Published in final edited form as:
Pers Individ Dif. 2009 March 1; 46(4): 454–459. doi:10.1016/j.paid.2008.11.018.

Risk-Taking Propensity Changes Throughout the Course of Residential Substance Abuse Treatment

Will M. Aklin, Ph.D.[1], **Matthew T. Tull, Ph.D.**[2], **Christopher W. Kahler, Ph.D.**[3], and **C.W. Lejuez, Ph.D.**[4]

[1] Department of Psychiatry and Behavioral Sciences, Behavioral Pharmacology and Substance Abuse, Johns Hopkins University School of Medicine, Baltimore, MD, USA

[2] Department of Psychiatry and Human Behavior, University of Mississippi Medical Center, Jackson, MS, USA

[3] Center for Alcohol and Addiction Studies, Brown University, Providence, RI, USA

[4] Center for Addictions, Personality, and Emotion Research and the Department of Psychology, University of Maryland, College Park, MD, USA

Abstract

High rates of relapse following treatment have compelled researchers to elucidate the individual difference factors that change among those who receive substance abuse treatment. Previous research has suggested that trait-disinhibition variables may be of particular relevance. Given that these variables are primarily considered to be trait-level factors, the extent to which they are malleable by treatment is an important consideration. Thus, the purpose of this study was to examine the effect of a residential substance abuse treatment program on specific trait-disinhibition variables (e.g., risk-taking, impulsivity). A sample of 81 inner-city substance users were assessed on self-report and behavioral indicators of trait-disinhibition over a 30-day course of treatment. Risk-taking propensity was found to significantly decrease from pre- to post-treatment. Results are discussed with respect to implications for better understanding the factors that may operate as mechanisms of change during treatment, thereby having the potential to inform substance abuse prevention and treatment programs.

Keywords

Risk-taking behaviors; assessment; substance abuse; treatment; trait-disinhibition

To whom correspondence should be addressed: Will M. Aklin, Ph.D., Johns Hopkins University School of Medicine, Department of Psychiatry and Behavioral Sciences, Behavioral Pharmacology and Substance Abuse, 5510 Nathan Shock Drive, Baltimore, MD 21224-6823, Phone: (410) 550-5370, Fax: (410) 550-7495, Email: waklin1@jhmi.edu.
Dr. Aklin is now at the National Institute on Drug Abuse, Behavioral and Integrative Treatment Branch, 6001 Executive Boulevard, Rm. 3150, Bethesda, MD 20892-9551; Phone: (301) 443-3207; Fax: (301) 443-6814; E-mail: aklinwm@mail.nih.gov

A portion of this manuscript was presented at the 41st annual meeting of the Association for Behavioral and Cognitive Therapies (ABCT) in Philadelphia, PA.

1. Introduction

Despite widespread advances in the assessment, prevention, and treatment of substance abuse and dependence, substance use-related problems continue to be prevalent and pose a tremendous cost to health, quality of life, and society (McLellan, Lewis, O'Brien, & Kleber, 2000). Therefore, a substantial body of research has focused on developing and evaluating treatments for substance abuse. Although substance abuse treatment has been found to be effective in facilitating abstinence for many individuals (Winters, Fawkes, Fahnhorst, Botzet, & August, 2007), inner-city, ethnic-minority substance abusers have been found to experience greater and more severe levels of substance abuse, placing them at heightened risk for treatment failure (relapse) than other subpopulations (Aklin et al., 2005). Consequently, researchers have attempted to elucidate the individual difference factors that are amenable to change (and thus can be targeted) among those in substance abuse treatment.

Trait-disinhibition variables (i.e., personality and temperamental characteristics) are hypothesized to play a key role in the development and maintenance of substance use behaviors (Krueger et al., 2002). Current research focusing on substance dependent populations generally recognizes that variables along the trait-disinhibition continuum work independently, as well as in combination, to constitute vulnerability for problematic substance use (Eysenck, Pearson, Easting, & Allsopp, 1985). Specifically, these determinants of trait-disinhibition have been found to be composed of several dispositional constructs (Krueger et al., 2002), as indexed by self-report and laboratory tasks of lower order factors, including impulsivity and risk-taking propensity.

