



Short communication

Delay discounting in opioid use disorder: Differences between heroin and prescription opioid users



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ABSTRACT

Background: Among those with opioid use disorder, heroin use is associated with poorer prognosis relative to use of prescription opioids alone. However, relatively little is known about distinguishing features between those who use heroin relative to those who use prescription opioids. In the present study we evaluated differences in delay discounting in those with opioid use disorder based on primary opioid of use. Delay discounting is associated with a range of negative outcomes and is an important therapeutic target in this population.

Methods: Treatment-seeking adults with opioid dependence completed self-report measures including past-month opioid use and the Monetary Choice Questionnaire (Kirby and Marakovic, 1996; Kirby et al., 1999), a measure of delay discounting. Participants were divided into two groups based on whether they used any heroin in the past 30 days or only prescription opioids, and delay discounting scores were compared between the groups. Group differences in sociodemographic or clinical variables were included in the analysis as covariates.

Results: Results from a forward stepwise linear regression indicated that heroin use was associated with significantly higher delay discounting ($B = -0.99$, $SE_B = 0.34$, $t = -2.88$, $p = 0.005$), even when considering covariates.

Conclusions: Adults with opioid dependence who exclusively used prescription opioids had lower delay discounting relative to those who used heroin. This finding contributes further to the literature suggesting that heroin use is associated with greater clinical severity among those with opioid use disorder.

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1. Introduction

The prevalence of heroin use and heroin use disorders has risen sharply in recent years, with the rate of past-year heroin use disorders almost doubling between 2002 and 2013 in the U.S. (Jones, 2013; Jones et al., 2015). Following years of increases in prescription opioid misuse, many new heroin users report having initiated opioid use with opioid analgesic medications (Cerda et al., 2015; Jones, 2013; Novak et al., 2016). The initiation of heroin use in this population is associated with a significantly poorer prognosis (Brands et al., 2004; Moore et al., 2007; Potter et al., 2013; Rosenblum et al.,

2007; Sigmon, 2006; Weiss et al., 2011). However, little is known about mechanisms that might explain differences between prescription opioid and heroin users, or facilitate the transition from prescription opioids to heroin.

One major difference between prescription opioids and heroin is that prescription opioids can be obtained legally for medical purposes. This may foster the belief that prescription opioids are less risky than heroin (Daniulaityte et al., 2012; Lord et al., 2011). Accordingly, greater impulsivity may be a distinguishing feature of those who use heroin relative to those who use only prescription opioids. Those who are more impulsive perceive risky behaviors to be less harmful (Arria et al., 2008; Doran et al., 2011; Robbins and Bryan, 2004), and may be more likely to engage in such behaviors, even adjusting for perceived risk (Ryb et al., 2006).

The tendency to over-value immediate relative to delayed reward, i.e., delay discounting, is a common feature of substance

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use and other addictive disorders (Bickel et al., 2014; MacKillop et al., 2011; Reynolds, 2006). Those with higher delay discounting act quickly on current needs, while devaluing future needs. This facet of impulsivity is particularly notable in opioid use disorder; heroin users not only show a dramatically larger preference for immediate rewards relative to healthy comparison samples (Kirby et al., 1999; Madden et al., 1997), but also have higher discounting rates compared to people who abuse alcohol, and rates similar to those who abuse cocaine (Kirby and Petry, 2004). Delay discounting has also been associated with negative treatment outcome in a variety of substance use disorder populations (MacKillop and Kahler, 2009; Stanger et al., 2012; Washio et al., 2011). However, only one published study has examined delay discounting among those who are dependent upon prescription opioids (Yi et al., 2007). To date, no published studies have examined differences in delay discounting between those with opioid use disorder who use prescription opioids vs. heroin.

The objective of the present study was to compare levels of delay discounting in a sample of adults with opioid use disorder, based on the type of opioid abused in the past month. We hypothesized that heroin users would show elevated delay discounting relative to prescription opioid users.

2. Methods

2.1. Participants

A sample of 151 participants seeking treatment for opioid use disorder was recruited from an inpatient detoxification unit as part of a larger study. In this sample, 139 participants completed the delay discounting measure. Eligible participants were 18 years or older, met *Diagnostic and Statistical Manual of Mental Disorders, 4th Edition* (American Psychiatric Association, 2000) criteria for opioid dependence, and were undergoing a buprenorphine stabilization and taper protocol as part of medical detoxification at the time of study participation. Exclusion criteria included presence of an acute psychiatric or medical disorder or cognitive impairment that would impede the ability to perform study procedures. Those with co-occurring substance use disorders and/or other non-acute psychiatric disorders were eligible to participate; no specific disorders were excluded.

