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Delay Discounting of Losses in Alcohol Use Disorders and Antisocial Psychopathology: Effects of a Working Memory Load

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Background: Alcohol use disorders (AUDs) are associated with increased discounting of delayed rewards and reduced executive working memory (eWM) capacity. This association is amplified when comorbid with antisocial psychopathology (AP). Furthermore, recent studies suggest that reduced WM capacity is associated with disinhibited decisions reflected by increased impulsive decision making on the delay discounting of rewards task. While discounting of delayed rewards is well studied, the discounting of delayed losses has received significantly less experimental attention.

Methods: The current study investigated (i) the rate of discounting of delayed losses in individuals with AUD only (n = 61), AUD with comorbid AP (n = 79) and healthy controls (n = 64); (ii) the relationship between eWM capacity and discounting of delayed losses; and (iii) the effect of a WM load on discounting of delayed losses. Discounting performance was assessed using a computerized discounting of delayed losses task.

Results: Results showed that the AUD-only and AUD-AP groups had higher rates of discounting of delayed losses and lower eWM capacity compared to the control groups. Lower individual eWM capacity was associated with increased discounting of delayed losses. However, WM load did not increase discounting rates overall.

Conclusions: These results support the hypothesis that greater discounting of delayed losses is associated with AUD and comorbid AP problems and lower individual eWM capacity.

Key Words: Alcohol Use Disorders, Antisocial Psychopathology, Delay Discounting Losses, Working Memory Capacity.

ALCOHOL USE DISORDERS (AUDs) are among the most highly comorbid conditions with antisocial psychopathology (AP). Results from the National Epidemiological Survey on Alcohol and Related Conditions suggest individuals with AP are 7 to 8 times more likely to meet criteria for an AUD, and 15 to 17 times more likely to meet criteria for a substance use disorder (Trull et al., 2010). AUDs are associated with poor self-regulation characterized by increased impulsive decision making, such as increased discounting of delayed rewards (Bobova et al., 2009; Finn, 2002; Finn et al., 2015; Petry, 2001), and reduced executive working memory (eWM) capacity (Bobova et al., 2009; Finn, 2002; Finn and Hall, 2004; Finn et al., 2015; Fridberg et al., 2013). This association is amplified when comorbid with other externalizing psychopathology, such as AP (Bobova et al., 2009; Finn et al., 2002, 2015; Moody et al., 2016; Petry, 2002). However, while the discounting of delayed rewards is well studied in populations with AUDs and comorbid psychopathology, the discounting of delayed losses in these populations has received much less experimental attention.

Previous work investigating impulsive decision making in externalizing populations suggests that individuals with AUDs neglect future negative consequences to a greater extent compared to controls (Dom et al., 2006; Endres et al., 2011; Kim et al., 2006; Mazas et al., 2000). Furthermore, in a study of drinking decisions in those with AUDs, high levels of comorbid AP symptoms were associated with higher rates of decisions to attend riskier drinking events (i.e., events associated with increased probability of negative outcomes), suggesting a greater insensitivity to aversive consequences compared to healthy controls (Finn et al., 2017). Studying discounting of delayed losses in individuals with AUDs and comorbid AP is particularly important given that, in cases of prolonged or habitual alcohol abuse, individuals' choices to continue drinking reflect, in part, a preference to avoid smaller immediate negative events (such as withdrawal, stress) in favor of long-term (delayed) negative consequences, such as serious health problems, divorce, and legal consequences (Madden and Bickel, 2010).

