Novelty seeking as a predictor of treatment retention for heroin dependent cocaine users

Todd C. Helmus *, Karen K. Downey, Cynthia L. Arfken, Melinda J. Henderson, Charles R. Schuster

Research Division on Substance Abuse, Department of Psychiatry and Behavioral Neurosciences, School of Medicine, Wayne State University, 2761 E. Jefferson, Detroit, MI 48207, USA

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Abstract

This study examined the relationship between novelty seeking and treatment retention among heroin dependent cocaine users. Participants were treated with buprenorphine maintenance and contingency management. The Tridimensional Personality Questionnaire's (TPQ) Novelty Seeking scale was administered to 68 participants prior to buprenorphine induction. Demographics, mood and anxiety disorders, antisocial personality disorder, and substance use were also assessed. Variables with significant relationships with overall retention were entered into a logistic regression analysis. In addition, using a survival analysis, all variables with significant relationships with time to drop-out were entered into a multivariate proportional hazards regression with time dependent covariates. Results demonstrated that although high novelty seekers, in comparison to low novelty seekers, were more likely to drop-out by the end of treatment, they had higher retention rates during the early phases of treatment. It is suggested that buprenorphine and contingency management were viewed by participants as novel treatment components and thus facilitated high novelty seekers’ success early in treatment. If replicated, results suggest that inclusion of novel treatment components might facilitate retention among this at-risk group. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Novelty seeking; Anti-social personality disorder; Buprenorphine; Heroin dependence; Poly-drug use; Contingency management; Treatment outcome

1. Introduction

Numerous studies have attempted to identify variables predictive of opioid substitution treatment outcome. Unfortunately, these studies have found that gender, level of education, ethnicity, duration of dependence, and number of past treatment attempts are not systematically related to rates of abstinence or retention. Employment status and age fare better but are not robust predictors (Judson and Goldstein, 1982; McLellan et al., 1983; Iguchi and Stitzer, 1991; Magura et al., 1991; Kang and De Leon, 1993; MacGowan et al., 1996; Saxon et al., 1996; Torrens et al., 1996). Antisocial personality disorder (ASPD) is highly prevalent in individuals seeking opioid substitution therapy (Rounsaville et al., 1982a; Brooner et al., 1997) but its diagnosis does not appear strongly related to outcome (Alterman et al., 1982; Rounsaville et al., 1982b; Woody et al., 1985; Gill et al., 1992; Darke et al., 1994; Brooner et al., 1998). Consequently, there remains a need to identify variables that reliably predict treatment outcome.

In contrast to the above referenced variables, novelty- or sensation-seeking may predict treatment outcome on a more reliable basis. A commonly used measure of sensation seeking is the TPQ’s Novelty Seeking scale (Cloninger, 1987). This scale reflects an individual’s tendency toward intense exhilaration or excitement in response to novel stimuli, leading to frequent exploratory behavior and avoidance of monotony (Cloninger et al., 1991). The personality and behavior as measured by this scale are purportedly regulated by the dopaminergic system (Benjamin et al., 1996; Ebstein et al., 1996), a system believed to mediate drug-taking behavior.
Numerous studies have now documented a robust relationship between substance use variables and novelty seeking. Studies have repeatedly documented that alcohol and drug users score higher on the TPQ’s Novelty Seeking scale than non-drug and non-alcohol users (Limson et al., 1991; Bab-Milkic et al., 1995; Sher et al., 1995). Smokers also demonstrate high Novelty Seeking scores (Pomerleau et al., 1992). Furthermore, high scores on both the Sensation Seeking scale (Zuckerman, 1979) and the TPQ’s Novelty Seeking scale have been associated with increased severity of addiction (Muntaner et al., 1989; Ball et al., 1994). Data also suggest a link between the initiation of drug use and novelty seeking. In an important longitudinal study, 11 year olds rated high in novelty seeking were significantly more likely to manifest symptoms of alcohol abuse at age 27 (Cloninger et al., 1988). Additionally, 5th graders who reported an intention to use alcohol scored higher in sensation seeking than those who had no such intention (Webb et al., 1995).

