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Risky Decision Making in College Students as a Function of Self-Reported Eating Behaviors

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Note: Tables located at the end of document.

Introduction:

Eating behaviors, in general, constitute feeding activities such as intake and regulation of calories necessary to sustain body weight (or to depreciate body weight via caloric deprivation), and in the context of the present study, fall along a spectrum in terms of severity (Levine & Smolak, 2016; Vartanian & Porter, 2016). Along this spectrum, eating behaviors can be further grouped into typical (least severe), disordered eating (DE) (severe), and clinical eating disorder pathologies (most severe) (Levine & Smolak, 2016; Vartanian & Porter, 2016). The present study focuses on DE, a class of atypical eating behaviors observed in pre-clinical samples that may represent an at-risk stage in the development of a clinical eating disorder (Hudson, Hiripi, Pope, & Kessler, 2007). Much of the research to date highlights factors related to DE to better assess symptoms and generate more effective interventions and treatments. In particular, research examined relationships between DE and emotion regulation (Cooper & Wade, 2015; Cooper, O'Shea, Atkinson, & Wade, 2014), impulsivity (Lundahl, Wahlstrom, Christ, & Stoltenberg, 2015), and perfectionism (Boone & Soenens, 2015; Graziano & Sikorski, 2014; Peixoto-Plácido, Soares, Pereira, & Macedo, 2015; Wade, Wilksch, Paxton, Byrne, & Austin, 2015). However, no research to date examined behavioral decision making in DE despite multiple studies showing risky decision making across eating disorder pathologies. The present study sought to examine behavioral decision making in college students with and without self-reported DE behaviors.

Eating Disorders and Disordered Eating

Eating disorders are life-threatening psychiatric disorders that are complex in etiology, with some research pointing to the potential intersection of sociocultural, psychological, and biological influences on development and maintenance of eating disorder pathologies (Culbert, Racine, & Klump, 2015). According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5; American Psychiatric Association, 2013), eating disorders are subdivided into three diagnoses: Anorexia Nervosa (AN), Bulimia Nervosa (BN), and Binge Eating Disorder (BED). AN encompasses three diagnostic features: a) persistent caloric restriction; b) fear of weight gain; and c) disturbed perception of body weight/shape (APA, 2013). BN includes three diagnostic features that distinguish it from AN: a) repeated binges (i.e., episode of significantly increased caloric intake in a short amount of time with associated lack of control over eating behaviors); b) repeated engagement in compensatory mechanisms (e.g., excessive exercise, use of laxatives, purging); and c) distorted self-evaluation (APA, 2013). BED is a new diagnosis in the DSM-5, with symptoms including: a) repeated episodes of binge eating; b) during a binge, experiencing such behaviors such as eating quickly, eating despite feeling full, and eating alone due to embarrassment; and c) distress about the

