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## Alcohol-Dependent Individuals Discount Sex at Higher Rates than Controls

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### Abstract

**Background**—Research on delay discounting has expanded our understanding of substance dependence in many ways. Recently, orderly discounting of sexual rewards has been demonstrated in both substance-dependent individuals, and healthy controls. Less clear, however, is if rates of sexual discounting are higher than controls in alcohol-dependent-individuals.

**Methods**—20 Alcohol-dependent individuals and 21 healthy control participants completed two delay-discounting tasks. One task involved monetary rewards, whereas the other involved the discounting of sexual rewards (i.e., number of sex acts).

**Results**—Alcohol dependent individuals discounted sexual rewards at significantly higher rates than did controls. There was a trend towards, but not a similarly significant relation for the discounting of monetary rewards.

**Conclusions**—Rates of sexual discounting are elevated in alcohol dependent individuals. If this relation is replicated in other at risk populations, the rapid devaluation of sexual rewards may be a behavioral marker of impulsive sexual choices.

### Keywords

Delay discounting; sex; alcohol; dependence

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## 1. INTRODUCTION

Choices are affected by the delay to the receipt of each alternative (i.e., rewards). This impact is often so pronounced that we would rather accept a smaller reward now than wait for a larger delayed reward. Research on this phenomenon, called delay discounting, has robustly contributed to our understanding of behavioral disorders such as substance abuse/dependence (see Bickel et al., 2012b, for a review). For example, alcohol-dependent individuals discount delayed money at higher rates than non-dependent controls. Moreover, alcohol-dependent individuals discount alcohol at higher rates than money (Petry, 2001). This rapid devaluation of delayed alcohol may explain these individuals' seemingly impulsive alcohol-oriented behavior (Bickel and Marsch, 2001).

Alcohol-dependent individuals also make seemingly impulsive choices regarding sex. These choices include alcohol abusers riskier partner choice (Cooper, 2002), heavy drinkers' heightened propensity to have multiple sexual partners (Graves, 1995; Wechsler et al., 1994), and alcohol-dependent individuals' low rates of condom use, multiple sex partners, and tendency to trade sex for drugs or money (Scheidt and Windle, 1995). Moreover, delay discounting rates predict teens' sexual behavior (Chesson et al., 2006), and college students discount delayed sexual stimuli (Lawyer, 2008). Thus, akin to their high rates of discounting of alcohol (Petry, 2001), alcohol-dependent individuals may discount delayed sex at high rates.

Research on sexual discounting may provide a laboratory-based marker for these dangerous behaviors. For example, Johnson and Bruner (2011) examined the discounting of delayed safe sex, relative to immediate unprotected sex. After sixty cocaine-dependent participants selected pictures of individuals they would have sex with, participants indicated their likelihood of waiting for a condom to have sex with 1) the person they most wanted to have sex with, 2) the person they least wanted to have sex with, 3) the participant they felt was most likely to have an STI, and 4) the individual they felt was least likely to have an STI. Individuals' ability to wait for a condom decreased as the delays increased, but this decrease was quickest for the individual they most wanted to have sex with (relative to the individual they wanted least), and for the individual least likely to have an STI (relative to most likely to have an STI).

Although research on sexual discounting has demonstrated that both substance-dependent individuals (Johnson and Bruner, 2011) and controls (Lawyer, 2008; Lawyer et al., 2010) exhibit orderly patterns of discounting, whether the rates of discounting are comparable across populations remains unclear. Given the wide range of impulsive sexual behavior linked to alcohol abuse/dependence, higher rates of sexual discounting may occur in alcohol-dependent individuals. The relative rates of sexual discounting in substance-dependent individuals and healthy controls, however, are currently unknown. The present study examined the discounting of sexual rewards (i.e., the number of sex acts) in alcohol-dependent individuals and healthy controls.

## 2. METHODS

### 2.1 Participants

These data were from a larger study on alcohol dependence. Exclusion criteria included dependence on other drugs (excluding marijuana and nicotine), unmanaged psychological diagnosis, medical illness, or age less than 18 years old. Participants were recruited through flyers posted at local businesses (separate flyers for alcohol dependent individuals and controls). Delay-discounting data from 20 individuals meeting DSM-IV (American Psychiatric Association, 2000) criteria for alcohol dependence and 21 individuals with no history of alcohol dependence were examined. Basic demographic data, including Ammon's Quick test (Ammons and Ammons, 1962), a well validated measure of intelligence, were collected (see Table 1 for demographic details).

