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The relation between delay discounting and disordered eating in college women

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The Relation Between Delay Discounting and Disordered Eating in College Women

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Abstract

Some researchers have suggested that impulsive behavior is a characteristic of disordered eating. Nevertheless, there are relatively few studies that have examined the relation between impulsivity and disordered eating. In the present study, I used a delay-discounting task to measure impulsive behavior in a sample of college women who met the criteria for disordered eating and in a sample of matched controls. On this task, participants completed trials on which they chose between smaller, sooner monetary rewards and larger, later monetary rewards, all of which were hypothetical. I found that women with disordered eating were no more impulsive, on average, than women without disordered eating. Although my results do not support previous research, future researchers may wish to examine whether different types of eating disorders are related to impulsive behavior.

CHAPTER 1

Introduction

Defining the Problem: Disordered Eating

The four primary eating disorders are anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED), and eating disorder not otherwise specified (ED-NOS; DSM-IV-TR; American Psychiatric Association, 2000). A low body mass index (BMI) due to self-starvation characterizes AN. Alternating binge and purge cycles, while maintaining a stable BMI, characterizes BN (where purging is any behavior that rids the body of calories, such as exercising, vomiting, laxatives, diuretics, etc.). Finally, binge cycles and a fluctuating BMI characterize BED.

Eating disorders in women typically emerge in late adolescence to early adulthood and often last throughout their lives (Hoek & van Hoeken, 2003). The occurrence of eating disorders in late adolescent to adult women has risen substantially in the last 30 to 40 years (Academy for Eating Disorders, 2011; Hoek & van Hoeken, 2003). In the United States, 0.5-1.0% of women have AN, and 1-2% have BN. In addition to women who receive a diagnosis for their disordered eating habits, 10% of women exhibit eating disorder symptoms that do not meet diagnostic criteria. In females, AN has a lifetime prevalence rate of approximately 0.5%, whereas BN falls between 1 and 3% (DSM-IV-TR; American Psychiatric Association, 2000). Eating disorders are most prevalent in females from adolescence to early adulthood (Hoek & van Hoeken, 2003).

Eating disorders are problematic because they have lasting physical effects. Health outcomes of individuals with AN include weakness, dehydration, fainting, hair loss, osteoporosis, and a slow heart rate (National Eating Disorder Association, 2005a).

Individuals with BN suffer health outcomes such as gastric and esophageal ruptures, tooth staining and decay, ulcers, electrolyte imbalances, and pancreatitis. Individuals with BED suffer health outcomes such as gallbladder disease, heart disease, high cholesterol and blood pressure, and Type II diabetes (National Eating Disorder Association, 2005a). As evidenced above, eating disorders leave a lasting and sometimes severe impact on health.

These disorders also have a large impact on society. For example, it costs on average between $5-6 billion a year in direct medical costs for the treatment of eating disorders in the United States (National Eating Disorder Association, 2005b). Additionally, individuals with eating disorders are prone to relapse, even after treatment (Keel & Brown, 2010; Keel, Dorer, Franko, Jackson, & Herzog, 2005). Given their increased incidence and related health concerns, eating disorders require further study.

In addition to the physical effects of eating disorders and their financial impact on society, they also have psychological effects. Eating disorders often co-occur with other psychological disorders and problematic behaviors. For example, substance use, depression, anxiety disorders, bipolar disorder, obsessive-compulsive disorder, and certain types of disruptive behavior (e.g., ADHD) commonly co-occur with eating disorders (Blinder, Cumella, & Sanathara, 2006; Lewinsohn, Striegel-Moore, & Seeley, 2000). In addition, disordered eating has been linked to impulsivity.

Disordered Eating and Impulsivity

In recent years, researchers have speculated that one characteristic of disordered eating may be impulsivity, or the inability to delay gratification. Nevertheless, the specific relation between disordered eating and impulsivity is still relatively unknown.

Vitousek and Manke (1994), for example, suggested that eating disorders fall along a spectrum of impulsivity, with BN and AN falling at opposite ends. They proposed that the impulsive behaviors that define BN place it on the impulsive side, whereas the rigid and constraining behaviors that define restricting AN place it on the self-control side of the spectrum (see also Claes, Vandereycken, and Vertommen, 2005). Additionally, Vitousek and Manke suggested that binging/purging AN falls between BN and restricting AN on the spectrum.

Ultimately, though, there have been few studies that have examined the relation between disordered eating and impulsivity. Moreover, studies that have examined this relation have produced somewhat equivocal findings. Rosval et al. (2006) examined differences in impulsivity in individuals with AN, BN, or no diagnosis of disordered eating. They used the Barratt Impulsivity Scale (BIS), the Stimulus Seeking subscale from the Dimensional Assessment of the Personality Pathology-Basic Questionnaire, and the Go/No-Go task to measure impulsivity. Patients with BN and AN (binge/purge subtype) had higher motor impulsiveness scores than controls and AN (restrictor subtype). Additionally, patients with BN had higher stimulus-seeking scores than controls and higher nonplanning scores than both AN groups. Overall, these results indicated that patients with binge behaviors (BN and AN binge/purge subtype) exhibited more behavioral impulsivity, and all eating disorder patients exhibited problems with attention.

