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Influence of Antisocial and Psychopathic Traits on Decision-Making Biases in Alcoholics

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Abstract

Background—Although decision-making processes have become a principal target of study among addiction researchers, few studies have specifically examined decision making among individuals with alcohol dependence (AD) and findings to date are mixed. The present study examined the relationship between AD and decision-making, and tested whether different facets of antisocial and psychopathic traits explain this association.

Methods—Participants were men with AD ($n = 22$), AD and comorbid antisocial personality disorder (AD+ASPD; $n = 17$), or a history of recreational alcohol use, but no current or lifetime symptoms of a substance use disorder, conduct disorder, or ASPD ($n = 21$). Decision making was tested using the Iowa Gambling Task (IGT).

Results—Across groups, participants reported similar levels of awareness of the contingencies of the task, but the AD groups with and without ASPD had poorer IGT performance compared to controls ($p < .05$). A block-by-block analysis revealed that while AD had slow, but steady improvement across the task, AD+ASPD exhibited initial improvement followed by a significant decrease in advantageous decision-making during the last 20 trials ($p < .05$). This was further confirmed via evidence that impulsive/antisocial personality traits, but not psychopathic traits, mediated poor IGT performance beyond ASPD diagnosis.

Conclusions—AD males favored risky choices regardless of whether they met criteria for ASPD. However, decision making deficits were more pronounced among those with ASPD, and personality traits characterized by impulsive and antisocial tendencies mediated the relationship between AD and decision-making.

Keywords

Alcohol Dependence; Antisocial Personality Disorder; Psychopathy; Decision-Making

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No participants in this study, including those in the control group, were recruited from universities or community colleges. Differences in education (years) resulted from control participants completing/partially completing formal vocational training programs.

Introduction

Impairments in decision making processes have become a principal target of study among addiction researchers. This emphasis is clinically intuitive given that a cardinal diagnostic feature of substance abuse and dependence is that the reinforcing aspects of alcohol and other drug use appreciably outweigh the negative consequences (e.g., health, occupational, social). A number of laboratory studies have used the Iowa Gambling Task (IGT; Bechara et al., 1994), a computerized behavioral task that requires respondents to simultaneously weigh the costs and benefits of their decisions, to evaluate decision making among individuals with substance use disorders (SUD). Studies typically report impaired performance among individuals with SUD, with response patterns suggesting a delay in their shift from disadvantageous to advantageous decisions rather than an inability to learn from contingencies (e.g., Verdejo-García et al., 2007). However, overall differences in IGT performance between individuals with SUD and non-SUD controls are generally reported to be modest, with considerable variability in task performance among individuals with SUD (e.g., Bechara & Damasio, 2002; Bechara et al., 2002).

Initial efforts to explain the observed heterogeneity in IGT performance among individuals with SUD suggest that antisocial traits may be important for identifying which substance abusers are most prone to disadvantageous decision-making. Preliminary support for this hypothesis was reported by Mazas and colleagues (2000) who examined IGT performance in a 2×2 design, crossing early-onset alcohol dependence (AD) and antisocial personality disorder (ASPD). Results indicated that AD was associated with a disadvantageous decision-making bias, such that individuals with AD favored choices with greater immediate rewards but larger future negative consequences. However, AD was no longer significantly related to impaired performance when ASPD was included in analyses. Subsequent studies similarly found that alcoholics and other drug abusers with antisocial traits show impairment on laboratory-based decision-making tasks that is either not present (e.g., Finn et al., 2002) or less pronounced (e.g., Dom et al., 2006; Petry, 2002) in their non-antisocial counterparts.

Despite initial evidence that antisocial traits account for the decision-making deficits observed among individuals with SUD, this hypothesis has not been extensively studied and recent studies have not found this effect. For example, one study found that antisocial traits in males with a history of SUD were associated with more advantageous decision making on the IGT (Vassileva et al., 2007), while others have reported that antisocial traits do not account for the relationship between AD and disadvantageous IGT performance (Kim et al., 2006; Fein et al., 2004). Given the importance of determining whether impaired decision making is a mechanism by which certain individuals are at increased risk developing and continuing maladaptive substance use, additional research is necessary to better characterize the role of antisocial traits in explaining IGT performance among individuals with SUD.