### 2.2 Procedure

Delay-discounting conditions were presented using a computer program (Johnson and Bickel, 2002) prior to any other study procedures. Both conditions used hypothetical amounts of money or hypothetical amounts of sex. Prior to starting the discounting procedure, participants were asked to estimate how many sexual encounters would be worth \$1,000 to them. The question was presented as follows:

I want you to imagine that you have the opportunity to have sex with your ideal sexual partner. Think about who that person would be. It could be someone you know, someone famous, or a fictional character. Write that person's name on a sheet of paper for your reference throughout the following tasks. No one other than you will see this paper, and staff will destroy the paper after this assessment.

For the following scenario, I want you to imagine that you have a choice of receiving some money and engaging in a series of sexual encounters with your ideal sexual partner that you have written on the sheet of paper. In the following question, fill in the number of sexual encounters that would make the two choices equally attractive to you.

Receiving \$1,000 right now would be just as attractive as engaging in \_\_\_\_\_ sexual encounters.

For delay-discounting conditions that included sex, the number of sex acts equivalent to \$1000 was entered into the discounting program. Because the program rounded the number of sex acts to the nearest whole number, a value of 8 sex acts was entered for individuals with equivalences lower than 8 (n=21) to assure that the participants were presented meaningful choices. Participants completed two delay-discounting conditions in a counterbalanced order.

Each discounting task presented a series of choices between an immediately available amount of a commodity and a larger amount of the commodity available after a delay. Trials were presented in a format identical to previous studies of discounting money versus drugs (Madden et al., 1999). The initial amount offered for the immediate option was 50% of the delayed amount. For example, if a subject indicated that 8 sexual encounters were worth

\$1000, the sexual discounting condition would present a choice between 4 immediate sexual encounters and 8 delayed sexual encounters. The lowest number of sex acts presented as the immediate option was 1 and the highest was 1 lower than the equivalence. For conditions with money, the immediate value was initially set at \$500 and the delayed value was fixed at \$1000.

The discounting tasks used an adjusting amount paradigm (Du et al., 2002). When the participants chose one of the two options, the immediate amount offered in the next trial was adjusted by +/- 50% of the current offer. If the participant chose the immediate amount, the immediate amount decreased by 50%; if s/he chose the delayed amount, the immediate amount increased by 50%. Participants chose between immediate and delayed amounts six times for each of the seven delays (1 day, 1 week, 1 month, 6 months, 1 year, 5 years, and 25 years). The sixth choice for each delay was used as the estimated indifference point, or the value at which the participant would be indifferent between the immediate and delayed options. The indifference points for each delayed commodity ranged between 0.8% and 100.08% of the undiscounted amount, describing those who always chose the immediate to those who always chose the delayed option, respectively.

### 2.3 Data Analysis

Using Mazur's (1987) hyperbolic model (Equation 1),

$$V = \frac{A}{1+kD}$$

which describes the rate ( $k$ ) that a particular amount ( $A$ ) of a reward is discounted by the passage of time ( $D$ ), we estimated  $k$  with nonlinear regression of the seven indifference points,  $V$ . These  $k$  values were then log transformed to normalize the distribution. Data analysis was conducted on the resulting normal distribution of  $\ln(k)$  values. From each regression we also obtained the root mean square error (RMSE), an estimate of the average difference between the model and each of the obtained data points, presented in the same units as the dependent variable (0–1 for proportions).

The RMSE and  $\ln(k)$  values were analyzed using a  $2 \times 2$  repeated measures ANOVAs with group (alcohol dependent vs. control) being a between-subject factor and delay discounting condition (monetary vs. sexual) being a within-subject factor. Subsequent pairwise comparisons were conducted using the Holm-Sidak method.

## 3. RESULTS

The RMSE's were low to moderate across all conditions ( $M = 0.199$ ;  $SD = 0.084$ ) suggesting that the hyperbolic model sufficiently described the data. A repeated measures ANOVA of the RMSEs found that there was not a significant difference in fit across groups ( $F[1,39] = 0.511$ ,  $p=0.479$ ), but the fits were poorer during the sexual discounting task ( $F[1,39]=8.576$ ,  $p=0.006$ ). Repeated measures ANOVA revealed main effects of group ( $F[1,39] = 7.23$ ,  $p = 0.010$ ) and discounting condition ( $F[1,39] = 32.35$ ,  $p<.001$ ) on  $\ln[k]$ , but no significant interaction between these factors.