Although several definitions of impulsivity have been proposed (Evenden, 1999), it is commonly referred to as the tendency to enter into situations or rapidly respond to cues for potential reward without much planning or deliberation and without consideration of potential punishment (Eysenck et al, 1985). Impulsivity also has been thought of as involving the choice of a smaller immediate reward over a larger delayed reward (i.e., delayed discounting). Risk-taking propensity, on the other hand, involves one's decision to engage in a particular behavior that balances the probability of positive or negative consequences (Leigh, 1999). Risk-taking propensity has been found to share common characteristics with impulsivity and other static personality traits (sensation seeking), but also has distinguishable features. For example, one could engage in risky behavior impulsively in the heat of the moment with risk-taking representing the behavioral manifestation of impulsivity or, conversely, with forethought and/or planning where risk-taking occurs at least somewhat independently of impulsivity.

Research suggests that the constructs of impulsivity and risk taking propensity differ in underlying neurobiological processes. Impulsivity relates to reduced ability to withhold approach behavior in the presence of reward-related stimuli (Brady, Myrick, & McElroy, 1998); risk taking propensity relates to sensitivity to reward stimuli and, consequently, to the approach behavior itself. Despite these differences, empirical evidence indicates that impulsivity and risk taking propensity work in concert to create a vulnerability to various risk behaviors, including substance use in general (Tarter et al., 2003).

Beyond their role in the development of substance use behaviors, risk-taking propensity and impulsivity also may increase due to chronic substance use and associated behaviors. Although little empirical evidence currently exists, one may conversely hypothesize that substance use treatment should be associated with a decrease in these constructs. Despite the apparent contribution of impulsivity and risk-taking propensity in the development and maintenance of substance use, few studies have examined whether these variables actually change as a function of abstinence/treatment, especially in regard to standard residential substance abuse treatments that serve the high-risk group of inner-city substance users (Lejuez et al., 2004). From a

theoretical perspective (with a social-cognitive model focus), trait-disinhibition variables might be amenable to change through treatment given the focus of behavioral treatments that target skill-based learning (e.g., decision making and problem solving).

In addition to providing information on an understudied population, the use of a residential treatment program provides an optimal setting for evaluating changes as behavioral confounds (substance use) can be controlled, and the natural changes during abstinence can be measured within a reliable and valid manner. Accordingly, the current study examined changes on impulsivity and risk-taking propensity within inner-city substance abusers over a 30-day course of treatment. It was expected that treatment participation would correspond with a decrease in scores on disinhibition-related domains (separate from practice effects of repeated administration of measures).

2. Method

2.1 Participants

Participants were patients admitted to a 136 bed, non-profit residential substance abuse treatment facility in Northeast Washington, D.C. A total of 81 consecutive admissions between the ages of 18-56 years without current psychotic symptoms participated in this study (see Table 1 for participant demographic characteristics). Participants were two-thirds male, 95% African American, average age was in the late 30's, and most only had a high school education.

2.2 Measures

2.2.1. Self-report Measures—To measure and account for individual differences, participants provided basic demographic information (e.g., age, gender, education level, occupation, and socioeconomic status).

The *Drug Use Questionnaire* (DUQ; Grant, Contoreggi, & London, 2000) was used to assess the extent of participants' polysubstance use across 11 different types of drugs: (1) cannabis, (2) alcohol, (3) cocaine, (4) MDMA, (5) stimulants, (6) sedatives, (7) opiates, (8) hallucinogens (other than PCP), (9) PCP, (10) inhalants, and (11) nicotine. Specifically, participants were asked if they have ever used a particular drug in their lifetime, how often they used it in the past year prior to treatment, and how often they used the drug during the period of their life when they were using it most frequently. The latter two questions were based on a 6-point scale: “never,” “one time,” “monthly or less,” “2 to 4 times a month,” “2 to 3 times a week,” and “4 or more times a week.”