In another study, Vervaet, van Heeringen, and Audenaert (2004) examined behavioral differences in individuals with BN, binging/purging AN, and restricting AN. They used the Dutch version of the Temperament and Character Inventory to measure impulsivity. They discovered that individuals with BN received higher scores on

measures of novelty seeking (a variety of impulsivity; Evenden, 1999) and impulsiveness than individuals with restricting AN. Claes et al. (2005) also investigated impulsivity in individuals with eating disorders by examining four personality dimensions: sensation seeking, premeditation, urgency, and perseverance. They used the Revised NEO-Personality Inventory to measure impulsivity. Individuals with AN (restricting) scored lower on urgency and sensation seeking and higher on premeditation and perseverance than individuals with BN. Overall, individuals with AN (binging/purging) and BN were more impulsive than AN (restricting).

Although the aforementioned studies provide some preliminary evidence on the possible relation between disordered eating and impulsivity, additional research would provide further clarification. One framework that has proved useful in recent years for understanding the relation between impulsivity and various types of problematic behavior is the delay-discounting framework.

Delay-Discounting Framework

Delay discounting has its roots in B. F. Skinner's (1938, 1953) operant psychology, which suggests that behavior is largely a function of its consequences presented in context. More recently, Ainslie, Rachlin, and others (e.g., Ainslie, 1975; Green & Myerson, 2004; Rachlin, Raineiri, & Cross, 1991) have suggested that impulsivity can be discussed within this operant framework. Specifically, individuals frequently make choices, some of which entail choosing between a smaller, sooner reward (SSR) and a larger, later reward (LLR). For instance, a person trying to lose weight might have to choose between a piece of cake, which she can eat right now (the SSR), and significant weight loss, which might not occur for a number of months (the

LLR). In this framework, choosing the SSR is the impulsive choice, whereas choosing the LLR is the self-controlled choice.

Many researchers have attempted to understand why organisms sometimes choose SSRs over LLRs—for example, choosing to eat a piece of cake right now—even though the value of the SSR is objectively less than the value of the LLR. According to one well-known framework, adding a delay to any reward leads that reward to be devalued, or discounted. Delay discounting, then, refers to the subjective devaluation of a reward as it is delayed in time (Ainslie, 1974; Critchfield & Kollins, 2001; Mischel & Ebbeson, 1970; Mischel & Metzner, 1962; Rachlin & Green, 1972); it is also a mechanism that some researchers have suggested may underlie impulsive decision making (Bickel & Marsch, 2001; Critchfield & Kollins, 2001; Reynolds, Ortengren, Richards, & de Wit, 2006). For example, when presented with the choice between $100 now and $100 in 1 week, people will likely choose $100 now, even though the objective amounts of the two rewards are equal. This is because adding a delay of 1 week to the latter reward reduces its subjective value. Similarly, when presented with the choice between $100 now and $200 in 1 year, many will choose the former amount. This is because the added delay of 1 year has reduced the value of $200 to an amount that is subjectively lower than $100 presented immediately. In sum, when given the choice between a SSR and a LLR, a person may discount the LLR to the extent that he or she acts impulsively and chooses the SSR, even though the objective value of the LLR is larger. Ultimately, an individual will choose whichever reward has the higher subjective value at any particular point in time (e.g., Ainslie, 1975; Green & Myerson, 2004; Rachlin et al., 1991).

To examine impulsive choices, researchers have frequently used delay-discounting tasks (a behavioral measure of impulsivity) in which participants make numerous choices between SSRs and LLRs (e.g., Rachlin et al., 1991). In the last 20 years, researchers have found that the following hyperbolic function nicely describes the choices that organisms make on delay-discounting tasks: $V = A/(1 + kD)$. In this equation, V refers to the discounted, or subjective, value of a particular reward (A) after some delay (D); and k indicates the rate of discounting, or how quickly a reward loses subjective value (Mazur, 1987). Smaller k values indicate slower discounting, and larger k values indicate faster discounting. More specifically, if k is larger, the LLR loses subjective value more quickly, and an organism will switch to the SSR. Thus, researchers have thus used k as an index of impulsivity.

Researchers have used this delay-discounting model to study several types of problematic behaviors. Mitchell (1999), for instance, examined differences in delay discounting between smokers and never-smokers. She gave her participants a delay-discounting task in which they made a series of choices between SSRs and LLRs. She found that smokers were more likely than never-smokers to choose SSRs over LLRs. Kirby, Petry, and Bickel (1999) examined the relation between heroin use and delay discounting in heroin addicts and non-drug-using controls. They found that heroin addicts discounted at twice the rate of the controls. Kollins (2003) examined the relation between substance use and delay discounting in college students. He found that individuals who self-reported more illicit drug use were more likely than their peers to choose SSRs over LLRs. Thus, individuals who used illicit drugs made more impulsive choices than those who did not.

Current Study

As noted previously, little research has examined the relation between disordered eating and impulsivity. Because a delay-discounting framework has proven useful in understanding the relation between impulsivity and different types of problematic behavior, it might prove useful in further examining impulsivity and disordered eating. The purpose of the present study was to examine the relation between disordered eating and impulsivity, as measured by responses on a monetary delay-discounting task.

CHAPTER 2

Method

Participants

Two hundred and eighty-four women between the ages of 18 and 22 (M = 18.67 years) participated in the study. The participants were undergraduate students who were enrolled in various psychology courses and who received partial course credit for their participation. The different ethnicities of the participants were as follows: African Americans (5.60%), Asian Americans (4.20%), Caucasian (84.50%), Hispanic (3.20%) and other (2.50%).