binges (APA, 2013).
DE can be thought of as at-risk eating behaviors, in that such behaviors can cause severe detriment to one's quality of life but fail to meet the diagnostic criteria for one of the three eating disorders outlined above (DiPasquale & Petrie, 2013). Researchers examined the risk factors associated with eating disorder development and in doing so, highlighted behaviors that may constitute DE (although the precise symptoms have not reached consensus) (Hudson et al., 2007; Rohde, Stice, & Marti, 2015; Wilksch et al., 2015). High rates of atypical eating behaviors (e.g., ritualistic food/caloric consumption, food restriction, binge/purge episodes, and/or extreme dieting) and employment of compensatory mechanisms (e.g., vomiting, use of laxatives/diuretics, and/or exercise) were seen in college-aged samples with DE (Cooley & Toray, 2001; Krahn, Kruth, Gomberg, & Drewnowski, 2005; Loth, MacLehose, Bucchianeri, Crow, & Neumark-Sztainer, 2014). Such DE behaviors are similar to those observed in eating disorders; however, these DE behaviors are typically less intense in terms of both frequency and severity (DiPasquale & Petrie, 2013; Uzun et al., 2006). Along these same lines, Uzun and colleagues (2006) theorized that researchers could find few college-aged participants who meet complete criteria for an eating disorder but many who exhibited DE behaviors. However, published rates of DE varied considerably due to factors such as the types of behaviors assessed, participant sex, and intensity of eating symptoms (Uzun et al., 2006). Some estimates were that 80% of first-year college women engaged in extreme dieting while 50% engaged in binge eating (Uzun et al., 2006). In terms of attitudes toward food, 82% of women demonstrated a marked drive to lose weight throughout college, with numbers dropping to 68% after college (DiPasquale & Petrie, 2013). In general, high rates of some DE behaviors are seen in college-aged women who do not meet criteria for a DSM-5 eating disorder diagnosis. Of note, research examining DE behaviors from the male perspective is lacking. This sex discrepancy is also observed with eating disorders, as significant sex differences exist in diagnostic rates for AN, BN, and BED (APA, 2013). It may be that eating disorders are socially constructed as "feminine" disorders, thereby discouraging men to openly discuss atypical eating behaviors with friends, family, and health professionals (Bunnell, 2015). Although we expect higher rates of DE in women than men, just as is seen with eating disorders, it is very likely that DE is present in men as well as women (Uzun et al., 2006). College is a period in which stress levels are high and academic achievement and identity exploration are at the forefront, factors that can exacerbate DE behaviors (Uzun et al., 2006). The present study seeks to add to the research examining DE prevalence rates while also furthering our understanding of how variables such as decision making may be related to severity of DE behaviors.

Decision Making and Eating Behaviors

Neuropsychological studies revealed deficits in several cognitive domains across individuals with eating disorders (see Tchanturia et al., 2004, for review). Most notably, deficits in executive functioning were observed in individuals diagnosed with AN and BN (Brand, Franke-Sievert, Jacoby, Markowitsch, & Tuschen-Caffier, 2007; Ehrlich et al., 2015; Juarascio, Manasse, Espel, Kerrigan, & Forman, 2015). Executive functioning refers to higher-order cognitive processes coordinated by the frontal lobes, including organization, planning, problem solving, set shifting, and working memory (Lezak, Howieson, & Loring, 2004; Wiechmann, Hall, & Azimipour, 2015). Another commonly assessed executive function is decision making, a process that can be defined as, at its simplest, a selection between two or more options. From a clinical perspective, risky decision making was defined as a myopic focus on immediate rewards at the expense of long-term outcomes (Bechara, Damasio, Damasio, & Anderson, 1994). For example, an individual who decided to take a larger, immediate reward associated with larger, long-term losses engaged in riskier decision making than an individual who decided to take a smaller, immediate reward associated with smaller, long-term losses.
Within the eating disorder literature, several studies found evidence of decision making deficits on formal behavioral tasks assessing risky decision making. These behavioral tasks included the Iowa Gambling Task (IGT; Bechara, Damasio, Damasio, & Anderson, 1994), a measure of risky decision making utilized in clinical and research settings. With the IGT and similar tasks, risky decision making was shown in individuals diagnosed with AN (Brogan, Hevey, & Pignatti, 2010; Cavedini et al., 2004), BN (Boeka & Lokken, 2006; Brogan et al., 2010; Liao et al., 2009), and BED (Danner, Ouwehand, van Haastert, Hornsveld, & de Ridder, 2011). Individuals with eating disorders may make riskier decisions due to a focus on immediately rewarding behaviors over less rewarding but more positive/healthy long-term behaviors. Food deprivation, binging, and purging may mimic an immediate reward for the individual that outweighed potential long-term negative consequences (e.g., abnormally slow heart rate, endocrine dysfunction, gastric rupture, low blood pressure, peptic ulcers, and more) (Wierenga et al., 2014). Decision making deficits (i.e., increased risk-taking) were also seen as a function of obesity (Brogan et al., 2010; Brogan, Hevey, O'Callaghan, Yoder, & O'Shea, 2011), and risky decisions predicted successful versus unsuccessful weight loss in a weight management program (Emery, Buelow, Olson, Landers, & Thaxton, 2016). Differences in Body Mass Index (BMI) were not associated with differences on the IGT (Brogan et al., 2011), yet BMI is frequently utilized as a control variable across studies of decision making and eating behaviors (e.g., Davis, Levitan, Muglia, Bewell, & Kennedy, 2004; Brogan et al., 2010). These patterns of real-world behaviors, and the focus on immediate versus long-term consequences, mimic how decisions were made in these lab-based behavioral decision making tasks.
While the focus of research to date has been on eating disorder samples, the present study extends the current literature to hypothesize risky decision making may also be present in individuals self-reporting DE behaviors, as both share similar features. The present study stands alone in its examination of decision making outcomes in individuals self-reporting a range of disordered eating behaviors. Such research could identify potential risk factors that underlie eating disorder development, thereby providing insight into treatment programs targeting risky decision making among individuals with DE behaviors.