The *Eysenck Impulsivity Scale* (EIS; Eysenck, Pearson, Easting, & Allsopp, 1985) is a 54-item forced choice (i.e., *yes* or *no*) measure that taps impulsiveness (19 items), venturesomeness (16 items), and empathy (19 items). The current study utilized only the impulsiveness subscale. Internal consistency for this scale was adequate ($\alpha = .72$).

2.2.2. Behavioral Tasks—The *Balloon Analogue Risk Task* (BART; Lejuez et al., 2002) was administered to assess risk-taking propensity. This behavioral task has been successfully used to describe currently occurring risk behaviors in young adults (Lejuez et al., 2002). At the start of the BART, the computer screen displayed four items: a small balloon accompanied by a balloon pump, a reset button labeled “Collect $$$,” a “Total Earned” display, and a second display labeled “Last Balloon” that listed the money earned on the last balloon. With each pump, money (5 cents per pump) was accumulated in a temporary bank. When a balloon exploded, all money in the temporary bank was lost, and the next uninflated balloon appeared on the screen. The participant could stop pumping the balloon at any time and click the “Collect $$$” button. A new balloon appeared after each balloon explosion or money collection until

a total of 30 balloons (trials) were completed. The probability that a balloon would explode was 1/128 for the first pump, 1/127 for the second, and so on until the 128th pump at which point the probability was 1/1. Modeling real-world situations in which excessive risk often produces diminishing returns and increasing threats to one's health and safety, each successive pump on any particular balloon trial (a) increased the amount to be lost due to an explosion and (b) decreased the relative gain of any additional pump.

Whereas instructions provided to the participant were based on those provided by Lejuez et al. (2002), the current version of the task did provide information that differed from the standard version to minimize a learning component to the task. Specifically, when participants were instructed to pump the simulated balloon to earn as much money as possible, taking into consideration that the balloon can pop at any time; they also were told a balloon could pop between 1 and 128 pumps and an average balloon will pop at 64 pumps. This latter information was given in order to examine the extent to which risk-taking on the task would change despite having relevant information about actual risk before and after treatment.

Although there are several potential dependent measures, we analyzed the adjusted number of pumps across balloons (BART score). This adjusted value, defined as the average number of pumps on balloons that did not explode, is preferable to the unadjusted average because the number of pumps is necessarily constrained on balloons that exploded, thereby limiting between-participant variability in the unadjusted averages.

The *Delay Discounting Procedure* (DDP; Kirby & Marakovic, 1996) provides a measure of the degree to which an individual shows preference for either small, immediate rewards or larger, delayed rewards, which may be stated as the rate at which the subjective value of deferred rewards decreases as a function of the delay until they are received. Specifically, participants are asked to make hypothetical choices between receiving a small amount of money immediately, and receiving a larger amount of money after a delay. Impulsivity is quantified using a hyperbolic discounting function generated by choice responses. Previous research has shown that individuals' discount curves are well described by the following hyperbolic discount function: $V = A / (1+kD)$ where V is the present value of the delayed reward A at delay D, and k is a free parameter that determines the discount rate. All delays are measured in days, and the values of k are scaled accordingly. As k increases the person discounts the future more steeply. Therefore, k can be thought of as an *impulsiveness parameter*, with higher values corresponding to higher levels of impulsiveness. At the start of the study, participants were shown a copy of the DDP and a verbal presentation of the instructions was given; a written version of the instructions also was provided at the top of the measure.

2.3. Treatment Program and Structure

Treatment at the center from which participants were recruited involves a mix of strategies adopted from Alcoholics and Narcotics Anonymous as well as group sessions focused on relapse prevention and functional analysis. With regard to the latter, patients are asked to identify thoughts, feelings, behaviors, consequences, and circumstances before and after the drug use or other target behavior (depressed mood). This functional analysis plays a critical role in helping patients assess the determinants, or high-risk situations that are likely to lead to substance use, thus providing insight into some of the reasons why an individual may use substances. Additionally, patients are encouraged to extinguish old habits and learn or relearn healthier skills and habits. Substance abusers in the program are taught these skills as both specific (applicable in the here and now) and general strategies that can be applied to a variety of other problems. Furthermore, patients also undergo standard community-based 12-Step mutual help programs, including AA and NA. Typical components of these treatments include (1) social and recreational counseling, (2) employment counseling, (3) drug refusal training, (4) anger management, and (5) relaxation training.