One possible reason for discrepant findings is that the taxonomic schemes and assessment instruments used to characterize antisocial behavior vary considerably. Psychiatric nomenclature for antisocial pathology has spanned sociopathy (Tyrer & Alexander, 1979), dissocial personality disorder (World Health Organization, 1990), psychopathy (Cleckley, 1941; Hare, 1998), and ASPD (APA, 1994). Among studies of decision making among individuals with SUD, ASPD and psychopathy have been the most widely used classification systems. ASPD is a behaviorally-focused construct characterized by an inability to adhere to accepted societal norms and is associated with criminality and persistent impulsive behavior patterns (APA, 1994). In contrast, psychopathy is conceptualized as a personality trait that encompasses interpersonal-emotional features, such as a lack of remorse and empathy, egocentricity, and manipulative and callous behavior. While the behaviorally-oriented criteria used to diagnose ASPD are clearly defined in the *Diagnostic and Statistical Manual of Mental*

Disorders (DSM-IV; APA, 1994), assessment approaches to psychopathy have been less straightforward. Recent studies have consistently found that measures initially developed to assess psychopathic personality traits have a two-factor structure; one factor captures psychopathic traits while the other captures impulsive and antisocial behavior (e.g., Benning et al., 2003, 2005). Moreover, behavioral genetic and human laboratory research has provided further support for the separable nature of these two factors by documenting distinct patterns of physiological reactivity to emotional stimuli (Benning et al., 2005), differential genetic influences (Blonigen et al., 2005), as well as unique patterns of performance on neuropsychological tests of executive function (Sellbom & Verona, 2007). Although several studies have reported an association between psychopathic traits and impaired IGT performance (Blair et al., 2001; Mitchell et al., 2002; van Honk et al., 2002), only one actually disentangled psychopathic from antisocial traits and found neither factor was associated with IGT performance in a sample of adult offenders (Schmitt et al., 1999).

The purpose of the present study was two-fold. The first goal was to conduct a well-controlled test of whether individuals with AD exhibit impaired IGT performance and to delineate the significance of comorbid ASPD. To this end, we compared men with AD but no current or lifetime history of clinically significant antisocial behavior (i.e., conduct disorder or ASPD) or other relevant co-occurring psychopathology to those with AD and ASPD, and non-AD, non-ASPD controls. In the present study, groups were predicted to exhibit differences in IGT performance, with successively increasing “disadvantageous” decision-making from the control group to the AD group, and then to the AD+ASPD group. This hypothesis was driven by the idea that risk-prone decision-making previously found among individuals with AD would be more strongly related to an overall pattern of externalizing behavior rather than be specific to AD. Such findings would provide important additional support for the initial work by Mazas and colleagues (2000) given that their sample was too small to statistically detect an effect of AD on IGT performance independent of ASPD (Mazas et al., 2000; Dom et al., 2006). The second goal of this study was to examine whether psychopathic traits, independent of antisociality, explain observed differences IGT performance between groups.

Method

Participants

Participants were 60 males (88% Caucasian, 10% African American, and 2% Hispanic), 18 to 39 years of age ($M = 26.1$, $SD = 6.0$). To be eligible, participants were in overall good health (body weight $\pm 20\%$ of the ideal by Metropolitan Life Insurance Company norms and no self-reported current or chronic medical conditions); reported no history of brain injury or hearing difficulties; were not taking central nervous system acting medication for the past 30 days; were literate in the English language and had at least a ninth grade education; and had specific knowledge that their mother was abstinent from alcohol during pregnancy. Exclusionary criteria included current or lifetime bipolar I or II disorder, agoraphobia, a psychotic disorder, posttraumatic stress disorder, panic disorder, obsessive compulsive disorder, and eating disorders, as well as a *current* mood disorder, generalized anxiety disorder, or an active substance use disorder. Exclusion of these disorders allowed for a clear examination of the relation among AD and IGT performance given that impaired IGT performance has been associated with other forms of psychopathology (e.g., Sevy et al., 2007). Psychopathology was assessed according to the DSM-IV (APA, 1994) using the Structured Clinical Interview for DSM-IV-Research Version (SCID-I; First et al., 1996) and the Structured Clinical Interview for Axis II Disorders (SCID-II; First et al., 1997). Familial alcoholism was exclusionary for control participants. Participants in both AD groups were required to have abstained from alcohol and all other substances for the 30-day period before the laboratory session as indicated

by self-report and a urine toxicology screen conducted on the day of testing for alcohol, amphetamines, barbiturates, benzodiazepines, cocaine, cannabis, and opiates.

Procedure

Recruitment—Figure 1 shows the development of the final sample. Participants were recruited by distributing brochures throughout a metropolitan area at recreational centers (e.g., bowling alleys), vocational schools, local businesses, and support groups for individuals with a history of substance abuse problems. Interested volunteers completed an in-person screening interview to determine initial eligibility based on self-reported data ($n = 200$). Those who reported a history of symptoms suggestive of AD, denied alcohol or other substance use within the past 30 days, and did not endorse exclusionary criteria were tentatively classified as AD ($n = 66$). Those who reported no alcohol or other substance-related problems or family history of substance use disorders and did not endorse exclusionary criteria were tentatively classified as controls ($n = 29$). Screened participants who endorsed any of the exclusionary criteria were not further considered ($n = 105$).

