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A Broad-Based Decision-Making Assessment Of College Women With Bulimia And Binge-Eating Disorder

Erin Murtha-Berg

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A BROAD-BASED DECISION-MAKING ASSESSMENT OF COLLEGE WOMEN
WITH BULIMIA AND BINGE-EATING DISORDER

by

Erin Murtha-Berg
Bachelor of Science, Black Hills State University, 2011

A Thesis

Submitted to the Graduate Faculty

of the

University of North Dakota

In partial fulfillment of the requirements

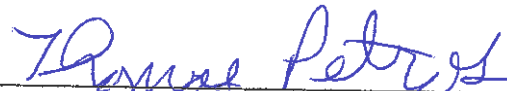
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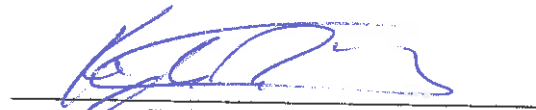
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This thesis, submitted by Erin Murtha-Berg in partial fulfillment of the requirements for the Degree of Master of Arts from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done, and is hereby approved.


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December, 2013

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ABSTRACT

Using a broad-based test battery (i.e., the IGT, GDT, BART, and select A-DMC subtests), the current study comprehensively assessed decision-making performance in different situations (e.g., where contingencies were and were not explicit, where the task was administered via computer and pencil-and-paper, where higher-quality decision making was reflected by low risk-taking and where higher-quality decision making was reflected by higher risk-taking) in groups with BN and BED compared to each other and to controls in a sample of primarily female college students (N=111). Analyses were run to explore whether these difference could possibly be explained by differences in measures of executive function, impulsivity-related personality traits, or obsessive-compulsive symptoms. Contrary to the researchers predictions and despite significant between-group differences on measures of executive function, impulsivity-related personality traits, obsessive-compulsive symptoms, depression and other anxiety symptoms, no significant between-group differences were identified on measures of decision making with the exception of the A-DMC Resistance to Framing subtest on which the BN group performed significantly *better* than controls. It should be noted that the majority of the analyses that were run to examine decision-making performance were inadequately powered to detect between-group differences had such differences existed. Future studies should seek to replicate these findings using larger samples.

CHAPTER I

INTRODUCTION

Eating disorders are characterized by marked disturbances in behaviors and other symptoms related to eating. Anorexia nervosa (AN) and bulimia nervosa (BN) are often recognized as the two main diagnoses of eating disorder, although the most recent revision of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; APA, 2013) now formally recognizes binge-eating disorder (BED) as a distinct category of eating disorder.

Eating Disorders Defined

Anorexia nervosa (AN) is uniquely characterized by dietary restriction resulting in the maintenance of significantly low body weight (i.e. less than minimally normal). AN is further characterized by an intense fear of gaining weight or recurrent behavior that interferes with weight gain despite low weight in addition to undue influence of body weight or shape on self-evaluation, distortion in body weight and shape experience, or denial of seriousness of low weight. Though it was included in the previous edition (DSM-IV-TR; APA, 2000), amenorrhea has been eliminated as a diagnostic criterion for AN in the DSM-5. AN is divided into two subtypes: restricting type and binge-eating/purging type. AN restricting type is a specifier used to

describe individuals who engage in excessive exercise, dieting, or fasting in order to achieve and maintain low body weight, whereas AN binge-eating/purging type is used to describe individuals who engage in binge eating, purging (i.e., self-induced vomiting, etc.) or both behaviors (APA, 2013).

Bulimia nervosa (BN), like AN, is characterized by undue influence of body weight and shape on self-evaluation. This over-evaluation of weight and shape in individuals with BN occurs in addition to recurrent episodes of binge eating followed by purging (e.g., self-induced vomiting or misuse of laxatives or diuretics) or other inappropriate compensatory behaviors (i.e., excessive exercise or fasting) to prevent weight gain. Binge eating episodes are discrete periods of time in which a person consumes an objectively large amount of food compared to what an average person would eat given a similar situation and circumstances and feels a loss of control over their eating during this time. BN is divided into two subtypes based on the use of different types of inappropriate compensatory behaviors: purging type and nonpurging type. Purging type is a specifier used to describe individuals with BN who engage in purging behaviors including vomiting, which is most commonly used. Nonpurging type is a specifier used to describe individuals with BN who do not regularly engage in purging behaviors but use other inappropriate compensatory behaviors instead, including engaging in excessive exercise and/or fasting to prevent gaining weight. The DSM-5 has reduced the frequency of these bingeing and inappropriate compensatory behaviors from twice-weekly as specified in the DSM-IV-TR to once-weekly during the span of at least 3 months. Unlike individuals with anorexia nervosa (AN) who are

underweight ($BMI \leq 17.5$), individuals with BN maintain a body weight that is in the normal range for one's age and height (Garner, 1997).

Binge-eating disorder (BED), like BN, is characterized by recurrent binge-eating episodes in which, during a discrete period of time, an individual consumes substantially more food than an average person would and feels a lack of a sense of control over their food consumption during this time. Unlike BN, the binge-eating episodes that occur in BED are not regularly followed by inappropriate compensatory behaviors (Danner, Ouwehand, Haaster, Hornsveld, & de Ridder, 2011). The DSM-5 requires that, in order to meet diagnostic criteria for BED, individuals must experience binge-eating episodes once-weekly during the span of at least three months. The DSM-5 includes BED as a formal eating disorder category whereas it was merely described in Appendix B as a category for further study in the DSM-IV-TR.

Although AN, BN, and BED are treated as distinct diagnostic disorder categories in the DSM, Fairburn, Cooper, and Shafran (2003) have proposed a transdiagnostic model of eating disorder. Not only do individuals with BN, AN, and BED share characteristic clinical features (i.e. over-evaluation of weight and shape, dietary restraint, and binge eating and purging for some), variability in the courses of eating disorder symptoms (Lavender et al., 2011) and "diagnostic migration" are often seen when looking at eating disorder diagnoses longitudinally. Taken together, this information suggests that eating disorders have common mechanisms that maintain them that cut across DSM diagnoses (see Fairburn et al., 2003, for full review).

Additionally, AN, BN, and BED share fundamental similarities in that each is characterized by a reduced ability to effectively regulate eating behavior (Brogan,

Hevey, & Pignatti, 2010), and, in terms of decision making, an engagement in behavior that is immediately reinforcing but results in negative consequences over time (Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007; Brogan, Hevey, O'Callaghan, Yoder, & O'Shea, 2011). In AN, individuals engage in dietary restriction and other behaviors which are thought to reduce anxiety related to fear of gaining weight in the short-term but often result in deleterious physical and psychological consequences over time (Cavedini et al., 2004). In BN, individuals engage in binge eating, which is thought to be immediately reinforcing in that it may result in momentary alleviation of negative affect (Boeka & Lokken, 2006). Individuals with BN also engage in inappropriate compensatory behaviors which are thought to be immediately reinforcing in that they appear to reduce anxiety related to fear of gaining weight and may reduce physical discomfort associated with binge eating but often result in deleterious physical and psychological consequences over time (Boeka & Lokken, 2006). In BED, individuals also engage in behavior that is thought to be immediately reinforcing but detrimental in the long term (Danner et al., 2011). Specifically, while binge eating may momentarily reduce negative affect such as anxiety, tension, or depressed mood, it may result in negative consequences in the long run (Brogan et al., 2011; Svaldi, Brand, & Tuschen-Caffier, 2010) such as obesity and other related medical problems.

Eating Disorder Prevalence, Correlates, and Treatment Outcomes

Though there are some cases in males, eating disorders occur primarily in females. In female community samples, the lifetime prevalence is 0.9% for AN, 1.5% for BN, and 3.5% for BED. In women, AN and BN generally begin in adolescence or

young adulthood whereas the mean onset of BED is later in young adulthood.

Comorbidity with other psychological disorders including mood, anxiety, substance-use disorders and other disorders related to impulse-control problems as well as personality pathology related to perfectionism, obsessive-compulsiveness, neuroticism, negative emotionality, harm avoidance, and impulsivity is common in individuals with eating disorders (Cassin & von Ranson, 2005; Hudson, Hiripi, Pope, & Kessler, 2007).

Further, medical complications such as gastrointestinal disturbances, dental problems for those who engage in self-induced vomiting, and other complications like electrolyte imbalances and cardiac conditions are potentially serious consequences for individuals with AN and BN (Mehler, 2001; Mitchell & Crow, 2006). Also, many individuals with BED are either overweight or obese (Hudson et al., 2007), which may put them at a higher risk of other medical conditions (i.e. diabetes, cardiovascular disease, certain types of cancer, etc.). Individuals who suffer from disordered eating may be more likely to experience distress and impairment in general with many reporting at least some level of role impairment. However, only a minority of individuals with eating disorders seek treatment (Hudson et al., 2007), and, although there is variability in the outcome research, some studies have found that over half of individuals who seek treatment for an eating disorder fail to obtain full symptom remission at follow-up and many relapse (Hellerskov et al., 2010). This seems to suggest that there is room for improvement in the treatment for eating disorders and for more research that seeks to inform such treatment.

Decision Making and Eating Disorders

The research examining decision-making performance in individuals with eating disorders is mixed. A number of recent studies have found differences in decision-making performance between individuals with eating disorders as well as individuals who are obese and controls (e.g. Cavedini et al., 2004; Cavedini et al., 2006; Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Brogan et al., 2011; Danner et al., 2011; Liao et al., 2009; Svaldi et al., 2010; Tchanturia et al., 2007). However, two studies did not find significant decision-making differences between individuals with eating disorders (AN and BN) and controls (Bosanac et al., 2007; Guillame et al., 2010).

Decision Making in Groups with Anorexia Nervosa

Cavedini et al. (2004) examined decision making using the Iowa Gambling Task (IGT) with a control group that consisted of women without AN and a clinical group of women with AN that was divided by subtype (restricting type and binge eating/purging type). The IGT is a computerized card task that assesses risky decision making in a situation where contingencies are not explicit (Bechara, Damasio, Damsio, & Anderson, 1994). Participants begin the task with a small amount of play money. They are instructed to maximize their money by selecting cards one at a time from 4 different decks of cards (A, B, C, and D) and are told that some decks are better than others. Each deck produces different distributions of monetary gains and losses. Decks A and B are considered disadvantageous because, while they have high expected gains, they have infrequent but high losses that give them an overall negative expected value. Decks C and D are considered advantageous as they have lower gains per trial but low

losses that give them an overall positive expected value (Cavedini et al., 2004). Thus, negative net values reflect a tendency to make poor decisions while positive net values reflect a tendency to make good decisions (Davis et al., 2010).

As was predicted by Cavedini et al. (2004), the group with AN performed significantly worse than the control group without AN on the IGT, producing a lower net score. Though the group with AN performed more poorly on the IGT compared to the control group and displayed a preference for the disadvantageous decks overall, their strategy as the task progressed did not differ significantly from that used by the control group. However, the different AN subtypes used different strategies as the task progressed: AN-restricting participants demonstrated an increasing preference for the disadvantageous decks while the AN-binge/purge participants displayed a more random decision-making performance in which neither type (e.g., disadvantageous or advantageous) of deck was favored. No significant correlations were found between total Yale-Brown-Cornell Eating Disorder Scale (YBC-EDS; Mazure, Halmi, Sunday, Romano, & Einhorn, 1994) scores, a measure of eating disorder symptom severity, or Body Mass Index (BMI), a measure of AN illness severity, and IGT performance among the group with AN, suggesting that AN symptom and illness severity is not related to decision-making performance. Further, significant differences were not found between the group with AN and the control group on neuropsychological tests that assess basic cognitive functions other than decision making including the Weigl's Sorting Test (Weigl, 1941), a measure of strategy-shifting ability, the Object Alternation Task (Freedman, 1990), a measure of one's ability to find a strategy by using feedback received, and the Wisconsin Card Sorting Test (Bergh, 1948), a

measure of cognitive strategy-shifting ability in a situation with a changing criterion. These results suggest that the poor decision-making demonstrated by the group with AN was not solely the result of a general cognitive deficit. Mood was not assessed in this study on the basis that some previous studies (e.g., McDowell et al., 2003) suggest that depressed mood does not impair cognitive function in individuals with AN. The authors suggest that the behavior employed by patients with AN is similar to that employed by patients with OCD (i.e., engaging in compulsions that reduce anxiety generated by obsessions which is reinforcing in the short-term but produces long-term negative consequences) (Cavedini et al., 2004).

In a continuation of this research, Cavedini et al. (2006) conducted a prospective study examining decision making prior to and following treatment in a clinical sample of women with AN. The female patients with AN were administered either cognitive-behavioral treatment alone or a combination of cognitive-behavioral and drug treatment (e.g. SSRIs). The group with AN performed significantly worse than the control group on the IGT at admission and post-treatment, and both the control group and the group with AN did not show significant improvement at discharge. The authors proposed that the fact that the AN group's decision-making performance did not improve after treatment may suggest that the decision-making impairment that was seen in the group with AN is not due to the effects of starvation and instead may be a trait condition (Cavedini et al., 2006). However, it should be noted by the reader that, as of yet, there are no treatments that have received strong empirical support (as defined by Chambless et al., 1998) for adults with AN, and the research supporting the use of

cognitive- behavioral therapy for acute weight gain in adults with AN is controversial (see McIntosh et al., 2005), which makes it difficult to assess such a conclusion.

