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The role of impulsivity traits and delayed reward discounting in dysregulated eating and drinking among heavy drinkers

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Abstract

Impulsivity is a multifaceted construct that has been linked to dysregulated eating and problematic alcohol use. The UPPS model identifies five personality-based impulsivity traits that have unique predictive utility: Negative Urgency, Perseverance, Premeditation, Sensation Seeking, and Positive Urgency. Delayed reward discounting (DRD) is an index of impulsive decision making characterized by preference for smaller immediate gains at the cost of larger delayed gains. In the current study, we sought to refine the influence of impulsive personality traits and DRD on disordered eating patterns and problematic drinking. One hundred and eight treatment-seeking heavy drinkers were assessed for UPPS impulsivity traits, DRD, disordered eating, alcohol use, and demographic information. With regard to disordered eating patterns, DRD predicted higher levels of Dietary Restraint and Weight and Shape Concerns. Negative Urgency predicted binge eating and Weight and Shape Concerns. Positive Urgency predicted Eating Concerns. Female sex predicted Eating, Weight, and Shape Concerns. When considering problematic alcohol use, only Negative Urgency and Sensation Seeking were predictive. This is the first study to examine both personality-based impulsivity and DRD in relation to pathological eating and drinking behavior. The results suggest the importance of disentangling the contributions of various impulsivity constructs on dysregulated eating.

Keywords

Eating disorders; Binge eating; Alcohol use; Impulsivity; Delay discounting; Behavioral economics

Introduction

Impulsivity is generally defined as a tendency to act without thinking, but different definitions of impulsivity emphasize specific aspects of personality and behavior such as the tendencies to respond prematurely, to respond without reflecting when making decisions, to inhibit responses poorly, and to prefer smaller immediate rewards instead of larger delayed ones (Evdenden, 1999). It is increasingly accepted that “impulsivity” is not a unitary construct but rather a family of constructs, some of which are closely related while others

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are quite distinct (Evenden, 1999; Robbins, Curran, & de Wit, 2012; Whiteside & Lynam, 2001). These separate constructs have unique predictive properties, thus it is important to study separate impulsivity domains and study their unique influences on psychopathology (Meda et al., 2009; Papachristou, Nederkoorn, Havermans, van der Horst, & Jansen, 2012). The constellation of traits and behaviors related to impulsivity has been linked to a number of psychiatric conditions, including substance use disorders (de Wit, 2009; Dalley, Everitt, & Robbins, 2011; Reynolds, 2006). Increasingly, these constructs have also been examined in relation to dysregulated eating (e.g., Claes, Vandereycken, & Vertommen, 2005; Lyke & Spinella, 2004). There is increasing agreement that impulsivity may be divided into three broad categories: personality-based constructs of impulsivity, behavioral indices of response inhibition, and indices of impulsive decision making (de Wit, 2009). In this study, we examined the influence of the personality-based impulsivity traits and the impulsive decision-making index on dysregulated eating patterns and problematic alcohol use.

The UPPS as a trait-based model of impulsivity and its correlates

In structural models of personality, impulsivity is conceptualized as a continuous trait. One such model was derived using the Five Factor Model of personality (Whiteside & Lynam, 2001). Whiteside and Lynam (2001) and Smith et al. (2007) have identified four separate but related impulsivity traits which have specific behavioral correlates and predictive utility, and can be understood within a comprehensive personality framework: (*lack of*) *Perseverance* is the inability to sustain attention and motivation on a task; *Sensation Seeking* is a tendency to seek out novel and thrilling experiences; (*lack of*) *Premeditation* is the tendency to act without thinking or failure to plan ahead; and *Urgency* is the tendency to act rashly while experiencing strong emotions. This latter domain has been further refined into *Positive Urgency*, the tendency to act rashly when experiencing positive emotions, and *Negative Urgency*, the tendency to act rashly when experiencing negative emotions (Cyders & Smith, 2007; Cyders et al., 2007).

Research on alcohol use and disordered eating using the UPPS framework has focused on under-control, or poor ability to self-regulate. Both problematic alcohol use (Fischer, Anderson, & Smith, 2004; Fischer, Settles, Collins, Gunn, & Smith, 2011; Smith et al., 2007; Stojek & Fischer, 2013; Whiteside & Lynam, 2009) and binge eating (Claes et al., 2005; Fischer et al., 2004, 2011; Fischer, Smith, & Cyders, 2008) are associated with Negative Urgency, and excessive drinking is associated with a number of other traits characterized by under-control (Cyders, Flory, Rainer, & Smith, 2009; Fischer & Smith, 2008; Miller, Flory, Lynam, & Leukefeld, 2003). In fact, alcohol use disorders and EDs often co-occur (Herzog, Keller, Sacks, Yeh, & Lavori, 1992) and Negative Urgency has been hypothesized as one of the underlying factors for this comorbidity (Anestis, Selby, & Joiner, 2007; Fischer et al., 2004, 2011; Fischer, Smith, & Cyders, 2006; Smith et al., 2007). Individuals with alcohol use disorders display higher levels of Negative Urgency when compared with healthy controls (Fischer et al., 2011; Whiteside & Lynam, 2009). Negative Urgency differentiated fifth graders who initiated alcohol drinking from those who did not, and it predicted increases in alcohol dependence symptoms in women across the first semester of college (Fischer et al., 2011; Stojek & Fischer, 2013), and Positive Urgency has prospectively predicted increases in alcohol consumption among college students (Cyders et