Discounting of Delayed Losses

Discounting delayed consequences (both in the context of rewards and losses) refers to a reduction in the subjective

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value of consequences as a function of the delay to their receipt (Green et al., 1997; Mazur, 1987). That is, a consequence available immediately will have more impact on a decision than a delayed consequence (Myerson and Green, 1995). In the context of rewards, increased discounting involves choosing the smaller more immediate outcome, compared to the larger delayed outcome, and is reflective of decision biases that contribute to more disadvantageous, disinhibited behavior (Bobova et al., 2009; Cantrell et al., 2008; Finn et al., 2015). This kind of decision is thought to reflect an engagement of the approach motivation system (Madden and Bickel, 2010). However, the discounting of delayed losses task differs from discounting delayed rewards in an important way, possibly reflecting an avoidance rather than appetitive approach. This is displayed by a recent study from Salters-Pedneault and Diller (2013), in which participants with higher self-reported anxiety and experiential avoidance were more likely to choose 3 shocks delivered after a delay over a single electric shock delivered immediately. Thus, increased discounting of delayed losses involves choosing the larger, delayed, aversive outcome over the smaller, more immediate aversive outcome, possibly reflecting a disadvantageous avoidance decision rather than an impulsive approach decision.

The extant literature is limited and conflicting with respect to whether discounting delayed losses is related to alcohol or other substance use disorders. Results from Takahashi and colleagues (2009) suggest a significant correlation between alcohol consumption and delayed losses, but this study did not assess for alcohol-related problems and only 1 of the 33 participants endorsed consuming alcohol daily. In another study from Odum and colleagues (2002), current-, never-, and ex-smokers were asked to indicate a preference for immediate versus delayed hypothetical health gains and health losses. They found increased discounting for health gains and losses in current smokers compared to never smokers, while the performance of ex-smokers was between that of never smokers and current smokers, suggesting individuals with lifetime substance use disorders discount future negative outcomes at higher rates compared to controls (Odum et al., 2002). However, in a recent study from Myerson and colleagues (2015), alcohol-dependent African American individuals discounted delayed rewards, but not losses, more steeply than matched controls, an effect largely driven by the male cases. Given the heterogeneity of these findings, the literature would benefit from additional research examining the mechanisms of discounting of delayed losses in AUDs and AP populations.

Working Memory and Decision Making

One mechanism important to decision making is eWM capacity. eWM capacity is a limited capacity system reflecting the capacity for resistance to distraction, maintenance of information, mental manipulation, and attentional control (Engle et al., 1999; Unsworth and Engle, 2007), processes that are thought to play a principal role in self-regulation and adaptive decision making (Barkley, 2001; Barkley et al., 2001; Barrett et al., 2004; Endres et al., 2011, 2014; Finn, 2002; Finn et al., 2015). Impaired eWM capacity is thought to contribute to disadvantageous decision making by interfering with an individual's ability to optimize goal-directed behavior while keeping less salient, delayed information in mind (Bobova et al., 2009; Finn and Hall, 2004; Hinson et al., 2003). Lower eWM capacity is associated with increased disadvantageous decision making on several different decision-making paradigms, such as the delay discounting of rewards (Finn et al., 2015), the Iowa Gambling Task (Bechara and Martin, 2004; Fridberg et al., 2013), and the Go/No-Go task (Endres et al., 2011; Finn et al., 2002). AUDs and other externalizing behaviors, such as conduct and antisocial problems, are also associated with reduced eWM capacity (Bechara and Martin, 2004; Bickel et al., 2007; Bobova et al., 2009; Endres et al., 2011, 2014; Finn et al., 2015; Fridberg et al., 2013). Furthermore, compromising eWM capacity via a working memory (WM) load increases impulsive decision making on a discounting of delayed rewards task in healthy adults (Hinson et al., 2002, 2003; Hofmann et al., 2009; Ward and Mann, 2000) and young adults varying in degree of externalizing psychopathology (Finn et al., 2015). Based on this body of work, eWM may also contribute to individual differences in discounting future losses. Furthermore, the differences in motivation for discounting rewards and losses make using a delay discounting of losses task an interesting probe for the mechanisms associated with the effects of a WM load.