Tchanturia et al. (2007) conducted a study examining the relationship between decision making and skin conductance responses (SCRs), which assess emotional or physiological arousal, in female patients with AN compared to women recovered from AN (ANR) and healthy controls (HC) using the IGT. The group with AN performed significantly worse overall on the IGT compared to the ANR and HC groups, and the ANR and HC groups performed similarly on the task. This finding is somewhat contrary to the results of Cavedini et al. (2006), who found that the decision-making performance of patients with AN did not improve post-treatment, and seems to suggest that the poor decision making demonstrated by the group with AN may be a state condition. Further, while the ANR and HC groups learned to avoid the disadvantageous decks, the performance of the group with AN did not improve as the task progressed. Additionally, the group with AN generated significantly lower anticipatory SCRs on both high and low-risk decks than the HC group throughout the task, but no significant differences were found in SCR between the AN and ANR groups and the HC and ANR groups. Anticipatory SCRs prior to the selection of high and low-risk cards were found to be positively correlated with IGT (e.g. lower anticipatory SCRs were related to lower IGT performance). Thus, the authors suggest that reduced anticipatory SCR may be related to the poor decision-making performance demonstrated by the group with AN (Tchanturia et al., 2007).

Decision Making in Groups with Bulimia Nervosa

Boeka and Lokken (2006) conducted a study examining decision making and BN using a sample of college women that was divided into a control group, which included participants with minimal or no eating disorder symptomology, and a group with BN, which included participants with a current or past BN diagnosis. When matched for age, level of education, and verbal intelligence, women in the group with BN performed significantly worse than the control group on the Iowa Gambling Task (IGT), showing preference for the disadvantageous decks. Unlike in the studies conducted by Cavendish et al. (2004, 2006), eating disorder symptom severity as measured by the Eating Disorders Examination Questionnaire (EDE-Q) and the Bulimia Test Revised (BULIT-R) was found to be negatively correlated with performance on the IGT. Lastly, while the group with BN was found to have significantly higher scores on the Beck Depression Inventory (BDI-II) compared to the control group as was expected, performance on the BDI-II was not found to be correlated with performance on the IGT. This, according to the authors, made controlling for depression symptoms when comparing the two groups unnecessary (Boeka & Lokken, 2006).

Brand et al. (2007) conducted a study examining decision making in BN with an all-female clinical sample using the Game of Dice Task (GDT). Similar to the IGT, the GDT is a computerized task that assesses decision making under risk. This task differs from the IGT, however, in that it assesses decision making in a situation where consequences are explicit. Participants begin the task with a small loan of play money and are instructed to guess the number that comes up on each of 18 throws of a die. The

participants are shown a display that contains 1 row of single numbers depicted on a die, 1 row of two numbers depicted on two dice, one row of three numbers depicted on three dice, and one row of four numbers depicted on four dice (see Figure 1 from Brand et al. (2007)). Alternatives contain a single number or a combination of two, three, and four numbers, and each alternative is related to a different gain/loss amount that remains fixed and visible to the participant at all times throughout the task. Further, those numbers/combinations of numbers having a lower probability of being rolled are associated with higher gain, but also with a higher loss (e.g., single number options are associated with a higher gain/loss than combinations with two numbers, etc.). Therefore, the amount of risk can be reasoned by the participant for each trial. Single numbers and combinations of two numbers are considered disadvantageous or “risky” as they are associated with frequent high losses and infrequent high gains (<50% probability of winning money). Combinations of three or four numbers are considered advantageous or “non-risky” in that they are associated with a higher probability of gain (>50% probability of winning money) over the long run. The authors also administered several tests of executive function that included the Color-Word Interference Test, Trail Making Test (TMT), Nelson’s Modified Card Sorting Test, and the Tower of Hanoi (Brand et al., 2007).

As the authors predicted, the performance of the group with BN on the GDT was significantly lower than that of the control group as demonstrated by more risky decisions. In the group with BN, psychiatric symptoms as measured by the Symptom Checklist (Franke, 2002) and personality traits as measured by the Freiburg Personality Inventory (Fahrenberg, Hampel, & Selg, 2001) and the Neuroticism scale (including

the Impulsiveness subscale) of the NEO Personality Inventory-Revised (Ostendorf & Angleitner, 2003) were not found to be significantly related to decision making. Interestingly, the Impulsiveness subscale score of the Neuroticism scale, while significantly higher in the group with BN compared to the control group, was not correlated with GDT performance in the BN group but was correlated with GDT performance in the control group. The authors suggest that the significantly higher mean impulsivity score of the group with BN compared to the control group may indicate a relationship between impulsivity and decision making that is not necessarily linear nor reflected by the correlations in the group with BN. It was found that patients with BN who took longer for the interference sheet of the Color Word Interference Test or the Trail Making Test (TMT) Part B, both executive function tasks, made more disadvantageous selections on the GDT, which suggests that executive function may be related to decision-making impairment in individuals with BN (Brand et al., 2007).

Decision Making in Binge-Eating Disorder and Obesity

Svaldi et al. (2010) conducted a study examining decision making in binge-eating disorder (BED) using an all-female clinical sample. The study consisted of a group with BED and an overweight control group (BMI >25) that both were administered the GDT. In addition, participants were given the TMT (Parts A and B), a measure of executive function. As was predicted by the authors, the group with BED performed significantly worse on the GDT compared to the overweight control group, as evidenced by a lower net score on the task. Further, the group with BED was found to advantageously utilize feedback less compared to the overweight control group. Specifically, the group with BED was found to change their game strategy significantly

less than controls in response to negative feedback following a “risky” selection. Also, the group with BED continued in the selection of a “safe” alternative in response to positive feedback following a “safe” choice significantly less than the overweight control group. Interestingly, contrary to the authors’ prediction, the group with BED was found to seek fun less and was less reward-responsive, as measured by the Behavioral Approach System (BAS) reward responsiveness subscale, than the overweight control group. No relationship was found between eating pathology and GDT performance in this study. However, the group with BED was found to have overall reduced executive function (TMT Part B-TMT Part A/ TMT Part A) and reduced cognitive flexibility specifically (lower score on the TMT Part B) compared to the overweight control group. The authors suggest that reduced executive function may contribute to impaired decision making in BED (Svaldi et al., 2010).

Davis et al. (2010) conducted a study to examine decision making and ability to delay gratification in women with BED compared to obese and normal weight controls without BED using an all-female clinical sample. The participants were administered the IGT and the Delay Discounting Task. The Delay Discounting Task (Richards, Mitchell, de Wit, & Seiden, 1997; Richards, Zhang, Mitchell, & de Wit, 1999) is a computerized task that measures delay of gratification (i.e., value of immediate rewards relative to delayed rewards). In this task, participants are asked different questions addressing whether they would prefer a small amount of money immediately (e.g. \$65) or a larger amount of a money after a delay (e.g. \$100): there are 5 delay periods (2, 30, 180, 365, and 730 days) that are assessed. Individuals who are less able to delay gratification show a tendency to prefer less money immediately as opposed to waiting a

certain number of days to receive a higher amount of money, especially as the delay period increases (Davis et al., 2010).

The obese control group and the group with BED performed significantly worse on the IGT compared to the normal weight control group. The obese control group and the group with BED also performed more poorly on the Delay Discounting Task, discounting larger future rewards in favor of smaller rewards that were more immediate, than the normal weight control group. Overall, compared to the normal weight control group, the performances of the obese control group without BED and the group with BED were not significantly different on the two measures (IGT and Delay Discounting Task). However, a major confounding variable was significant differences in education level among the groups. The normal weight control group had a much higher level of education, and when an ANOVA was run adding education level as a main-effect variable in the design, the group differences were no longer found to be statistically significant for either the IGT or the Delay Discounting Task (Davis et al., 2010). This suggests that the group differences on the IGT and the Delay Discounting Task may have been mediated by differences in educational level.

However, a recent study by Danner et al. (2011) which did control for education level found significant decision-making differences as measured by the IGT between a group with BED and a normal weight group as well as between an obese group without BED and the normal weight group. No significant decision-making differences between these two groups (BED and obese group without BED) were found though. Further analysis found that the performance of normal weight women on the IGT improved over time, but the performance of obese women without BED and women with BED

did not. This suggests that women with BED and obese women without BED may share a decision-making impairment in decision-making situations where the consequences are not explicit (e.g. IGT). The authors also found a negative correlation between binge-eating disorder severity as measured by the Binge Eating Scale (BES) and performance on IGT in that IGT performance decreased as binge-eating disorder severity increased. They also found a negative correlation between BMI and IGT performance in that, as BMI increased, IGT performance decreased. Lastly, a correlation between sensitivity to punishment as measured by the Behavior Inhibition Scale (BIS) and IGT performance was found in that participants with lower sensitivity to punishment performed more poorly on the IGT. Binge-eating severity was positively correlated with BMI and lower sensitivity to punishment (Danner et al., 2011).

Brogan et al. (2011) conducted a study examining decision making in obese participants compared to normal weight controls using a male and female clinical sample. The participants were administered the IGT. As predicted by the authors, the obese group performed significantly worse overall than the control group on the decision-making task. Further, although the control group demonstrated an increasing preference for the advantageous deck as the task progressed, the obese group failed to demonstrate this same learning. Instead, the obese group did not demonstrate a clear preference for either type of deck (e.g., disadvantageous or advantageous), suggesting that the impaired performance on the IGT was not due to impulse control. Performance on the IGT was not related to eating pathology for the obese group, the comparison group, or the sample as a whole. Further, impulsivity as measured by the Consideration of Future Consequences (CFC) scale (Strathman, Gleicher, Boninger, & Edwards,

1994) was not related to IGT performance in the obese group. Though executive functioning was not measured in this study, the authors suggest that the lack of correlation between decision-making deficits and eating pathology may indicate that reduced executive functioning may be behind the poor decision making of the obese group. They suggest that future studies should be conducted to assess the role of executive functioning in decision making of obese individuals (Brogan et al., 2011).

Decision Making in Both Groups with Anorexia and Groups with Bulimia

Liao et al. (2009) conducted a study examining decision making using a clinical sample of women with BN and a control group (AN patient data from a previously published study (Tchanturia et al., 2007) was also used for comparative purposes). All three groups had been administered the IGT, and skin conductance response (SCR) measurements were taken while subjects performed the task. These SCR measurements were used as an index of somatic/emotional responding prior to making high risk decisions (anticipatory SCR) and after seeing the result of one's card selection (response SCR) (Liao et al., 2009).

Overall, in line with the researchers' prediction, both the group with AN and the group with BN scored significantly lower than the control group on the IGT. While the controls learned to avoid the disadvantageous decks during the task, the groups with AN and BN did not, suggesting that the clinical groups were impaired in learning to advantageously use feedback to guide decision making in an ambiguous situation like the IGT. However, while the group with AN generated significantly lower levels of anticipatory and response SCR measurements during the IGT than controls, which is consistent with the findings of Tchanturia et al. (2007), the group with BN scored

similarly to the control group. These results suggest that the poor IGT performance of the group with AN may be influenced by a lack of somatic arousal but that somatic arousal does not seem to drive the poor decision-making performance of the group with BN. No correlation was found between the Barratt Impulsivity Scale (BIS; Patton, Stanford, & Barratt, 1995), a measure of impulsivity, and IGT performance. One subscale (e.g. doubts about action) of the Frost Multidimensional Perfectionism Scale (FMPS; Frost, Marten, Lahart, & Rosenblate, 1990), a measure of perfectionism, was significantly negatively correlated with IGT performance. Finally, obsessive-compulsive symptoms as measured by the Obsessive-Compulsive Inventory (OCI; Foa, Kozak, Salkovskis, Coles, & Amir, 1998) were found to be significantly negatively correlated with IGT performance. However, the relationships between obsessive-compulsive symptoms and decision-making performance were not examined separately for each group. Instead, a correlation was run using all of the groups combined. The authors suggest that it is possible the obsessive-compulsive symptoms, which are common in individuals with eating disorders, may be behind the poor IGT performance of the AN and BN groups (Liao et al., 2009).

Brogan et al. (2010) conducted a study looking at decision making in AN, BN, and obesity with an all-female clinical sample using the IGT. This study is an improvement over previous research in that it was the first to compare multiple eating-disordered groups: AN, BN, and obese patients. Significant decision-making differences were found in the groups with AN, BN and obesity compared to the control group. All three groups performed more poorly than the control group as demonstrated by a lower net score and failure to learn to choose from the advantageous decks during

the IGT. No significant differences were found between the clinical groups (AN, BN, or obese) though, suggesting that a decision-making deficit is common to these groups (Brogan et al., 2010).

Bosanac et al. (2007) conducted a study examining executive function, memory, and visuospatial functioning in underweight and “weight-recovered” female patients with AN and female patients with BN compared to a normal control group. In this study, decision making was also assessed using the IGT. Contrary to the results of a number of other studies (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Cavedini et al., 2004; Cavedini et al., 2006; Liao et al., 2009), the groups with AN and BN did not perform significantly different from the normal control group on decision making as measured by the IGT although the clinical groups trended toward lower scores. The authors suggest that this discrepancy may have been due to low statistical power resulting in increased likelihood of Type II error in their study compared to previous studies with more participants. Specifically, while at least 20 participants per group were needed in order to achieve a desired power of .80, groups of 16 or less participants were used in this study (e.g. AN group= 16, BN=13, NC= 16) (Bosanac et al., 2007). In other words, this study appeared to have lacked adequate ability to detect between group differences had these differences existed. There have been a number of studies that have used larger groups, many with groups of more than 20 participants, that have found differences between groups with AN and BN and groups without eating disorders (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Cavedini et al., 2004; Cavedini et al., 2006; Liao et al., 2009).

Guillame et al. (2010) conducted a study examining decision-making performance and eating disorders with a large clinical sample of women with AN and BN and a control group using the IGT. Contrary to the researchers' prediction, the groups with AN and BN did not perform significantly different from the control group on decision making as measured by the IGT (Guillame et al., 2010).