al., 2009). In contrast, Sensation Seeking has been consistently associated with the frequency of alcohol use although not necessarily with levels of alcohol misuse (Cyders et al., 2009; Fischer & Smith, 2008; Miller et al., 2003).

There is a well-established link between Negative Urgency and loss of control over eating, e.g., frequency of objective binge eating (Fischer et al., 2004). This relationship is consistent across clinical and nonclinical samples (Claes et al., 2005; Fischer et al., 2004, 2011; Fischer & Smith, 2008). The evidence for a link between Premeditation or Perseverance and binge eating is less consistent such that some researchers have found a negative relationship between these two traits and bulimic behaviors (Claes et al., 2005; Miller et al., 2003) while others have not (Fischer, Smith, & Anderson, 2003). Interestingly, Negative Urgency has also been linked to pathological eating behaviors and attitudes that may be conceptualized as examples of over-control or excessive self-regulation. Specifically, Negative Urgency has been associated with dietary restraint as well as Concern for Dieting subscale of the Restraint Scale in a nonclinical sample (Mobbs, Ghisletta, & Van der Linden, 2008). Research on individuals with Binge Eating Disorder and Bulimia Nervosa has identified a dietary-negative affect subtype characterized by both dietary restraint and negative affect (Grilo, Masheb, & Wilson, 2001; Masheb & Grilo, 2008; Stice, 2001). Individuals who fall into this subtype have higher Negative Urgency scores than individuals with pure dietary subtype of binge eating (Carrard, Crépin, Ceschi, Golay, & Van der Linden, 2012). Thus, it appears that Negative Urgency may be related to different dimensions of disordered eating behavior, including those that represent excessive self-regulation.

Overall, there is evidence that these different dispositional traits are uniquely associated with different motives for drinking and eating, and represent unique predisposing sensitivities to pathological drinking and dysregulated eating patterns. The common link between Negative Urgency and pathological eating and drinking patterns may be explained using negative reinforcement theory (Bandura, 1969; Cooper, 1994; Fischer et al., 2004; Heatherton & Baumeister, 1991), as well as Baumeister's self-control theory (Muraven & Baumeister, 2000). From the negative reinforcement perspective, individuals may tend to turn to alcohol and/or food to alleviate negative affect and cope with distress. In the short-term, the experience of drinking and/or eating is reinforcing because it regulates emotions. Therefore, Urgency is a common underlying factor for pathological drinking and eating insofar that it predisposes individuals to engage in these maladaptive behaviors when experiencing negative affect. Additionally, self-control has been hypothesized to be akin to a muscle – easily strained when additional pressure, such as stress or resisting temptation, is applied (Muraven & Baumeister, 2000). Thus, individuals who try to exert over-control (e.g., follow dietary rules) may have a higher tendency to make impulsive decisions when distressed because their self-control is strained. Overall, the theoretical basis for the comorbidity between pathological drinking and eating points to specific dispositional traits, particularly those associated with the ability to make effective decisions when experiencing distress.

DRD as a form of impulsivity and its relationship to appetitive behavior patterns

Delayed reward discounting (DRD) is a behavioral economic index of impulsive decision making (Madden & Bickel, 2009). DRD indexes the discounting of a reward's value based

on its delay – or how quickly a reward loses its value as a function of time (MacKillop et al., 2011). This may be conceptualized as an inability to delay gratification in that DRD conveys the preference for a smaller immediate reward relative to a larger delayed reward, and is a hallmark feature present in addiction (MacKillop et al., 2011). High DRD can be conceptualized as an index of under-control (i.e., failure to self-regulate) and low DRD as over-control (i.e., excessive or rigid self-regulation). The majority of research has focused on the relationship of DRD to addiction, thus the under-control aspects of DRD. A large body of empirical evidence has accumulated linking DRD and addictive behaviors (for a meta-analytic review, see MacKillop et al., 2011). Overall, individuals with alcohol misuse and dependence have higher levels of DRD (i.e., they discount future rewards more steeply) than normal controls (MacKillop et al., 2011). Thus, there appears to be a link between DRD and problematic appetitive behaviors present in addiction.