Measures

I used the Eating Attitudes Test to assess disordered eating and a delay-discounting task to assess impulsivity. To control for possible differences in alcohol and nicotine use, two factors that are predictive of increased impulsivity (Mitchell, 1999; Petry, 2001), I gave participants the Michigan Alcohol Screening Test and the Fagerstrom Test for Nicotine Dependence. The participants also answered two demographic questions ("What is your current GPA?" and "Are you a member of a fraternity or sorority?"). Additional demographic questions are included as part of the Eating Attitudes Test (e.g., "What is your ethnicity?").

Eating Attitudes Test (EAT). The Eating Attitudes Test (EAT) is a screener used to determine whether individuals exhibit disordered eating (see Appendix A; Garner & Garfinkel, 1979). According to Ocker, Lam, Jensen, and Zhang (2007), questions on the EAT parallel criteria that clinicians use to diagnose individuals with eating disorders using the DSM-IV-TR. The test contains 26 items that participants answer on a 5-point

Likert-type scale (*always, usually, often, sometimes, rarely, never*). Researchers score *always*, *usually*, and *often* responses as 3, 2, and 1, respectively; all other responses receive a score of 0. The lowest cumulative score on the EAT is 0, and the highest possible score is 78, with scores over 20 indicating disordered eating. Past research has found that the EAT is a valid and reliable measure of disordered eating, with a Cronbach's alpha between .79 and .94 (Garner & Garfinkel, 1979; Garner, Olmsted, Bohr, & Garfinkel, 1982).

Michigan Alcohol Screening Test (MAST). The Michigan Alcohol Screening Test (MAST) is a 22-item screener used to determine if an individual is a problem drinker (see Appendix B; Selzer, 1971). All items have *yes*/*no* response options. Responses receive a score of 1 if participants select *yes* for items 2, 3, 5, 6, or 7 through 22. Responses receive a score of 1 if participants select *no* for items 1 and 4, which are reverse-scored. The lowest possible score is 0, and the highest possible score is 22. Scores between 0 and 2 denote "no apparent problem," scores between 3 and 5 denote "early or middle problem drinker," and scores of 6 or greater denote a "problem drinker." Past research has indicated that the short version of the MAST and the MAST is valid and reliable, with high test-retest reliability and a Cronbach's alpha between .83 and .95 (Barry & Fleming, 1992; Hayes, Merz, & Nicholas, 1995; Hedlund & Vieweg, 1984).

Fagerstrom Test for Nicotine Dependence (FTND). The Fagerstrom Test for Nicotine Dependence (FTND) is a 6-item screener used to determine the level, high or low, of an individual's nicotine dependence (see Appendix C for items and scoring information; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). The lowest possible score is a 0, and the highest possible score is a 10. Scores between 0 and 2 denote very

low dependence, scores between 3 and 4 denote low dependence, 5 denotes medium dependence, scores between 6 and 7 denote high dependence, and scores between 8 and 10 denote very high dependence. The FTND is a reliable measure that has internal consistency (Cronbach's alpha = .56 to .81) and construct validity (Pomerleau, Carton, Lutzke, Flessland, & Pomerleau, 1994; Stavem, Rogeberg, Olsen, & Boe, 2008).

Delay-Discounting Task (DDT). The delay-discounting task (DDT) is comprised of several trials where participants choose between two hypothetical amounts of money. The two hypothetical amounts of money include a smaller amount to be received immediately and a larger amount to be received after some delay. On this computer-based survey, there were seven different delay values: 1 week, 2 weeks, 1 month, 6 months, 1 year, 5 years, and 25 years. The SSR was displayed on the left side of the screen, whereas the LLR (which was always $1,000 after a delay) was displayed on the right side of the screen. On the first trial at each delay value, participants chose between one half of the maximum reward value, or $500 now, and $1,000 after a delay period. The subsequent choices were titrated, so that previous choices affected later choices. Specifically, on the second trial, the SSR was titrated either up or down by one half of the initial difference (i.e., $250, or one half of the difference between $500 and $1,000) depending on whether participants chose the SSR or the LLR on the first trial: If they had chosen the SSR, the second choice was between $250 now and $1,000 delayed, but if they had chosen the LLR, the second choice was between $750 now and $1,000 delayed. Depending on their second choice, the next amount adjustment to the SSR was equal to one half of the previous adjustment (i.e., one half of $250, or $125 up or down). For example, if participants had chosen the SSR on the first trial ($500) and the SSR on the

second trial ($250), the third choice was between $125 now and $1,000 delayed. If they had chosen the SSR on the first trial ($500) but the LLR on the second trial ($1,000), the third choice was between $375 now and $1,000 delayed. Each subsequent choice involved an SSR that was titrated up or down by one half of the previous difference. This procedure produces rapid convergence on an indifference point (i.e., the point at which the SSR was subjectively equal to the LLR), which is assumed to be the SSR on what would have been the seventh choice at each delay, had there actually been one. This pattern was repeated with participants making six choices at each of the seven different periods of delay. Thus, there were 42 choices between SSRs and LLRs. Previous research has shown the DDT to be a reliable and valid measure of delay discounting (Kollins, 2003; Simpson & Vuchinich, 2000).

Procedure

One to three participants at a time completed the study in a moderately sized room containing six computer stations. A researcher met participants outside the room and asked them to sit at a computer for the duration of the study. After signing an electronic consent form, all participants first completed the two demographic questions (about GPA, sorority membership; other demographic questions are part of the EAT). Next, two questions asked participants about their current smoking and drinking behaviors ("Do you currently smoke cigarettes?" and "Do you currently drink alcohol?"), to which participants answered either *yes* or *no*. Only participants who endorsed those items completed the FTND and/or MAST. Participants then completed the EAT and finally the DDT.