Complete abstinence from drugs and alcohol is required upon entry into the center and through the duration of the program, with the exception of caffeine and nicotine; regular drug testing is provided and any drug or alcohol use results in immediate dismissal from the center. When needed, detoxification from an outside source is required prior to entry into the center. Typical treatment lasts between 30 and 180 days, and aside from scheduled activities (group retreats, physician visits), residents are not permitted to leave the center grounds during treatment. All participants in this study were scheduled for 30 days of treatment. During the final stages of the residential program, the focus shifts outward, supporting the patient to make independent employment and living arrangements. The training level of staff at the program includes a range of doctoral and master's level clinicians and certified substance abuse counselors.

2.4. Procedures

Procedures for this study were approved by the University of Maryland's Institutional Review Board.

2.4.1. Stratification and Random Assignment—Participants were recruited into the study when they first enrolled at the treatment facility. Each participant was asked if they would like to participate in a study examining changes in behavior and personality. All participants enrolled in the study began by providing informed consent and completed a basic demographics form, including a thorough description of the study. Participants were then randomly assigned to a Pre-post assessment group (n = 41) or a Post-assessment Only group (n = 40), using a stratification procedure. This design was done to allow within- and between-group comparisons and eliminate the possibility of pre-testing effects (Kazdin, 2003). This initial assessment session for participants occurred during a 3-day window (3rd through 5th day at the center) so that the study would not interfere with standard treatment intake procedures. In addition to off-site detoxification *prior* to entering the center on an as needed basis, this time frame allowed adequate time for acclimation to the center and to further ensure that the patient's acute withdrawal symptoms had subsided.

2.4.2. Pre-post Assessment Group—Upon entry into the study, 41 participants assigned to the Pre-post assessment group completed a battery of questionnaires to assess demographics, drug use history, impulsivity, and behavioral measures, including the BART and DDP.

After participants completed questionnaires and the behavioral tasks, they were told the amount of money they had earned, ranging from $10-$20 based on their performance on the BART, and were asked to sign a receipt. Money earned from the study was deposited in the participants' account at the facility on the next business day. Participants were not allowed to access their money until discharge from the facility. Each session lasted no more than 60 minutes. Study participants were reassessed on one of their last 3 days of treatment (28th, 29th or 30th day at the center). Procedures for the post-assessment were consistent with those used for the pre-assessment.

2.4.3. Post-assessment Only Group—Participation in the Post-only group was exactly the same as the 30-day reassessment given to the Pre-post group. Specifically, 40 participants provided informed consent and completed the demographic questionnaire at pre-treatment and the remaining questionnaires at post-treatment. Reimbursement procedures were the same as those used for the Pre-post assessment group.

3. Results

3.1. Data Analysis Plan

Data analyses were focused on examining the extent to which scores on behavioral and self-report measures assessing disinhibition-related constructs change across participation in 30 days of residential treatment. First, to examine the extent to which scores across each domain decreased as a function of treatment, separate paired t-tests were used as the primary test of significance. Next, we examined the extent to which changes from pre- to post-treatment were due to the practice effects of repeated administration of measures. Specifically, between-groups analyses of variance (ANOVAs) were used to compare post-treatment scores from the Pre-post group to the Post-only group. All *p* values were 2-tailed and the statistical significance threshold was set at $p < 0.05$.

3.2. Preliminary Analyses

Descriptive data for demographic variables and primary variables of interest at pre-and post treatment for both groups are provided in Table 1. Comparisons indicated that individuals assigned to the Pre-post group and Post-only group were not significantly different from each other on demographic characteristics, including age, gender, marital status, total household income, employment status, and education[1]. For polysubstance use, no significant differences were found (Table 1).

3.3. Within-Group Comparisons of Risk-Taking Propensity for Pre-post Group

To examine whether risk-taking propensity decreased from pre- to post-treatment, paired *t*-tests were conducted. Results indicated a significant decrease on BART score from pre- to post-treatment. However, no significant changes were found for delay discounting or Eysenck impulsiveness. Findings suggest a general change (decrease) on BART scores from pre- to post-treatment, consistent with our first hypothesis (Table 2).