Of the tentatively classified individuals ($n = 95$), 84% were contacted and invited to participate in the laboratory study; the remaining 16% were unable to be contacted following the initial screening interview (e.g., change of residence). Of those contacted and invited to participate, approximately 85% ($n = 68$) agreed and attended the laboratory session and 13% ($n = 10$) agreed, but repeatedly cancelled or failed to attend their scheduled appointment. Two men were unable to participate in the laboratory session due to involvement with the legal system.

In the laboratory session, eight additional individuals were excluded due to either equipment failure ($n = 3$), exclusionary DSM-IV Axis I disorders ($n = 2$; i.e., psychotic disorder, bipolar I disorder), invalid scores on the Psychopathic Personality Inventory (PPI; Lilienfeld & Andrews, 1996; $n = 2$), or a positive urine toxicology screen for cannabis ($n = 1$). Individuals included in the final sample did not differ from the overall screening sample in age, $t(198) = .37$, or ethnic composition, $\chi^2 = 5.14$, p values $> .10$.

Laboratory Protocol—Participants arrived at the laboratory at 9:00 a.m. Each participant was presented with a detailed description of the study procedures and provided written informed consent. All participants then completed clinical interviews and a battery of self-report measures, underwent the emotion-modulated startle procedure (see Miranda et al., 2003), and completed the IGT.

Measures

Decision Making—The IGT (Bechara et al., 1994) is a computerized assessment of decision making under variable magnitudes and probabilities of hypothetical rewards and punishments. Participants were presented with four decks of cards labeled A, B, C, and D. Each deck contained 40 cards associated with varying amounts of financial gain and loss and was created to provide a balance of gains to losses that changed as the task progressed. Decks A and B initially yielded large gains with few losses. After 20 plays from these decks, however, the losses became larger and consistent play from these disadvantageous decks resulted in a net loss for the game. In contrast, decks C and D initially generated larger losses than gains, but over time the gains from these decks increased relative to the losses. As such, consistent play from these advantageous decks resulted in net winnings for the game. Participants were instructed to select cards from the decks until the computer signalled that the game was over, with the goal of winning as much hypothetical money as possible. Participants were not informed of how many plays they had; the task continued until 100 cards had been selected. Consistent with previous research, IGT performance was characterized by dividing the task into 5 consecutive blocks of 20 card selections. A *net score* was calculated within each block

by subtracting the number cards selected from the two disadvantageous decks (A + B) from the number selected from the two advantageous decks (C + D). An overall *total IGT score* was calculated as the sum of the net scores across all 5 blocks (e.g., Bechara et al., 1994; Dom et al., 2006; Kim et al., 2006). Higher scores reflect more advantageous decision making performance on the task.

To assess participants' insight to the contingencies of the task, after each 20-trial block participants were asked, "Tell me all you know about what's going on in this game." The query was asked by trained staff and responses were audio recorded and rated by two independent reviewers who were blind to participants' diagnostic status. Level of insight was operationally defined according to one of three categorical levels: (1) *No Insight*: no expressed knowledge specifying the advantageous or disadvantageous decks or had incorrect knowledge; (2) *Partial Insight*: knowledge specifying one of the two advantageous or disadvantageous decks but did not have knowledge of the others; and (3) *Full Insight*: knowledge of the two advantageous and two disadvantageous decks or had an understanding of the strategy of the task (i.e., lose more from decks that provide more money). Interrater reliability for insight ratings across blocks ranged from 0.66 to 1.00 (M kappa = .88). Discrepancies in ratings were resolved by a third blinded rater. This measure was used in the present study to determine whether group differences in IGT performance were attributable to differences in their ability to accurately identify the contingencies of the task.

Psychopathology—The SCID-I and SCID-II diagnostic interviews were administered by two clinical psychology doctoral students who received systematized training in diagnostic assessment. All interviews were audio taped and a randomly chosen subset of taped interviews (20%) was rerated by the second interviewer to determine the reliability of diagnostic decisions. All diagnostic decisions were based on the in-vivo interview. Interrater reliability (kappa) of Axis I diagnostic decisions was high for both current ($M = 1.0$) and lifetime disorders ($M = .96$, range = .70 to 1.0). Interrater reliability (kappa) of Axis II diagnostic decisions was excellent ($M = .98$, range = .76 to 1.0).