Past research on eating dysregulation has concentrated on the under-control aspects of DRD, or the relationship between inability to delay gratification and obesity or binge eating behavior. One study has found that obese women discount future rewards more steeply than normal-weight controls (Weller, Cook, Avsar, & Cox, 2008), suggesting that women with higher Body Mass Index (BMI) may discount the long-term benefits of not consuming excess calories when presented with the immediate opportunity to do so. A study that compared obese women and women with Binge Eating Disorder to healthy controls found that obese women and those with Binge Eating Disorder had higher level of DRD compared with normal controls (Davis, Patte, Curtis, & Reid, 2010). Another study that recruited a nonclinical sample of women found that DRD was related to the tendency to overeat with a sense of loss of control (i.e., disinhibition), but not restraint on the Three-Factor Eating Questionnaire, such that women with higher DRD were more likely to binge eat compared with those with lower DRD levels (Yeomans, Leitch, & Mobini, 2008). However, as disordered eating behaviors and attitudes can be characterized by both under-control (e.g., binge eating) and over-control (e.g., severe dietary restraint), DRD may be an informative index of pathological overvaluing of future rewards. In fact, one study comparing individuals with Anorexia Nervosa with healthy controls found that individuals with Anorexia discount future rewards significantly less steeply than controls (Steinglass et al., 2012) lending some support to the notion of pathologically low discounting in eating disordered behaviors characterized by over-control. Thus, while there is some support for a link between DRD and binge eating behavior, it appears that the role of DRD in disordered eating, which encompasses weight and shape concerns as well as dietary restraint, may be more nuanced, as evidenced by lower DRD levels in women who engage in pathological dietary restriction – those with Anorexia. As DRD taps into both under-control and over-control, it has the potential to further elucidate the mechanisms underlying disordered eating behaviors.

Relationships between DRD and UPPS traits

DRD is measured via laboratory tasks in which individuals make decisions between smaller immediate rewards and larger later rewards (Dougherty, Mathias, Marsh, & Jagar, 2005). Unlike the UPPS model, which measures traits that are a combination of cognitive and affective processes, laboratory tasks reflect quite specific and circumscribed behavioral processes (Dick et al., 2010). They have been conceptualized as a “snapshot” of actual

behavior under specific circumstances. As such, these behavioral samples should be influenced by stable personality traits, thus there should be some overlap between self-report measures of trait impulsivity and laboratory tasks (see Cyders & Coskunpinar, 2011). A factor analytic study found that individuals low in Premeditation were more willing to forego larger later rewards in favor of smaller sooner rewards (Lynam & Miller, 2004). However, Reynolds, Ortengren, Richards, and de Wit (2006) did not find strong correlations between personality measures and behavioral tasks of impulsivity. Similarly, another study of both UPPS indices and DRD in relation to drinking found no significant associations between the two (Murphy & Mackillop, 2012). A recent meta-analysis that examined the relationships between the UPPS facets and various behavioral tasks of impulsivity (Cyders & Coskunpinar, 2011) found small, though significant, effect sizes between them. Laboratory measures of delay discounting appear to be related to the traits of Premeditation and Sensation Seeking (Cyders & Coskunpinar, 2011). At the same time, it has long been argued that the self-report and laboratory tasks may tap into different constructs, and the results of the meta-analysis indicate that the overlap in variance between self-report and laboratory measures is small even when it is significant. Therefore, examining delay discounting alongside UPPS traits provides incremental and nonredundant information regarding these different impulsivity constructs in relation to problematic drinking and eating patterns.

Current study

Both problematic alcohol use and certain aspects of dysregulated eating have been conceptualized as impulsive behaviors in which an individual exhibits under-control, and they often co-occur. Negative Urgency has been conceptualized as one common underlying factor between these two behaviors. Delayed reward discounting appears to be another potential common thread as it has been shown to be higher in individuals with problematic drinking patterns as well as those who binge eat. At the same time, certain aspects of disordered eating are characterized by over-control, which makes the relationship between impulsivity, problematic drinking, and disordered eating more nuanced.

In the current study, we sought to refine the relationship of UPPS impulsivity traits and DRD to two behaviors that have been conceptualized as impulsive – disordered eating and dysregulated alcohol consumption. Specifically, we examined disordered eating symptoms including restraint, concerns about eating, weight, and shape, as well as the occurrence of binge eating in a sample of individuals with problematic alcohol consumption. This allowed us to examine the overlapping and unique contributions of personality-based constructs of impulsivity and an index of impulsive decision making on maladaptive eating and drinking patterns. Based on the previous findings, we had several hypotheses. We hypothesized that Negative Urgency would significantly predict binge eating, dietary restraint, and problematic alcohol use. We also hypothesized that Sensation Seeking would significantly predict problematic alcohol use but not disordered eating symptoms. Based on previous studies, we also hypothesized that DRD would significantly predict binge eating and problematic drinking. Additionally, we hypothesized that DRD would be negatively associated with restraint as lower DRD scores represent over-control, a pattern associated with restricting

food intake. Finally, we conducted exploratory analyses on the remainder of disordered eating symptoms, which included concerns about eating, weight, and shape.