Figure 1 (top panel) shows that discounting rates were higher in the sexual relative to monetary condition ( $t[40] = 5.687, p < 0.001$ ). Sexual discounting rates were higher in alcohol-dependent individuals, relative to controls ( $t[39] = 2.204, p = 0.031$ ). Although the monetary discounting rates were higher in alcohol-dependent individuals, relative to controls, this difference was not statistically significant ( $t[39] = 1.965, p = 0.053$ ). The bottom panels show fits of equation 1 to the median indifference points for alcohol dependent (left) and control (right) participants. Discounting rates were generally higher for the alcohol dependent group, and the model fits (RMSE) were better for the monetary discounting.

#### 4. DISCUSSION

This study was the first to demonstrate higher-than-control sexual discounting rates in substance-dependent individuals. These elevated sexual discounting rates in alcohol-dependent may provide a laboratory marker for the seemingly impulsive sexual behavior seen in this population (Leigh and Stall, 1993; Scheidt and Windle, 1995). This laboratory-measured process may generalize to the sexual impulsivity exhibited by alcohol-dependent individuals. Specifically, with delayed safe sex failing to retain its value, immediate unprotected sex may be particularly appealing (Johnson and Bruner, 2011), leading to elevated rates of impulsive sexual behavior. Future research should examine relations between sexual discounting and sexual practices.

Unlike previous studies (Bjork et al., 2004; Claus et al., 2011; Mitchell et al., 2005; Petry, 2001), however, monetary discounting rates trended towards but were not significantly higher in alcohol-dependent individuals relative to controls. Although this relation may have been significant with larger samples, the lack of statistical significance is consistent with Bickel et al.'s (2012a) recent finding ( $n = 796$ ) that the relation between alcohol use and discounting rate is secondary to smoking status (also see MacKillop et al., 2007).

Although equating sex and money may be difficult, the current sexual discounting procedure was a logical extension of the procedures used to assess the discounting of drugs (Madden et al., 1997; Petry, 2001), health (Odum et al., 2002), and freedom (Petry, 2003). This procedure, however, differed from Lawyer et al.'s (2010) manipulation of the duration of the sexual encounter, and Johnson and Bruner's (2011) procedure which assumed that casual sex with a condom would be more rewarding than casual sex without a condom. Moreover, the current study examined discounting in alcohol-dependent individuals whereas Johnson and Bruner examined sexual discounting in cocaine-dependent individuals, and Lawyer et al. examined discounting in healthy college students. The consistent and orderly data obtained across these differing procedures and populations suggests the generality of this process.

Limitations to the task highlight the robustness of the relation revealed in the present study. For instance, for participants with equivalences of 8 ( $n = 21$ ), two choices drove indifference points to their lowest level. When this happened at short delays, high discounting rates were obtained. This procedural detail may preempt the procedure's ability to discriminate between populations with tendencies to discount at high rates (e.g., opioid users who do versus do not share needles; Odum et al. 2000). Because of this limitation, only a robust difference in sexual discounting between groups could be observed in the current study.

Definitive conclusions from these data, however, may require additional studies addressing the limitations of the present work. For example, future studies should provide data on time horizon to determine if time horizon interacted with responding. Also, akin to the discounting of drugs, the current findings await replication across other populations prone to seemingly impulsive sexual behavior such as cocaine-dependent individuals. Additionally, the link between these laboratory assessments and sexual behavior in naturalistic settings remains underdeveloped. Moreover, there is no data to demonstrate that our alcohol dependent sample engaged in high levels of impulsive sexual behavior. Thus, this work is but a preliminary step towards understanding seemingly impulsive sexual behavior. Once the mechanisms are understood, important work ameliorating these response patterns in afflicted populations can begin.