2.2. Procedure

All procedures were approved by the local Institutional Review Board. Participants who provided written informed consent completed a battery of self-report questionnaires during one 30-min session.

Participants were categorized into one of three groups: 1) heroin users (heroin use on ≥ 4 days in the 30 days prior to hospitalization, with < 4 days of prescription opioid use during that time), 2) prescription opioid users (prescription opioid use on ≥ 4 of the 30 days prior to hospitalization, with < 4 days of heroin use during that time), or 3) combined heroin and prescription opioid users (≥ 4 days of both heroin and prescription opioid use in the 30 days prior to hospitalization).

2.3. Measures

Participants self-reported demographic information. Substance use disorder and other psychiatric diagnoses were extracted from participants' medical records.

The 17-item Brief Addiction Monitor (BAM; Cacciola et al., 2013) was used to collect information about past-month substance use. The BAM has shown good test-retest reliability as well as strong predictive validity (Cacciola et al., 2013).

The Monetary Choice Questionnaire (MCQ; Kirby and Marakovic, 1996; Kirby et al., 1999) is a 27-item self-report measure that was used to characterize participants' rates of delay discounting. Each item presents a choice between two monetary rewards—one smaller, immediate reward and one larger, delayed reward (e.g., "Would you prefer \$19 today or \$25 in 53 days?"). "Discounting rates," or k values, represent the rates at which individuals devalue rewards based on their delay, and can be inferred from individuals' patterns of choices across items. Estimation of k values was performed according to standardized scoring procedures that utilize Excel-based software (Kirby, 2000; Kirby et al., 1999). Inconsistencies in the data, such as nonsystematic discounting, are accounted for by estimating k using a participant's observed pattern of choices rather than his or her performance on a single item (Kirby, 2000). These procedures result in the k value that most likely gave rise to the observed data; these values can range from 0.00016 to 0.25, with higher k values indicating a stronger preference for smaller, immediate rewards and thus a more impulsive decision-making style. Consistent with previous literature (Kirby et al., 1999), k scores were log-transformed to approximate a normal distribution. The MCQ has demonstrated strong retest reliability (Kirby, 2009).

2.4. Data analysis

The three groups of study participants were compared on sociodemographic and drug use variables using univariate analysis of variance (ANOVA) for continuous variables and chi-square tests for categorical variables. Variables for which differences were statistically significant were added to the main study analysis.

These groups were then collapsed into two groups: prescription opioid use only and any heroin use. We then conducted a forward stepwise regression examining the association between opioid type and delay discounting (log-transformed k score). This approach was used to account for the potential confounding effects of covariates, while also mitigating concern about high overlap among independent variables.

3. Results

Descriptive statistics for sociodemographic and drug use variables are presented in Table 1. Based on self-reported opioid use in the 30 days prior to hospital admission, 60 participants (43.2%) were defined as heroin users, 33 (23.7%) were defined as prescription opioid users, and 46 (33.1%) were defined as combined users. The groups differed significantly with respect to age, education, current cigarette smoking, and diagnosis of a stimulant use disorder (see Table 1). Mean k scores for heroin users, combined users, and prescription opioid users were 0.095, 0.090, and 0.060, respectively; higher k scores denote greater delay discounting (see Fig. 1).

Because the heroin and combined users were similar in relation to both opioid use and sociodemographic characteristics, we collapsed these groups to reflect a single heroin-user group. This group was compared with the prescription opioid users, controlling for age, education, cigarette smoking, and diagnosis of a stimulant use disorder. The results of the regression indicated that only opioid group was associated with delay discounting ($B = -0.99$, $SE_B = 0.34$, $t = -2.88$, $p = 0.005$); all other variables were excluded from the model (p s ranged from 0.52 to 0.74). Specifically, delay discounting was significantly higher among those who used heroin relative to those who exclusively used prescription opioids.

4. Discussion

In a sample of adults hospitalized for opioid use disorder, we found that those who used heroin (whether with or with-

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