Material and methods

Participants

Our sample consisted of heavy drinkers seeking treatment for alcohol use disorders. The total sample consisted of 108 participants. The mean age in the sample was 42 (Range = 21–64). Our sample was predominantly male and White (see Table 1 for complete Descriptive Statistics). Among the White participants, three (3%) reported considering themselves Hispanic. The mean level of education was 14 years ($SD = 2.6$; Range = 10–22). The mean score on the measure of alcohol dependence (i.e., Alcohol Use Disorders Identification Test, see the *Measures* section) was indicative of harmful and hazardous drinking and likely dependence (Range = 5–40). The participants reported consuming on average 53 standard drinks per week (Range = 3–258). Among those who reported at least one binge eating episode ($n = 32$) in the past month, the mean number of binges was 8.16 ($SD = 9.29$; Range = 1–50). We used the standard equation to calculate the BMI:

$$\text{BMI} = (\text{Weight [lbs]} \div \text{Height [in]}^2) \times 703$$

The participants in our sample were on average in the overweight category (Range = 18–57; see Table 2 for Descriptive Statistics).

Measures

Eating Disorders Examination – Questionnaire (EDE-Q; Fairburn & Beglin, 1994)—The EDE-Q is a 28-item self-report measure derived from the Eating Disorders Examination interview. It assesses the frequency of disordered eating symptoms over the past 28 days. It yields four subscale scores: Restraint (i.e., deliberately trying to limit the amount of food consumed), Shape Concern (i.e., importance of being a certain figure), Weight Concern (i.e., importance of being a certain weight), and Eating Concern (i.e., preoccupation with eating and calories, fear of losing control over eating). The four subscales were used as outcome variables in this study and their internal reliability was satisfactory (Cronbach's α 's from 0.74 to 0.89). Additionally, the EDE-Q assesses binge eating in the preceding 28 days. The EDE-Q describes the behavior of eating a large amount of food followed by a question about loss of control over eating. The participants estimate the number of times that they experienced overeating accompanied by loss of control in the past 28 days. That count was used as a dichotomous outcome variable (i.e., any number other than 0 was coded as “binge eating present”).

Alcohol Use Disorders Identification Test (AUDIT; Babor, De la Fuente, Saunders, & Grant, 1992; Babor, Higgins-Biddle, Saunders, & Monteiro, 2001; Saunders, Aasland, Babor, De La Fuente, & Grant, 1993)—The AUDIT is a 10-item measure that assesses problematic alcohol use. Responses are coded on a scale from 0 to 4 (usually inquiring about the frequency of behavior). Scores above 8 indicate problematic drinking and above 15, likely dependence (Babor et al., 2001). The internal reliability of the AUDIT was 0.78 in our sample.

UPPS-P (Smith et al., 2007; Whiteside & Lynam, 2001)—The UPPS-P is a 59-item, Likert-type scale designed to assess the personality-based impulsivity constructs of Negative Urgency, Positive Urgency, (lack of) Premeditation, (lack of) Perseverance, and Sensation Seeking. It was factor-analytically derived based on the five-factor personality model framework. A validation study found convergent and discriminant validity among these impulsivity constructs, and each trait was associated with unique risky behaviors such as binge eating, purging, binge drinking or pathological gambling (Smith et al., 2007). The internal reliabilities ranged from 0.81 to 0.85.

Monetary Choice Questionnaire (MCQ; Kirby, Petry, & Bickel, 1999)—The MCQ is a validated self-report measure of DRD. Individuals make 27 choices between smaller immediate rewards and larger delayed rewards. We utilized the approach used by Kirby et al. (1999) to estimate hyperbolic temporal discounting functions from the MCQ. The pattern of responding allows for calculating the temporal discounting function, known as the k value, at three levels of magnitude (i.e., small \$25–\$35; medium: \$50–\$60; and large: \$75–\$85). Participants in our study made choices for hypothetical rewards, although responding on the DRD measures that offer actual money is closely correlated with the hypothetical ones (Johnson & Bickel, 2002; Lagorio & Madden, 2005; Madden, Begotka, Raiff, & Kastern, 2003). The DRD k values were positively and very highly correlated across small, medium, and large magnitudes ($r = 0.86–0.91$, $p < 0.0001$). Therefore, to avoid inflation of Type I error, we elected to use only the medium magnitude k value as a representative indicator of delay discounting.

Timeline Followback Alcohol Use Calendar (TLFB; Sobell & Sobell, 2000)—TLFB was used for descriptive purposes to assess frequency and quantity of alcohol consumption. Participants were interviewed about their alcohol consumption in the preceding 28 days and reported the number of alcoholic drinks consumed each day of the month.

Demographics

All participants completed a standard demographics questionnaire in which they answered questions about their sex, annual income, height, and weight. Body Mass Index (BMI) was calculated based on these data using the standard equation.