The authors of this study argue that this discrepancy may have been due to differences in patient characteristics between their study and previous studies (Guillame et al., 2010). While their study excluded medicated and depressed individuals on the basis that these variables may affect decision-making performance, there have been a few previous studies that did not address or control for medication and depression status. For example, they argue that one previous study excluded participants based on medication status (Cavedini et al., 2004), but some did not address medication status (Boeka & Lokken, 2006; Cavedini et al., 2006). In another study (Tchanturia et al., 2007), almost half of the patients were taking SSRIs at the time of the experiment; however, no significant differences were found between those taking medication and those who were not taking medication (Tchanturia et al., 2007). Further, one study (Tchanturia et al., 2007), found depression scores to be significantly negatively correlated with decision-making performance as measured by the IGT. Some studies, the authors argue, do not address depression status (Cavedini et al., 2004; Cavedini et al., 2006). In other studies (Boeka & Lokken, 2006; Liao et al., 2009; Tchanturia et al., 2007), the mean depression level as measured by the BDI-II was higher in ED groups than controls. Thus, the authors argue that depression or medication may have negatively impacted decision making in the clinical groups and contributed to the poor

IGT performance in some of these previous studies (Guillame et al., 2010). While the explanations proposed by Guillame et al., (2010) may be true, one could argue that using a euthymic and non-depressed sample of eating disorder patients only represents a smaller, less impaired, subset of that population and may not be generalizable to the larger population of individuals with eating disorders, in which a sizable portion suffer from depression and/or take medication.

Limitations of Current Research

One limitation of the existing research on decision making and eating disorders is that only one measure of decision making is used, most frequently the IGT (with the exception of Brand et al., 2007 and Svaldi et al., 2010, who used the GDT). First, using any single measure of decision making may be limited in comprehensively assessing decision making because that assumes that decision making is a unidimensional construct (Brogan et al., 2011). Further, using the IGT alone in evaluating decision making is potentially problematic in that this task assesses decision making in a somewhat ambiguous situation where the contingencies are not explicit (Brand et al., 2007; Svaldi et al., 2010). Some argue that this type of decision-making situation with non-explicit consequences may not be similar to that experienced by individuals with eating disorders (Brand et al., 2007; Svaldi et al., 2010). Instead, individuals with eating disorders are often aware of the consequences of their behavior (e.g., individuals with eating disorders often recognize that their eating behaviors may likely result in detrimental physical and social consequences) (Svaldi et al., 2010) and that it may be beneficial to assess decision making in individuals with eating disorders using a task with explicit consequences (e.g. the GDT). Further, a study comparing decision making

in both situations (e.g. one with non-explicit consequences as measured with the IGT and explicit consequences as measured with the GDT) across groups with eating disorders is lacking (Brand et al., 2007). Also, lacking within the current eating disorder and decision-making literature is a study that examines decision making in a situation where higher-quality decision making is associated with higher-risk decisions as is the case in the Balloon Analogue Risk Task (BART). Instead, included in the current research are tasks in which higher-quality decision making is associated with lower-risk decisions (e.g. IGT and GDT).

Additionally, the decision-making instruments that have been administered in previous studies, particularly the IGT and the GDT, are computerized tasks. Recent work (Bruine de Bruin, Parker, & Fischhoff, 2007) has developed and validated a pencil-and-paper self-report measure of decision making: the Adult Decision-Making Competence (A-DMC) index. In this task, the participant is presented with a number of written scenarios in which they have to read and integrate information before coming to a decision. The Adult Decision-Making Competence (A-DMC) index appears to require a much greater degree of cognitive processing and working memory than the IGT or the BART. Van Dyke and Petros (2013) recently reported that measures of personality and cognition differentially predicted decision-making performance depending upon whether the task was administered via the computer verses via pencil-and-paper. This highlights the need to examine decision-making performance on tasks that are administered through different mediums.

Also, an overwhelming majority of the studies examining decision making and eating disorders have been conducted using a clinical sample with eating disorders. Only one of the studies reviewed (Boeka & Lokken, 2006) has been conducted using a college sample, a population for which eating disorders are prevalent and persistent (Eisenberg, Nicklett, Roeder, & Kirz, 2011). Also, lacking in the decision making and eating disorder literature is a study that compares BN and BED, two disorders that are conceptually very similar, especially BED and BN non-purging type.

Further, as emphasized by Guillame et al. (2010), many of these studies do not address obsessive-compulsive symptoms, which are prevalent in individuals with eating disorders and have been found to negatively impact decision-making performance on the IGT (Lawrence et al., 2006). Though eating disorders and obsessive-compulsive disorder (OCD) are seemingly very different conditions and are categorized as such in the DSM-5, they both have a similar cognitive feature: repetitive thoughts and preoccupation with a feared stimulus. With eating disorders, the thoughts and preoccupations are geared toward food and body weight and shape whereas with obsessive compulsive disorder, the thoughts and preoccupations are primarily focused on checking, washing, mental neutralizing, ordering, or hoarding, etc. (Altman & Shankman, 2009).

Anxiety disorders, in particular OCD, have been found to be more prevalent in women with eating disorders (Kaye et al., 2004). Epidemiological studies have reported the lifetime prevalence of OCD in individuals with BN to be between 14.3% and 17.4% in community samples (Angst et al., 2004; Hudson et al., 2007) and as high at 43% in populations with eating disorders (Godart, Flament, Perdereau, & Jeammet, 2002;

Swinbourne & Touyz, 2007). Further, lifetime prevalence of OCD in individuals with BED has been found to be 8.2% in a large community sample (Hudson et al., 2007). High prevalence rates of OCD in individuals with AN have been found as well (e.g. up to 69% in populations with eating disorders (Godart et al., 2002; Swinbourne & Touyz, 2007)). Others studies have found a high comorbidity between obsessive-compulsive tendencies and disordered eating in an all-female college sample (Roberts, 2006). This research seems to suggest that the co-occurrence of OCD and eating disorders is not due to chance.

Longitudinal studies of the comorbidity of ED and OCD suggest that the co-occurrence of the two conditions may be due to an underlying etiological factor (Altman & Shankman, 2009), and studies that have found higher rates of OCD in relatives of individuals with AN and BN compared to controls (Lilenfeld et al., 1997, 1998; Strober, Freeman, Lampert, & Diamond, 2007) further lend support to the notion that EDs and OCD share a common etiological factor. A common etiological factor that has been suggested is personality traits such as impulsivity and perfectionism, which are core personality traits shared by both individuals with EDs and OCD (Altman & Shankman, 2009). Gay, Rochat, Billieux, d'Acremont, and Van der Linden (2008) suggested that urgency, a specific pathway of impulsivity, is associated with compulsive behaviors in OCD, and others have suggested that this this may be the common personality trait shared by individuals with EDs and OCD (Altman & Shankman, 2009).

Lastly, many of the previous studies linking eating pathology to decision-making deficits have failed to consistently identify the potential source of these

decision-making deficits. Potential sources of decision making-deficits in individuals with eating disorders include impulsivity, executive functions, skin conductance responses, and obsessive-compulsive symptoms. Impulsivity has been examined but found not to be significantly correlated to decision-making performance in women with BN (Brand et al., 2007) and obese clinical groups (Brogan et al., 2011) or AN, BN, and control groups combined (Liao et al., 2009). However, these studies assessed impulsivity as a unitary construct (e.g. Impulsiveness subscale score of the Neuroticism scale of the NEO Personality Inventory-Revised and total scores on Barratt Impulsivity Scale and Consideration of Future Consequences Scale), and did not look at the relationship between different impulsivity traits (e.g., negative urgency, etc.) and decision making in the groups with eating disorders. Further, Liao et al. (2009) did not examine the relationships between impulsivity and decision-making performance separately for each individual group. One study found a correlation between executive function and decision-making performance in a BN group (Brand et al., 2007). Another found reduced overall executive function and reduced cognitive flexibility specifically in a BED group compared to controls (Svaldi et al., 2010). Two studies have found a correlation between reduced skin conductance response (SCR) and poor decision-making performance on the IGT in groups with AN (Liao et al., 2009; Tchanturia et al., 2007), but not in BN (Liao et al., 2009). Finally, obsessive-compulsive symptoms, including hoarding symptoms specifically (Lawrence et al., 2006), have been found to be significantly negatively correlated with IGT performance in some studies (Liao et al., 2009). Some suggest that it is possible that these obsessive-compulsive symptoms, which are common in individuals with eating disorders, may be behind the poor IGT

performance of the groups with AN (Cavedini et al., 2006) and BN (Laio et al., 2009). This study (Liao et al., 2009) is limited, however, in that it did not examine the relationship between scores on the OCI and IGT performance looking at each individual group (AN, BN, and controls); instead, a correlation was run using all three groups combined.

One study that very eloquently documented the need to understand the potential age-related sources of decision-making deficits was reported by Henninger, Madden and Huettel (2010). These authors found that older adults made significantly lower-quality decisions on the BART and the Cambridge Gambling Task (CGT; Rogers et al., 1999) compared to younger adults, demonstrating higher levels of risk-aversion and selection of lower-probability options, respectively (Henninger et al., 2010). In this study, it was found that age-related cognitive decline in processing speed and working memory mediated age group differences in decision quality. When cognitive factors were removed, there were no significant age differences in decision making, suggesting that age-related cognitive decline in processing speed in particular may manifest itself as impaired decision making in older adults. Suggestions are made that differences in presentation of information may diminish these differences in decision making in older adults (Henninger et al., 2010). The work of Henninger et al. (2010) provides an important model for identifying potential sources of eating disorder related deficits in decision making.

The study of decision making in individuals with eating disorders and the factors that may contribute to these decision-making impairments is a valuable area of research as it may have important clinical implications for informing treatment.

Previous research has found differences in treatment outcome as a function of decision-making as reflected by performance on the IGT in other clinical populations including individuals with OCD (Cavedini et al., 2002). Similarly, it may be beneficial to study those factors that are thought to impact or contribute to decision making in individuals with eating disorders (e.g., executive function, impulsivity-related personality traits, and obsessive-compulsive symptoms) as they may be related to treatment response.

The Current Study

Through the use of a broad-based decision-making test battery, the proposed study will comprehensively assess decision making in order to thoroughly examine performance differences in groups with BN and BED compared to each other and to controls using a sample of primarily female college students. In particular, decision making under risk will be investigated in a situation where contingencies are not explicit (e.g., IGT) as well as in a situation where contingencies are made explicit (e.g., GDT). Further, decision making will be examined in situations where the task is administered via computer (e.g. IGT, GDT, and BART) and where the task is administered via pencil-and-paper (e.g., A-DMC subtests including Resistance to Framing, Consistency in Risk Perception, and Applying Decision Rules). Additionally, decision making will be assessed in a situation where higher-quality decision making is associated with lower risk-taking (e.g., IGT and GDT) and where higher-quality decision making is related to higher risk-taking (e.g. BART).

It is hypothesized that the BN and BED groups will perform more poorly than the control group on the computerized decision-making tasks in which higher-quality decision making is associated with lower risk (e.g., IGT, GDT). Further, it is

hypothesized that the BN and BED groups may even perform better than the control group on the computerized decision-making task in which higher-quality decision making is associated with higher risk (e.g., the BART). Exploratory comparisons will also be performed to examine possible decision-making differences between the BN and BED groups and possible differences in decision-making on the pencil-and-paper decision-making tasks (i.e., the ADMC subtests) compared to the computerized decision-making tasks (i.e. IGT, GDT, and BART) among the groups. Further, analyses will be run to explore whether these difference may be explained by differences in measures of executive function, impulsivity-related personality traits, or obsessive-compulsive symptoms.

CHAPTER II

METHOD

Participants

The sample consisted of all female participants (N=111): 83 control participants (CG), 21 participants with a diagnosis of bulimia nervosa (BN) either currently (n=20) or in the past (n=1), and 7 participants with a current diagnosis of binge-eating disorder (BED). Participants were primarily recruited from a subject pool of undergraduate psychology students at the University of North Dakota campus (n=108) although some participants were recruited from the community through advertisements throughout the university and at local mental health clinics (n=3). A priori power analysis with a desired power of .80 and an effect size of .4 with three groups indicated that a total sample size of 66 was needed for this study. In addition, a sample size was chosen that was consistent with previous work in this area, which has typically utilized groups of between 15 and 29 participants.

Procedures

During the initial phase of the study, a large group of potential participants (N=1069) was screened on the Eating Disorder Diagnostic Scale (EDDS) and asked to complete the Obsessive-Compulsive Inventory-Revised (OCI-R), UPPS-P Impulsive Behavior Scale, Executive Function Index (EFI), Rutgers Alcohol Problem Index

(RAPI), Rutgers Alcohol Problem Index-Drug version (RAPI-D), and a series of demographic questions electronically via Qualtrics. Based on performance on the EDDS, participants were contacted and invited back to participate in the second phase of the study. Specifically, participants with a current or past diagnosis of bulimia nervosa in the absence of meeting any exclusionary criteria were included in the BN group, and participants with a current or past diagnosis of binge-eating disorder in the absence of meeting any exclusionary criteria were include in the BED group. Participants without a current or past diagnosis of an eating disorder and who did not meet any of the exclusionary criteria were included in the control group. Exclusionary criteria for all three groups included severe psychiatric disturbance, a history of entering treatment for substance-related disorder, head trauma or neurological disease or disorder, learning disability or ADHD, as these factors are thought or have been found to be related to decision making.