Novelty- or sensation-seeking traits have also been associated with relapse to drug use. Meszaros et al. (1999) found that high scores on the Novelty Seeking scale predicted relapse in detoxified male alcoholics. Furthermore, in the first of two studies by McKay and colleagues, 95 cocaine dependent patients identified situational and intrapersonal factors associated with a prior relapse to cocaine use (McKay et al., 1995). McKay found three common ‘pathways’ to relapse, one of which identified state-dependent sensation seeking as a key precipitating factor. In a second study (McKay et al., 1999), 100 cocaine users were followed for 12 months following a 3- or 4-week treatment program. Results indicated that relapse and ‘near miss’ episodes (during which individuals came close to but did not use cocaine) were differentiated by increased levels of state-dependent sensation seeking the week prior to relapse.

Importantly, novelty seeking has been directly linked to treatment retention. Kravitz et al. (1999) demonstrated that individuals scoring higher on the TPQ Novelty Seeking scale were significantly more likely to drop out of an alcohol dependence treatment program. Novelty seeking was also associated with attrition in a clinical trial for the treatment of anxiety disorders (Wingerson et al., 1993).

The present study was designed to examine whether impulsivity and sensation seeking traits, as measured by the TPQ’s Novelty Seeking scale, were predictive of treatment outcome in a population of heroin dependent cocaine users. In addition, early reports employing a sub-sample of this population suggested that high novelty seekers performed comparably better in the early stages of treatment (Helmus et al., 1998) and worse during latter stages (Henderson et al., 1999). Such a relationship makes intuitive sense given that novelty seekers’ sensation seeking characteristics and aversion to monotony may drive them to stay in treatment during early phases, when treatment is new and interesting, but cause them to become bored as treatment continues. Consequently, a secondary purpose of this study was to characterize the predictive ability of novelty seeking as a function of time in treatment.

2. Methods

2.1. Participants

A total of 68 participants were recruited through local newspaper advertisements and word-of-mouth referrals. They met DSM-IV criteria for opioid dependence and agreed to participate in a 29-week treatment program that included voucher based reinforcement therapy (VBRT), buprenorphine maintenance, and individual and group cognitive behavioral therapy. To be eligible, the baseline urine test had to be positive for heroin and cocaine. A diagnosis of cocaine dependence was not required for participation in this study. All participants underwent a detailed medical exam and laboratory tests and were required to be in generally good health. Psychiatric evaluations were conducted via Structured Clinical Interview for the DSM-IV for Axis I (SCID-I; First et al., 1996a) and Axis II (SCID-II; First et al., 1996b) disorders. Participants with most DSM-IV Axis I diagnoses were allowed to participate, however candidates with current schizophrenia, bipolar disorder, dementia and delirium were excluded. All volunteers willing to participate signed and received a copy of the consent form for the study. This study was approved by the Human Investigation Committee (Institutional Review Board) of this institution.

2.2. Measures

The Tridimensional Personality Questionnaire (TPQ; Cloninger et al., 1991) was administered during the 1st week of treatment. The TPQ is a 100-item true/false paper-and-pencil test that assesses the three personality dimensions of Novelty Seeking, Harm Avoidance, and Reward Dependence (Cloninger et al., 1991). High Harm Avoidance reflects the tendency to be cautious, tense, and avoidant of aversive stimuli. Individuals high in Reward Dependence are extremely sensitive to reward cues, they seek social approval and their behavior is more resistant to extinction. The Novelty Seeking scale, previously described, is comprised of four sub-scales: Exploratory Excitability, Impulsiveness, Extravagance, and Disorderliness. The scores on this scale have been shown to be significantly correlated with Zuckerman’s Sensation Seeking scale (McCourt et al., 1993) and the Eysenck Personality Questionnaire’s Psychoticism scale (Sher et al., 1995). Sher et al. (1995)
have found that Cronbach alpha internal consistency estimates for the TPQ's scales range from 0.72 to 0.85 (Sher et al., 1995). Using the present population, our own evaluation of internal consistency reveals a similar range of 0.68–0.78. The 6-month test-retest reliability estimates range from 0.70 to 0.79 (Cloninger et al., 1991) and 2-week test-retest estimates range from 0.85 to 0.87 (Sher et al., 1995).