The Present Study

The present study examined behavioral decision making in a sample of college students self-reporting eating, both typical and disordered, behaviors. Previous research suggested risky decision making across eating disorder diagnoses. Considering that eating disorders and DE share many features, similar decision making deficits may be present in a DE sample. Importantly, the presence of this relationship at an earlier, at-risk stage in the development of eating pathology would highlight a potential point upon which intervention and/or treatment could be implemented. The first study aim was to assess rates of DE behaviors among college students. Next, risky decision making was assessed through administration of two computerized tasks. It was hypothesized that individuals with greater DE behaviors will display riskier decision making compared to individuals with fewer DE behaviors, as individuals endorsing DE may rely more on immediate, emotion-centered decision making strategies. It is this propensity towards short-term, reward-focused outcomes that mimics real-world behaviors in general (Bechara et al., 1994) and to DE behaviors more specifically. As such, we find it necessary to approach this potential relationship from a behavioral—rather than self-report—perspective.

Method

Participants

The study was approved by the University's Institutional Review Board and all participants provided informed consent. Two studies were conducted: an online study assessing rates of DE behaviors and an in-person study assessing relationships between DE behaviors and risky decision making. Any participant completing the first study was eligible to complete the second study (i.e., there were no additional restrictions on participation for the in-person study).
A total of 550 participants, all over age 18 (244 men, Mage = 18.85, SDage = 2.77, 69.5% European American, 13.5% African American, 5.2% Asian American or Pacific Islander, 2.3% Hispanic American, 9.5% Other Ethnicity) and enrolled in introductory psychology courses completed the online study. Of these, 120 also scheduled and completed an in-person session assessing behavioral decision making. The number of in-person participants was limited in part by lab space constraints. Ten participants were removed from further analyses (six reported a diagnosis of Attention-Deficit/Hyperactivity Disorder, one reported a diagnosis of BN, and three had previous

experience with the behavioral tasks), leaving a final sample of 110 participants (35 men, Mage = 18.46, SDage = 0.95, 67.6% European American, 15.2% African American, 4.8% Asian American or Pacific Islander, 4.8% Hispanic American, 7.6% Other Ethnicity). Independent-samples t-tests indicated no significant differences between those who completed just the online study and those who also completed the in-person study in terms of study variables, ps > .345. All participants were debriefed upon completion of the study protocol.

Measures

Eating Attitudes Test-26 (EAT-26). The EAT-26 is a 26-item measure used as a screening tool for the presence/absence of an eating disorder (Garner, Olmsted, Bohr, & Garfinkel, 1982). It was included due to its inclusion of questions assessing different DE behaviors. Responses ranged from 0 (none to minimal) to 3 (always), with higher scores (range: 0-78) indicating a greater likelihood of eating disorder pathology. Summed scores were calculated for the present study. Additionally, scores on this measure were split by participants scoring above or under the cut-off score of 20 put forth by the authors to indicate at-risk eating behaviors (Garner et al., 1982). Internal consistency was high in our sample (= .89). Previous psychometric examinations of the scale showed high discrimination between individuals with and without AN (84.9% correctly classified based on cut-off score of 20) and moderate to strong correlations with weight, body size estimates, and body image (Garner et al., 1982).

Eating Disorder Examination Questionnaire (EDE-Q).