During the second phase of the study, participants were administered the WAIS-IV Vocabulary Subtest followed by the pencil-and-paper decision-making tasks (e.g., Adult Decision-Making Competence (A-DMC) index subtests including Applying Decision Rules, Consistency in Risk Perception, and Resistance to Framing), the three computerized decision-making tasks (i.e., IGT, GDT, and BART), and the BDI-II and the BAI, all which were administered by trained researchers after informed consent had been obtained. The cognitive measures were given in an alternating fashion such that participants with an identification number that was odd were given the measures in this order (i.e., WAIS-IV Vocabulary Subtest, A-DMC subtests, IGT, GDT, and BART followed by the BDI-II and BAI) and participants with an identification number that

was even were given these measures in the opposite order (i.e., BART, GDT, IGT, A-DMC subtests, and WAIS-IV Vocabulary Subtest, followed by the BDI-II and BAI) to guard against fatigue effects. Upon completion of all tasks, participants were debriefed and given information about how to follow-up on the results of the research.

Measures

Eating Disorder Diagnostic Scale (EDDS): The EDDS is a 22-item self-report measure designed to identify individuals with anorexia nervosa, bulimia nervosa, and binge-eating disorder diagnoses per the DSM-IV (Stice, Telch, & Rizvi, 2000), although this measure was computer-scored in such a way as to reflect the recent DSM-5 revisions in eating disorder diagnostic criteria for the current study. This instrument has demonstrated sound psychometric properties in the diagnostic evaluation of all three disorders (AN, BN, and BED). Overall, it has demonstrated good internal consistency across items (symptom composite $\alpha = .89$) and satisfactory test-retest reliability ($r = .87$) as well as criterion validity (with diagnoses generated by structured diagnostic interview; mean $\kappa = .83$). Further, the original validation study found evidence that is suggestive of the measure's content validity (e.g., panel of experts' refinement of items and agreement that EDDS items address relevant DSM criteria) and convergent validity (e.g., significant positive correlations between the EDDS and other established and validated measures of eating pathology) in a heterogeneous sample of adult females (Stice et al., 2000). Because it is brief and able to be given by untrained persons, the EDDS is useful in situations where a full-length diagnostic interview by a trained professional is not feasible (Anderson, De Young, & Walker, 2009), making it ideal for use in the current study.

Iowa Gambling Task (IGT): The IGT is a computerized task that assesses risky decision making in a situation where contingencies are not explicit (Bechara et al., 1994). Participants start the task with a \$2,000 USD loan of play money, and there are 100 trials in which the participant selects a card from four different decks. Each deck produces different distributions of monetary gains and losses. Two decks (decks A and B) are considered disadvantageous because, while they have high expected gains (+\$100 per trial), they have infrequent but high losses that give them an overall negative expected value. The remaining two decks (C and D) are considered advantageous as they have lower gains per trial (+50) but low losses that give them an overall positive expected value. Thus, for this particular task, higher-quality decision making is associated with lower-risk decisions (Henninger et al., 2010). Decision making is generally examined in two different ways for the IGT: evaluation of the overall net score (i.e., total number of advantageous choices (from decks C and D) minus total number of disadvantageous choices (from decks A and B)) and evaluation of the net score as the task progresses, which can be done by dividing the 100 trials into 5 blocks of 20 trials each and comparing the net scores of each block (Danner et al., 2011). Although the measure was created to assess decision making in patients with orbitofrontal cortex damage, the measure has been used to assess decision making in a number of other clinical populations including women with eating disorders, and the bulk of evidence suggests the construct validity of the measure in detecting decision making deficits in clinical populations when used in the context of a comprehensive evaluation (Buelow & Suhr, 2009). The extent to which this measure is applicable to test-retest situations is not known, and some studies have found a learning effect such

that participants perform better with multiple test administrations (Buelow & Suhr, 2009); however, the IGT will not be used for test-retest purposes in the current study.

Game of Dice Task (GDT): The GDT is a computerized task that assesses risky decision making in a situation where contingencies are made explicit (Brand et al., 2005). Participants begin the task with 1,000 € (Euro) and are instructed to maximize their capital with 18 throws of a die. For each trial, the participant is instructed to guess which number/combination of numbers presented on the screen contains the number that will be thrown in the coming up trial. If the number that is thrown in a trial matches the single number that is chosen or if it is present in the number combination that has been chosen, the participant receives a monetary gain. Conversely, if the number does not match or is not contained in the selected number combination, the participant incurs a monetary loss (Brand et al., 2005; Brand et al., 2007).

There are four “levels” of alternatives in the GDT, and each level contains different amounts of numbers. Alternatives contain a single number or a combination of two, three, and four numbers (Brand et al., 2007) that is associated with a different gain/loss amount that remains fixed and visible to the participant on the screen throughout the entire task (i.e., a single number option is associated with 1000 € gain/loss; combinations containing two numbers are associated with 500 € gain/loss; combinations containing three numbers are associated with 200 € gain/loss; combinations containing four numbers are associated with 100 € gain/loss). The gain/loss associated with the alternative is related to its probability of occurrence (e.g., those numbers/combinations of numbers having a lower probability of being rolled are

associated with higher gain, but higher loss), and the amount of risk can be reasoned by the participant for each option (e.g., for single number options, it can be easily reasoned that there is a 1:6 chance of winning 1000 € but a 5:6 chance of losing that same amount of money) (Brand et al., 2005; Brand et al., 2007) .

Single numbers and combinations of two numbers are considered disadvantageous or “risky” as they are associated with frequent high losses and infrequent high gains (<50% probability of winning money). Combinations of three or four numbers are considered advantageous or “non-risky” in that they are associated with a higher probability of gain (>50% probability of winning money) over the long run (Brand et al., 2005; Brand et al., 2007). Decision making is generally examined in a few different ways for the GDT including evaluation of the overall net score (i.e., total number of “non-risky” or safe choices minus total number of “risky” choices) and evaluation of the ending balance (e.g., the balance with which the participant ends the task).

GDT performance has been found to be correlated with other measures of executive function and feedback processing (see Brand, Labudda, & Markowitsch, 2006), which is suggestive of the construct validity of the measure. Further, the GDT has detected decision-making performance differences in a number of clinical populations (e.g., pathological gambling, Parkinson’s disease, Korsakoff’s syndrome, and OCD) compared to controls including women with eating disorders (see Brand et al., 2007).

Balloon Analogue Risk Task (BART): The BART is a computerized task used to measure decision-making quality (Lejuez et al., 2002). In this task, participants are

presented with a series of 10 virtual balloons that they are instructed to inflate using key presses. The participant accumulates a small amount of money for each key press (1 cent/key press) that they make on an un-popped balloon. The money accumulated for a particular balloon is lost if the participant pops the balloon by inflating it too much, but the risk of popping the balloon and subsequently losing the accumulated money is small. Decision making on this task is typically defined by the average number of key presses on un-popped balloons. Because participants tend to pump too-few times compared to what is considered ideal (e.g., 64 pumps; Lejuez et al., 2002), higher values on this measure are indicative of better decision making and lower values reflect poorer decision making. This is unlike the IGT where higher-quality decision making is associated with lower-risk decisions (Henninger et al., 2010). The test has demonstrated adequate test-retest reliability ($r=.77, p<.001$; White, Lejuez, & de Wit, 2008), and significant correlations between the BART Adjusted Average Pump Count score and measures of risk-related constructs and self-reported risk behavior is suggestive of the construct validity of this measure (Lejuez et al., 2002).

Adult Decision-Making Competence (A-DMC) Index: The A-DMC index, which was adapted from the Youth Decision-Making Competence index (Y-DMC; Parker & Fischhoff, 2005) is a 103-item, pencil-and-paper instrument that includes 7 subtests that assess different components of the decision-making process (Bruine de Bruin et al., 2007): these different subtests include Resistance to Framing, Recognizing Social Norms, Under/Overconfidence, Applying Decision Rules, Consistency in Risk Perception, Path Independence, and Resistance to Sunk Costs. Overall, the measure has demonstrated good internal consistency reliability (Cronbach's $\alpha = .83$ across the seven

A-DMC subtests) and test-retest reliability ($r = .68, p < .001$). Furthermore, evidence has been found in support of the construct validity of the measure as reflected by significant relationships with related measures of cognitive ability and decision-making style. Additionally, the A-DMC overall has demonstrated predictive validity as reflected by significant correlations with measures of decision outcomes (Bruine de Bruin et al., 2007). For the present study, the Resistance to Framing, Applying Decision Rules, and Consistency in Risk Perception subtests were used. These subtests were chosen because factor analysis using the principal factors method revealed that the Applying Decision Rules, Resistance to Framing, and Consistency in Risk Perception subtests have the highest factor loadings ($r = .46-.79$) out of all of the subtests on a one-factor model that appears to represent the construct of decision-making ability (Bruine de Bruin et al., 2007).

The Resistance to Framing subtest is designed to evaluate whether differences in the way a problem is described or presented affect the examinee's value assessment. It has demonstrated adequate internal consistency reliability (Cronbach's $\alpha = .62$) and test-retest reliability ($r = .58, p < .001$). This 14-item task is divided into two different types of items: risky-choice and attribute framing (Bruine de Bruin et al., 2007).

The 7 risky-choice framing items present participants with a hypothetical scenario in which they must indicate their preference for a "risky-choice" option or a "sure-thing" option on a scale from 1 (definitely would choose Option A) to 6 (definitely would choose Option B). Participants are presented with a gain version and a loss version equivalent of the same problem later in the survey, which is considered 1 "item." For example, the gain version of one problem states that the lives of 1,200

endangered animals are being threatened by pesticide and presents the participant with two options: Option A, if used, will result in 600 animals being saved for sure, and Option B, if used, has a 75% chance that 800 animals will be saved and 25% chance that no animals will be saved. Participants are instructed to indicate their preference between the two options on a 6-point scale with 1 indicating the participant would definitely choose Option A and 6 indicating that the participant would definitely choose Option B. The corresponding loss version presents the same hypothetical scenario but frames the options as a loss (i.e. Option A, if used, will result in 600 animals being lost for sure, and Option B, if used, has a 75% chance that 400 animals will be lost and 25% chance that 1,200 animals will be lost). The other risky-choice framing items present hypothetical scenarios that involve income tax, dropping out of school, unusual disease outbreak, cancer treatment, and stock market investment strategies, and instruct examinees to indicate a preference between a risky option and a sure thing option (Bruine de Bruin et al., 2007).

In the 7 attribute framing items, participants are asked to rate their judgment of a hypothetical product or situation on a 6-point scale. Participants are presented with a positively framed version of the problem and negatively framed equivalent of the same problem later in the survey, which is considered 1 “item.” For example, the positively framed version of one problem states that 35% of graduating seniors who completed a survey reported that they did not cheat during their college career. Participants are instructed to rate the incidence of cheating at their university from 1 (very low) to 6 (very high). The negatively framed equivalent of this problem states that 65% of graduating seniors who completed a survey reported that they did in fact cheat during

their college career and instructs participants to rate incidence of cheating. The other attribute framing items present products or situations that involve condom effectiveness, meat quality, project funding, performance evaluation, fining, and cancer treatment (Bruine de Bruin et al., 2007).

The 10-item Applying Decision Rules subtest is designed to assess ability to effectively apply different sets of rules to make decisions. For each item, participants are presented with a hypothetical consumer who wishes to purchase a DVD player but has preferences that differ in terms of 4 different DVD features: picture quality, sound quality, programming options, and reliability of brand. Participants are instructed to choose from 5 different DVD players labeled A, B, C, D, and E, each which vary in how they are rated from 1 (very low) to 5 (very high) on these four different features but are the same in terms of price to meet the preferences of the hypothetical consumer. This subtest has demonstrated adequate internal consistency reliability (Cronbach's $\alpha = .73$) and test-retest reliability ($r = .77, p < .001$) (Bruine de Bruin et al., 2007).

The 20-item Consistency in Risk Perception subtest is designed to measure one's ability to follow probability rules (Bruine de Bruin, Parker et al., 2007). In this task, participants are instructed to guess the probability of a specific event happening to them at two different points of time in the future (e. g. within the next year and within the next 5 years) on a scale from 0%, which indicates no chance, and 100%, which indicates certainty. This task includes time-frame pairs (e.g., what is the probability of an event happening within the next year, and what is the probability of an event happening within the next 5 years), subset-superset pairs (i.e., probability that you will die from any cause is a superset of the subset of dying in a terrorist attack), and

complementary pairs (i.e., probability of getting into a car accident and probability of not getting into an accident). Items include such events as visiting the dentist, having a cavity filled, dying from any cause, dying in a terrorist attack, having something stolen, having someone break into one's home and steal something, etc. This subtest has demonstrated adequate internal consistency reliability (Cronbach's $\alpha = .72$) and test-retest reliability ($r = .72, p < .001$) (Bruine de Bruin et al., 2007).

The Executive Function Index (EFI): The EFI is a brief, self-report measure that assesses executive function (Spinella, 2005). This instrument consists of 27 items and 5 subscales that are attributed to executive functions and were derived through item analysis and factors analysis: Motivational Drive, Strategic Planning, Organization, Impulsive Control, and Empathy. The Motivational Drive subscale assesses behavioral drive, activity level, and interest in novelty. The Strategic Planning subscale measures strategic planning as reflected in tendencies to think ahead, plan, and use strategies. The Organization subscale measures the ability to carry out organized, goal-directed behavior as reflected by multitasking, sequencing, and holding information in one's mind to make decisions. The Impulse Control subscale assesses the ability to control one's impulses as reflected by self-inhibition, risk taking, and social conduct. The Empathy subscale assesses empathy as reflected by a concern for the well-being of others, prosocial behaviors, and cooperative attitude. Higher scores on all of these subscales are indicative of *better* executive functioning. The scores from all 5 subscales are summed to produce a total score that is an overall index of executive function. The internal consistency of the individual scales (Cronbach's α ranging from .69-.76) as well as the total score (Cronbach's $\alpha = .82$) is good. Additionally, the measure correlates

strongly with other validated self-report measure of executive functioning which is supportive of the construct validity of this measure (Spinella, 2005).