Procedure

The data for this study were collected during an in-person assessment for a parent intervention study. In order to be invited for the assessment, individuals had to indicate a desire to quit drinking during a preceding telephone interview. Therefore, all participants in this study were self-identified problem drinkers seeking treatment. During the screening session, participants completed a number of surveys on a computer, and underwent a clinical interview on their drinking patterns and volume. Participants were compensated \$45 for 3 hours of participation. At the conclusion of the session all participants were provided with a list of treatment referrals in the local community. All procedures were approved by the University of Georgia Institutional Review Board.

Data analysis

We examined the distributions of variables using histograms and log transformed the variables that exhibited negatively or positively skewed distributions (i.e., income, k values, quantity of alcoholic drinks consumed, EDE-Q subscales, and binge eating frequency). Subsequently, we conducted Pearson zero-order correlations between the variables of interest to examine the relationships between the variables. Hierarchical linear regressions were used to determine unique contributions of personality-based impulsivity (UPPS) variables and DRD (k value medium) on disordered eating symptoms as measured by the EDE-Q subscales and problematic alcohol use as measured by the AUDIT. The trait-based impulsivity variables selected for the regression models were based on the statistically significant correlations between these variables and the EDE-Q subscales. A logistic regression was used to determine the unique contributions of the trait-based impulsivity variables and DRD on the presence/absence of binge eating, as the sample did not consist exclusively of individuals who reported binge eating. We coded any participants who reported at least one instance of binge eating as “binge eating positive.” For all regression models, we entered sex and income in the first step as covariates because the DRD task consists of making choices for monetary rewards and sex was correlated with the outcome variables related to disordered eating symptoms as well as to Negative Urgency, Premeditation, and Sensation Seeking. We conducted collinearity diagnostics for the models that included both Negative and Positive Urgency as the correlation between the two constructs was 0.69. We examined the variance inflation factor and tolerance, and used Allison’s (1999) criteria to determine multicollinearity (i.e., a variable is multicollinear if its variance inflation factor is above 2.5 and tolerance is below 0.40).

Results

Bivariate correlations

Among the impulsivity constructs, DRD was only significantly correlated with Positive Urgency (see Table 2). DRD was also significantly negatively correlated with income, consistent with findings of other studies (Baker, Johnson, & Bickel, 2003; MacKillop & Kahler, 2009; MacKillop et al., 2010). Among the EDE-Q subscales, all were significantly positively correlated with Negative Urgency. Eating Concern was also significantly positively correlated with Positive Urgency while both Weight and Shape Concern subscales were significantly correlated with Premeditation. All EDE-Q subscales except for Eating Concern were significantly negatively correlated with DRD. Binge eating was significantly correlated with Negative and Positive Urgency. Finally, when considering drinking behavior, alcohol dependence scores were significantly associated with Negative and Positive Urgency as well as Sensation Seeking but were not associated with DRD. Alcohol dependence scores were also significantly positively related to Eating Concern subscale scores and binge eating.

Relative contributions of UPPS variables and DRD to disordered eating

We conducted four linear regressions with each of the EDE-Q subscales as an outcome variable (see Table 3). In the bivariate correlation analysis, we identified the trait-based personality variables that were significantly associated with each of the disordered eating symptoms and problematic drinking. First, sex and income were entered as covariates,

followed by the trait-based impulsivity variables that were significantly correlated with the outcome variable, and in the final step DRD was entered. In the model with Eating Concern as the outcome variable, both Negative and Positive Urgency were entered as predictors, as the diagnostics did not indicate that the two constructs were collinear ($VIF < 2.5$, Tolerance > 0.40). Both sex and DRD contributed significant unique variance to the prediction of Dietary Restraint. Sex and Positive Urgency contributed significant variance to the prediction of Eating Concerns. Sex, Negative Urgency, and DRD contributed significant variance to the prediction of both Weight and Shape Concerns.

In the logistic regression, we entered sex and income as covariates in the first block ($\chi^2 = 14.63$, $p < 0.05$, $df = 2$). When the covariates were included, 71% of the cases were accurately identified as binge eaters or nonbinge eaters. Female sex was the only significant predictor of being in the binge eating group (OR = 5.50, $p < 0.01$, 95% CI [2.23–13.58]), indicating that women were substantially more likely than men to be in the binge eating group. As Negative and Positive Urgency were significantly correlated with binge eating, we included these two variables in the second block. This addition significantly improved the model's ability to predict binge eaters (χ^2 step = 6.08, $p < 0.05$). The new model was able to correctly predict 82.2% of the sample as binge eaters or nonbinge eaters. Females were nearly five times more likely to be in the binge eating category than males (OR = 4.80, $p < 0.05$, 95% CI [1.77–13.00]) and 1-point increase on Negative Urgency increased the likelihood of being in the binge eating category (OR = 1.11, $p < 0.05$, 95% CI [1.00–1.23]). Scores on Positive Urgency did not contribute significant variance to the prediction of binge eater status when simultaneously entered with scores on Negative Urgency. Adding DRD did not significantly improve the model's ability to correctly identify individuals' binge eater status (χ^2 step = 3.39, $p = 0.06$).