The EDE-Q is a 28-item measure of eating disorder severity (Fairburn, Cooper, & O'Connor, 2008), and was also selected due to its use as a screening instrument for DE behaviors. The EDE-Q includes four subscales that further assess the cognitive structure of eating disorders: Restraint, Eating Concern, Shape Concern, and Weight Concern. Responses were calculated according to the amount of days (out of the past 28 days) one has acted on the question (e.g., "Have you been deliberately trying to limit the amount of food you have been eating to influence your shape or weight (whether or not you have succeeded)?"), with responses ranging from 0 (No days) to 6 (Every day). Summed scores for each of the four subscales were calculated, with higher scores indicative of more severe eating behavior symptomology (Fairburn et al., 2008). Internal consistency was high in our sample (= .90 total; .84-.94 by subscale). Previous research has indicated good concurrent and criterion validity for the measure (Mond, Hay, Rodgers, Owen, & Beumont, 2004).

Game of Dice Task (GDT).

The computerized GDT assesses risk-taking behavior as a function of decision making (Brand et al., 2005), and was chosen due to the focus on behavioral risky decision making. The GDT mimics a gambling-type situation. Participants were told to maximize profit by predicting 18 throws of a single virtual die (Brand et al., 2005). Prior to each throw, participants were instructed to select/predict a single number or combination of numbers (up to four numbers), with each selection bearing potential gain/loss amounts. Selecting a single number yielded the greatest gain but also the greatest loss ($1000). Conversely, selecting a combination of numbers yielded smaller gains but also smaller losses: $500 for a combination of two numbers, $200 for a combination of three numbers, and $100 for a combination of four numbers. The number of selections indicated greater (1,2) or lesser (3,4) risky decision making (Brand et al., 2005). The present study assessed risky decision making by utilizing the proportion of risky choices (1 or 2 number combinations), with greater values indicating riskier decisions. Scores could range from 0% (no risky choices) to 100% (only risky choices). The GDT differentiated between patient and healthy control samples, and showed some correlations with other behavioral decision making measures (Schiebener & Brand, 2015).

Iowa Gambling Task (IGT).

Participants completed the standard computerized version of the IGT to assess risky decision making (Bechara, 2007; Bechara et al., 1994), as the IGT is currently the only clinically-available behavioral measure of risky decision making. Participants started with a loan of $2,000 and were given instructions to maximize profit over 100 trials. Participants made selections from four decks of cards (Decks A, B, C, and D). Selections from Decks A and B resulted in an average profit of $100 per selection, whereas Decks C and D resulted in an average profit of $50 per selection. However, after making 10 selections from Decks A and B, participants incurred a net loss of $250. After making 10 selections from Decks C and D, participants incurred a net gain of $250 (Bechara et al., 1994). Therefore, Decks A and B were termed "disadvantageous" decks, whereas Decks C and D were termed "advantageous" decks. It is important to analyze performance on the IGT as the task progresses, as such information provides critical distinctions in decision making performance across earlier and later deck selections. The initial trials of the IGT, termed decision making under ambiguity (Brand, Recknor, Grabenhorst, & Bechara, 2007), constitute selections from both disadvantageous and advantageous decks as participants do not know much about the relative risks and benefits of each deck yet. The final trials (60 [Brand et al., 2007] or 40 [Ko et al., 2010; Noel, Bechara, Dan, Hanak, & Verbanck, 2007]), termed decision making under risk, are different from the initial trials in that participants have gained enough experience to learn of the relative risks and benefits of each deck. Therefore, continued selections from disadvantageous decks during the final trials constitutes risky decision making. To examine the influence of DE behaviors on decision making under risk, we analyzed the percent of individual deck selections (A,B,C,D) on the last 60 trials. Scores could range from 0% (no selections from that deck) to 100% (only selections from that deck). Validity for the IGT has previously been shown (Bechara, 2007), with continued concerns about test-retest reliability due to strong practice effects (Buelow & Suhr, 2009). Impaired decision making on the IGT is seen among individuals with pathological gambling, frontal lobe injuries, schizophrenia, and high levels of psychopathy characteristics (Buelow & Suhr, 2009).