Current Study

The primary aim of this study was to extend the study of discounting future consequences and comorbid externalizing behaviors to include discounting of future losses and to investigate the role of eWM in making decisions about losses. Participants were recruited for 1 of 3 groups: an AUD with AP group (AUD-AP), an AUD-only group (AUD), and controls without AUDs (DSM-5 Alcohol Use Disorder; American Psychiatric Association, 2013) or other externalizing disorders. We hypothesized (i) that AUD-AP will be associated with greater rates of discounting delayed losses compared to those with AUDs without comorbid AP and controls; (ii) lower eWM capacity will be associated with higher rates of discounting delayed losses; and (iii) a WM load will be associated with increased discounting of delayed losses, independent of group membership.

MATERIALS AND METHODS

Participants

Sample Characteristics. The sample consisted of 204 young adults (M age = 21.4, SD = 2.65) in 3 groups: individuals with a current AUD and comorbid AP (AUD-AP; n = 79; 51% female), individuals with a current AUD and no AP (AUD; n = 61; 46% female), and healthy controls (n = 64; 56% female). The sample was 65.9% European American, 13.8% Asian, 8.7% African American, 7.2% Hispanic/Latino, and 4.3% endorsing multiple ethnicities. Of the total sample, 78.3% were current undergraduate students at a large Midwestern university. Sample characteristics are listed in Table 1.

Recruitment. Participants were recruited from the community using flyers posted at various locations in the community and advertisements in local newspapers. Following Widom's (1977) approach, these advertisements were designed to recruit individuals varying in terms of alcohol use, as well as level of impulsive, disinhibited traits. The range of advertisements included those asking for "daring, rebellious, defiant individuals," "carefree, adventurous individuals who have led exciting and impulsive lives," "impulsive individuals," "quiet, reflective, and introspective persons," "persons interested in psychological research," "heavy drinkers wanted for psychological research," and "social drinkers wanted for psychological research." This approach has been effective in eliciting responses from healthy controls as well as individual with AUDs, antisocial personality, and generally disinhibited participants (Bogg and Finn, 2009; Finn et al., 2015).

Inclusion Criteria. Advertisement respondents were administered a phone interview to determine if they met study inclusion criteria. Respondents meeting study inclusion criteria were between 18 and 30 years old, able to read and speak English, had at least a 6th-grade education, had consumed alcohol on at least 1 occasion in their life, did not report any severe head injuries (i.e., concussions or traumatic head injuries), and no history of severe psychological problems (schizophrenia or any psychosis unrelated to substance use). Participants meeting these criteria were asked a series of questions assessing current and lifetime alcohol and drug use, childhood conduct disorder, and adult antisocial personality disorder. Those meeting study inclusion criteria were recruited; however, only those meeting group inclusion criteria (i.e., AUD-AP, AUD, or control) after the diagnostic interview in the first session were permitted to continue participation. Group inclusion was determined using DSM-5 (American Psychiatric Association, 2013) criteria for Alcohol Use Disorder and Antisocial Personality Disorder.

Table 1. Demographic Characteristics and Lifetime Problem Counts by Condition

Measure/variable	Control	AUD	AUD-AP
n (male/female)	64 (28/36)	61 (33/28)	79 (39/40)
Age, *M* (SD)	20.8 (2.3)	21.4 (2.3)	22.0 (3.1)
Years of education, *M* (SD)	14.8 (2.0)	15.0 (1.6)	14.0 (2.0)
Current student, %	94.1	79.1	38.9
OWS, *M* (SD)	52.0 (14.0)	51.7 (15.2)	40.1 (11.4)
$\log_{10} k$, *M* (SD)	−2.63 (1.18)	−2.11 (1.15)	−1.84 (1.23)
Mean (SD) lifetime problems with			
alcohol	2.29 (3.4)	25.23 (11.7)	35.1 (13.6)
Conduct disorder problems	2.62 (2.5)	7.79 (3.6)	15.7 (3.3)
Adult antisocial problems	1.12 (1.1)	4.72 (2.8)	14.6 (6.7)

OWS, operation word span. Lifetime problems were summed positive responses to questions from the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA; Bucholz et al., 1994) in the sections for specific disorders (and types of substances for substance use disorders). Conduct disorder problems were for problems/behaviors occurring in childhood or adolescence. Adult antisocial problems were positive responses to questions for the antisocial personality disorder section of the SSAGA.