Prior to making choices on the DDT, participants read the following instructions:

On the next few pages, you will be asked to make a series of choices between two hypothetical amounts of money. One amount could be obtained immediately; the other amount would be available after a certain period of time. For example, you might be asked to choose between:

$500 now	or	$1000 in 1 week
(1)		(0)

In each case, if you prefer the smaller, immediate reward, you will press (1). If, however, you prefer the larger reward later, you will press (0). There are no right or wrong answers. We are simply interested in the option you prefer, so please make your choices as honestly and accurately as possible. Do not rush through this survey or randomly choose your answers. Please press (1) to continue.

Participants then completed the DDT as described above. After completing all of the tasks, the participants were debriefed and given information about counseling in case they wanted to discuss possible eating, drinking, or smoking problems.

CHAPTER 3

Results

From the initial sample of 284 women, there were 47 participants with EAT scores greater than 20 (which suggests disordered eating); however, only 34 could be matched. I then identified 34 participants whose scores on the EAT were greater than 20 and 34 participants whose EAT scores were 5 or lower but who had equal scores on the MAST and similar scores on the FTND (I was unable to match scores perfectly). To assure that the FTND scores for the two groups were not significantly different, I ran a Wilcoxon Signed-Ranks test. I used this statistical test because FTND scores were not normally distributed due to the small number of participants who reported that they smoked. There was not a significant difference in FTND scores between participants with disordered eating and participants without disordered eating, $z = -1.0$, $p = .32$. There was, however, a significant difference in EAT scores between participants with disordered eating ($M = 27.62$, $SD = 6.40$) and participants without disordered eating ($M = 3.68$, $SD = 1.43$), $t(33) = -24.09$, $p < .0001$, $d = 5.24$.

In order to examine differences in the rate of discounting between individuals with disordered eating and those without disordered eating, I first plotted the median indifference points for women with EAT scores greater than 20 and for women with EAT scores of 5 or less (see Figure 1). The hyperbolic function fit the data well for the disordered eating ($R^2 = 0.98$) and non-disordered eating groups ($R^2 = 0.97$). The hyperbolic function also fit the data well for at least one half of the participants in each group (see Table 1). There were 19 out of 34 participants in the disordered eating group and 17 out of 34 participants in the non-disordered eating group with R^2 values greater

than 0.85. The median R^2 values for the disordered eating and non-disordered eating groups were 0.88 and 0.86, respectively. I ran a Wilcoxon Signed-Ranks test to analyze the R^2 values for the two groups and found no significant difference, $z = -1.24$, $p = .21$.

A visual assessment of the median indifference points (see Figure 1) suggested that there was no difference in discounting between individuals with disordered eating and the matched controls. Nevertheless, to provide more precise statistical information, I conducted two statistical analyses. I first compared the derived discounting parameters (*k* values) using a Wilcoxon Signed-Ranks test. I used this test because *k* values are typically not normally distributed. The *k* values for participants in the disordered eating group (median = 0.39) were not significantly different from the *k* values for participants without disordered eating (median = 0.22), $z = -0.12$, $p = .91$.

I also used area under the curve (AUC) to measure the rates of delay discounting in the two groups. Myerson, Green, and Warusawitharana (2001) discussed problems with using derived parameters (*k*) to compare groups. AUC, however, is an atheoretical measure that uses actual indifference points, rather than a derived parameter, to measure discounting. As stated previously, an indifference point is the point at which the SSR and LLR are subjectively equal. To calculate AUC, delay was conveyed as a proportion of the maximum delay (in this case, 25 years), and the subjective value was conveyed as the proportion of the actual LLR amount (in this case, $1,000). Then I constructed a graph using these normalized values. Vertical lines drawn from each indifference point to the *x*-axis separated the graph into trapezoids. The sum of the trapezoids was equal to the AUC. AUC values range from 0.0 to 1.0, with 0.0 indicating very steep discounting and 1.0 indicating no discounting. In contrast with *k* values, AUC values tend to be normally

distributed. Thus, parametric statistics are appropriate when analyzing AUC values. Figure 2 shows the average area under the curve for women with EAT scores greater than 20 and for women with EAT scores of 5 or less. A dependent-samples *t* test found no significant difference in the average AUC values between participants with disordered eating ($M = 0.28$, $SD = 0.27$) and those without disordered eating ($M = 0.32$, $SD = 0.29$), $t(33) = -0.59$, $p = .56$.

CHAPTER 4

General Discussion

The purpose of this study was to examine the relation between disordered eating and impulsivity in college women. I identified women with and without disordered eating, as measured by responses on the EAT, and had them complete a delay-discounting task, a behavioral measure of impulsivity. In sum, I found that women with disordered eating did not discount delayed rewards differently than women without disordered eating. Thus, women with disordered eating may not be more impulsive than women without disordered eating.