Several other measures were also administered to participants. The presence of a current diagnosis of a mood disorder (major depression or dysthymia), anxiety disorder, and cocaine dependence were gathered from SCID-I data. Also, the presence of ASPD was assessed with the SCID-II (First et al., 1996b). These semi-structured interviews were administered by a trained psychologist or clinical psychology graduate student. The Beck Depression Inventory (BDI; Beck et al., 1961) and the HIV Risk Assessment Battery (RAB) were administered during the 1st week of treatment. The RAB (Metzger et al., 1993) is a self-report measure which quantifies high risk behavior for HIV infection within the previous 6 months. There are subscores of drug and sex related risk behaviors.

2.3. Procedures

2.3.1. Medication

Buprenorphine hydrochloride:naloxone hydrochloride tablets were provided by Reckitt and Colman (Hull, England) through the Research Triangle Institute and the National Institute on Drug Abuse. The tablets used were 8 mg buprenorphine HCl:2 mg naloxone HCl and 2 mg buprenorphine HCl:0.5 naloxone tablets (Suboxone tablets), administered sublingually.

Prior to detailing the dosing procedures, it is important to note that an option of an increased dose at week 4 was introduced into the study at the approximately half-way point of subject recruitment. Previous research examining the dose efficacy of buprenorphine has been primarily based on a sublingual liquid form of the medication. However, recent studies have demonstrated that the bioavailability of the tablet form, utilized in this study, is only 65% of that of the liquid form (Schuh and Johanson, 1999). Consequently, a decision was made to allow for higher doses when participants showed evidence of continued illicit opiate use. Therefore, the last 38 (55.9%) participants enrolled in this study received increased buprenorphine doses if they remained opiate positive in week 4. Comparisons on treatment retention between the 31 individuals who did not have the option of a dose increase and the 38 individuals who did revealed no significant differences.

During week 1 (visits 1–7), buprenorphine dose was gradually increased up to 8 mg administered daily. During weeks 2–17, participants reported to the clinic only three times per week for dosing. Participants were dosed 16 mg on Monday and Wednesday and 24 mg on Friday (due to medication side-effects three participants were given lower doses). Of the 38 participants given the option of a dose increase, 18 (47.4%) individuals met criteria for dose increases. Of these 18 participants, 16 had their dose increased to 32 mg on Monday and Wednesday and 48 mg on Friday and held constant thereafter. Only two participants requested intermediate dose increases resulting in a dosing schedule of 24 mg on Monday and Wednesday and 32 mg on Friday.

2.3.2. Treatment description

Participants had weekly individual therapy beginning at week 2 and group therapy during weeks 6–17. Individual therapy utilized a combined cognitive behavioral and motivational enhancement approach adopted from manuals used in Project MATCH (Kadden et al., 1995; Miller et al., 1995). Group therapy was adapted from a manualized therapy developed by Robert Brooner at Johns Hopkins University.

2.3.2.1. Treatment conditions. At week 6, participants remaining in the study (n = 49) were assigned to one of three behavioral treatment conditions: voucher based reinforcement therapy (VBRT; n = 20), reduced value VBRT (rVBRT; n = 9) and a yoked control (YC; n = 20) group. The VBRT and rVBRT conditions were modeled after Higgins et al. (1994). In the VBRT conditions, participants would earn vouchers redeemable for merchandise in return for urine specimens negative for both heroin and cocaine. The value of vouchers escalated for each consecutive drug free urine sample produced. The rVBRT condition was similar to the VBRT condition with the exception that voucher values were reduced by ~40%. Each YC participant was linked in sequential manner to a VBRT participant. The YC participant received vouchers of the same value and frequency as their yoked counterpart but independent of his/her own urinalysis results. An analysis comparing the treatment outcomes of these three groups demonstrated that there were no significant differences in either retention or abstinence (Downey et al., 2000). Consequently, for the purposes of the present investigation, these groups were combined.

Following the active treatment phase, a standard maintenance phase was continued from week 18 through week 29. Vouchers were no longer issued during this time period and participants were not required to attend group therapy. For these reasons, the focus of the present study is on the first 17 treatment weeks.