Participants were required to abstain from using alcohol and other drugs for 12 hours, to have a meal within 3 hours of the session, and to have at least 6 hours of sleep the night prior. Participants were also given a breath alcohol test (AlcoSensor IV; Intoximeters Inc., St. Louis, MO) to ensure a breath alcohol level of 0.0%. Sessions were rescheduled if these criteria were not met.

Measures

Diagnostic Ascertainment. AUD and AP symptoms were assessed with the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA) provided by the Collaborative Study on the Genetics of Alcoholism group. The SSAGA shows good test–retest reliability, inter-rater reliability (κ = 0.70 to 0.90; Bucholz et al., 1994, 1995), and good construct validity when compared with other semi-structured interviews (κ = 0.60 to 0.70; Hesselbrock et al., 1999). Participants in the present study were placed in 1 of 3 groups based on the SSAGA: no current or past diagnosis, current AUD with no AP, and current AUD with AP.

Executive Working Memory Capacity. eWM capacity was assessed using a computerized version of the Operation Word Span task (OWS; Conway and Engle, 1994), a measure of eWM that taps attention switching in dual task contexts involving the simultaneous competition for attentional resources and the maintenance of activation of mental representations. The OWS requires solving a simple mathematical operation while remembering a word (ex: 8/4 + 6 = 8 BED). The participant is instructed to read the math operation aloud, to indicate whether the provided solution is correct ("yes" or "no"), and to say the word. After a series of operation-word pairs (block length varying from 2 to 6 pairs), the participant recalls the words that followed each operation in the exact order they were presented. Performance is quantified as the total number of correctly recalled words.

Delay Discounting Task. The delay discounting task was developed in E-Prime 2.0 (Psychology Software Tools, Inc. 2012) by the first author and administered via desktop computer. Participants were asked to make a series of choices between losing a specific amount of money immediately or losing $50 after 1 of 6 time delay periods (i.e., 1 week, 2 weeks, 1 month, 3 months, 6 months, 1 year). Prior to the task, participants were informed that all choices were hypothetical and that they would not be losing any of their experiment compensation. Immediate monetary amounts varied from $2.50 to $47.50 in $2.50 increments. Participants completed 6 randomly ordered delay blocks, 1 for each delay period. Within each block, participants were presented with ascending and descending value trials. On the ascending trials, the immediate loss value increased from $2.50 to a maximum of $47.50 in $2.50 increments and stopped when the participant switched from the immediate to the delayed option. Similarly, descending sequences stopped when the participant switched from the delayed to the immediate option. Preference for the immediate, smaller losses results in higher switch points on both the ascending and descending trials and is viewed as more advantageous. Likewise, preference for the delayed, larger losses results in smaller switch points on both the ascending and descending trials and is viewed as less advantageous.

Working Memory Load. Participants were randomly assigned to either a "WM load" or a "no-load" condition (between-subjects design). A no-load trial proceeds as follows: a choice option is displayed for 1 second, a fixation cross is presented for 10 seconds, a choice prompt with "$ NOW" and "$ LATER" is presented, and a decision is recorded. In the WM load condition, a 3-digit number is presented after the choice option, the subject counts backwards by 3s for 10 seconds, a choice prompt with "$ NOW" and "$ LATER" is presented, a choice is recorded, then a prompt to remember the 3-digit number presented earlier in the trial.