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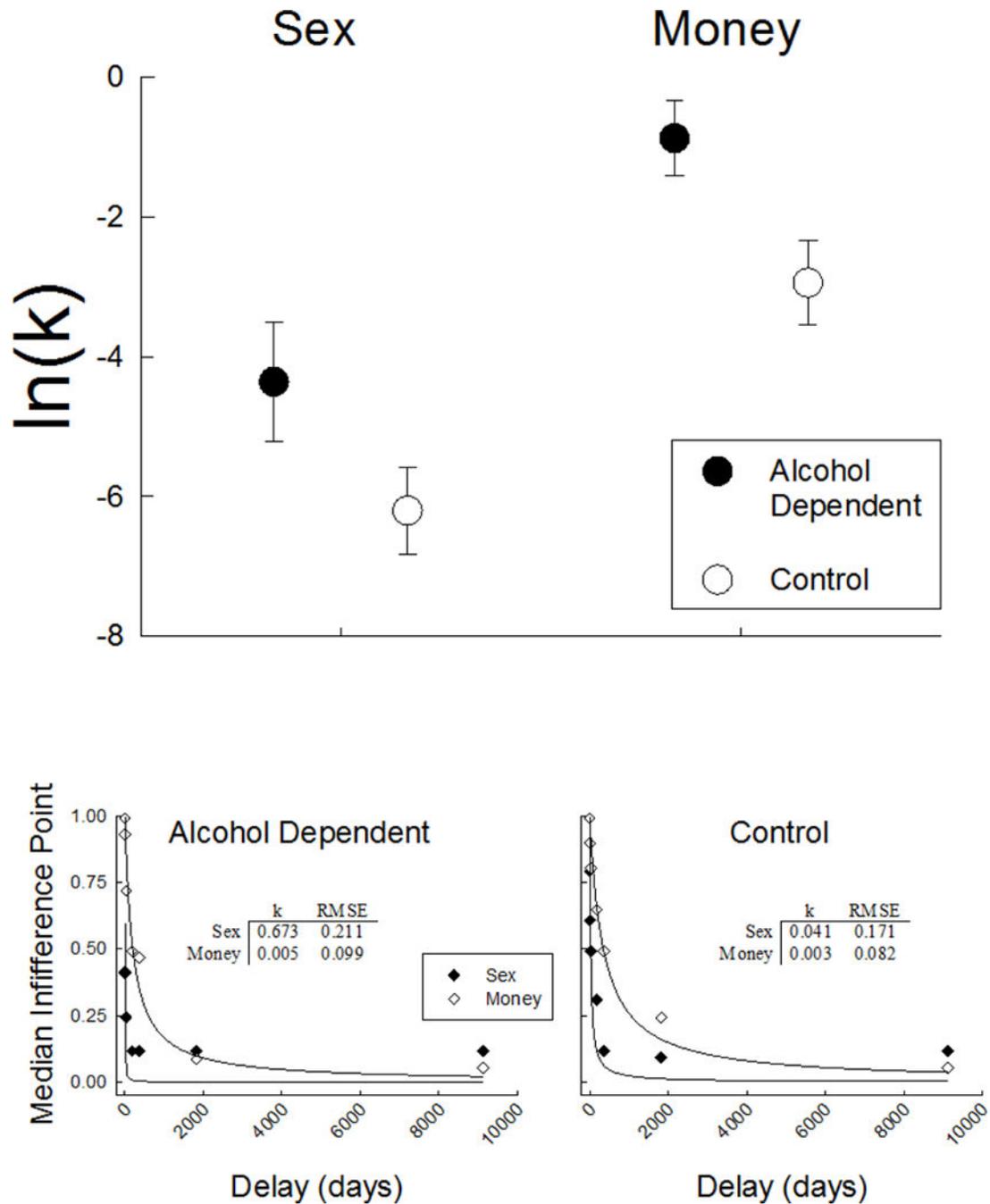
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**Figure 1.** Top panel shows mean discounting rates ( $\ln[k]$ ; y-axis) for money and for sex (x-axis) in alcohol-dependent individuals (closed circles) and healthy control participants (open circles). Higher  $\ln(k)$  values indicate higher rates of discounting. Error bars show one standard error of the mean. Bottom panels show model fit to the median indifference points for sexual discounting (closed diamonds) and monetary discounting (open diamonds) in alcohol dependent (left) and control (right) participants.

**Table 1**

Demographic characteristics of study participants.

	<b>Alcohol Dependent</b>	<b>Healthy Control</b>	<b>t[df]</b>	<b>p</b>
Subjects	20	21	-0.25[39]	0.80
male	15	15		
female	5	6		
Non-white	4	5	0.29 [39]	0.78
Age in years (SD)	37.95 (14.98)	38.65 (10.68)	0.31 [39]	0.76
Median sex acts = \$1000 (IQR)	10 (8,12)	8 (8,8)	-1.49[38]	0.14
Quick test (SD)	38.95 (5.73)	39.05 (6.01)	-0.08[39]	0.94
Years Ed (SD)	13.5 (1.72)	13.80 (2.55)	0.31 [39]	0.76
Income in USD (SD)	741 (\$729)	\$990 (\$1,204)	0.73 [39]	0.47

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