The (negative) Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking, and Positive Urgency (UPPS-P) Impulsive Behavior Scale: The UPPS-P Impulsive Behavior Scale is a 59-item self-report measure that assesses five personality pathways leading to impulsive behavior (Whiteside & Lynam, 2001; Lynam, Smith, Whiteside, & Cyders, 2006). This instrument is a revised version of the UPPS Impulsive Behavior Scale (Whiteside & Lynam, 2001), which was derived through factor analysis of the Five-Factor Model (FFM) of personality (Costa & McCrae, 1992) and nine widely-used impulsivity measures in a large college sample, and is divided into four subscales, each representing a different distinct impulsivity-related personality traits: negative urgency, lack of premeditation, lack of perseverance, and sensation seeking (Whiteside & Lynam, 2001). The UPPS-P incorporates a scale developed by Cyders et al. (2007) that assesses another distinct impulsivity-related personality trait: positive urgency (Lyman et al., 2006).

The (negative) Urgency subscale assesses an individual's tendency to engage in impulsive actions in response to negative emotions, possibly in an attempt to lessen those unpleasant emotions (Whiteside, Lynam, Miller, & Reynolds, 2005). For example, one of the items included in this subscale asks the participant to respond to the statement "When I'm upset I often act without thinking" on a 5-point Likert-type scale ranging from "not true of me" to "very true of me" (Whiteside & Lynam, 2001). One study found this subscale to be most strongly related to eating problems compared to the other three subscales of the UPPS (Miller, Flory, Lynam, & Leukefeld, 2003).

Other studies have found this subscale to be predictive of bulimic symptomology in particular in college and clinical samples, even when controlling for other relevant covariates (i.e., depression, anxiety symptoms, the other three UPPS subscales, etc.) (Anestis, Selby, & Joiner, 2007; Anestis, Smith, Fink, & Joiner, 2009). Further, a meta-analysis of 50 studies in this area of research found negative urgency to have the largest effect size with respect to bulimia symptom expression when compared to the other three subscales of the UPPS (Fischer, Smith, & Cyders, 2008). The Lack of Premeditation subscale assesses difficulty in thinking through the consequences of one's actions prior to engaging in them. The Lack of Perseverance subscale measures an individual's tendency to experience difficulty in sustaining focus on a task that is boring or difficult. The Sensation Seeking subscale assesses a tendency to seek out experiences that are exciting and to be open to engaging in new experiences that may prove dangerous (Whiteside et al., 2005). The Positive Urgency subscale, which was later added to the UPPS, assesses an individual's tendency to engage in impulsive actions in the presence of positive emotions (Lynam et al., 2006; Cyders et al., 2007).

Obsessive-Compulsive Inventory-Revised (OCI-R): The OCI-R, which is a shortened version of the Obsessive-Compulsive Inventory (OCI; Foa et al., 1998), is an 18-item self-report measure designed to assess distress related to obsessive-compulsive symptoms (Foa et al., 2002). The instrument consists of 6 subscales reflecting the most common types of obsessive-compulsive symptom categories: Checking, Washing, Obsessing, Mental Neutralizing, Ordering, and Hoarding. The subscales are DSM-IV theoretically driven and derived through factor analysis. This instrument was designed and validated for use in clinical and nonclinical populations (Foa et al., 2002). It has

demonstrated good to excellent internal consistency reliability (total sample; $\alpha = .90$ (total score); α ranging from .83-.90 (subscales)) and test-retest reliability ($r_s = .57-.91$) and has generated evidence that is suggestive of the convergent validity of the measure (e.g., the measure correlated highly with the original OCI (total scores $r_s = .98$; subscale scores $r_s > .90$ except the Mental Neutralizing scale in which $r_s = .74$) (Foa et al., 2002). These psychometric qualities were largely retained in a large a non-clinical college sample (Hajcak, Huppert, Simons, & Foa, 2004).

Beck Depression Inventory, Second Edition (BDI-II): The BDI-II is a widely-used, psychometrically-sound 21-item self-report instrument aimed at measuring depression symptoms (Beck, Steer, & Brown, 1996). The individual's score is interpreted by comparing their raw score to cutoff scores that may be indicative of different levels of depression (Beck et al., 1996).

Beck Anxiety Inventory (BAI): The BAI is a widely-used, psychometrically-sound 21-item self-report instrument that assesses severity of anxiety symptoms (Beck, Epstein, Brown, & Steer, 1988). The individual's score is interpreted by comparing their raw score to cutoff scores that may be indicative of different levels of anxiety (Beck et al., 1988).

Wechsler Adult Intelligence Scale, fourth edition (WAIS-IV), Vocabulary Subtest: The WAIS-IV Vocabulary subtest is a 30-item measure of verbal ability (Sattler & Ryan, 2009). For this subtest, participants are asked to provide definitions for different words that become increasingly more difficult to define as the subtest progresses. This subtest provides a good estimate of general cognitive ability. Factor

analysis has revealed that the Vocabulary subtest has the highest loading on “g” out of all the WAIS subtests (Sattler & Ryan, 2009).

Rutgers Alcohol Problem Index (RAPI): The 18-item RAPI is a brief, self-report measure used to screen for problem drinking in adolescents and young adults (White & Labouvie, 1989, 2000). This instrument has demonstrated both sound reliability and appears to demonstrate construct validity in clinical as well as nonclinical samples of adolescents and young adults (White & Labouvie, 1989, 2000; White et al., 1988). Additionally, the 18-item version correlates very highly ($r = .99$) with the original 23-item version (White & Labouvie, 2000). Thus, the short, 18-item version was used in this study. For the purposes of this study, participants were asked to answer items related to problem drinking during the past year.

Rutgers Alcohol Problem Index- Drug (RAPI-D): The RAPI has demonstrated sound reliability and appears to demonstrate construct validity in clinical as well as nonclinical samples of adolescents and young adults (White & Labouvie, 1989, 2000; White et al., 1988). This measure has been modified to assess for problem drug-use as well. The RAPI-D is a brief, 26-item self-report measure used to screen for problem drug-use in adolescents and young adults (Johnson & White, 1995). For the purposes of this study, participants were asked to answer items related to problem drug-use including the use of marijuana and all other illegal drugs during the past year.

Statistical Analyses

Initial data inspection revealed that several of the variables violated the assumption of normality. Thus, data transformation procedures were conducted on a number of variables that demonstrated significant skewness and/or kurtosis to approach

normality. A square root transformation was used for those variables demonstrating moderate positive skew including the BART adjusted average pump count, A-DMC Resistance to Framing subtest, UPPS-P Lack of Perseverance scale, UPPS-P Positive Urgency scale, all OCI-R scores (Washing, Obsessing, Hoarding, Ordering, Checking, Mental Neutralizing, and OCI-R total score), the BDI-II and the BAI. Variables that demonstrated a moderate negative skew (e.g., GDT ending overall net score and ending balance and EFI Empathy scale) were reflected followed by a square root transformation; thus, interpretation of these variables must also be reversed. Finally, arcsine data transformation was applied to the A-DMC Consistency in Risk Perception subtest as the variable was reflected as a proportion.

Data analysis was conducted using the Statistical Package for Social Sciences (SPSS), version 20.0. A series of between-groups, one-way analysis of variance (ANOVAs) was run to compare groups (i.e., BN, BED, and CG) on the demographic variables (e.g., age, education level), body mass index (BMI), estimated cognitive ability, depression symptoms, and anxiety symptoms. Further, between-groups, one-way ANOVAs were run to compare the groups on decision-making performance on the different tasks. Games-Howell post-hoc testing was conducted to follow-up significant F-values generated by ANOVA. This post-hoc test was chosen because unequal variances and/or unequal cell sizes were observed for all variables. Additionally, in order to make comparisons with current research, a 3 (Group) x 5 (Block) mixed-design ANOVA was run to examine group differences in performance, or strategies, on the IGT as the task progressed. Pearson bivariate correlation analysis was run to examine the relationship between UPPS-P, EFI, and OCI-R scores and performance on the

decision-making tasks. Finally, Pearson bivariate correlation analysis was run to examine the relationship between eating disorder symptom severity as specified in the DSM-5 (i.e., frequency of inappropriate compensatory behaviors in BN and frequency of binge-eating episodes in BED) and decision-making performance in the group with BN and group with BED.

CHAPTER III

RESULTS

Demographic Variables

The means and standard deviations are presented in Table 1 for each group for age; education level; Vocabulary subtest of the Wechsler Adult Intelligence Scale, 4th Edition; Body Mass Index (BMI); Beck Depression Inventory, 2nd Edition (BDI-II); Beck Anxiety Inventory (BAI); Rutgers Alcohol Problem Index (RAPI); and Rutgers Alcohol Problem Index- Drug version (RAPI-D) scores. A series of one-way ANOVA was run to compare the groups on these variables. No significant differences were found between the groups for age, education, or Vocabulary subtest raw score. A significant difference between the groups was observed for the BDI-II, $F(2,107)=12.72$, $p<.001$. Subsequent Games-Howell post-hoc testing revealed that the BN group scored significantly higher than both the CG ($p<.001$) and the BED group ($p=.010$), but there was no significant difference between the CG and BED group on the BDI-II. Further, there were significant between-group differences on the BAI, $F(2,108)=5.69$, $p=.004$. Subsequent Games-Howell post-hoc testing revealed that the BN group scored significantly higher than the CG ($p=.012$) and the BED group ($p=.006$) but there was no significant difference between the BED and CG on the BAI. While the one-way ANOVA revealed significant between-group differences on BMI, $F(2,108)=6.06$, $p=.003$), there were no significant group differences identified Games-Howell post-hoc

analysis. Finally, there were no significant between group differences on RAPI or RAPI-D scores.

Table 1

Group Differences on Demographic Variables

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|----------------------|-----------|-----------|------------|----------|----------|
| Age | n=82 | n=21 | n=7 | | |
| <i>M</i> | 20.13 | 21.05 | 19.71 | .474 | .624 |
| <i>SD</i> | (4.21) | (4.47) | (1.38) | | |
| Education | n=83 | n=21 | n=6 | | |
| <i>M</i> | 13.77 | 13.90 | 13.66 | .095 | .909 |
| <i>SD</i> | (1.24) | (1.92) | (1.63) | | |
| Vocabulary Raw Score | n=83 | n=21 | n=7 | | |
| <i>M</i> | 34.59 | 36.61 | 36.14 | .797 | .453 |
| <i>SD</i> | (7.02) | (6.97) | (6.34) | | |
| BMI | n=83 | n=21 | n=7 | | |
| <i>M</i> | 23.27 | 26.25 | 28.39 | 6.057 | .003 |
| <i>SD</i> | (4.28) | (6.37) | (5.95) | | |
| BDI-II | n=82 | n=21 | n=7 | | |
| <i>M</i> | 8.02 | 17.43 | 8.00 | 12.715 | <.001 |
| <i>SD</i> | (5.84) | (9.93) | (3.92) | | |
| BAI | n=83 | n=21 | n=7 | | |
| <i>M</i> | 8.33 | 14.71 | 6.29 | 5.694 | .004 |
| <i>SD</i> | (7.66) | (11.07) | (1.98) | | |
| RAPI | n=69 | n=17 | n=4 | | |
| <i>M</i> | 3.93 | 4.47 | 3.25 | .113 | .893 |
| <i>SD</i> | (5.45) | (5.06) | (2.22) | | |
| RAPI-D | n=22 | n=9 | n=1 | | |
| <i>M</i> | 4.91 | 3.89 | .000 | .268* | .791 |
| <i>SD</i> | (10.69) | (5.99) | | | |

Note. *M*= Mean. *SD*= Standard Deviation. *CG*= Control Group. *BN*= Bulimia Nervosa. *BED*= Binge-Eating Disorder. Age is reported in years. Education is reported in total years completed. Vocabulary Raw Score= WAIS-IV Vocabulary Subtest Raw Score. *BMI*= Body Mass Index. *BDI-II*= Beck Depression Inventory, 2nd Edition, Raw Score. *BAI*= Beck Anxiety Inventory Raw Score. *RAPI*= Rutgers Alcohol Problem Index. *RAPI-D*= Rutgers Alcohol Problem Index- Drug Version. *An independent samples t-test was run to compare the *CG* and the *BN* group on the *RAPI-D* (as the *BED* group *n*=1).

Executive Function Index (EFI) Scores

The means and standard deviations are presented in Table 2 for the EFI composite score and for the Motivational Drive, Organization, Strategic Planning, Impulse Control, and Empathy scale scores for the different groups (e.g., CG, BN, and BED). A series of one-way ANOVA was run to compare the groups on these variables. There were significant between-group differences on the EFI composite score, $F(2,105)=8.66, p<.001$, with the Games-Howell post-hoc test revealing that the BN group scored significantly lower than the CG ($p<.001$) while there were no significant differences between either the BN and BED groups or the CG and the BED group despite that fact that the BED group had a mean score that was identical to the BN group. This may be a result of using the Games-Howell post-hoc test, which is a very conservative post-hoc analysis used when the homogeneity of variance assumption has been violated and/or unequal cell sizes are observed. Further, there were significant between-group differences on the Organization scale, $F(2,107)=8.89, p<.001$, with the Games-Howell post-hoc test revealing that the BN group scored significantly lower than the CG ($p<.001$) while there were no significant differences between either the BN and the BED groups or the CG and the BED group. This scale assesses ability to carry out organized, goal-directed behavior, with higher scores indicating higher levels of organization and lower levels indicating lower levels of this construct. There were also significant between-group differences on the Impulse Control scale, $F(2,108)=5.58, p=.005$, with the Games-Howell post-hoc analysis revealing that the BN group scored significantly lower than the CG ($p=.001$) while there were no significant differences between either the BN and the BED groups or the CG and the BED group. This scale

assesses the ability to control one’s impulses as reflected by self-inhibition, for example, with higher scores indicating higher levels of impulse control and lower scores indicating lower levels. Finally, there were no significant between group differences on the Motivational Drive, Strategic Planning, or Empathy scales. The Motivational Drive scale assesses behavioral drive, activity level, and interest in novelty, and the Strategic Planning Scale reflects tendencies to think ahead, plan, and use strategies. The Empathy scale assesses empathy and concern for the well-being of others. On all of the EFI scales, higher scores are indicative of better executive functioning.