Relative contributions of UPPS variables and DRD to problematic drinking

We conducted a hierarchical linear regression to determine the relative contributions of personality traits and DRD to problematic drinking (see Table 3). In the first step, we entered sex and income as covariates, in the second step we entered scores on Negative and Positive Urgency, Premeditation, and Sensation Seeking as these were the trait-based impulsivity variables significantly correlated with problematic drinking, and in the final step we entered DRD. When examining the collinearity diagnostics, we detected that Positive Urgency was collinear with another construct ($VIF = 2.56$, Tolerance = 0.39), thus it was removed from the model. Only Negative Urgency and Sensation Seeking contributed significant unique variance to the prediction of problematic alcohol use.

Discussion

Both disordered eating and problematic drinking have been conceptualized as impulsive behaviors characterized by under-control, but little work has been done examining how over-control might affect disordered eating. In this study, we sought to clarify the relationship of personality-based constructs of impulsivity and impulsive decision making on disordered eating patterns and problematic alcohol consumption. We examined a host of disordered eating symptoms (i.e., dietary restraint, concern about eating, weight, and shape, and binge

eating occurrence) in a sample of problematic alcohol drinkers. Overlapping and unique contributions of impulsivity traits and DRD to disordered eating symptoms and problematic alcohol use were measured.

With regard to disordered eating symptoms, this study generally supported the link between Negative Urgency and disordered eating. Individuals who were female and had high levels of Negative Urgency were more likely to binge eat and had higher Weight and Shape Concerns. However, Negative Urgency was not predictive of Dietary Restraint or Eating Concerns. Contrary to some of the previous research and the hypothesis, individuals who discounted more steeply (i.e., displayed higher impulsivity) were not more likely to engage in binge eating. However, individuals who discounted less steeply (i.e., displayed lower impulsivity) and who were female, had higher levels of Dietary Restraint. Lower discounting also predicted higher Weight and Shape Concerns above and beyond sex and Negative Urgency. The only significant predictors of Eating Concern were female sex and Positive Urgency, such that individuals who were female and displayed higher levels of Positive Urgency also displayed higher levels of Eating Concerns. As hypothesized and as found in previous studies, individuals with high levels of Negative Urgency and high Sensation Seeking had higher levels of problematic drinking patterns. However, contrary to other studies on delay discounting in alcohol drinkers, individuals who discounted future rewards more steeply did not have higher levels of problematic alcohol use, although given the sample of treatment-seeking heavy drinkers this may have been a function of restriction of range. Overall, it appears that Negative Urgency is a common underlying factor in eating and drinking behaviors characterized by under-control, namely binge eating and problematic drinking. DRD was a unique underlying factor for behaviors characterized by over-control, particularly dietary restraint.

The findings of Negative Urgency's influence on binge eating and problematic drinking are consistent with previous studies that found that individuals who have higher levels of Negative Urgency are more likely to engage in binge eating and have problematic drinking patterns (Anestis et al., 2007; Claes et al., 2005; Cyders & Smith, 2008; Fischer et al., 2004, 2011; Fischer & Smith, 2008; Fischer et al., 2008; Smith et al., 2007; Stojek & Fischer, 2013; Whiteside & Lynam, 2009). Additionally, the finding that Negative Urgency predicted Weight and Shape Concerns is somewhat corroborated by previous studies that found a relationship between Negative Urgency and Concern for Dieting on a Dietary Restraint scale (Mobbs et al., 2008). Apart from Negative Urgency, only Positive Urgency was predictive of Eating Concern in our sample, while other trait-based impulsivity constructs did not predict any eating-related variables. This is a unique finding as while both Negative and Positive Urgency have been associated with problematic drinking and pathological gambling, only Negative Urgency, but not Positive Urgency, has been predictive of disordered eating (Cyders et al., 2007; Fischer & Smith, 2008; Smith, Cyders, Fischer, & Simmons, 2004; Smith et al., 2007). The finding that Sensation Seeking predicted problematic alcohol use above and beyond Negative Urgency is consistent with other studies (Cyders et al., 2009; Fischer et al., 2008; Miller et al., 2003). While high levels of these traits are characterized by under-control (i.e., deficiencies in self-regulation), this study also found that over-control (i.e., excessive self-regulation) was associated with disordered eating behaviors. In contrast to personality-based studies, there have been far fewer studies examining delay discounting