2.4. Data analysis

In collaboration with our statistician, Novelty Seeking scores were examined both as a continuous measure and as a categorical variable. Although results for the
two approaches were similar, use of the median split was preferred as the survival plot of the quartiles did not meet the assumption of a monotonic increase as would be expected if there was a linear relationship between Novelty Seeking scores and time to drop-out (i.e. the two highest quartile lines were clearly separated from the two lowest quartile lines of the survival analysis but both ends of the quartiles were indistinguishable from each other). Thus, there was no loss in variability by the dichotomization of novelty seeking. To be consistent, we used the median split for the analysis of overall retention. Finally, we believe this dichotomization affords greater clinical utility as it is easier to classify those scoring ‘high’ and ‘low’ than those with minor score differences.

novelty seeking status (high vs. low) was the independent variable and treatment retention was the dependent variable. For the analysis of sample characteristics, means and standard deviations were calculated. When variables met the assumptions of normality and homoscedasticity, Pearson product moment correlations and independent sample t-tests were utilized. When variables failed to meet these assumptions, Spearman correlations and the Mann–Whitney U statistic were conducted. When dependent variables were dichotomous, chi-square analyses were conducted.

A chi-square statistic was utilized to characterize the relationship between retention status (completed vs. dropped-out by week 17) and novelty seeking (high vs. low). Further bivariate comparisons were performed to determine whether treatment condition (for this purpose VBRT and rVBRT conditions were combined and compared with the YC group), whether participants were enrolled in the study at the time dose increases were afforded (dosing increase option), and whether other previously studied predictor variables were also related to retention. These other variables, simply referred to as additional predictor variables, included demographics (age, gender, ethnicity, marital status, education, employment), psychiatric variables (BDI, ASPD diagnosis, a diagnosis of a mood/anxiety disorder), substance use variables (a diagnosis of current cocaine or alcohol dependence and the number of days of cocaine use 30 days prior to treatment) and the TPQ’s Harm Avoidance and Reward Dependence scale scores. The variables found to have at least a trend relationship ($P < 0.10$) with overall retention status were then entered into simultaneous entry logistic regression analyses. Given that the purpose of this paper was to determine whether novelty seeking predicted outcome above and beyond that of the other studied variables, block-wise entry was utilized. The treatment condition, dosing increase option, and additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales) were entered on block number 1 and novelty seeking was entered on block number 2.

To assess the relationship between novelty seeking and the time to drop-out (an alternative measure of retention), survival analysis was conducted using proportional hazards regression with time-dependent covariates. The outcome event was whether or not a person dropped out before the end of week 17, and the timing variable was the number of weeks in treatment. In addition to novelty seeking, treatment condition, dosing increase option, and the additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales) were also assessed in this manner. All variables with trend ($P < 0.10$) bivariate associations with retention were entered into a multivariate simultaneous entry proportional hazards model regression survival analysis. When significant, the additional predictor variables, treatment condition, and dosing increase option were entered into block number 1 and novelty seeking in block number 2. Data are presented in terms of the $-2 \log$ likelihood ($–2LL$) and adjusted hazards ratio ($\text{HR}_\alpha$).

### 3. Results

#### 3.1. Sample characteristics

A description of this study’s sample is provided in Table 1. For the entire sample, the mean score ($\pm$ S.D.) on the TPQ Novelty Seeking scale was $16.8 \pm 4.7$. For purposes of establishing concurrent validity, the relationships between novelty seeking and several other variables were evaluated. As expected, participants with