These results do not support the findings from previous research, which found a relation between disordered eating and impulsivity (Vitousek & Manke, 1994; Claes et al., 2005; Rosval et al., 2006; Vervaet et al., 2004). Vitousek and Manke (1994) first suggested that eating disorders fall on a continuum of impulsivity, where BN and AN are on opposite ends. Claes et al. (2005) confirmed this notion and found that patients with restrictive AN exhibited more premeditation and perseverance and less urgency and sensation seeking (impulsivity-related traits) than BN patients. They also found binging-purging AN patients' impulsivity-related traits to fall between BN and restrictive AN on the continuum. Vervaet et al. (2004) found similar results in that individuals with AN (binging/purging) and BN were more impulsive than restricting AN. Finally, Rosval et al. (2006) found that patients with binge behaviors (BN and AN binge/purge subtype) exhibited more behavioral impulsivity, and all eating disorder patients exhibited problems with attention.

There are at least three possible explanations for why my results do not coincide with previous research. First, there truly may be no difference in impulsivity between women who have disordered eating habits and those who do not. This seems unlikely, though, given previous research on the topic. In fact, previous findings have led some researchers to conclude that impulsivity is one of the key characteristics of disordered eating (e.g., Claes et al., 2005; Vitousek & Manke, 1994).

A second possible explanation is that delay discounting may measure only certain facets of impulsivity. In reality, impulsivity is likely a complex construct. Evenden (1999), for instance, described over 20 varieties of impulsivity (e.g., inattention, inhibitory control, functional impulsivity). Other researchers have also suggested that impulsivity is multifaceted (see, e.g., Gerbing, Ahadi, & Patton, 1987; Meda et al., 2009). Whiteside and Lynam (2001), for example, reported that impulsivity is multidimensional, containing four different facets: urgency, premeditation, perseverance, and sensation seeking. Thus, past studies examining the relation between impulsivity and disordered eating—none of which used delay-discounting tasks and instead used more traditional measures of impulsivity (e.g., BIS)—may have been examining different facets of the construct and how they were related to disordered eating. It is also possible that delay discounting may simply be measuring how people discount delayed rewards and not impulsivity per se. One way to test this would be to replicate the present study and include different types of impulsivity measures (e.g., the DDT, the Barratt Impulsiveness Scale). The extent to which responses on the DDT are related to various impulsivity measures would help determine whether delay discounting is possibly measuring some other aspects of impulsivity.

The third possible explanation, and the one that seems most feasible in the present study, is that there are differences in impulsivity between individuals with and without disordered eating, but that the different types of eating disorders (e.g., AN, BN) "cancel out" any differences in discounting one might expect to see in a study of women with types of disordered eating that are otherwise not specified. Specifically, given previous research (e.g., Claes et al., 2005), one might expect women with BN to be more impulsive than a control group and those with AN to be less impulsive than a control group. If there were individuals with AN and BN in this study, then their levels of impulsivity may have averaged out to be similar to the matched controls. The EAT only measures disordered eating and does not differentiate between AN, BN, or BED. As a result, the canceling-out effect is plausible given the previous suggestion that eating disorders may fall along a continuum (e.g., Claes et al., 2005). This continuum of impulsivity often positions AN and BN at opposite ends, with impulsivity defining BN and self-control defining AN (Rosval et al., 2006; Vervaet et al., 2004; Vitousek & Manke, 1994). To assess this possibility, it would be important to replicate the present study substituting another measure that more accurately distinguishes between the different eating disorders; one such measure is the Eating Disorder Diagnostic Scale (EDDS), which identifies individuals with AN, BN, and BED (Stice, Telch, & Rizvi, 2000).

There were also some interesting secondary findings in this study. First, the group R^2 value for participants in the disordered eating group was high (0.98). This suggests that the hyperbolic function accurately describes discounting in individuals with disordered eating. This provides further evidence that a hyperbolic function best

describes delay discounting across a wide range of individuals, including those with and without different types of problem behaviors. Second, there were more individuals than expected who met the criteria for disordered eating (47 out of 284, or 16.5%). Although Hoek and van Hoeken (2003) found that the prevalence of AN, BN, and BED for young females was 0.3%, 1%, and 1% respectively, the prevalence of disordered eating in the present sample of women was higher. It was also 6.5% higher than the prevalence of eating disorder symptoms that do not meet diagnostic criteria (10%; Academy for Eating Disorders, 2011). This could possibly be due to the imbalance of men and women at James Madison University. With more women than men, competition could be a factor in the prevalence of disordered eating. Additionally, the high number of individuals who met the criteria for disordered eating may be because the EAT measures disordered eating habits and is not a clinical diagnostic tool for AN, BN, or BED. Thus, the overall prevalence rate in the current sample is higher because the criteria are general and less stringent than clinical guidelines. Finally, problematic drinking and nicotine addiction were low in this sample. Again, if competition between women for men is the reason why disordered eating is high in this sample, low to no drinking or nicotine use is possibly desirable to the opposite sex. This finding, however, is different from previous research that has found comorbidity between eating disorders and substance abuse (Holderness, Brooks-Gunn, & Warren, 1993).

Overall, individuals with disordered eating were no more impulsive than individuals without disordered eating in the current study. A possible limitation for this study is that I did not account for comorbid disorders that are related to disordered eating. Although I did control for smoking and drinking, I did not control for depression, bipolar

disorder, or disruptive behavior (e.g., ADHD; Lewinsohn, Striegel-Moore, & Seeley, 2000). In individuals with bipolar disorder, impulsivity is related to mania more so than depression (Swann, Steinberg, Lijffijt, & Moeller, 2009). Additionally, ADHD is related to impulsivity (Winstanley, Eagle, & Robbins, 2006). It is possible that if individuals in the present study also had one of these disorders, their impulsivity could have been related to that underlying disorder and not to the presence of disordered eating habits. It would be important to assess these comorbid disorders in future studies. Additionally, participants in this study were college students. Previous studies have suggested that eating disorders are present from adolescence to early adulthood (Hoek & van Hoeken, 2003). As such, it would be a good idea to examine other age groups. In fact, other researchers might find that impulsivity is present only in certain subgroups. Future studies should examine individuals in this age range who are in late high school, who did not go to college, and who are out of college to gain a broader understanding of the relation between impulsivity and disordered eating. Ultimately, future research is needed to understand the extent to which individuals with disordered eating habits are impulsive. With more knowledge about the characteristics of individuals with disordered eating habits (e.g., impulsivity), treatment of these disorders can potentially improve.