and disordered eating symptoms. Some have found evidence for the relationship between delay discounting and Binge Eating Disorder (Davis et al., 2010) or weight status (Weller et al., 2008) while others have not (Nederkoorn, Smulders, Havermans, Roefs, & Jansen, 2006). In this study, there was no relationship between BMI and DRD, and discounting did not predict membership in the binge-eating group. Although one study found that discounting was related to disinhibition but not dietary restraint (Yeomans et al., 2008), in this study discounting was predictive of Dietary Restraint as well as Weight and Shape Concerns, and the relationship between discounting and these disordered eating symptoms was negative. A previous study comparing individuals with Anorexia Nervosa with normal controls found that individuals with Anorexia discount the future significantly less steeply than controls (Steinglass et al., 2012). As Anorexia is characterized by severe dietary restriction as a result of weight and shape concerns, the inverse relationship between disordered eating symptoms characterized by over-control and delay discounting appears to be in line with findings of Steinglass and colleagues. While there is little research on potentially pathologically low levels of impulsivity in the eating disorders field, there is some evidence for this notion in other maladaptive behaviors. For example, a study that examined obsessive-compulsive symptoms in a nonclinical sample, found that the UPPS model's lack of Premeditation negatively predicted checking and ordering behaviors thus indicating that being highly premeditative may be pathological (Zermatten & Van der Linden, 2008). Thus, it appears that more research is warranted into the influence of low impulsivity (i.e., over-control) into maladaptive behaviors such as disordered eating as it may be an important pathway that contributes to the development or maintenance of these symptoms.

It has been repeatedly demonstrated that acting rashly in the face of intense emotions is associated with maladaptive behaviors, such as binge eating or excessive alcohol consumption. This is consistent with the cognitive-behavioral model of binge eating which posits that individuals tend to engage in disordered eating behaviors when experiencing overwhelming negative emotions (Agras & Telch, 1998; Smyth et al., 2007). It is also consistent with the negative reinforcement model of drinking whereby individuals experience a momentary relief in negative affect as a result of drinking (Bandura, 1969; Cooper, 1994; Fischer et al., 2004). While Urgency is a tendency to act impulsively in emotional contexts, emotional contexts also impair the ability to control or suppress an automatic (or prepotent) response (Bechara & Van Der Linden, 2005; Schulz et al., 2007). Additionally, some studies have found that higher Urgency is associated with impaired ability to consider the future consequences of an action (Billieux, Gay, Rochat, & Van der Linden, 2010; Dolan, Bechara, & Nathan, 2008; Perales, Verdejo-Garcia, Moya, Lozano, & Perez-Garcia, 2009; Zermatten, Van der Linden, d'Acremont, Jermann, & Bechara, 2005). Thus, it appears that high Negative Urgency represents a combination of emotional and cognitive processes, which result in maladaptive behaviors, such as binge eating, weight and shape concerns, and problematic drinking.

While both Negative Urgency and delay discounting are associated with disordered eating, the findings of this study suggest that they also represent distinct constructs with unique contributions to disordered eating symptoms. Disordered eating symptoms characterized by over-control such as dietary restraint and concerns about weight or shape focus on valuing

long-term outcomes over the immediate pleasures of eating. Therefore, it is likely that individuals who discount future rewards at a steeper rate (i.e., have less self-control) will have lower levels of disordered eating symptoms such as dietary restraint, because the future consequences of their behavior are not as salient. Given that discounting was negatively associated with these disordered eating symptoms, individuals who have the ability to delay immediate gratification may be more likely to persist in dieting. As such, here may be an indirect path from discounting and binge eating. Research has demonstrated that dieting may be a precursor to disordered eating and binge eating (Presnell, Stice, & Tristan, 2008; Stice, Presnell, & Spangler, 2002). Thus, it may be that less steep discounting (i.e., more self-control) fosters dieting. Dietary restriction coupled with intense emotions may in turn lead to binge eating episodes. Thus, the relationship between DRD and objective binge eating may be mediated via dieting.

One limitation to our findings is that the sample consisted of individuals who were self-identified problem drinkers seeking treatment. As such, we did not assess for the influence of alcohol use disorders on nutrition and eating habits specifically. However, access to this unique sample allowed us to test the common and unique impulsivity constructs related to disordered eating and problematic drinking. Obese participants were not recruited specifically, and the mean BMI was 25.79 (i.e., in the overweight category) while the mode was 24 (i.e., in the normal weight category). Thus, there may not be a relationship between DRD and BMI present due to restriction of range. Additionally, our sample consists of both men and women, and previous studies have found an association between binge eating and DRD in women specifically (Davis et al., 2010; Weller et al., 2008). Thus, in a larger sample, it would be helpful to examine interactions between gender and the various impulsivity constructs in question.

As there is a dearth of studies on the relationship between delay discounting and disordered eating symptoms, there is a need to expand this literature to further clarify contributions of discounting. It would be important to replicate these findings in a clinical sample of individuals with eating disorders, as well as in a sample of healthy individuals without problematic drinking patterns. Additionally, it would be informative to examine the potential mediational pathway between discounting and binge eating via dieting. Finally, it would be helpful to conduct an experimental study of individuals who report binge eating symptoms to examine whether inducing an intense emotional state alters their discounting rates to steeper ones. It will also be helpful to collect samples with enough power to test sex differences.