Estimation of Discounting Rate. Discounting rate was estimated using a single-parameter hyperbolic function (Mazur, 1987) represented by the following equation:

$$V_p = \frac{V}{1 + k * \mathrm{d}t}.$$

In this equation, V_p represents the present (discounted) value (the average of the switch point for ascending and descending trials at a particular delay), the constant V was the amount of the delayed loss ($50), d$t$ was the length of the time the loss is delayed in days, and k is the discounting rate. The dependent variable used in these analyses is the log10-transformed k value to address skewness in the k distribution. This hyperbolic model has been found to account for significantly more variance than exponential function models in several studies (Bickel and Marsch, 2001; Kirby, 1997; Kirby and Herrnstein, 1995). It suggests that when the larger loss is more temporally distant, choices for the delayed option ($50 after some delay) can be described as disadvantageous and inconsistent with long-term goals. Likewise, choices for the smaller, immediate losses can be described as more advantageous. Smaller (more negative) *logk* values reflect less discounting, while larger (more positive) values indicate greater discounting.

Data Analysis

R version 3.3.1 (R Core Team, 2016) was used for these analyses. Univariate analysis of variance (ANOVA) with the factors group (3: Control, AUD, AUD + AP) and WM load (2: No Load, Load) was used to examine the main effects of group and WM load to test the hypotheses regarding the effect of group and WM load manipulation on discounting rate ($\log_{10}$-transformed k value). Planned comparisons were used to test the hypotheses that the AUD-AP group would have significantly higher delay discounting rates and lower measures of eWM capacity than both controls and AUD groups. A linear regression analysis was used to investigate how eWM capacity predicted discounting rate. One-way ANOVA was used to examine the relationship between group and eWM capacity. Because eWM capacity scores differed between groups (the controls having higher scores) and cognitive capacity is associated with performance on delay discounting of rewards task (Finn et al., 2015), analysis of covariance (ANCOVA) was conducted to examine potential influence of this factor.

RESULTS

Main Effects

Figure 1 displays the mean discounting rates separated by group. As hypothesized, an ANOVA revealed a main effect of group on discounting rate, $F(2, 201) = 4.26$, $p < 0.05$. Planned comparisons revealed that the control group had significantly lower discounting rates ($M = -2.58$, SD = 1.22) compared to both AUD-only ($M = -2.08$, SD = 1.14; $p < 0.05$; d [95% CI] = 0.45 [0.09, 0.8]) and AUD-AP groups ($M = -1.88$, SD = 1.22; $p < 0.001$; d [95% CI] = 0.65 [0.31, 0.99]), suggesting those in both AUD groups chose the delayed option (more disadvantageous) more frequently than the control group. When race, sex, age, and current student status were included as covariates, the main effect of group remained, $F(2, 201) = 7.63$, $p < 0.001$. No other covariate reached statistical significance. However, discounting rates for the AUD-AP group did not differ significantly from the AUD-only group ($p = 0.41$). Our analyses failed to reveal a main effect of WM load condition ($p = 0.99$) nor an interaction between group and WM load condition ($p = 0.87$).

Regression analysis revealed a significant main effect of eWM capacity on discounting rate, $F(1, 203) = 10.80$, $\beta = -0.019$, $p < 0.01$, suggesting that reduced eWM capacity is associated with increased discounting of delayed losses (more disadvantageous decisions). Furthermore, a 1-way ANOVA revealed a significant main effect of group on eWM capacity, $F(2, 201) = 18.61$, $p < 0.001$. A Tukey post hoc test revealed the AUD-AP group to have significantly lower eWM capacity scores ($M = 40.05$, SD = 11.43) compared to AUD ($M = 51.74$, SD = 15.24, $p < 0.001$, d [95% CI] = −0.88 [−1.24, −0.53]) and controls ($M = 51.97$, SD = 13.98, $p < 0.001$, d [95% CI] = −0.94 [−1.29, −0.59]). The AUD-only group and controls did not differ significantly on eWM capacity scores. Because eWM capacity scores differed between groups and cognitive capacity is associated with performance on delay discounting of rewards task (Finn et al., 2015), an ANCOVA was conducted to examine potential influence of this factor. Results revealed a significant effect of group on discounting rate, $F(2, 201) = 4.91$, $p < 0.01$, after controlling for the effect of eWM. The covariate, eWM, was also significantly associated with discounting rate, $F(1, 202) = 5.15$, $p < 0.05$.