Table 1

AUC, k, R^2, and EAT scores for individuals with disordered eating and without disordered eating

	AUC	*k*	R^2	EAT
Disordered Eating				
1	0.0506	0.4282	0.8435	47
2	0.2445	0.0046	0.9048	45
3	0.1144	0.1356	0.9579	37
4	0.4362	0.0163	0.9258	37
5	0.6495	0.0044	0.9617	34
6	0.1539	0.5766	0.6315	33
7	0.1346	0.4016	0.7417	32
8	0.3593	0.039	0.8083	31
9	0.1437	0.0769	0.9765	31
10	0.5717	0.0078	0.8054	30
11	0.425	0.0853	0.1415	29
12	0.8277	2.3602	0.8188	28
13	0.0531	0.3412	0.9739	27
14	0.076	1.744	0.9004	26
15	0.0918	0.5047	0.9659	26
16	0.2832	0.0296	0.9842	26
17	0.0818	0.062	0.9074	26
18	0.0482	1.3845	0.7187	26
19	0.0436	0.233	0.9753	25
20	0.0214	0.3515	0.8981	24
21	0.1004	0.1316	0.8869	24
22	0.5984	0.0071	0.7738	24
23	0.2686	0.1706	0.0643	24
24	0.0453	0.7415	0.9543	23
25	0.5429	0.0102	0.3237	24
26	0.9733	0.0002	0	23
27	0.2272	0.0513	0.8724	23
28	0.1293	0.0009	0.9079	23
29	0.2602	0.0212	0.8408	23
30	0.2299	0.085	0.9591	23
31	0.3079	0.0892	0.8594	21
32	0.1021	0.0004	0.5879	21
33	0.9329	0.0002	0	21
34	0.0123	1.9743	0.9061	22
Non-Disordered Eating				
1	0.1526	0.0496	0.9628	5
2	0.0811	0.1166	0.7649	5

3	0.03	0.2832	0.9513	5
4	0.6297	0.0053	0.4704	5
5	0.9381	0.2818	0.9242	5
6	0.526	0.3179	0.8961	5
7	0.2797	0.363	0.0634	5
8	0.0086	15.1153	0.9205	4
9	0.2633	0.7543	0.9478	4
10	0.0442	0.4777	0.8082	4
11	0.0372	0.291	0.9851	5
12	0.1401	0.0263	0.9393	3
13	0.544	0.008	0.6991	4
14	0.5983	0.0037	0.7357	4
15	0.6579	0.0048	0	2
16	0.3092	0.9975	0.8286	3
17	0.7478	0.0157	0.9277	4
18	0.0604	0.1597	0.4793	5
19	0.7225	0.0022	0.2715	5
20	0.1603	0.1613	0.9525	5
21	0.0316	0.0187	0.9551	3
22	0.0661	0.2685	0.0649	1
23	0.3714	0.0247	0.9624	3
24	0.568	0.083	0.9682	0
25	0.0474	0.2184	0.9681	2
26	0.2754	0.067	0.9215	2
27	0.3181	0.0018	0	3
28	0.751	0.0017	0	4
29	0.0847	0.3022	0.9592	5
30	0.8882	0.0011	0	4
31	0.0223	1.9369	0.9421	0
32	0.4309	2.1417	0	4
33	0.0792	0.0002	0	4
34	0.1646	0.6629	0.7964	3

Note. Participants 1-34 in the disordered eating group were matched with participants 1-34 in the non-disordered eating group. Thus, Participant 1 in the disordered eating group was matched with Participant 1 in the non-disordered eating group, Participant 2 in the disordered eating group was matched with Participant 2 in the non-disordered eating group, and so on.

Figure 1

Median indifference points and best-fitting hyperbolic functions for women with EAT scores of 5 or less (closed circles and solid line) and greater than 20 (open circles and dashed line).