ASPD was assessed using the SCID-II. ASPD was diagnosed when the respondent met full DSM-IV criteria for conduct disorder with onset before age 15 *and* endorsed at least 3 criteria for ASPD occurring after age 15. Antisocial behaviors that were secondary to involvement with alcohol or other drugs were not included as diagnostic markers for either conduct disorder or ASPD. That is, conduct problems and antisocial behaviors that occurred exclusively during substance-induced intoxication or in an effort to obtain alcohol or other drugs were not sufficient for a diagnosis of either conduct disorder or ASPD. Audiotaped interviews for *all* participants were rerated by a second interviewer. Interrater reliability was excellent (kappa = 1.0).

Personality Characteristics and Intellectual Functioning—The PPI is a widely used self-report measure of psychopathic personality characteristics. The PPI contains eight subscales which were previously factor analyzed into two distinguishable factors (Benning et al., 2003, 2005). Factor 1, labeled *fearless dominance*, measures the interpersonal and affective aspects of psychopathic personality traits (e.g., emotional detachment, lack of remorse and empathy, egocentricity, and manipulative and callous behavior). Factor 2, labeled *impulsive antisociality*, measures antisocial deviance, such as unreliable and impulsive behavior and interpersonal aggressiveness. Higher scores indicate greater traits on each factor. The PPI has good internal consistencies (.90 to .93) and high test-retest reliability (.95; Lilienfeld & Andrews, 1996). The internal consistency coefficient (Cronbach's α) in this study was 0.86. Consistent with previous research (e.g., Edens et al., 2008), Factor 1 and Factor 2 scores were not significantly correlated ($r = -0.14$). The *fearless dominance* subscale was used as a continuous measure of psychopathic personality traits and the *impulsive antisociality* subscale

was used as a continuous measure of antisocial traits. The PPI contains validity scales to evaluate the veracity of respondents' reports: (1) the PPI variable response inconsistency (VRIN) scale identifies inconsistent reporting and (2) the deviant responding scale detects participants who are malingering, responding carelessly, or experience difficulty understanding the items (Lilienfeld & Andrews, 1996). Based on these scales, two participants in the AD group were excluded from analyses because their scores were more than 2 standard deviations above the mean. The Shipley Institute of Living Scale (Shipley, 1940) was used to estimate intellectual functioning.

Data Analysis

All variables were initially examined for missing data and pertinent continuous variables were examined for distribution normality. Overall group performance on the IGT was examined using a one-way analysis of variance (ANOVA) with the total IGT score as the dependent measure. Group differences across the chronology of the task were examined using a 3 Group (AD+ASPD, AD, Control) $\times$ 5 Block (Trials 1-20, 21-40, 41-60, 61-80, 81-100) mixed ANOVA. Chi square was used to test whether groups differed in their ability to accurately identify the contingencies of the task. Cohen's delta (d) was used as a measure of effect size (Cohen, 1988) and $p < .05$ was used as the significance criterion.

The influence of psychopathic and antisocial traits (measured by the *fearless dominance* and *impulsive antisociality* factors of the PPI, respectively) was characterized using a 4-step hierarchical linear regression approach (Baron & Kenny, 1986): 1) evidence of a significant association between diagnostic group status and IGT performance; 2) evidence of a significant association between diagnostic group status and the potential mediators (psychopathic and antisocial traits); 3) evidence of a significant association between each potential mediator and IGT performance; and 4) evidence that when the influence of a potential mediator is incorporated, diagnostic group status is no longer significantly associated with IGT performance. Specifically, the sum of the net scores across blocks 3, 4, and 5 was the dependent variable, and diagnostic group status and the mediator were independent variables that were entered into successive blocks to examine the preceding relationships. Each mediator was tested separately. Performance during the last 3 blocks was used as the dependent measure in mediational analyses because our objective as to delineate whether psychopathic traits, independent of antisociality, explained observed differences in IGT performance between groups. Previous research has consistently shown that most participants, including nonclinical individuals, randomly select cards from all decks during the initial blocks of the IGT then shift toward the advantageous decks as the contingencies of the task are learned. Therefore, because the initial blocks involve trial and error learning as the participant develops a strategy, consistent advantageous or disadvantageous performance preferences are typically not evident until later in the task. Indeed, studies that report IGT performance deficits among individuals with substance use disorders typically find that deficits emerge around block 3, when control participants begin to demonstrate a selection preference for cards from the advantageous decks (e.g., Bechara et al., 2001, 2002; Bechara & Martin, 2004; Kim et al., 2006; Monterosso et al., 2001). Notably, this pattern of results was reported by Mazas et al. (2000) among individuals with ASPD. Significance was based on variance accounted for by a variable by itself (R^2) or its addition to the model (ΔR^2), with critical $p < .05$; the direction of relationships between variables was determined by examining variable coefficients. All analyses were conducted using SPSS 14.0 (SPSS Inc., Chicago, IL).