3.4. Changes on Post-Treatment Scores between Pre-post and Post-only Groups

Next, to examine the potential influence of practice effects due to repeated administration of the measures, one-way between-groups ANOVAs were conducted to compare post-treatment scores between the Pre-post group and Post-only group (Table 3). No study variables indicated a significant difference at post-treatment between groups. Specifically, no significant differences were found on post-treatment BART scores between the Pre-Post and Post Only group, $\eta_p^2 = .01$. Similar findings were obtained for Eysenck impulsiveness, and delay discounting. Therefore, in line with our second hypothesis, it is unlikely that any change in BART performance within the Pre-Post group could be attributed to the influence of pre-testing. Results of these analyses are summarized in Table 3 for between-group conditions.

4. Discussion

Changes in relevant scores on trait-disinhibition variables (e.g., personality and temperamental characteristics) during substance abuse treatment were examined. In line with our hypotheses, risk-taking propensity, as indexed by participants' BART responses indicated a significant pre-post decrease. However, there was no significant pre-post change on either of the impulsivity-based disinhibition variables. Finally, there was evidence that the risk-taking decrease was not simply due to the influence of pre-testing. Several explanations for this pattern of findings are offered.

[1]While the mean BART score was higher for participants who dropped-out of treatment (M=42.16) compared to those who remained in treatment (M=39.15), the difference was non-significant, p = .62.

First and foremost, participants' propensity to engage in risk-taking was assessed through scores on the BART, with findings suggesting that individuals became less risky as a function of participation in substance abuse treatment. It is possible that more long-term pharmacological effects of drugs that were elevated at baseline evidenced some reversal across treatment, thereby resulting in lower BART scores. Researchers have begun to utilize functional magnetic resonance imaging (fMRI) scans as a way to examine brain function and brain changes during the course of substance abuse treatment (examining changes on risk-taking; Rao et al., 2008; Vorhold et al., 2007). Specifically, the prefrontal cortical area of the brain (responsible for risk-taking and impulsivity) may be altered during the course of treatment. Thus, future studies that aim to better understand the intersection between brain functions and changes on risk-taking at the biological level may help to elucidate the exact change mechanisms at play, including differentiating which processes produce change (pharmacological effects of drug use and/or abstinence).

Risk-taking propensity might have also been modulated through program structure and accountability in the program. For example, individuals in the treatment program must adhere to strict guidelines that prohibit the use of any drugs and any use is grounds for dismissal. Therefore, participants spend a significant amount of time with clear and immediate negative consequences for their risky behavior, which may stand in contrast to other parts of their life where immediate consequences for risky behavior may not have been present. Additionally, patients may have become less risky on the BART because of the structure in the treatment center. Although there are no reported studies that suggest individuals are more risky in environments with limited structure, one could reasonably speculate that having scheduled activities, as well as a formal structure for each day, may limit one's ability to engage in risky behaviors. Therefore, these findings may be a function of the change in the environment and structure which, in turn, decreased risky behavior due to the interruption in the association between substance use and the drug-using environment. Thus, by providing participants with an environment where one can focus exclusively on behavior change may have been reason alone for the reported decrease on BART scores.

Findings must, of course, be considered in light of limitations present. One major limitation of the current findings is our inability to determine whether change in risk-taking propensity could be attributed to the residential treatment specifically as opposed to prolonged abstinence. Another limitation involves the fact that the current study included a homogeneous sample of inner-city, male, African American substance abusers. Accordingly, there needs to be some caution before making generalizations to other samples. While not necessarily generalizable to all samples of inner-city substance abusers, the current study provides valuable data on a group whose personality characteristics (risk proneness) might allow for the development of unique treatment opportunities. Future studies should expand these methods to more diverse samples to examine the scope and generalizability of these findings to other substance abusing groups. These findings, if truly robust, should hold across samples and study populations, particularly in residential treatment settings where heightened levels of risk-taking are often the rule, not the exception. Future studies also should examine whether changes in risk-taking propensity predict or mediate maintenance of change in substance abuse behavior.