<table>
<thead>
<tr>
<th>Characteristics of the sample ($n = 68$)</th>
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<tr>
<td><strong>Demographics</strong></td>
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<tr>
<td>Age (mean $\pm$ S.D.)</td>
</tr>
<tr>
<td>Male (%)</td>
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<tr>
<td>African-American (%)</td>
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<tr>
<td>High-school education or above (%)</td>
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<tr>
<td>Employed (%)</td>
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<tr>
<td>Married/cohabitating (%)</td>
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<tr>
<td><strong>Psychiatric diagnosis</strong></td>
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<td>Major depression current (%)</td>
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<tr>
<td>Dysthymia (%)</td>
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<tr>
<td>Any anxiety disorder (%)</td>
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<tr>
<td>Mood/anxiety disorder current (%)</td>
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<tr>
<td>Antisocial personality disorder (%)</td>
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<tr>
<td><strong>Substance use diagnosis (current)</strong></td>
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<tr>
<td>Opiate dependence (%)</td>
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<tr>
<td>Cocaine dependence (%)</td>
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<td>Alcohol dependence (%)</td>
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<td>Other diagnosis of dependence (%)</td>
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* ASPD diagnosis is missing for one participant.
ASPDP scored higher on novelty seeking than those without ASPDP (18.9 ± 5.1 vs. 16.0 ± 4.4; t = 2.24, d.f. 65, P < 0.05) and Caucasians scored higher than African-Americans (18.5 ± 5.3 vs. 16.1 ± 4.4; t = 1.93, d.f. 66, P < 0.05). Novelty seeking also showed a significant and inverse relationship to age (r = −0.28, P < 0.05). Finally, although the Risk Assessment Battery’s (RAB) Sex scale was unrelated to novelty seeking, there was a significant and direct relationship between Novelty Seeking and the RAB Drug scale (r = 0.32, P < 0.01).

In terms of novelty seeking’s dichotomous split, high novelty seeker’s average score on this measure was 20.8 ± 3.1 (n = 32) while the low novelty seeking group’s score was 13.2 ± 2.6 (t = 11.17, d.f. 66, P < 0.001). For treatment exposure, the percent of counseling sessions attended was comparable for high and low novelty seekers (42.1 ± 29.5 vs. 43.8 ± 33.6%, respectively; t = 0.22, d.f. 66, NS). In addition, of the 38 individuals who were afforded the option of a medication dose increase, the percentage of high and low novelty seekers actually meeting criteria for an increase was comparable (43.8% (n = 7) vs. 50% (n = 11); χ² = 0.15, d.f. 2, NS).

3.2. Retention

A total of 25 participants (36.8%) were successfully retained during the 17-week treatment period, while 43 participants dropped out of the study. High novelty seekers had significantly higher drop-out rates than low novelty seekers (78.1 vs. 50.0%; χ² = 5.76, P < 0.05; Fig. 1). Bivariate comparisons between retention and the additional predictor variables also demonstrated that younger participants tended to have higher drop-out rates (t = 1.79, d.f. 66, P = 0.08). Neither treatment condition, dosing increase option, nor any of the other additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales) were associated with retention status. Those variables with significant relationships with retention were then entered into a sequential simultaneous entry logistic regression model. Age was entered into block 1, and novelty seeking into block 2. The first block resulted in a model χ² of 3.31 (d.f. 1, P < 0.10). When novelty seeking was added there was a significant model χ² improvement (4.04; d.f. 1, P < 0.05). In this final model, age was non-significant (B = 0.05; Wald = 1.36; NS) while high novelty seeking significantly predicted overall drop-out (B = 1.10; Wald = 3.87; P < 0.05). In particular, the odds of dropping out of treatment were 3.01 (95% CI 1.01–9.03) times greater for high than low novelty seekers.

In line with Kravitz et al. (1999), models containing interaction terms for novelty seeking by treatment condition and by dosing increase option were examined. These models were non-significant, demonstrating that the relationship between novelty seeking and drop-out rate was similar among both treatment conditions and dosing option conditions.