DISCUSSION

The central goal of this study was to extend our understanding of the relationship between externalizing psychopathology and delayed discounting of losses and to investigate the role of eWM in making decisions about delayed losses. This study tested the following hypotheses: (i) that individuals with AUDs and comorbid antisocial problems would be associated with greater rates of discounting delayed losses; (ii) that reduced eWM capacity would be associated with increased rates of discounting delayed losses; and (iii) compromising eWM capacity via a WM load would be associated with increased rates of discounting delayed losses independent of group. As hypothesized, individuals with AUDs and comorbid AP showed increased discounting rates compared to the control group, but not individuals with AUD. Additionally, AUD-AP individuals were associated with reduced measures of eWM capacity compared to healthy controls and the AUD group, although the AUD group did not differ from controls. Furthermore, lower measures of eWM capacity were also associated with increased discounting rates. However, contrary to our hypothesis, WM load did not increase discounting rates.

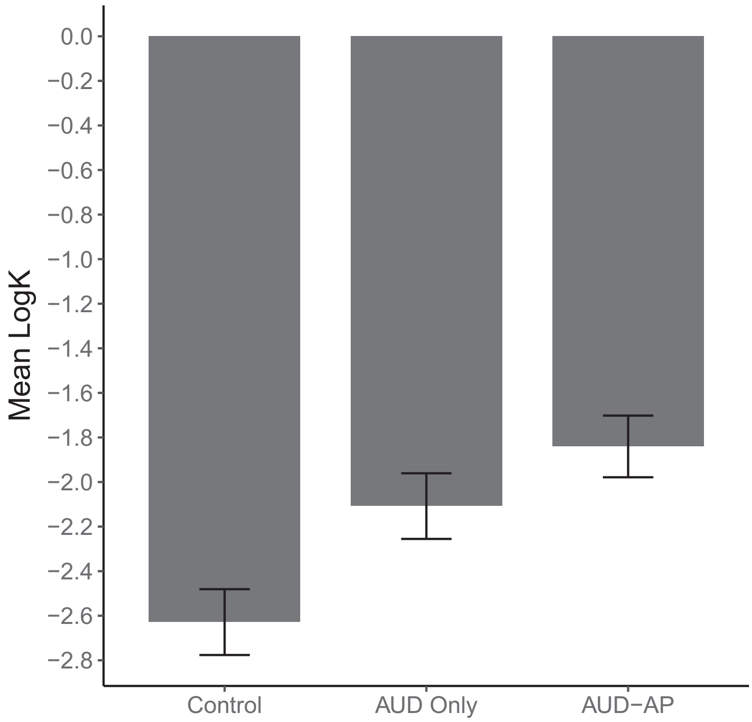

Fig. 1. Mean $\log_{10}(k)$ by group collapsed across task condition. Error bars represent 95% confidence interval for the group mean.

The finding that individuals with AUD and comorbid AP have increased discounting of delayed losses is consistent with previous work showing increased discounting of delayed losses in individuals with alcohol (Takahashi et al., 2009) and other substance use disorders (Odum et al., 2002) and extends this work by investigating discounting of delayed losses in a sample with comorbid externalizing problems (i.e., AUDs with AP). Additionally, our results add to the growing literature showing that individuals with comorbid AUDs and other externalizing psychopathology discount delayed consequences more steeply than healthy controls (Dom et al., 2006; Mazas et al., 2000). This form of decision bias may contribute to the development and maintenance of disinhibited behaviors among those with AUD and AP.

Although questions remain about the mechanism by which individuals with AUDs and comorbid AP present with increased discounting rates, results suggest that eWM capacity could play a role in the context of losses. The significant association between reduced eWM capacity and higher discounting rates supports previous work suggesting eWM capacity is important for behavioral regulation and modulating disadvantageous, impulsive tendencies. This is consistent with data suggesting reduced eWM capacity is associated with increased discounting of delayed rewards (Bobova et al., 2009; Finn et al., 2015), as well as less advantageous decisions on the Iowa Gambling Task (Bechara and Martin, 2004; Fridberg et al., 2013).