Procedure

Information about both the online and in-lab sessions was posted on the department's online research sign-up system, and interested participants were able to read additional information about each study prior to choosing a study session. Participants gave informed consent for both the online and in-lab sessions and were debriefed at the end of each session. The online session included administration of the EAT-26, EDE-Q, and demographic questionnaires (including questions about age, gender, ethnicity, and current height and weight to allow for calculation of BMI). At the end of the online session, participants read a debriefing statement and information about the lab-based session. Completion of the online session allowed interested participants to sign up for the lab-based session. The second, in-person session consisted of the GDT and IGT completed in a randomized order, and participants were debriefed at the end of the study. Participants were given course credit after each session.

Results

Descriptive statistics are provided in Table 1. A power analysis conducted with G*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007) indicated that a sample of 89 participants was needed to detect a medium effect with alpha of .05 and power of .95.

The first study aim was to assess rates of DE in a college (undergraduate student body) sample. This aim was addressed by examining scores on the EAT-26 and EDE-Q in the online sample. Garner and colleagues (1982) stated that a score of 20 on the EAT-26 should act as a cut-off, with scores above 20 indicating concerns about eating behaviors warranting follow-up assessment. In the present study, 62 participants (11.27%) scored above the cut-off score, and a greater proportion of women (15.89%; M = 11.71, SD = 9.16) than men (5.74%; M = 8.18, SD = 6.56) fell in this range, 2(1,N = 546) = 13.83, p < .001. No differences were found between men and women on the study variables, ps > .103; however, due to sex differences in DE behaviors and behavioral decision making, sex was included as a predictor in the remaining analyses.

Prior to addressing the second study aim, IGT deck preferences were examined with a repeated measures ANOVA due to lack of independence of observations. Mauchly's Test of Sphericity was significant, 2(5) = 43.73, p < .001; therefore, the Greenhouse-Geisser correction was applied. The overall ANOVA was significant, F(2.495, 269.490) = 16.59, p < .001, partial 2 = .133. During the later IGT trials (Trials 41-100), participants preferred Deck D to Deck A (p < .001) and Deck C (p < .01), Deck C to Deck A (p < .01), and Deck B to Deck A (p < .001). Therefore, participants in general avoided Deck A compared to the other decks.

The second study aim was to assess the relationship between DE behaviors and risky decision making. It was hypothesized that individuals with greater DE behaviors will

display riskier decision making compared to individuals with fewer DE behaviors. Multiple regressions were utilized to assess this hypothesis. Sex, current BMI (M = 25.16, SD = 5.37) based on self-reported current height and weight, scores on the EAT-26, and scores on the EDE-Q subscales were the predictors, and performance on the IGT (percent selections from Deck A, B, C, D) and GDT (proportion of disadvantageous selections) were the outcome variables. Correlations between the predictor variables are presented in Table 2.

First, the assumptions of multiple regression were examined per Tabachnick and Fidell (2013) and Cohen and colleagues (2003). The outcome variables (GDT, IGT scores) were measured on a continuous scale, and the predictor variables were measured on a categorical (sex) or continuous (BMI, EAT-26, EDE-Q) scale. Six predictors remained in the analyses following examinations of multicollinearity, and our total sample size was slightly under the recommended 20 per predictor (Tabachnick & Fidell, 2013). The presence of outliers was examined with scatterplots and histograms of the residuals. No outliers emerged for the GDT or IGT Decks B and D, but potential outliers were identified for Deck A and Deck C. An examination of leverage and Cook's D indicated one outlier in the Deck A analysis that also showed high leverage. This data point was removed from the remaining analyses. The assumption of normality of residuals was examined with residual plots. The Kolmogorov-Smirnov statistic was significant for IGT Decks C and D, indicating concerns with normality. In addition, distributions of the residuals indicated concerns about heteroscedasticity for the Deck C analyses. To correct for these concerns, a square root transformation, due to the presence of zeros in the data, was applied to each of the outcome variables. Finally, multicollinearity was assessed with the Variance Inflation Factor (VIF). When all four EDE-Q subscales were included in the regression, the VIFs for Shape Concerns (VIF = 7.77-7.94) and Weight Concerns (VIF = 7.68-7.81) were over 5. To correct for this, Shape Concerns, the highest VIF, was removed from the analyses. The VIF for the remaining six predictors was under 5 (see Table 3).