Next, a survival analysis was conducted to assess the relationship between novelty seeking and time to drop-out. For bivariate analysis, all variables were assessed in a proportional hazards model. This analysis demonstrated no significant effects of novelty seeking, treatment condition, dosing increase option, or additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales). A proportional hazards model with time dependent covariates was then utilized to assess the potential changes in the impact of variables over time. For each variable, time dependent covariates, along with their respective main effects, were entered simultaneously into independent models. The model including the novelty seeking and novelty seeking by time interaction was significant (−2LL = 330.50; overall χ² = 11.67, d.f. 2, P < 0.01). For the additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales), only the model including the age and age by time interaction was statistically significant (−2LL = 319.32; overall χ² = 11.36, d.f. 2, P < 0.01). The models including the treatment condition by time interaction and the dosing increase by time interaction were both non-significant. The novelty seeking and age interactions were then entered into a proportional hazards regression model with the age and age by time interaction entered into block 1 and the novelty seeking and novelty seeking by time interaction into block 2. Block one resulted in a −2LL of 19.32 and an overall χ² of 11.35 (d.f. 2, P < 0.01). When novelty seeking and the novelty seeking by time interaction were added, there was a significant change in −2LL from the previous block (−2LL = 8.15, d.f. 2, P < 0.05; Table 2). Results of this analysis demonstrated that while there was no
significant main effect, there was a significant interaction between novelty seeking and time in treatment. As shown in Fig. 2, high novelty seekers showed higher retention rates than low novelty seekers early in treatment but this effect reverses during the 8th week of treatment. As with novelty seeking, there was no main effect for age but there was a significant age by time interaction. These results indicate that during the early stages of treatment, older participants experience decreased retention rates in comparison to younger participants but younger participants drop-out more frequently later in the study.

To determine whether novelty seeker’s time to drop-out varied as a function of either treatment condition or dosing increase option, these variables were entered as interaction terms with novelty seeking. These interactions were non-significant.

4. Discussion

Results demonstrate that individuals who are high in novelty seeking are more likely to drop-out over the entire course of a 17-week clinical trial for heroin dependent cocaine users. However, high novelty seekers were more likely than low novelty seekers to be retained during the early phases of treatment and were more likely to drop-out during the later phases.

Only one of the additional predictor variables (psychiatric variables, substance use variables, demographics and TPQ Harm Avoidance and Reward Dependence scales) in the present study was related to retention. Specifically, there was an age by time interaction for the survival analysis on the time to drop-out. That is, early in treatment, older participants experienced higher drop-out rates in comparison to younger participants, but by week 10 this effect had reversed. Although this study had the power to detect significant differences for novelty seeking and age, the study’s small sample size may not have allowed for adequate statistical power in detecting smaller but possibly important differences for other predictor variables. Therefore, implications based on this study’s negative findings should be limited. To our knowledge, however, this is the first study to examine age, novelty seeking, and any other predictor variable in terms of their interactions with time. The results suggest a provocative idea, that the weight and direction of risk factors for poor treatment outcome vary with time in treatment. Further, the conclusions one reaches regarding progress in treatment may vary depending on when treatment outcome is accessed. Analyses using time-dependent covariates may be fruitful in future studies examining time to relapse.

The results of the present study demonstrating that high novelty seekers are at greater risk for treatment attrition have been previously demonstrated in different populations. Kravitz et al. (1999) is the only known study to examine novelty seeking and retention in a substance abuse treatment population. In this clinical trial for alcohol dependence, every one point increase in the Novelty Seeking score increased the odds of drop-out by 7%. Wingerson et al. (1993) examined patients in a clinical trial for anxiety disorders and found that drop-outs scored higher in novelty seeking than those who were retained. Although unrelated to retention per se, Meszaros et al. (1999) found that high scores on the Novelty Seeking scale predicted relapse in detoxified male alcoholics. Clearly, more studies are needed to confirm these findings. However, the initial agreement between several different studies suggests that high novelty seeking appears to be an important and possibly consistent risk factor for poor treatment retention across a range of mental health and substance use disorders.

The identification of a variable that systematically predicts treatment attrition is important. Successful retention in opioid substitution therapy has been associated with a decrease in HIV risk behavior (Meandzija

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**Table 2**

Model improvement (change in \(-2\text{LL}\)) when novelty seeking is added to the block-wise proportional hazards survival analysis

<table>
<thead>
<tr>
<th></th>
<th>HR(_a)</th>
<th>95% CI</th>
<th>Wald</th>
<th>(P)-value</th>
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<tbody>
<tr>
<td>Novelty seeking</td>
<td>0.50</td>
<td>0.15–1.64</td>
<td>1.32</td>
<td>NS</td>
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<tr>
<td>Novelty seeking × time</td>
<td>1.20</td>
<td>1.02–1.40</td>
<td>4.98</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Age</td>
<td>1.09</td>
<td>1.00–1.19</td>
<td>3.64</td>
<td>NS</td>
</tr>
<tr>
<td>Age × time</td>
<td>0.99</td>
<td>0.98–0.99</td>
<td>6.67</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

\(a\) CI, confidence interval; HR\(_a\), adjusted hazards ratio. Age and age × time interaction was entered in block 1 with novelty seeking and novelty seeking × time interaction in block 2. All other variables were excluded from analysis due to non-significant associations with retention. For block 2, the change in \(-2\text{LL}\) from block 1 was 8.15 (d.f. 2, \(P<0.05\)).