Results

Sample Characteristics

Characteristics of the sample are presented in Table 1. Thirty-nine subjects met criteria for AD and 21 had a history of recreational alcohol use, but no current or lifetime symptoms of a SUD, conduct disorder, or ASPD. Of those with AD, 17 also met criteria for ASPD. In terms of other DSM-IV axis II disorders among those with AD, 10.3% met criteria for avoidant personality disorder, 15.4% obsessive compulsive personality disorder, 5.1% paranoid personality disorder, 2.6% schizoid personality disorder, and 2.6% narcissistic personality disorder. There were no significant differences in non-ASPD axis II disorders between the AD groups; none of the control participants met criteria for an axis II disorder. All AD participants attended support groups for alcohol-related problems (e.g., alcoholics anonymous). There were no differences between groups in terms of the number of months since last alcohol use ($F [2, 57] = .18, p = .84$). The mean number of months since last alcohol use (standard deviation) across the control, AD, and AD+ASPD groups was 10.2 (19.83), 13.64 (21.34), and 13.56 (21.65), respectively. The control group was significantly younger, had more years of education at the time of testing, and had higher Shipley IQ scores than both AD groups.¹ There were no differences between AD and AD+ASPD, except AD+ASPD had fewer years of education. Intercorrelations between study variables are presented in Table 2.

Although the control group was significantly different from the AD groups in terms of IQ, we elected not to statistically control for IQ because it has been established that IQ and antisocial behavior are highly interdependent. IQ is among the most well recognized correlates and risk factors for antisocial behavior across the lifespan, with recent reports indicating that for males this association appears to be entirely attributable to common genetic factors (e.g., Hinshaw, 1992; Koenen et al., 2006; Nigg & Huang-Pollock, 2003; Simonoff et al., 2004). Consistent with recommendations for the appropriate use of analysis of covariance, removing variance associated with IQ would alter the diagnostic group variable substantially thereby obscuring part of the group effect and producing uninterpretable or spurious findings (e.g., Cohen & Cohen, 1983; Miller & Chapman, 2001; Porter & Raudenbush, 1987).

Decision-Making Performance by Diagnostic Status

Results of a one-way univariate ANOVA with total IGT scores as the dependent measure indicated that groups differed significantly on overall IGT performance ($F [2, 57] = 3.59, p < .05$). The mean (standard deviation) total IGT scores across the control, AD, and AD+ASPD groups were 16.43 (20.28), 2.45 (20.09), and .47 (21.57), respectively. Pairwise comparisons indicated that AD and AD+ASPD groups performed significantly worse than controls (p values $< .05, d = .69$ and $.76$, respectively), but not from each other ($p = .77, d = .09$). Notably, across groups no participants ran out of disadvantageous or advantageous card selections.

To identify whether groups differed in IGT performance across the task, we conducted a 3 Group $\times$ 5 Block mixed-design ANOVA, with group (AD, AD+ASPD, controls) as the between-subjects factor and block (trials 1-20, 21-40, 41-60, 61-80, 81-100) as the within-subjects factor. Results indicated a significant effect for group ($F [2, 57] = 3.59, p < .05$), block ($F [4, 228] = 7.14, p < .001$), and a significant group $\times$ block interaction ($F [8, 228] = 2.31, p < .05$). To elucidate the nature of this interaction, follow-up one-way ANOVAs were conducted within each block. Results indicated a marginally significant difference between groups in block 3 ($F [2, 57] = 3.07, p = .05$), such that the AD group performed significantly more poorly than the control group ($p < .05, d = -.71$). No other group differences were observed in block 3. Results also indicated a significant difference between groups in Block 5 ($F [2, 57] = 6.99, p < .05$), such that the AD+ASPD group performed significantly more poorly than the control ($p = .001, d = 1.11$) and AD group ($p < .05, d = .74$), with large and medium effect size

magnitudes, respectively. There was no difference between the AD and control groups ($p = .16$, $d = .48$) in Block 5. Post hoc tests revealed no significant differences among groups in blocks 1, 2 or 4 (p values $> .53$). Taken together, as illustrated in Figure 2, results showed a general increase in advantageous performance across the task, an overall between-groups difference, and a precipitous decline in performance by the AD+ASPD group during the last 20 trials.