Overall, this is the first study that we know of to examine the relative contributions of impulsivity traits and an index of impulsive decision making on disordered eating symptoms. It appears that both bear on disordered eating symptoms and have unique pathways through which they influence those symptoms. This study constitutes one step toward disentangling the contributions of various impulsivity constructs on dysregulated eating, but clearly more studies are needed to clarify these relationships.

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Table 1

Descriptive statistics and frequencies.

Characteristic	Mean (SD) or %
Age M(<i>SD</i>)	42 (11)
BMI M(<i>SD</i>)	25.79 (9.09)
Sex (% male)	63%
White	75%
Black	21%
American Indian	2%
Multiracial	2%
Binge eating	30%

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Table 2

Bivariate correlations.

	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 AUDIT	22.78 (7.16)														
2 Drinks per week	52.83 (41.18)	0.44 **													
3 BMI	25.79 (9.09)	-0.10	0.05												
4 Dietary restraint	1.26 (1.58)	0.10	-0.21 *	-0.09											
5 Eating concern	0.70 (1.07)	0.22*	-0.09	0.02	0.58 **										
6 Weight concern	1.73 (1.72)	0.11	-0.23 *	-0.06	0.68 **	0.65 **									
7 Shape concern	2.09 (1.73)	0.16	-0.20 *	-0.05	0.58 **	0.89 **	0.53 **								
8 Binge eating	2.42 (6.24)	0.24 *	-0.08	-0.18	0.41 **	0.68 **	0.59 **	0.53 **							
9 Delay discounting	0.10 (0.08)	0.11	0.08	0.06	-0.22 *	0.05	-0.20 *	-0.25 **	-0.05						
10 Negative urgency	32.92 (7.21)	0.51 **	0.01	-0.09	0.21 *	0.32 **	0.30 *	0.32 **	0.35 *	0.01					
11 Positive urgency	32.16 (8.72)	0.36 **	0.11	0.06	0.12	0.35 **	0.19 [†]	0.16	0.27 **	0.20 *	0.69 **				
12 Lack of premeditation	22.79 (5.78)	0.11	-0.04	-0.12	0.11	0.02	0.22 *	0.21 *	0.14	-0.16	0.33 **	0.31 **			
13 Sensation seeking	32.29 (7.75)	0.23 *	0.17 [†]	-0.04	-0.05	0.02	-0.09	-0.08	0.12	0.10	0.09	0.33 **	0.16 [†]		
14 Perseverance	19.59 (5.23)	0.03	-0.03	-0.01	-0.04	-0.08	0.11	0.12	-0.02	0.03	0.32 **	0.30 **	0.52 **	0.19 [†]	
15 Female sex	37%	0.12	-0.17	-0.08	0.33 **	0.22 *	0.43 **	0.42 **	0.33 **	-0.04	0.23 *	-0.01	0.24 *	0.22 *	0.13

Note: BMI, Body Mass Index; AUDIT, Alcohol Use Disorders Identification Test; Female sex coded as 1; Male sex coded as 0. Correlations at $p < 0.10$ are noted in bold font.

[†] $p < 0.10$.

* $p < 0.05$.

** $p < 0.01$.

Table 3
Hierarchical linear regressions of impulsivity traits and DRD in relation to eating concerns and alcohol misuse.

	Restraint			Eating concern			Weight concern			Shape concern			AUDIT		
	R	R ²	β	R	R ²	β	R	R ²	β	R	R ²	β	R	R ²	β
Step 1	0.34**	0.12**		0.27*	0.07*		0.42**	0.18**		0.44**	0.19**		0.21	0.05	
Sex		0.32**	0.21*			0.42**						0.43**			0.09
Income		0.14	-0.15			0.06						0.14			-0.18 [†]
Step 2	0.38**	0.14**		0.42**	0.18**		0.48**	0.23**		0.51**	0.26**		0.57**	0.32**	
Sex		0.28**	0.20*			0.35**						0.36**			0.03
Income		0.16 [†]	-0.07			0.08						0.15 [†]			-0.13
Negative urgency		0.17 [†]	0.06			0.21*						0.25**			0.48**
Positive urgency			0.29*												
Premeditation						0.06						0.04			
Sensation seeking															0.20*
Step 3	0.43**	0.18**		0.43**	0.19**		0.52**	0.27**		0.55**	0.30**		0.57**	0.33**	
Sex		0.27**	0.20*			0.35**						0.35**			0.03
Income		0.07	-0.11			0.01						0.08			-0.11
Negative urgency		0.16 [†]	0.04			0.22*						0.26**			0.48**
Positive urgency			0.21*												
Premeditation						0.03						0.01			0.19*
Sensation seeking															0.07
Delay discounting			-0.22*			-0.20*						-0.22*			

[†] $p < 0.10$.

* $p < 0.05$.

** $p < 0.01$.