Results of the multiple regressions are presented in Table 3. To minimize Type I error rate, only analyses significant at the .01 level were interpreted. No significant predictors emerged for risk-taking on the GDT, ps > .232, or in IGT Deck A, ps > .088, or Deck C, ps > .147, selections. Greater Eating Concerns on the EDE-Q were associated with fewer Deck B selections, p = .006, and greater Deck D selections, p = .010, on the later trials (Trials 41-100) of the IGT.

Discussion

The present study examined behavioral decision making in college students self-reporting a range of eating behaviors on a spectrum from typical to atypical, but in the absence of a diagnosed eating disorder. Two overall study aims were addressed. First, descriptive information was provided regarding prevalence of self-reported DE behaviors. We found 11.27% of our sample scored above the recommended cut-off score on the EAT-26, indicating concerns about DE behaviors. Additional examination of scores by sex showed a greater prevalence of self-reported DE in women than men; however, given the difference in number of men (244) versus women (306) in the study, this result should be replicated in a larger sample and with a more equal sex distribution. Our present finding of a sex difference is consistent with the gendered disparity of eating disorder diagnosis rates more generally, as well as with previous research on DE behaviors (Bunnell, 2015). However, given the nature of the self-report data in this study, it is unclear whether the eating behaviors endorsed were indicative of behaviors that could lead to a diagnosable eating disorder or those that may represent a lifestyle modification to improve health and well-being.

The second study aim was to assess risky decision making in individuals self-reporting a spectrum of DE behaviors. We hypothesized individuals with greater DE will display riskier decision making compared to individuals with fewer DE, but our results did not support this hypothesis. No significant relationships were found between eating behaviors on the EAT-26 or EDE-Q and the GDT. This finding is in contrast to previous research showing risky decisions on the GDT as a function of eating disorder diagnosis (Brand et al., 2007), but again our participants did not have a self-reported eating disorder diagnosis. Although in general (independent of eating behaviors) participants learned to avoid Deck A during the later IGT trials, we found few relationships between DE and performance on the IGT. Specifically, the only significant findings were between Eating Concerns and Deck B and D selections. Contrary to prediction, individuals endorsing a higher level of DE on the EDE-Q Eating Concerns subscale made more advantageous—not riskier—selections from these decks. Individuals bypassed the high immediate rewards (but long-term negative consequences) of Deck B in favor of the lower immediate rewards (but long-term positive outcomes) of Deck D (Bechara, 2007). However, it should be noted that the overall proportion of variance in decision making accounted for by DE was low (.07-.09 across decks), reflecting an overall low practical significance of these findings.

Taken together, the present findings are inconsistent with research findings of risky decision making among individuals with eating disorders on the IGT (e.g., Boeka & Lokken, 2006; Brogan et al., 2010) and GDT (Brand et al., 2007). Yet, no studies to date have examined risky decision making in a pre-clinical sample (i.e., individuals with DE but not a diagnosed eating disorder). Therefore, the present preliminary study provides initial evidence that the decision making deficits seen in various eating pathologies (AN, BN, BED, obesity) may not be evident in DE behaviors. Given the types of eating behaviors included in DE, and the lack of formal diagnostic criteria, it is possible that our results are a function of eating "oddities" or dieting/lifestyle changes intended to improve health. For example, an individual in the process of increasing their fitness level, with associated restrictive eating patterns, in an effort to improve overall health could result in higher scores on the EAT-26 or EDE-Q. Participants may have exhibited advantageous decision making performance on the IGT due to this focus on longer-term positive consequences (i.e., greater monetary gains on the IGT; improved health outcomes in the real world).