Mediating Effects of Psychopathic and Antisocial Traits on Decision-Making

Mediational analyses were conducted in reference to performance during the last 3 blocks. Consistent with the ANOVA-based analysis, diagnostic status was significantly associated with performance, $R^2 = .11$, $p = .009$ (Step 1), with the previously observed linear relationship reported above ($\beta = -.33$). Psychopathic traits, as measured by the *fearless dominance* factor of the PPI, were not significantly associated with diagnostic status ($R^2 = .05$, $p > .05$, $\beta = -.22$; Step 2), and were not associated with IGT performance ($R^2 = .00$, $p = .74$, $\beta = -.05$; Step 3). Unsurprisingly, when entered into a combined model including psychopathic traits in a first block and diagnostic status in a second block, diagnostic status was still significantly associated with IGT performance ($\Delta R^2 = .11$, $p < .05$; Step 4). The overall model accounted for approximately 11% of the variance ($R^2 = .11$, $p < .05$).

We tested the same mediational model using the *impulsive antisociality* factor of the PPI. As reported above, the Step 1 association was evident ($R^2 = .11$, $p = .009$, $\beta = -.33$). In addition, diagnostic status was significantly associated with *impulsive antisociality* ($R^2 = .26$, $p < .001$; Step 2). *Impulsive antisociality* was also significantly associated with IGT performance ($R^2 = .07$, $p < .05$; Step 3), reflecting an inverse relationship between *impulsive antisociality* and performance ($\beta = -.26$). In the combined model of diagnostic status, incorporating the influence of *impulsive antisociality* in an initial block, diagnostic status exhibited a nonsignificant regression coefficient ($\beta = -.27$, $p > .05$; Step 4), suggesting that characteristics tapped by *impulsive antisociality* mediate the differences in IGT performance. The overall model accounted for 12% of the variance ($R^2 = .12$, $p < .05$).

Iowa Gambling Task Insight

Results of a chi square analysis indicated that groups did not differ on strategy insight by the end of the task ($\chi^2 = 3.6$, $p = .46$). Overall, the majority of participants were unable to identify the advantageous or disadvantageous decks (56.9%), 25.9% were able to specify one of the two advantageous or disadvantageous decks but not the others (partial insight), and 17.2% had knowledge of the two advantageous and two disadvantageous decks or had an understanding of the strategy of the task (full insight).

Discussion

This study examined the effect of AD on decision-making on a validated laboratory task and delineated the influences of ASPD along with two facets of psychopathy, namely fearless dominance and impulsive antisociality. Consistent with our predictions, alcoholics with and without ASPD exhibited generally impaired decision-making compared to a control sample in terms of overall IGT performance. However, a block-by-block analysis revealed that the nature of this impairment differed based on the presence of ASPD. While alcoholics without ASPD generally exhibited slow, but steady improvement across the task, alcoholics with ASPD exhibited initial improvement followed by a notable decrease in advantageous decision-making during the last block of trials. This finding suggests that non-ASPD alcoholics have a delay in their shift from disadvantageous to advantageous decisions rather than an inability to learn from contingencies. In contrast, alcoholics with ASPD did not differ from controls in their initial shift toward advantageous decisions but had difficulty sustaining this pattern over time.

This finding is consistent with recent work that found highly impulsive individuals had difficulty sustaining advantageous decision making performance on the IGT (Sweitzer et al., 2008). Moreover, analyses with continuous measures of different facets of antisocial pathology revealed that impulsive antisociality traits, which reflect a propensity for rash, undeliberative behavior, mediated IGT performance. In contrast, psychopathic traits, which reflect a propensity toward unempathic, manipulative behavior, did not mediate IGT performance. Interestingly, across groups participants were similarly aware of the contingencies of the task.

Our finding that individuals with AD exhibit disadvantageous decision-making on the IGT compared to non-AD controls is consistent with several earlier studies (e.g., Dom et al., 2006). Moreover, the finding that heterogeneity in IGT performance among alcoholics was related to differences in antisociality may help to explain why several studies did not find decision-making deficits among alcoholics and highlights the importance of assessing individual difference variables when characterizing decision-making abilities. An important finding of this study was that psychopathic traits were not associated with impaired decision making as measured using the IGT. Although several studies have reported an association between psychopathy and IGT performance (Blair et al., 2001; Mitchell et al., 2002; van Honk et al., 2002), these studies did not test the effects of psychopathic and antisocial traits separately. Our results provide additional support to the growing body of research which indicates that the *fearless dominance* (i.e., psychopathic) and *impulsive antisociality* factors of the PPI are distinct, with divergent correlates (e.g., Benning et al., 2005; Blonigen et al., 2005; Sellbom & Verona, 2007). The present findings suggest that alcoholics high in psychopathic traits (i.e., high in *fearless dominance*), who presumably have low levels of trait anxiety and a tendency to engage in deceitful and manipulative behavior (Benning et al., 2005), are able to learn from variable contingencies and modify their behavior in an adaptive manner. This finding coincides with recent neuropsychological data which indicated high *fearless dominance* factor scores were associated with enhanced performance on tests of executive cognitive functions, while greater *impulsive antisociality* factor scores were associated with impairment (Sellbom & Verona, 2007).