Although we found a relationship between eWM capacity and discounting of delayed losses, the results did not support our hypothesis that compromising eWM capacity would result in higher discounting rates. This result was surprising due to the number of studies reporting that WM load increases impulsive, disinhibited decision making on a number of different decision tasks, such as the Iowa Gambling Task (Fridberg et al., 2013), the incentivized Go/No-Go paradigm (Endres et al., 2014), and a delay discounting of rewards task (Finn et al., 2015; Hinson et al., 2002, 2003). One explanation for the difference between discounting delayed rewards and losses is that a decision between 2 rewards is competing approach decisions, whereas a decision between 2 losses reflects competing avoidance decisions. Optimal decision making in the context of rewards requires shifting ones' attention from the more salient, immediate disadvantageous option to the more distal, less salient advantageous option. However, a decision between 2 negative outcomes, such as in the current task, requires choosing the more salient, immediate, advantageous option. This kind of avoidance–avoidance decision may not require the same shifting of one's attention to evaluate the optimal choice. Therefore, compromising eWM capacity may not increase discounting of losses in the same way.

Limitations and Future Directions

This study was not without limitations. First, our sample was small compared to studies investigating the effects of a WM load on discounting delayed rewards (Finn et al., 2015). Additionally, our sample consisted of mostly young, Caucasian undergraduate students who volunteered to participate and thus limits the generalizability of our results. Additionally, it is possible that the person responding to the advertisement will act in such a way as to be consistent with the advertisement in order to gain entry into the study. Second, a potential criticism of our methodology is that choices on our delay discounting task were between hypothetical, rather than actual, losses. Its possible choices between actual losses would yield different results; however, numerous studies using hypothetical outcomes have found similar hyperbolic functions to studies using actual money (Kirby and Herrnstein, 1995; Kirby and Maraković, 1995). Third, 58 participants (No Load = 30; Load = 28) did not display discounting on any delay blocks and an additional 43 (No Load = 11; Load = 32) displayed interdelay switch points that differed by more than 3 trials (>$7.50) at 3 or more delays. Conclusions from this study may have differed had stricter exclusionary criterion been employed. Due to the effort involved in exhibiting performance akin to never discounting (i.e., participants who choose the immediate option on every potential trial on both ascending trials and descending trials), we conclude that these data reflect legitimate decision making. In fact, this pattern of responding is the most optimal, insofar as it reflects high levels of self-control. Additionally, we have previously shown that those with externalizing disorders are more inconsistent in their switch points on a reward delay discounting task, and that a WM load increases inconsistency (Dai et al., 2016). For the above reasons, we view these data as representing a legitimate decision-making pattern and have thus retained these observations in our final sample.

CONCLUSION

In summary, this study makes 2 important contributions to the literature on the association between externalizing behaviors, eWM capacity, and disadvantageous decision making. First, the results show that individuals with AUDs with and without comorbid antisocial problems discount delayed negative consequences at higher rates compared to controls. This pattern of disadvantageous decision making, whereby larger future negative consequences are discounted when compared to smaller, immediate negative consequences, represents experimentally the process by which individuals with high levels of externalizing problems continue to engage in disinhibited behaviors that may have long-term negative consequences. Second, the results demonstrate an association between reduced eWM capacity and rates of discounting delayed losses. This result suggests that eWM capacity plays an important role in assessing long-term negative consequences. This study did not compare rates of discounting losses and rewards in individuals with increased levels of externalizing psychopathology. Previous work suggests negative outcomes are discounted in a similar fashion to rewards in healthy controls (Estle et al., 2006; Murphy et al., 2011); however, individuals with substance use disorders were shown to discount future health gains at slightly higher rates compared to future health losses (Odum et al., 2002). Future work should focus on investigating these differences in a population with high levels of externalizing problems.

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