in women is often related to the desire to emulate this "thin-ideal" body type (Williams, Thomsen, & McCoy, 2003). It is possible that the media is promoting this obsession with the desire to be thin, and is therefore strengthening "thin-ideal" as a risk factor for developing an eating disorder.

Although the fact that no significant trends emerged from the remaining eating attitudes and behaviors factors could simply be due to insufficient sample sizes, Table 2 shows that the high and low groups for the factor "thin ideal" did have a wider range in their means in comparison to some of the other factors. For example, for the factor "avoidance of food," the overall mean and the mean of the high group only differ by two points. Although the mean scores along the factors are not directly comparable, since the maximum possible obtained score differs for each factor, the trend in means suggests that the participants had a wider range of responses to the factor "thin ideal" than they did to some of the other factors. This may partially account for why the factor "thin ideal" was

the only eating attitudes and behavior factor that mediated participants' responses to the LDT.

It is especially noteworthy that BMI did not mediate participants' responses to the LDT. Like many of the other eating attitudes and behaviors factors, the mean BMI's of the "low BMI" group and "high BMI group" were very similar (21.73 and 26.57 respectively). This suggests that overall, the women in the current study had similar BMI's, so BMI was not a useful between groups factor. However, the fact that the eating attitude "thin ideal" mediated women's responses to the LDT, while BMI did not, suggests that attitudes about eating might have a stronger relationship to preoccupations with food than BMI does. Previous researchers have concluded that the current formula for BMI does not accurately classify individuals as "overweight" or "underweight," because it does not take other important variables, like sex or eating behaviors, into account (Kuczmarski & Flegal, 2000). The current results support this movement away from relying on BMI as a diagnostic tool for eating disorders and obesity, and suggest that measuring attitudes about eating is a critical component of assessing and treating unhealthy eating patterns.

It is interesting that the factors "low intensity exercise" and "high intensity exercise" mediated opposing patterns in responses to the LDT. Women who engage in more low intensity exercise responded slightly faster to the active words, while women who engage in more high intensity exercise actually responded somewhat slower to the active words. This effect is difficult to interpret, since high rates of exercise in general were expected to correlate with faster reaction times to the active words. However, re-examining the 21 active words suggests that the majority of the words relate to the "low

intensity exercise" factor. Because the majority of the active words were taken directly from the exercise behaviors questionnaire, most of the words are clearly distinguishable as low intensity or high intensity exercises. According to the factor analysis, only three of the words (*running, sport, jog)* are high intensity exercises, but six of the words are low intensity exercises (*dancing, stretch, treadmill, walking, yoga, aerobic*). The remaining twelve words were either did not having corresponding items on the exercise behaviors questionnaire, or have corresponding items that did not load as a "high intensity" or "low intensity" exercises. Because there were twice as many low intensity words included in the active word group, it is possible that the active words were overall more relevant to the lives of individuals who engage in low intensity exercise. Although there are not enough items included in the current study to explore this trend, future studies should separate specific types of exercise, rather than measuring general levels of exercise. The current results suggest that exercise-related words grab the attention of low intensity exercisers, however, future research is necessary to further explore this finding.

Future studies examining exercise attitudes and behaviors should involve large sample sizes, because the overall low power of the current study may have prevented significant trends involving the exercise factors from emerging. Table 2 shows that the current participants engaged in very little low intensity exercise across the board; even the "high group" displayed a relatively low rate of low intensity exercise. A larger sample size might increase the range of low intensity exercise behaviors, which could alter the trends in the data. It is possible that with a wider range, the current trend of participants who engage in more low intensity exercise responding slightly faster to active words might become significant. If these individual differences are observable at

such a subtle level, these differences might increase with a wider range of low intensity exercise behaviors. Although the current trend suggests that low intensity exercisers respond faster to active words, this trend must be corroborated by future studies involving more participants.

Future studies should aim for larger sample sizes than that of the current study especially in terms of the community participant group. The current study only included 16 community participants, which prevented the community and college participants from being analyzed separately due to issues of power. It was expected that community members and college students would typically engage in different eating and exercise patterns, however, this hypothesis could not be tested with the small sample sizes. Overall, there was less variance in the questionnaire responses of the college sample than the community sample, suggesting that the community participants might represent a more diverse group and provide an interesting focus for future research. However, this may simply be an artifact of sample size, so more community members must be tested in order to establish that they represent a more diverse population. Still, the community sample might be an interesting group to pursue in terms of research on the relationship between low levels of exercise and obesity, because community members are less likely to exercise than college students are, since they do not have constant access to a gymnasium and typically have less free time.

Examining the cognitive processes behind exercise patterns especially merits further attention due to the lack of previous research on this topic. Exercise has become an integral aspect of eating disorders. While BN used to be defined as regularly vomiting or taking laxatives after eating, exercising compulsively after eating is now considered to

be a form of BN (*DSM-IV-TR*, 2000). Furthermore, high levels of exercise are a recognized risk factor for developing anorexia (Fairburn, Cooper, Doll, & Welch, 1999). Still, the role that cognition plays in perpetuating these unhealthy exercise practices remains unclear. Clinicians have integrated exercise into their definition of eating pathology, but researchers have not incorporated exercise attitudes and behaviors into studies on eating disorders. However, exercise should not just be considered in the context of eating disorders; low levels of exercise are a risk factor for developing obesity (CDC, 2009). Because exercise is a key component in the development of both eating disorders and obesity, it surely merits future investigation.

Another area that future studies might explore is the development of an "Eating Attitudes Test" for men, analogous to the EAT used in the current study. Although the EAT is not technically designed for women, the current study found that almost only women obtained high scores on the EAT. This suggests that women are more preoccupied with the types of body image issues that are referenced on the EAT. This does not mean, however, that men are not concerned with body image. Current research has actually determined that body image satisfaction is an important issue during male adolescence (Jones & Crawford, 2005). However, the current EAT does not asses many of the bodily insecurities that men typically experience. For example, the desire to develop muscles is a central aspect of male body image, and there are no questions regarding muscle mass or having a muscular physique on the EAT. Future researchers should work to construct a questionnaire that assesses male preoccupation with body image, so the cognitions that are related to unhealthy eating and exercise patterns in men can be examined.

The current study revealed some interesting trends in the relationship between individuals' attitudes and behaviors around eating and exercise and the processing of food and exercise-related words, which merit further exploration. The fact that women high in thin ideal seem to be preoccupied with food-related words similarly to how anorexic women are preoccupied with food-related words suggests that CBT could be useful for treating unhealthy thought processes that put individuals at risk for developing an eating disorder. Instead of waiting for individuals to present with AN, BN, or BED, clinicians might be able to intervene at an earlier stage using CBT and prevent a potential eating disordering from escalating. Current findings do not demonstrate a relationship between cognitive processing and obesity or propensity for weight gain, but future research involving a large sample of obese or borderline obese participants might yield interesting results. Furthermore, the current study suggests research involving exercise patterns should be pursued in a more focused manner, because participants demonstrated cognitive processing associated with specific types of exercise patterns.

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[1] Degrees of freedom were corrected for inequality of variance.
[2] The three-factor eating questionnaire was added to the study after 37 participants had been run, so only 39 participants completed this questionnaire.