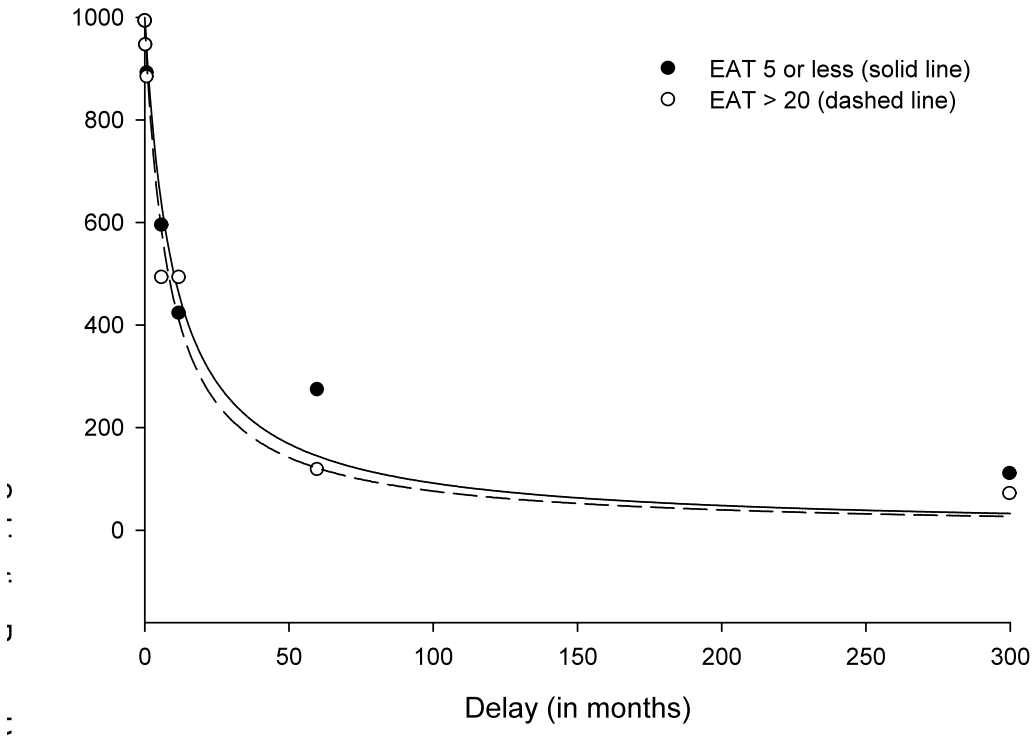
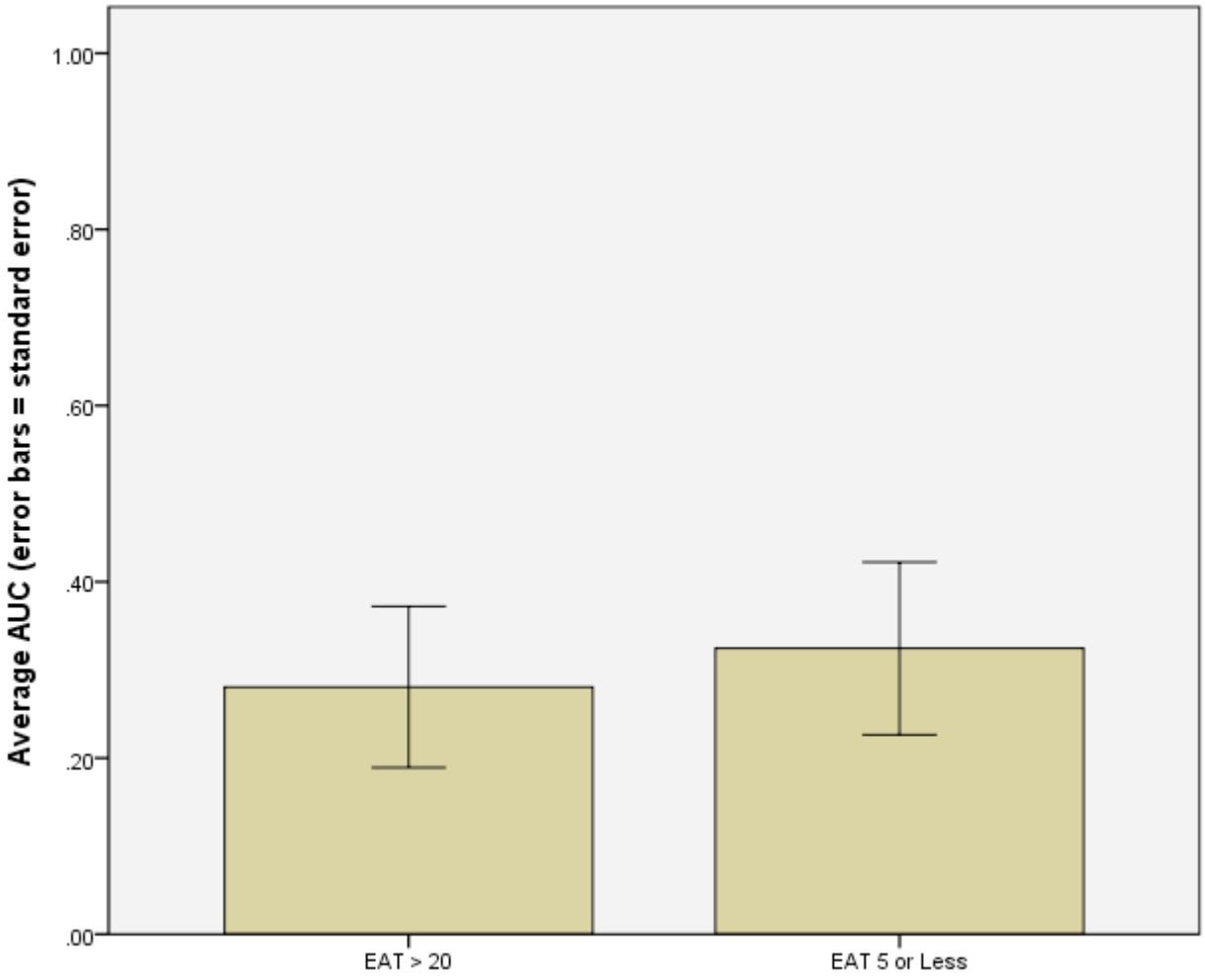