The present findings also have important implications for understanding the mechanisms that underlie the well-established and robust relationship between antisocial traits and alcoholism and for informing intervention strategies for this subgroup of alcoholics. Prospective studies consistently report that antisocial behavior in youth is one of the strongest risk factors for adolescent alcohol use (e.g., Elkins et al., 2007). Moreover, intervention research shows that antisocial youth are more likely to drop out of treatment and experience a poorer clinical course following completion of alcohol and drug interventions (Brown et al., 1996; Kaminer et al., 1992). Similar findings have been reported with adults (e.g., Goldstein et al., 2007) and typological research has consistently identified a subgroup of alcoholics that is distinguishable by the presence of high levels of antisocial traits (Babor et al., 1992; Cloninger, 1987; Zucker, 1994), accounting for approximately 14% of adults with AD (Regier et al., 1990). Although studies have identified a consistent and strong relationship between antisocial traits and alcohol misuse across development, few have attempted to elucidate the mechanisms that mediate this association.

Our findings suggest that individuals who persistently engage in impulsive and antisocial behaviors may be prone to AD, at least in part, because of their propensity toward decision-making biases that favor immediate reward despite subsequent negative consequences. This notion coincides with the essential features of the diagnostic criteria for substance dependence (APA, 1994) and fits with contemporary theories of addiction which postulate that dysfunction in brain regions which govern decision making is critically involved in the development of SUD (Bechara, 2005; Goldstein & Volkow, 2002). This circuitry involves the ventromedial prefrontal cortex (vmPFC), which includes the medial portion of the orbitofrontal cortex as

well as the more ventral sections of the medial prefrontal and anterior cingulate cortices. Through inputs from the amygdala, the vmPFC is principally involved in the evaluation of stimulus characteristics and determining adaptive behavioral responses (e.g., Schoenbaum & Roesch, 2005). Damage to this region is associated with myriad behavioral disturbances that involve difficulty avoiding repeated negative consequences, as well as impairments in IGT performance (e.g., Bechara et al., 1994). It has been postulated that dysfunction in these brain regions confers liability for alcohol and other substance dependence by compromising an individual's ability to weigh the immediate reinforcing aspects of alcohol and other drug use against the future negative consequences (Bechara, 2005; Goldstein & Volkow, 2002).

One possibility is that antisocial individuals have heritable differences in brain regions that impair their ability to weigh the positive and negative consequences of their behavior and this deficit in turn confers liability for antisocial behavior and alcoholism. Quantitative genetic studies have provided indirect support for this hypothesis by showing antisocial traits and alcohol problems share a common genetic vulnerability (Button et al., 2007; Slutske et al., 1998). On the other hand, there is also compelling evidence that alcohol is particularly harmful to the prefrontal cortex during early adolescence (Crews et al., 2007; Spear, 2007) and it has been well documented that antisocial youth initiate drinking at a younger age and drink more heavily than non-antisocial youth (e.g., Elkins et al., 2007; Tucker et al., 2003). It is therefore possible that impairments in decision making among antisocial individuals are secondary to the neurotoxic effects of early recurrent alcohol use. Although prospective studies have not adequately examined this hypothesis, results of a recent longitudinal study indicated that heavy alcohol use at ages 18-19 predicted impaired IGT performance at ages 20-21 more strongly than recent alcohol use (Goudriann et al., 2007). While this finding suggests that young adults who drink heavily during adolescence may have lasting impairments in decision making processes compared to their non-heavy drinking peers, it is important that future research establish whether alcohol use during adolescence plays a causal role in the development of decision making deficits and/or whether such deficits predate the onset of drinking and predict which youth will develop problems with alcohol.