It is unclear, however, why only the Eating Concerns subscale was associated with IGT performance. Examining the individual items from this subscale show some overlap with obsessive-compulsive symptomatology. Endorsing these items may incline such individuals to be acutely aware of changes in their environment, leading to improved decision making strategies such as those seen in some individuals diagnosed with obsessive-compulsive disorder (Buelow & Suhr, 2009). Other items on the Eating Concerns subscale assess behaviors such as eating in secrecy, social eating, and guilt (Fairburn et al., 2008). Endorsement of these items—as well as those previously discussed—could reflect one of two behaviors: (a) a predisposition to future eating disorder pathology or (b) an attempt to model healthier eating behaviors, such as by following a physician's strict diet to improve health. As the present study relied on self-report in non-treatment seeking college students, it is unclear to what degree some eating behaviors may be inaccurately identified as disordered on these measures. Future research should aim to tease apart these differences in reasons behind eating behaviors. There are differences in the type of decision making assessed with the IGT and GDT, which help to better understand the inconsistent findings across measures. On the IGT, participants must learn to choose advantageously via feedback on previous trial wins/losses (Brand et al., 2007). These relative risks are not known at the start of the study, and participants must pay attention to the feedback in order to learn. This learning process is reflected in the differentiation between decision making under ambiguity (first 40 trials) and decision making under risk (last 60 trials) on this task.

On the GDT, however, the risks associated with each decision are made explicit at the start of the task (Brand et al., 2005). On the first GDT trial, participants know the exact monetary value of choice. The amount of money at stake on each IGT selection ($50-100 gains) is lower than the amount of money at stake on each GDT selection ($100-1000) as well. It is possible our results differed on the IGT and GDT due to differences in learning the probabilities associated with each decision, or to differences in the magnitude of the wins/losses across tasks.

Limitations

The present study had several important limitations. First, we relied on self-report measures to assess DE. In general, self-report measures could underestimate the actual prevalence of behaviors if individuals are uncomfortable sharing such information with a researcher. Future research should attempt to better assess DE behaviors with the use of more thorough measures, including both self- and other-report, and a structured clinical interview. It could also be the case that social desirability factors influenced responses, particularly among men. As atypical eating behaviors are often regarded as "feminine" issues,

accurate disclosure of DE behaviors could be withheld among men due to societal pressures to conform to normative masculine behavior. Due to disparities in the number of participants across sex (more women than men), future research should seek the better highlight sex differences in examinations of both prevalence rates and the presence of decision making deficits. Our sample size was also a potential limitation in the present study. Although a power analysis indicated likely sufficient power to detect medium effects, the study was underpowered to detect smaller effects. Future research utilizing a larger sample of participants is necessary to better ascertain differences in decision making as a function of typical and atypical eating behaviors. Finally, the present work was limited in the lack of a consistent definition of DE behaviors. Future research is needed to better delineate the DE construct, including a better way to distinguish between behaviors that reflect health and wellness (e.g., dieting to lose weight for better cardiovascular health) and those that reflect detrimental, atypical eating behaviors. A consistent definition and conceptualization of DE will allow future researchers to examine how it functions as an at-risk stage in eating disorder development.

Conclusions

Taken together, the present results provide minimal evidence of a relationship between self-reported eating behaviors and behavioral decision making. This preliminary data suggests that the decision making deficits seen across eating disorders may not be present in an earlier, pre-clinical stage; however, it is important to note that this study utilized a small sample of non-treatment seeking college students. Future research should replicate and expand on these findings with a more diverse sample, a more in-depth examination of potential confounding behaviors such as healthful dieting per physician's instructions, and different measures of decision making to examine whether probability learning or type of decisions made are affected by eating behaviors.

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Table 1. Means and standard deviations for study variables

	Online Screening			In-Person Session
	Total	Men	Women	
Variable	***M (SD)***	***M (SD)***	***M (SD)***	***M (SD)***
EDE-Q				
Restraint	0.74 (1.13)	0.51 (0.91)	0.92 (1.25)	0.77 (1.24)
Eating Concerns	0.47 (0.91)	0.27 (0.60)	0.63 (1.06)	0.52 (0.93)
Shape Concerns	1.55 (1.61)	0.83 (1.18)	2.13 (1.68)	1.63 (1.62)
Weight Concerns	1.36 (1.51)	0.74 (1.08)	1.86 (1.61)	1.45 (1.51)
GDT	--	--	--	42.35 (27.00)
IGT				
Deck A	--	--	--	15.92 (10.16)
Deck B	--	--	--	31.01 (16.74)
Deck C	--	--	--	22.22 (23.58)
Deck D	--	--	--	32.66 (19.05)

Note: BMI = Body Mass Index; EAT = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination; IGT = Iowa Gambling Task, selections from each deck during Trials 41-100; GDT = Game of Dice Task, proportion of disadvantageous selections.