Table 2

Group Differences on Executive Function Index (EFI) Composite and Scale Scores

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|---------------------------------|-----------|-----------|------------|----------|----------|
| EFI Composite Score | | | | | |
| <i>n</i> | n=80 | n=21 | n=7 | | |
| <i>M</i> | 102.70 | 94.43 | 94.43 | 8.655 | <.001 |
| <i>SD</i> | (9.74) | (6.20) | (7.63) | | |
| Motivational Drive Scale | | | | | |
| <i>n</i> | n=83 | n=21 | n=7 | | |
| <i>M</i> | 14.55 | 13.57 | 14.14 | 1.141 | .323 |
| <i>SD</i> | (2.67) | (2.84) | (2.41) | | |
| Organization Scale | | | | | |
| <i>n</i> | n=82 | n=21 | n=7 | | |
| <i>M</i> | 18.33 | 15.19 | 15.86 | 8.886 | <.001 |
| <i>SD</i> | (2.95) | (3.83) | (4.60) | | |
| Strategic Planning Scale | | | | | |
| <i>n</i> | n=82 | n=21 | n=7 | | |
| <i>M</i> | 25.95 | 24.19 | 24.71 | 2.596 | .079 |
| <i>SD</i> | (3.39) | (3.39) | (1.50) | | |

Table 2 (continued)

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|-----------------------|-----------|-----------|------------|----------|----------|
| Impulse Control Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 17.42 | 14.71 | 16.29 | 5.584 | .005 |
| <i>SD</i> | (3.28) | (3.85) | (2.29) | | |
| Empathy Scale | n=82 | n=21 | n=7 | | |
| <i>M</i> | 25.96 | 26.76 | 23.43 | 2.432 | .093 |
| <i>SD</i> | (3.08) | (2.51) | (4.04) | | |

Note. *M*= Mean. *SD*= Standard Deviation. *CG*= Control Group. *BN*= Bulimia Nervosa. *BED*= Binge-Eating Disorder. *EFI*= Executive Function Index.

UPPS-P Impulsive Behavior Scale Scores

The means and standard deviations are presented in Table 3 for the UPPS-P Negative Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking and Positive Urgency scale scores for the different groups (e.g., *CG*, *BN*, and *BED*). A series of one-way ANOVAs was run to compare the groups on these variables. There were significant between-group differences on the Negative Urgency scale, $F(2,104)=21.47, p<.001$, with Games-Howell post-hoc testing revealing that the *BN* group scored significantly higher than the *CG* ($p<.001$) while there were no significant differences between either the *BN* and the *BED* groups or the *CG* and the *BED* group. This scale assesses negative urgency, with higher scores reflecting more of a tendency to behave impulsively in response to negative emotions and lower scores reflecting less of a tendency to behave this way. Further, there were significant between-group differences on the Lack of Perseverance scale, $F(2,103)=4.55, p=.013$, with Games-Howell post-hoc testing revealing that the *BN* group scored significantly higher than the *CG* ($p=.013$) while there were no significant differences between either the *BN* and

the BED groups or the CG and the BED group. This scale assesses lack of perseverance, with higher scores reflecting more of a tendency to experience difficulty in sustaining focus on a task that is boring or difficult and lower scores reflecting less of a tendency to experience difficulty sustaining focus on these tasks. There were also significant between-group differences on the Positive Urgency scale, $F(2,106)=12.22$, $p<.001$, with Games-Howell post-hoc testing revealing that the BN group scored significantly higher than the CG ($p<.001$) while there were no significant differences between either the BN and the BED groups or the CG and the BED group. This scale assesses positive urgency, with higher scores reflecting more of a tendency to behave impulsively in response to positive emotions and lower scores reflecting less of a tendency to behave this way. While there were significant between-group differences on the Lack of Premeditation scale, $F(2,105)=3.53$, $p=.033$, there were no significant group differences identified with Games-Howell post-hoc testing. This scale measures lack of premeditation, with higher scores reflecting more difficulty in thinking through the consequences of one's actions prior to engaging in them and lower scores reflecting less difficulty in doing so. Finally, there were no significant between group differences on the Sensation Seeking scale. This scale assesses sensation seeking, with higher scores reflecting a tendency to seek out novel and exciting experiences and willingness to engage in new experiences that may prove dangerous and lower scores reflecting less of a tendency to engage in this behavior.

Table 3

Group Differences on UPPS-P Impulsive Behavior Scale Scores

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>P</i> |
|-----------------------------|-----------|-----------|------------|----------|----------|
| Negative Urgency Scale | n=79 | n=21 | n=7 | | |
| <i>M</i> | 23.96 | 33.81 | 28.43 | 21.469 | <.001 |
| <i>SD</i> | (6.16) | (6.32) | (6.16) | | |
| Lack of Premeditation Scale | n=80 | n=21 | n=7 | | |
| <i>M</i> | 20.35 | 23.19 | 22.57 | 3.526 | .033 |
| <i>SD</i> | (4.51) | (5.19) | (4.35) | | |
| Lack of Perseverance Scale | n=79 | n=20 | n=7 | | |
| <i>M</i> | 17.18 | 20.40 | 18.57 | 4.547 | .013 |
| <i>SD</i> | (4.33) | (4.36) | (4.61) | | |
| Sensation Seeking Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 32.11 | 34.95 | 29.86 | 2.137 | .123 |
| <i>SD</i> | (6.80) | (5.66) | (7.22) | | |
| Positive Urgency Scale | n=82 | n=21 | n=6 | | |
| <i>M</i> | 21.72 | 30.24 | 24.83 | 12.215 | <.001 |
| <i>SD</i> | (6.35) | (8.04) | (10.59) | | |

Note. *M*= Mean. *SD*= Standard Deviation. *CG*= Control Group. *BN*= Bulimia Nervosa. *BED*= Binge-Eating Disorder. UPPS-P= The (negative) Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking, and Positive Urgency (UPPS-P) Impulsive Behavior Scale.

Obsessive-Compulsive Inventory-Revised (OCI-R) Scores

The means and standard deviations are presented in Table 4 for the OCI-R total score and the Washing, Obsessing, Hoarding, Ordering, Checking, and Mental Neutralizing scale scores for the different groups (e.g., *CG*, *BN*, and *BED*). A series of one-way ANOVA was run to compare the groups on these variables. There were significant between-group differences on the OCI-R total score, $F(2,106)=6.19, p=.003$, with Games-Howell post-hoc testing revealing that the *BN* group scored significantly

higher than the CG ($p=.006$) while there were no significant differences between either the BN and the BED groups or the CG and the BED group. This score is derived from summing the scores of its six scales (Washing, Obsessing, Hoarding, Ordering, Checking, and Mental Neutralizing) which assess the extent to which the examinee is experiencing distress as a result of common symptoms seen in individuals with OCD. This score provides an overall measure of the presence and severity of obsessive-compulsive symptoms with higher scores reflecting higher levels of distress caused by obsessive-compulsive symptoms and lower scores reflecting lower levels of distress caused by obsessive-compulsive symptoms.

Further, there were significant between-group differences on the Obsessing scale, $F(2,106)=9.45$, $p<.001$, with Games-Howell post-hoc testing revealing that the BN group scored significantly higher than both the CG ($p=.001$) and BED group ($p=.027$) while there were no significant differences between the CG and the BED group. This scale assesses obsessions, with higher scores reflecting higher levels of distress caused by obsessive thoughts and lower scores reflecting lower levels of distress caused by obsessions. Also, there were significant between-group differences on the Mental Neutralizing Scale, $F(2,108)=4.958$, $p=.009$, with Games-Howell post-hoc testing revealing that the BN group scored significantly higher than both the CG ($p=.029$) and the BED group ($p=.028$) while there were no significant differences between the CG and the BED group. This scale assesses mental neutralizing, with higher scores reflecting higher levels of distress caused by attempting to mentally neutralize, or defuse, obsessions and lower scores reflecting lower levels of distress caused by this process. Further, although there were significant between-group

differences on the Checking scale, $F(2,108)=3.37$, $p=.038$, no between-group differences were identified using Games-Howell post-hoc testing. This scale assesses checking symptoms, with higher scores reflecting higher levels of distress caused by checking behaviors and lower scores reflecting lower levels of distress caused by this behavior. Finally, there were no significant between-group differences on the Hoarding, Washing, and Ordering scales. These scales assess hoarding, washing, and ordering symptoms, respectively, with higher scores reflecting higher levels of distress caused by these behaviors and lower scores reflecting lower levels of distress caused by these symptoms.

Table 4

Group Differences on Obsessive-Compulsive Inventory-Revised (OCI-R) Scores

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|-------------------|-----------|-----------|------------|----------|----------|
| OCI-R Total Score | n=82 | n=20 | n=7 | | |
| <i>M</i> | 11.13 | 19.90 | 11.57 | 6.193 | .003 |
| <i>SD</i> | (8.07) | (11.11) | (6.97) | | |
| Washing Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 1.12 | 1.86 | 1.43 | 1.549 | .217 |
| <i>SD</i> | (1.44) | (1.85) | (1.13) | | |
| Obsessing Scale | n=82 | n=20 | n=7 | | |
| <i>M</i> | 1.66 | 4.20 | 1.14 | 9.448 | <.001 |
| <i>SD</i> | (2.20) | (2.97) | (1.46) | | |
| Hoarding Scale | n=82 | n=21 | n=7 | | |
| <i>M</i> | 2.37 | 4.05 | 3.29 | 2.956 | .056 |
| <i>SD</i> | (1.92) | (2.58) | (3.15) | | |

Table 4 (continued)

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|---------------------------|-----------|-----------|------------|----------|----------|
| Ordering Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 3.18 | 3.52 | 2.71 | 0.218 | .805 |
| <i>SD</i> | (2.82) | (2.82) | (1.98) | | |
| Checking Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 1.71 | 3.33 | 2.57 | 5.729 | .004 |
| <i>SD</i> | (1.69) | (2.71) | (2.94) | | |
| Mental Neutralizing Scale | n=83 | n=21 | n=7 | | |
| <i>M</i> | 1.06 | 2.33 | 0.43 | 3.978 | .022 |
| <i>SD</i> | (1.88) | (2.71) | (0.53) | | |

Note. M= Mean. SD= Standard Deviation. CG= Control Group. BN= Bulimia Nervosa. BED= Binge-Eating Disorder. OCI-R= Obsessive-Compulsive Inventory-Revised.

Computerized Decision-Making Task (IGT, GDT, and BART) Scores

The means and standard deviations are presented in Table 5 for the computerized decision-making task scores including the IGT overall net score, IGT ending balance, GDT overall net score, GDT ending balance, and the BART adjusted average pump count scores for the different groups (e.g., CG, BN, and BED). The IGT overall net score provides an overall measure of risky decision-making performance and is generated by subtracting the total number of disadvantageous deck selections (e.g., A and B) from the total number of advantageous deck selections (e.g., C and D), with higher scores reflecting better or safer decision-making performance and lower scores indicating poorer or riskier decision making. The GDT overall net score provides an overall measure of risky decision-making performance in a situation with explicit contingencies and is generated by subtracting the total number of risky die

selections (i.e., choosing from one or two-number combinations) from the total number of safe or “non-risky” die selections (i.e., choosing from three or four-number combinations), with higher scores reflecting better or safer decision-making performance and lower scores indicating poorer or riskier decision making. The GDT ending balance, which is the final balance with which the participant has ended the task, provides another overall measure of risky decision-making performance in a situation with explicit contingencies. The BART adjusted average pump count is the average number of key presses on un-popped balloons and provides an overall measure of decision making. Because participants tend to pump too-few times compared to what is considered ideal (e.g., 64 pumps; Lejuez et al., 2002), higher values on this measure are indicative of better decision making and lower values reflect poorer decision making. A series of one-way ANOVA was run to compare the groups on these variables. There were no significant between group differences on any of the computerized decision-making scores.

Further, a 3 (Group) x 5 (Block) mixed-design ANOVA was run to examine group differences in performance, or strategies, on the IGT as the task progressed using group as the between-group factor and block net scores, which are generated by subtracting the total “disadvantageous” card selections from the total “advantageous” card selections for each successive block of 20 trials, as the within-subjects factor. There was a significant main effect for the within-subject factor of block net scores as the IGT progressed, $F(2, 105)=6.480, p<.001$, suggesting that participants experienced a learning effect as reflected by mean block net scores that increased as the task progressed (e.g., Block 1= -3.62; Block 2= 3.35; Block 3= 3.97; Block 4= 4.58; Block

5=4.91). However, both the main effect of group and the interaction between group and block net score were not significant, suggesting that there were no significant between-group differences on IGT performance and that performance on the IGT as the task progressed did not differ as a function of group status.