There are a number of considerations that should be kept in mind with regard to these findings. First, relatively homogeneous groups of males were examined, and although strict inclusion criteria increased internal validity, this approach may have resulted in a less representative sample of alcoholics. Second, although considerable efforts were made to recruit control participants who were demographically similar to those with AD, control participants may not have comprised the ideal comparison group given that they were younger, had higher IQ scores, and more years of education than the AD groups. In addition, control participants did not significantly differ from those with AD or AD+ASPD on the fearless dominance factor of the PPI. While this finding is not unprecedented, i.e., similar findings have been reported in studies comparing non-incarcerated controls with prison inmates (Chapman et al., 2003; Uzieblo et al., 2007), failure to detect between group differences in psychopathic traits raises possible concerns regarding the utility of the fearless dominance factor of the PPI among individuals with AD. Although it is possible that AD and AD+ASPD participants underreported psychopathic traits, this explanation seems unlikely given that individuals with questionable PPI scores (i.e., extreme scores on PPI validity scales) were excluded from analyses and group differences in impulsive antisociality were found in the expected direction. Nonetheless, future research with larger samples should further evaluate the utility of the PPI among individuals with AD. Third, several studies have found gender differences in IGT performance and data from neuroimaging research indicates that men and women activate different brain regions during IGT performance (e.g., Bolla et al., 2004). Therefore, examining IGT performance among women with AD and ASPD is an important focus for future research. Finally, the inclusion of a non-alcoholic ASPD group would have allowed for a more systematic delineation of the relationship between ASPD and IGT performance.

Despite these considerations, this is the first study to examine the relationship between AD and IGT performance and concurrently examine whether facets of psychopathy underlie these differences. Although one interpretation could be that decision-making deficits are more strongly associated with antisocial traits than the development of AD, a variety of evidence indicates that heritable or acquired disadvantageous decision making confers liability for AD and antisociality, in part, through a general disposition toward externalizing psychopathology. An important focus of future research will be to unravel the chronology of these associations and to further elucidate the neurobiological mechanisms that underlie these decision-making deficits.

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Figure 1.

Diagram of participant screening and selection process. Volunteers were deemed ineligible for further participation at the initial screening for any of the following reasons: Probable exclusionary psychiatric condition (11%), health problems (17%), CNS acting medication (16%), traumatic brain injury (12%), prenatal alcohol exposure (10%), insufficient literacy in the English language (3%), hearing difficulties (3%), age > 39 years (2%), never consumed alcohol (5%), family history of alcoholism among potential control participants (31%), lacked knowledge of familial alcoholism (5%), met diagnostic criteria for alcohol abuse but not AD (11%). AD = Alcohol Dependent; AD+ASPD = Alcohol Dependent and Antisocial Personality Disorder.

Figure 2.

Mean IGT net scores with standard errors for participants with comorbid alcohol dependence and antisocial personality disorder (AD+ASPD; $n = 17$), alcohol dependence (AD; $n = 22$), and controls ($n = 21$). A net score was calculated within each block by subtracting the number cards selected from the two disadvantageous decks (A + B) from the number selected from two advantageous decks (C + D). Block 1 = trials 1-20, Block 2 = 21-40, Block 3 = 41-60, Block 4 = 61-80, Block 5 = 81-100; * $p < .05$; † $p < .001$

Table 1

Sample Characteristics

Variable, <i>M</i> (<i>SD</i>)	Controls (<i>n</i> = 21)	AD (<i>n</i> = 22)	AD+ASPD (<i>n</i> = 17)	Significant Differences
Age (years)	22.6 (4.3)	29.3 (5.6)	27.1 (6.1)	Control < AD [†] and AD+ASPD [*]
Education (years)	14.5 (1.4)	12.9 (2.4)	11.3 (1.4)	Control > AD [*] and AD+ASPD [†] AD > AD+ASPD [*]
Shipley IQ	108.1 (9.4)	97.8 (11.1)	96 (10.2)	Control > AD [†] and AD+ASPD [†]
Fearless Dominance	0.7 (2.0)	-0.3 (2.1)	-0.3 (2.2)	
Impulsive Antisociality	-1.7 (2.7)	-0.03 (2.6)	1.7 (1.9)	Control < AD+ASPD [†]

*
 $p < .05$;

[†]
 $p < .01$

Table 2
Zero-Order Intercorrelations of IGT Performance Across Study Variables

Variable	2	3	4	5	6	7	8
1 IGT (total score)	0.92 ^{††}	-0.31 [*]	-0.10	0.17	0.33 [*]	-0.02	-0.19
2 IGT (trials 41-100)		-0.33 [†]	-0.10	0.22	0.39 [†]	0.05	-0.26 [*]
3 Group Status			0.29 [*]	-0.58 ^{††}	-0.46 ^{††}	-0.22	0.51 ^{††}
4 Age				0.08	-0.11	-0.04	-0.14
5 Education					0.53 ^{††}	0.18	-0.47 ^{††}
6 Shipley IQ						0.25	-0.28 [*]
7 PPI Fearless Dominance							-0.14
8 PPI Impulsive Antisociality							

Note: Data are Pearson *r* correlations. IGT = Iowa Gambling Task. PPI = Psychopathic Personality Inventory

*
p < .05;

[†]
p < .01;

^{††}
p < .001