Figure 2

Average AUC values for women with EAT scores of 5 or less and greater than 20



Appendix A

Eating Attitudes Test

1. What is your current age?
2. What is your current height?
3. What is your current weight?
4. What is your highest weight (excluding pregnancy)?
5. What is your lowest adult weight?
6. What is your current college status?
    a. Freshman
    b. Sophomore
    c. Junior
    d. Senior
    e. Graduate Student
7. What is your ethnic/racial group?
    a. African American
    b. Asian American
    c. European American
    d. Hispanic
    e. American Indian
    f. Other
8. Do you participate in athletics at any of the following levels:
    a. Intramural
    b. Inter-collegiate

c. Recreational

d. High School teams

Please check a response for each of the following statements using the following scale:

Always	Usually	Often	Sometimes	Rarely	Never
1	2	3	4	5	6

1. Am terrified about being overweight
2. Avoid eating when I am hungry
3. Find myself preoccupied with food
4. Have gone on eating binges where I feel I may not be able to stop
5. Cut my food into small pieces
6. Aware of the caloric contents of foods I eat
7. Particularly avoid food with high carbohydrate content (bread, rice, potatoes, etc.)
8. Feel that others would prefer if I ate more
9. Vomit after I have eaten
10. Feel extremely guilty after eating
11. Am preoccupied with a desire to be thinner
12. Think about burning up calories when I exercise
13. Other people think I'm too thin
14. Am preoccupied with the thought of having fat on my body
15. Take longer than others to eat my meals
16. Avoid foods with sugar in them
17. Eat diet foods
18. Feel that food controls my life
19. Display self-control around food
20. Feel that others pressure me to eat
21. Give too much time and thought to food
22. Feel uncomfortable after eating sweets
23. Engage in dieting behavior
24. Like my stomach to be empty
25. Have the impulse to vomit after meals
26. Enjoy trying new foods

Please respond to each of the following questions:

1. Have you gone on eating binges where you feel that you may not be able to stop? (Eating much more than most people would eat under the circumstances)

   ____No ___Yes

   If YES, on average, how many times per month in the last 6 months? _____

2. Have you ever made yourself sick (vomited) to control your weight or shape?

   ____No ____Yes

   If YES, on average, how many time per month in the last 6 months?

3. Have you ever used laxatives, diet pills, or diuretics (water pills) to control your weight or shape?

   ____No ____Yes

   If YES, on average, how many times per month in the last 6 months? ____

4. Have you ever been treated for an eating disorder?

   ____No ____Yes

Appendix B

Michigan Alcohol Screening Test

1. Do you feel you are a normal drinker? ("normal" – drink as much or less than most other people)

   ___Yes ___No

2. Have you ever awakened the morning after some drinking the night before and found that you could not remember a part of the evening?

   ___Yes ___No

3. Does any near relative or close friend ever worry or complain about your drinking?

   ___Yes ___No

4. Can you stop drinking without difficulty after one or two drinks?

   ___Yes ___No

5. Do you ever feel guilty about your drinking?

   ___Yes ___No

6. Have you ever attended a meeting of Alcoholics Anonymous (AA)?

   ___Yes ___No

7. Have you ever gotten into physical fights when drinking?

   ___Yes ___No

8. Has drinking ever created problems between you and a near relative or close friend?

   ___Yes ___No

9. Has any family member or close friend gone to anyone for help about your drinking?

___Yes ___No

10. Have you ever lost friends because of your drinking?

___Yes ___No

11. Have you ever gotten in trouble at work because of drinking?

___Yes ___No

12. Have you ever lost a job because of drinking?

___Yes ___No

13. Have you ever neglected your obligations, your family, or your work for two or more days in a row because you were drinking?

___Yes ___No

14. Do you drink before noon fairly often?

___Yes ___No

15. Have you ever been told you have liver trouble such as cirrhosis?

___Yes ___No

16. After heavy drinking have you ever had delirium tremens (D.T.'s), severe shaking, visual or auditory (hearing) hallucinations?

___Yes ___No

17. Have you ever gone to anyone for help about your drinking?

___Yes ___No

18. Have you ever been hospitalized because of drinking?

___Yes ___No

19. Has your drinking ever resulted in your being hospitalized in a psychiatric ward?

___Yes ___No

20. Have you ever gone to any doctor, social worker, clergyman, or mental health clinic for help with any emotional problem in which drinking was part of the problem?

    ___Yes ___No

21. Have you been arrested more than once for driving under the influence of alcohol?

    ___Yes ___No

22. Have you ever been arrested, even for a few hours because of other behavior while drinking?

    ___Yes ___No

Appendix C

Fagerstrom Test for Nicotine Dependence

1. How soon after you wake up do you smoke your first cigarette?
    A. After 60 minutes
    B. 31-60 minutes
    C. 6-30 minutes
    D. Within 5 minutes

2. Do you find it difficult to refrain from smoking in places where it is forbidden?
    A. No
    B. Yes

3. Which cigarette would you hate most to give up?
    A. The first in the morning
    B. Any other

4. How many cigarettes per day do you smoke?
    A. 10 or less
    B. 11-20
    C. 21-30
    D. 31 or more

5. Do you smoke more frequently during the first hours after awakening than during the rest of the day?
    A. No
    B. Yes

6. Do you smoke even if you are so ill that you are in bed most of the day?
    A. No
    B. Yes

Scoring:

Q1 and Q4: A (0) B (1) C (2) D (3)

Q2, Q5, and Q6: A (0) B (1)

Q3: A (1) B (0)

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