Table 2. Correlations between predictor variables

Variable	1	2	3	4	5	6
1. BMI	--	.088	.148	.089	**.297***	**.307***
2. EAT-26		--	**.686***	**.553***	**.469***	**.510***
3. EDE-Q Restraint			--	**.714***	**.619***	**.644***
4. EDE-Q Eating				--	**.624***	**.677***
5. EDE-Q Shape					--	**.929***
6. EDE-Q Weight						--

*$p < .01$

Note: BMI = Body Mass Index; EAT-26 = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination, Restraint, Eating Concern, Shape Concern, and Weight Concern subscales.

Table 3. Regression analysis

Outcome	Predictors	*F*	*p*	R^2	VIF	*B*	*SE(B)*	*β*	*t*	*p*
GDT		0.74	.620	.04						
	Gender				1.24	-0.07	0.18	-0.04	-0.40	.687
	BMI				1.12	0.02	0.02	0.13	1.20	.233
	EAT-26				1.67	0.09	0.09	0.14	1.09	.276
	Restraint				3.01	-0.08	0.21	-0.07	-0.41	.682
	Eating				2.48	0.23	0.22	0.16	1.06	.294
	Weight				2.63	-0.19	0.17	-0.18	-1.09	.278
IGT A		0.95	.465	.05						
	Gender				1.22	0.22	0.16	0.16	1.43	.155
	BMI				1.11	0.01	0.01	0.08	0.75	.453
	EAT-26				1.67	0.02	0.07	0.04	0.33	.741
	Restraint				3.03	0.21	0.18	0.20	1.20	.232
	Eating				2.51	-0.15	0.19	-0.12	-0.78	.435
	Weight				2.62	-0.25	0.14	-0.27	-1.72	.089

Table 3 (continued).

Outcome	Predictors	*F*	*p*	R^2	VIF	*B*	*SE(B)*	*β*	*t*	*p*
IGT B		1.58	.160	.09						
	Gender				1.23	0.02	0.14	0.01	0.11	.909
	BMI				1.11	-0.00	0.01	-0.03	-0.25	.807
	EAT-26				1.67	0.08	0.07	0.15	1.24	.220
	Restraint				3.05	0.13	0.16	0.13	0.78	.435
	Eating				2.53	-0.48	0.17	-0.42	-2.79	**.006**
	Weight				2.65	0.18	0.13	0.21	1.35	.181
IGT C		0.68	.669	.04						
	Gender				1.24	0.03	0.17	0.02	0.17	.870
	BMI				1.11	0.01	0.01	0.10	0.95	.343
	EAT-26				1.66	0.05	0.08	0.07	0.56	.575
	Restraint				3.04	0.03	0.20	0.02	0.14	.892
	Eating				2.53	-0.31	0.21	-0.23	-1.46	.148
	Weight				2.64	0.01	0.16	0.01	0.07	.948

Table 3 (continued).

Outcome	Predictors	*F*	*p*	R^2	VIF	*B*	*SE(B)*	*β*	*t*	*p*
IGT D		1.34	.247	.07						
	Gender				1.24	0.07	0.14	0.05	0.50	.616
	BMI				1.11	-0.00	0.01	-0.01	-0.10	.918
	EAT-26				1.66	-0.02	0.06	-0.04	-0.34	.731
	Restraint				3.04	-0.23	0.15	-0.25	-1.52	.132
	Eating				2.53	0.43	0.16	0.40	2.63	**.010**
	Weight				2.64	-0.06	0.13	-0.08	-0.49	.626

Note: BMI = Body Mass Index; EAT-26 = Eating Attitudes Test-26; EDE-Q = Eating Disorder Examination, Restraint, Eating Concern, and Weight Concern subscales.