Table 5

Group Differences on the IGT, GDT, and BART

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|----------------------------------|-----------|-----------|------------|----------|----------|
| IGT Overall Net Score | n=83 | n=21 | n=7 | | |
| <i>M</i> | 10.24 | 18.48 | 10.86 | .755 | .472 |
| <i>SD</i> | (26.78) | (30.01) | (28.70) | | |
| IGT Ending Balance | n=83 | n=21 | n=7 | | |
| <i>M</i> | -723.92 | -308.10 | -702.86 | .877 | .419 |
| <i>SD</i> | (1212.98) | (1523.92) | (1466.69) | | |
| GDT Overall Net Score | n=83 | n=21 | n=7 | | |
| <i>M</i> | 9.11 | 8.86 | 6.86 | .246 | .783 |
| <i>SD</i> | (9.38) | (9.09) | (9.51) | | |
| GDT Ending Balance | n=83 | n=21 | n=7 | | |
| <i>M</i> | 225.30 | -123.81 | -1428.57 | 1.514 | .225 |
| <i>SD</i> | (2812.71) | (2589.96) | (2082.24) | | |
| BART Adjusted Average Pump Count | n=83 | n=21 | n=7 | | |
| <i>M</i> | 22.57 | 25.30 | 26.77 | .653 | .523 |
| <i>SD</i> | (11.61) | (14.13) | (10.20) | | |

Note. M= Mean. SD= Standard Deviation. CG= Control Group. BN= Bulimia Nervosa. BED= Binge Eating Disorder. IGT= Iowa Gambling Task. GDT= Game of Dice Task. BART= Balloon Analogue Risk Task.

Pencil-and-Paper Decision-Making Task (ADMC Resistance to Framing, Consistency in Risk Perception, and Applying Decision Rules) Scores

The means and standard deviations are presented in Table 6 for the scores from the paper-and-pencil administered Adult Decision-Making Competence (A-DMC) index's Resistance to Framing, Consistency in Risk Perception, and Applying Decision

Rules subtests for the different groups (e.g., CG, BN, and BED). A series of one-way ANOVA was run to compare the groups on these variables. There were significant between-group differences on the Resistance to Framing subtest, $F(2,111)=6.51$, $p=.002$, with Games-Howell post-hoc testing revealing that the BN group scored significantly lower than the CG ($p=.021$) while there were no significant differences between the CG and the BED group and the BED and the BN groups despite the fact that the BED group had a mean that was even lower than the mean of the BN group. This, again, may be a result of using the very conservative Games-Howell post-hoc test which takes into account heterogeneity of variance and unequal group sizes. Performance on this particular task is evaluated by the extent to which the examinee is able to resist being influenced by the way the question is framed in their assessment of the value of that question. It should be noted that a lower score on this particular subtest is indicative of *better* decision making. Finally, there were no significant between-group differences on the Consistency in Risk Perception or the Applying Decision Rules subtests. These tasks assess the extent to which the examinee is able to follow probability rules and apply different sets of rules in making decisions, respectively. On both of these tests, higher scores reflect better decision making.

Pearson bivariate correlations were run to examine the relationship between eating disorder symptom severity and decision-making performance within the group with BN and within the group with BED. This analysis revealed one significant and strong negative correlation within the BN group between average weekly frequency of inappropriate compensatory behaviors and performance on the A-DMC Applying Decision Rules subtest ($r=-.719$, $p<.001$) such that, as frequency of symptoms

increased, performance on the Applying Decision Rules subtest decreased. No significant correlation was identified between average weekly frequency of binge-eating episodes and decision-making performance within the BED group.

Table 6

Group Differences on the A-DMC Subtests

| | <i>CG</i> | <i>BN</i> | <i>BED</i> | <i>F</i> | <i>p</i> |
|--------------------------------|-----------|-----------|------------|----------|----------|
| Resistance to Framing | n=83 | n=21 | n=7 | | |
| <i>M</i> | 1.00 | .701 | .694 | 6.506 | .002 |
| <i>SD</i> | (.434) | (.370) | (.422) | | |
| Consistency in Risk Perception | n=83 | n=21 | n=7 | | |
| <i>M</i> | .730 | .774 | .714 | 2.939 | .057 |
| <i>SD</i> | (.086) | (.083) | (.056) | | |
| Applying Decision Rules | n=83 | n=21 | n=7 | | |
| <i>M</i> | .758 | .784 | .791 | .418 | .660 |
| <i>SD</i> | (.143) | (.126) | (.105) | | |

A-DMC= Adult Decision-Making Competence Index. CG= Control Group. BN= Bulimia Nervosa. BED= Binge- Eating Disorder. M= Mean. SD= Standard Deviation.

CHAPTER IV

DISCUSSION

Decision Making

There were no significant differences between the groups on any of the computerized decision-making tasks including the IGT, GDT, and BART. These results do not support our primary hypotheses that women with BN and BED would perform significantly worse on decision-making tasks in which low risk is associated with higher-quality decision-making (e.g., the GDT and the IGT) nor do they support the secondary hypothesis that women with BN and BED would possibly perform even better than controls on a decision-making task in which high risk is associated with higher-quality decision making (e.g., the BART). Further, these results are inconsistent with a number of previous studies that have found individuals with eating disorders to perform significantly worse than individuals without eating disorders on computerized decision-making tasks including the IGT and the GDT (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Brogan et al., 2011; Cavedini et al., 2004; Cavedini et al., 2006; Danner et al., 2011; Liao et al., 2009; Svaldi et al., 2010; Tchanturia et al., 2007). More specifically, a number of previous studies have found women with BN (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Liao et al., 2009) and women with BED (Danner et al., 2011; Svaldi et al., 2010) to perform more poorly on the IGT and the GDT compared to controls.

The current study was different from many of the previous studies, particularly in recruitment. While one study recruited college students (Boeka & Lokken, 2006), the remaining studies utilized primarily clinical and/or community samples (Brand et al., 2007; Brogan et al., 2010; Danner et al., 2011; Liao et al., 2009; Svaldi et al., 2010). The current study sample consisted of primarily female psychology undergraduate students. It is possible that the sample that was recruited for this study, which included primarily individuals who were functioning well enough to be attending college, was functioning better than samples that included individuals who were distressed or impaired enough to seek mental health services. However, scores from the BDI-II, which is a measure of depressive symptoms and is often used as a general measure of psychological impairment, appear to be similar between women with BN in the current study and women from previous studies that found decision-making differences using college (e.g., $M=15.50$; Boeka & Lokken, 2006) and clinical ($M=18.6$; Laio et al., 2009) samples. On the other hand, the mean BDI-II score of women with BED in the current study ($M=8.00$) appears to be lower than previous studies that included a clinical sample of women with BED ($M=16.1$), suggesting that the BED group used in the current study may have been less psychologically impaired than in previous studies. Age and education level, variables that have been found to be related to decision-making performance in previous studies (e.g., Davis et al., 2008; Henninger et al., 2010), appear to be similar for the BN and BED groups used in the current study and the BN and BED groups in previous studies that identified decision-making differences. Furthermore, it is possible that the discrepancy between the current study and previous studies that have found decision-making differences has to do with the fact that a

number of previous studies have compared clinical (inpatient or outpatient) eating disorder groups who were distressed/and or impaired enough to be seeking mental health services to controls recruited from the community.

Further, the current study differs from previous studies examining decision-making performance and eating disorders in that eating disorder status (e.g., diagnosis of BN or BED) was assessed using diagnostic criteria from the DSM-5, versus the DSM-IV-TR, which is less stringent in that the frequency requirement for inappropriate compensatory behaviors and/or binge-eating episodes has been reduced (e.g., from twice-weekly to once a week on average for both BN and BED). Evaluation of the eating disorder symptom severity of the sample used in the current study revealed that the BN group's average weekly frequency of inappropriate compensatory behaviors ($M=5.38$, $SD=3.598$) is indicative of symptoms that are moderate in severity according to DSM-5 criteria regarding BN symptom severity ratings. Further, the BED group's average weekly frequency of binge-eating episodes ($M=2.86$, $SD=.900$) was indicative of only mild symptoms. It is possible that the eating disorder symptoms reported by the BN and BED groups in the current sample were less severe than previous studies that used the more stringent DSM-IV-TR criteria. Some studies have found a relationship between eating disorder symptom severity and decision making including the current study in which Pearson bivariate correlation analysis revealed a very strong and negative correlation ($r=-.719$, $p<.001$) between eating disorder symptoms (i.e., total average weekly inappropriate compensatory behaviors) and performance on the A-DMC Applying Decision Rules subtest within the BN group. Thus, differences in eating disorder symptom severity may have contributed to the discrepancy between the

insignificant between-group differences on decision making found in the current study and significant between-group decision-making differences identified in previous studies. Further, it is possible that the discrepancy between the results of the current study and the results of previous studies that detected decision-making differences between individuals with eating disorders compared to those without eating disorders may be due to sampling error such that the sample means of the current study do not approach the population means.

Some might argue that the discrepancy between the findings from this study and previous studies that identified significant decision-making differences is the result of using measures with poor psychometrics. However, the measures that were utilized in this study to assess eating disorder diagnoses (e.g., EDDS) and decision-making performance (i.e., IGT, GDT, BART, A-DMC) appear to be reliable and valid (see Methods section) and have been used in previous research. Moreover, a number of studies have found group decision-making differences using these measures (e.g., Brand et al., 2007; Bruine de Bruin et al., 2007; Cavellini et al., 2004; Henninger et al., 2010).

However, the findings from this study are consistent with two previous studies that did not find significant differences between patients with eating disorders (AN and BN) and controls on decision-making tasks administered via computer (Bosanac et al., 2007; Guillame et al., 2010). Though significant decision-making differences as measured by the IGT were not detected between a clinical sample of women with eating disorders compared to a group of women without eating disorder by Bosanac et al. (2007), their analysis was inadequately powered to detect group differences on

decision-making measures. Similar limitations with low power were observed in the current study. A priori power analysis with a desired power of .80 and an effect size of .4 with three groups indicated that a total sample size of 66 (22 participants per group) was needed for the current study. Though the total sample size was adequate (N=111), the group sizes were unequal (CG=83; BN=21; BED=7) with the smallest group containing only 7 participants. With the exception of the A-DMC Resistance to Framing subtest (observed power=.831; partial η^2 = .014) , inadequate power was observed ($1-\beta <.8$) for analysis of variance on the measures of decision making including the IGT overall net score (observed power= .175; partial η^2 = .014), IGT ending balance (observed power= .198; partial η^2 = .016;), GDT overall net score (observed power= .079; partial η^2 =.003), GDT ending balance (observed power= .262; partial η^2 =.022) , BART adjusted average pump count scores (observed power= .171; partial η^2 =.013) , A-DMC Consistency in Risk Perception subtest score (observed power= .512; partial η^2 = .046), and A-DMC Applying Decision Rules subtest score (observed power= .116; partial η^2 =.008). Thus, it appears that the majority of analyses run for the current study were inadequately powered to detect between-group differences had such differences existed. Furthermore, a number of studies that have used larger groups, many with groups of more than 20 participants, have found differences between groups with AN and BN and groups without eating disorders (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Cavedini et al., 2004; Cavedini et al., 2006; Liao et al., 2009), and it is possible that the discrepancy between the current study and these previous studies has to do with differences in effect sizes (e.g., the current study had observed effect sizes that were lower than these previous

studies) and power. On the other hand, it should be considered that, for many of the between-group analyses of decision making, the BN group trended toward performing *better* than the CG on decision-making tasks.

Guillame et al. (2010) also failed to find significant group differences on decision making as measured by the IGT between a clinical sample of women with BN and women with AN compared to women without eating disorders. The authors of this study argued that their failure to find significant between-group differences on decision-making tasks may have been due to differences in patient characteristics between their study and previous studies (Guillame et al., 2010). Specifically, their study excluded medicated and depressed individuals on the basis that these variables may affect decision-making performance and that medication and depression status may have been potential confounds in previous studies that identified significant decision-making differences between women with eating disorders and controls. The current study differs from the study by Guillame et al. (2010) in that, though medication status and depression symptoms were assessed, participants were not excluded on these bases based on the argument that doing so may have lessened the generalizability of the study. However, only a small percentage (6.3%) of the sample reported currently taking SSRIs for the present study, and an independent samples t-test did not reveal significant differences on any of the decision-making measures between participants currently taking SSRIs and those not taking SSRIs. This is similar to previous studies that assessed medication status but failed to detect significant decision-making differences between participants taking SSRIs and those who were not taking medication (Tchanturia et al., 2007). The mean depression level as measured by the

BDI-II was higher in the BN group than the CG and the BED group for the current study, which is consistent with previous research (Boeka & Lokken, 2006; Liao et al., 2009; Tchanturia et al., 2007). However, Pearson bivariate correlation analysis did not reveal a significant correlation between depression level and any of the decision-making measures within the BN group for the current study. This is also consistent with Boeka and Lokken (2006) who failed to find a significant relationship between depression level and decision-making performance despite finding a significantly higher level of depression in college women with BN compared to controls. Thus, although depression was significantly higher in the BN group, it was not found to be related to decision-making in the current study.

The group with BN performed significantly lower than the CG on the A-DMC Resistance to Framing subtest. The A-DMC Resistance to Framing subtest is designed to evaluate whether differences in the way a problem is presented or framed affect the examinee's value assessment. Performance on this task is evaluated by the extent to which the examinee is able to resist being influenced by the way the question is framed in their assessment of the value of that question. For this particular task, a lower score is indicative of *better* decision-making performance. Thus, the BN group performed significantly *better* than the CG on this task and was better able to resist being influenced by the framing of questions. This is the first study that the researchers are aware of in which women with BN performed significantly *better* than controls on a decision-making measure. Although there do not appear to be any previous studies that have examined decision-making differences in individuals with eating disorders using the A-DMC subtests specifically, this particular finding contradicts the general findings

of several previous studies that have found groups with eating disorders to perform significantly worse compared to controls on computer-administered decision-making tasks (Boeka & Lokken, 2006; Brand et al., 2007; Brogan et al., 2010; Brogan et al., 2011; Cavedini et al., 2004; Cavedini et al., 2006; Danner et al., 2011; Liao et al., 2009; Svaldi et al., 2010; Tchanturia et al., 2007) or that have found no differences between the groups with eating disorders and those without eating disorders (Bosanac et al., 2007; Guillame et al., 2010). It is important to note the apparent differences in cognitive-processing demands between the computerized decision-making tasks (e.g., the IGT, GDT, and the BART) and the pencil-and-paper administered A-DMC subtests used in this study. Specifically, the A-DMC subtests require the participant to read and integrate information after having been presented with a number of written scenarios before coming to a decision. Thus, these subtests appear to require a much greater degree of cognitive processing and working memory capacity than the IGT, GDT, or the BART and, arguably, are more generalizable to real-world decision making. This makes the finding that the BN group performed significantly better than the CG on one of the A-DMC subtests in the current study particularly noteworthy.