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**Fig. 2.** Survival curve of retention as a function of novelty seeking status. High novelty seekers show higher retention rates early in treatment and lower retention rates during treatment’s latter phases.
The novelty of the treatment protocol itself may possibly account for the high novelty seekers' initially good treatment response. To this end, unlike the daily dosing required by methadone maintenance treatment, our protocol allowed participants to dose only three times per week. Buprenorphine maintenance therapy was also new to the Detroit area when the study began. Furthermore, since buprenorphine was not an FDA approved medication for the treatment of heroin dependence it was necessary to state in the informed consent form that it was an experimental medication. Consequently, buprenorphine's novelty may have resulted in the medication being perceived by participants as being somewhat risky. This was evidenced during consenting procedures where many individuals were vocal in their concern regarding their use of an 'experimental' drug. Thus, individuals who were high in novelty seeking may have been more likely to stay in the study during the early phases out of an interest in experiencing what might be considered a novel/experimental medication. Furthermore a relatively complex set of contingencies were scheduled to take effect after the 6th week of treatment so individuals high in novelty seeking may have been motivated to stay in the study long enough to experience the contingency procedure. Once participants had ample opportunity to experience the medication and the contingency was in place for several weeks, these patients may have become disenchanted and bored with therapy and so began dropping out at disproportionate rates.

In addition, although the treatment protocol may have had a role in influencing treatment outcome, there does not appear to be any evidence that this biased the treatment sample itself. For example, the average Novelty Seeking score of this poly-drug using sample (16.8), while higher than normative values (range from 12.0 to 13.7; Cloninger et al., 1991) was still comparable to the scores of other substance using populations such as drug users (16.3 ± 4.98; Nagoshi et al., 1992), alcoholics (18.1 ± 5.6; Kravitiz et al., 1999) and smokers (16.8 ± 5.2; Pomerleau et al., 1992). In addition, our rate of ASPD (25.4%) was similar to those documented in several other investigations (Rounsaville et al., 1982a; Brooner et al., 1997), and our demographic and psychiatric characteristics are comparable to those seen in our own methadone maintenance program (unpublished data). Consequently, there do not appear to be any measurable deficits concerning the generalizability of this sample.

It is important to note several weaknesses of the present study. First, this study, despite its utilization of a powerful contingency management treatment paradigm, suffered from a relatively high drop-out rate. By week 17, 63% of the original sample had dropped out. Although it is well known that cocaine use during maintenance therapy is a risk factor for poor treatment outcome and retention (Kolar et al., 1990; Condelli et al., 1991; Yancovitz et al., 1991), the specific reasons for poor retention in the present study are unknown. Nonetheless, it is unclear if these results would transfer to a study with greater treatment success. In addition, there is no direct evidence of our 'novel' treatment hypothesis. A control group consisting of a standard methadone maintenance population would have been advantageous in demonstrating whether these results were a function of participants' perception of treatment. Furthermore, we did not collect any standardized information pertaining to the perception of buprenorphine or voucher based reinforcement therapy or to individual's familiarity with these treatments. Consequently, these conclusions remain speculative at this time.

If the results of this study can be replicated then such findings may have important treatment implications. If novelty seeking individuals can be engaged early in treatment then they may have improved opportunities for long-term success. One possible means of engagement may be to introduce novel stimuli into the treatment protocol. Such stimuli may include periodic changes in the treatment protocol itself or other types of changes that make the treatment experience new and interesting. In fact, a previous review (Bardo et al., 1996) on novelty seeking suggested that treatments may benefit from protocols that utilize novel stimuli to improve treatment outcome.
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