Age, Education Level, and Cognitive Ability

All three groups were similar in age, education level, and estimated cognitive ability as measured by the WAIS-IV Vocabulary subtest, which are factors that have been found to be associated with decision-making performance (i.e., Danner, Hagemann, Schankin, Hager, & Funke, 2011; Davis et al., 2008; Henninger et al., 2010). Further, there were no significant differences between the groups in terms of negative consequences of substance use, which has also been found to be related to

decision-making performance (Bechara et al., 2001; Bechara & Damasio, 2002), and individuals who had entered treatment for substance abuse or dependence were excluded from the study to further protect the current study from threats to internal validity. Thus, these factors do not appear to explain differences in decision making (or lack thereof) that were found in this study.

Executive Function

There were significant differences between groups on the EFI composite score as well as the Organization and Impulse Control scales such that the BN group scored significantly lower than the CG while there were no significant differences between either the BN and BED groups or the CG and the BED group. These differences suggest that the BN group was lower in terms of overall executive functioning than both the CG and the BED group but that the BN and BED groups and the CG and the BED group were similar in terms of overall executive functioning. The Organization scale assesses ability to carry out organized, goal-directed behavior, with higher scores indicating higher levels of organization and lower levels indicating lower levels of organization. Thus, these differences suggest that the BN group reported more difficulty carrying out organized or goal directed behavior than the CG and that the BN and BED groups and the CG and the BED group were similar in terms of organization. The Impulse Control scale assesses the ability to control one's impulses as reflected by self-inhibition, for example, with higher scores indicating higher levels of impulse control and lower scores indicating lower levels of this construct. Thus, the between-group differences that were found suggest that the BN group reported less of a tendency to engage in impulse control than the CG and that the BED and BN groups and the CG

and BED group were similar in their ability to control impulse. No group differences were found on the Motivational Drive, Strategic Planning, and Empathy scales suggesting that the BN, BED, and CG were similar in their behavioral drive and interest in novelty, their ability to strategically plan, and their empathy for others.

Executive functioning is a broad and multifaceted construct, and the research examining cognitive performance including performance on tasks of specific components of executive function in women with BN and BED compared to controls is mixed and arguably inconclusive at present (see Van den Eynde et al., 2011, for review). However, the results of this study are somewhat consistent with previous decision making and eating disorder research that has found reduced executive functioning as reflected by tests of cognitive flexibility (e.g., Part B of the TMT) in women with BN (Brand et al., 2007), but not consistent with research that has found reduced executive functioning in individuals with BED (Svaldi et al., 2010) compared to controls. Games-Howell post-hoc testing, which is a very conservative post-hoc analysis used when the homogeneity of variance assumption has been violated and/or unequal group sizes are observed, was used to analyze between-group differences for these and all other variables. It is possible that using this post-hoc test contributed to a failure to find significant group differences between the BED group and the CG, groups whose sizes were largely unequal. Some studies have found correlations between executive function and decision-making performance in women with BN (Brand et al., 2007), including the current study. Within the BN group, Pearson bivariate correlation analysis revealed that organization was strongly positively correlated with GDT overall net score ($r=-.474$, $p=.030$; GDT overall net score must be interpreted inversely due to

the use of reflection of the variable during data transformation) in the current study such that lower organization was associated with poorer decision making on this task. Further, within the BN group, impulse control was strongly positively correlated ($r=.683, p=.001$) with consistency in risk perception such that lower impulse control was related to poorer decision making on this task.

Despite these differences in executive functioning between women with BN compared to the CG and their relationship to decision-making performance, the BN group performed similarly to the CG and the BED group on tasks of decision making, and even significantly better than the CG on one of the tasks (i.e., A-DMC Resistance to Framing Subtest). Thus, the results of the current study suggest that reduced executive functioning overall and as reflected by lower organized or goal-directed behavior and lower impulse control may not explain the decision-making differences that have been found between women with BN and CGs in previous studies.

Impulsivity-Related Personality Traits

There were significant differences between groups on the Negative Urgency, Positive Urgency, and Lack of Perseverance scales such that the BN group scored significantly higher than the CG while there were no significant differences between either the BN and the BED groups or the CG and the BED group. This suggests that the BN group reported a higher tendency to act impulsively in the presence of negative and positive emotions and more difficulty in sustaining focus on difficult or boring tasks than the CG but that the BN and BED groups and CG and BED group were similar on these impulsivity-related personality traits. These results are generally consistent with previous research that has found higher impulsivity in women with BN compared to

women without eating disorders (e.g., Brand et al., 2007;) and studies that have found negative urgency specifically to be related to bulimic symptoms (Fischer, Smith, & Anderson, 2003). While some previous research has found trait impulsivity including the specific facets of sensation-seeking and urgency to be negatively correlated with decision-making performance in non-eating disordered individuals (Bayard, Raffard, & Gely-Nargeot, 2011; Brand et al., 2007; Franken, Strien, Nijs, & Muris, 2008), others have failed to find a significant relationship between impulsivity assessed as a unitary construct and decision-making performance in women with BN (e.g., Brand et al., 2007). In the current study, lack of perseverance was strongly negatively correlated with IGT overall net score ($r = -.510$, $p = .022$) such that higher scores on this measure were associated with poorer decision-making performance within the BN group. Interestingly, negative urgency was strongly *positively* correlated with GDT ending balance ($r = -.501$, $p = .021$; GDT balance must be interpreted inversely as the variable was reflected during data transformation procedures) such that a higher tendency to act impulsively in the face of negative emotions was associated with better decision-making performance within the BN group.

Despite these differences in impulsivity-related personality traits between the group with BN compared to the CG and the relationships that were found between these traits and decision-making, the BN group performed similarly on all decision-making tasks compared to the CG and BED group and even significantly better than the CG on one of the decision-making tasks (e.g., A-DMC Resistance to Framing). Thus, the results of the current study suggest that the decision-making differences that have been found in previous studies between women with BN and CGs may not be fully

explained by differences in impulsivity-related personality traits like negative or positive urgency or lack of perseverance.

Obsessive-Compulsive Symptoms

There were significant differences between groups on the OCI-R total score in that the BN group scored significantly higher than the CG while there were no significant differences between either the BN and BED groups or the CG and the BED group. Further, there were significant between-group differences on the Obsessing and Mental Neutralizing scales such that the BN group scored significantly higher than both the CG and BED group while there were no significant differences between the CG and the BED group. These scales measure distress pertaining to obsessive-compulsive symptoms and attempts to mentally-neutralize these obsessions with higher scores indicating more reported distress. Thus, the between-group differences found in this study suggest that the BN group reported higher distress regarding obsessive-compulsive symptoms generally than the CG while the level of distress for these symptoms was similar for both the BN group compared to the BED group and the CG compared to the BED group. Further, the between-group differences found in this study suggest that the BN group reported higher levels of distress pertaining to obsessions and attempting to mentally neutralize these obsessions compared to the CG and the BED group while the level of distress pertaining to obsessions and mental neutralizing was similar for the CG compared to the BED group.

Although there is some variability, the results of this study are generally consistent with epidemiological research that has found a higher rate of obsessive-compulsive symptoms in individuals with BN than those without eating disorders in

community (Angst et al., 2004; Hudson et al., 2007) and in college (Roberts, 2006) samples. Another study found significant decision-making differences between individuals with OCD and controls using one measure (e.g., the IGT) and non-significant differences using another (e.g., the GDT) (Starcke, Tuschen-Caffier, Markowitsch, & Brand, 2010). Some previous studies have found a negative relationship between some obsessive-compulsive symptoms and decision-making performance (e.g., Lawrence et al., 2006) including decision-making performance as measured by the IGT (i.e., Laio et al., 2009). Some have suggested that obsessive-compulsive symptoms may have accounted for the decision-making differences between women with eating disorders compared to those without eating disorders in previous studies (e.g., Cavedini et al., 2006; Laio et al., 2009). However, no relationship was found within the BN group between those obsessive-compulsive symptoms on which the BN group difference and any of the decision-making tasks in the current study.

Despite significant differences on distress related to obsession-compulsive symptoms overall and obsessing and mental neutralizing specifically between women with BN compared to both the CG and the BED group in the current study, the BN group performed similarly on tasks of decision making, and even better on one of the tasks (i.e. A-DMC Resistance to Framing subtest), compared to the CG. Thus, the results of the current study suggest that the decision-making differences that have been found in previous studies between women with BN compared to CGs may not be fully explained by differences in obsessive-compulsive symptoms.

Depression and Anxiety Symptoms

Significant group differences were identified on depressive symptoms in the current study. Specifically, the BN group had a significantly higher level of depressive symptoms as measured by the BDI-II than both the CG and the BED group. While some of the previous studies examining decision making and eating disorders did not appear to assess depressive symptoms (Cavedini et al., 2004; Cavedini et al., 2006), the findings from this study are generally consistent with previous decision making and eating disorder studies that have assessed depressive symptoms and have found depressive symptom levels to be higher in groups with BN and AN (Boeka & Lokken, 2006; Liao et al., 2009; Tchanturia et al., 2007). Some studies have found that depressive symptoms negatively impact decision-making performance (Murphy et al., 2001) including performance on the IGT (Tchanturia et al., 2007), while others have found no relationship between depressive symptoms and decision-making performance in women with BN (Boeka & Lokken, 2006; Laio et al., 2009). Pearson bivariate correlation analysis did not reveal a significant correlation between depression level and any of the decision-making measures within the BN group in the current study.

Though the BN group had a significantly higher level of depressive symptoms compared to both the CG and the BED group in this study, the BN group was similar to the CG and the BED group on the measures of decision making, and even significantly better on one task (i.e., A-DMC Resistance to Framing Subtest). It should be considered that the mean depressive symptom level ($M=17.43$) as measured by the BDI-II in the BN group is indicative of depressive symptoms that are only mild in

severity, which is similar to the BDI-II scores of college women with BN in another recent study (e.g., $M=15.50$; Boeka & Lokken, 2006).

Additionally, there were significant group differences on anxiety symptoms identified in the current study. Specifically, the BN group had a significantly higher level of anxiety symptoms as measured by the BAI than both the CG and the BED group while the CG and the BED group were similar in terms of anxiety symptom levels. This is consistent with previous research that has found higher rates of anxiety symptoms and disorders in individuals with BN (Kaye, Bulik, Thornton, Barbarich, & Masters, 2004). While some of the previous studies examining decision making performance in groups with eating disorders assessed obsessive-compulsive symptoms specifically (e.g., Laio et al., 2009), they did not assess other, more general types of anxiety symptoms. Some studies have found that anxiety symptoms impact decision-making performance including performance on the IGT (Miu, Heilman, & Houser, 2008), and other studies have found anxiety symptoms to result in greater risk-avoidance in decision-making tasks (Maner et al., 2007; Raghunathan & Pham, 1999). In the current study, Pearson bivariate correlation analysis revealed strong positive correlations between the BAI and IGT overall net score ($r=.510, p=.018$) and IGT ending balance ($r=.600, p=.004$) within the BN group such that higher anxiety symptoms were associated with *better* decision-making performance on these tasks. Thus, one might have even expected the BN group to have performed better on the tasks in which higher-quality decision making was associated with lower risk taking (e.g., IGT, GDT) and worse on tasks in which higher-quality decision making was reflected by higher risk taking (e.g., the BART).

Despite the fact that the BN group had a significantly higher level of anxiety symptoms compared to both the CG and the BED group that were found to be related to better decision-making performance on some tasks, the BN group performed similarly on all decision making (IGT, GDT, and BART) irrespective of how decision-making quality was determined (i.e., higher-quality reflected by lower risk taking or higher quality reflected by higher-risk taking). It should be noted that the mean anxiety symptom level ($M=14.71$) as measured by the BAI in the BN group from this study is indicative of only mild anxiety symptoms. Future research should seek to examine the role of anxiety symptoms, especially as they relate to in-the-moment decision-making performance in individuals with eating disorders.

Conclusion

In sum, the results of this study suggest similar decision-making performance in a sample of primarily college women with BN and BED compared to controls despite significant differences on other variables that have been found to or appear to be theoretically related to decision-making (e.g., executive functioning, impulsivity-related personality traits and obsessive-compulsive symptoms as well as other anxiety and depression symptoms). In fact, the BN group demonstrated significantly better performance on one of the pencil-and-paper decision-making tasks that arguably requires more cognitive effort (i.e., A-DMC Resistance to Framing Subtest) than the computerized tasks (e.g., the IGT, GDT, and BART). It should be noted that the majority of the analyses that were run to examine decision-making performance differences were inadequately powered to detect between-group differences had such differences existed. Future studies should seek to replicate these findings using larger

samples. Furthermore, future research should seek to examine interactions between in-the-moment negative affect (e.g., depressed mood and anxiety states) and impulsivity-related personality traits and executive functioning on decision-making in women with eating disorders.

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