Finally, the mechanisms responsible for changes on BART scores remain unclear. At a biological level reduced reward sensitization or reduced dopaminergic sensitization could serve as biologically-based mechanisms that could elucidate changes on BART scores. Considering reward sensitization as a change mechanism appears plausible given that most drugs are believed to have a partial commonality in biological substrate at the dopamine level. However, future work testing this consideration is needed to better understand the findings obtained here.

To set the stage for future investigations, there needs to be a better understanding as to why impulsivity (delay discounting and self reported impulsiveness) was not impacted by treatment. Specifically, it would be important to examine the extent to which interactions between these variables may fit within a larger model of change in treatment. The reported lack of change on either of the impulsivity measures may be due to the use of paper and pencil assessment as opposed to a behavioral task (such as that used for risk-taking propensity). As one example, delay discounting is often considered a behavioral task; however, the paper and pencil format lacks real consequences (at least as used in the current study) and relies more on hypothetical consequences.

This study is the first in a promising line of research demonstrating that standard residential treatment can impact variables that are known contributors to substance use (risk-taking propensity). Of note, our results remained significant even after controlling for the potential bias of repeated administration of the measures. Because the risk propensity domain demonstrated a decrease as a result of treatment provides theoretically and practically relevant predispositions that may offer additional information related to substance abuse treatment. Furthermore, such information could potentially lead to enhanced discrimination of effective treatment strategies across various levels of substance abuse severity by identifying salient variables for intervention.

Given the ability for risk-taking to change, larger scale investigations need to elucidate the mediating and moderating personality and temperamental variables that might influence levels of change. There might also be merit in examining changes across specific drug classes as opposed to a variety of different drugs (primary cocaine or opiate users within alcohol treatment programs, or caffeine and/or nicotine users). Investigations of this nature have the potential to uncover self-regulatory mechanisms and coping skills that help to prevent decisions to self-medicate. Furthermore, such processes may lead to develop pathway models of substance abuse that offer researchers and clinicians credible information to guide their interventions.

For example, the development of tailored treatments could be used to modulate risk taking behaviors by focusing on training one's decision-making and context-specific choices. Furthermore, these findings highlight the importance of the use of behavioral tasks to allow researchers to collect more precise, time- and context-specific results. In an effort to inform treatment modification and enhancement, depending on the level of change across these variables, individuals could be targeted to receive treatment modules developed to address these specific behaviors. These findings, along with related studies, may eventually provide the theoretical framework for treatment studies that can target these factors and explore the development, treatment and prevention of substance abuse disorders.

Acknowledgments

This research was conducted as part of the first author's requirement for a doctoral degree in clinical psychology, under the supervision of the fourth author. This work was supported by the National Institute on Drug Abuse Grant R01 DA19405 awarded to the forth author (CWL).

The authors thank Drs. Samuel A. Ball, Deborah C. Beidel, Kathleen Carroll, Marek Chawarski, Mike Dougherty, Courtney Ferrell, Barry C. Smith, and Eric Wish for helpful comments on earlier versions of this manuscript, David Baruch, Isreal Loeb, Jason A. Keith, T. Timothy Barnes, P. P. Givens and B. D. Williams for assistance with subject recruitment and data collection assistance.

References

Aklin WM, Lejuez CW, Zvolensky MJ, Kahler CW, Gwadz M. Evaluation of a behavioral measure of risk-taking propensity with inner-city adolescents. Behaviour Research and Therapy 2005;43:215–228. [PubMed: 15629751]

Brady KT, Myrick H, McElroy S. The relationship between substance use disorders, impulse control disorders, and pathological aggression. American Journal on Addiction 1998;7:221–230.

Evenden J. Impulsivity: A discussion of clinical and experimental findings. Journal of Psychopharmacology 1999;13:180–192. [PubMed: 10475725]

Eysenck SBG, Pearson PR, Easting G, Allsopp JF. Age norms for impulsiveness, venturesomeness, and empathy in adults. Personality and Individual Differences 1985;6:613–619.

Grant S, Contoreggi C, London ED. Drug abusers show impaired performance in a laboratory test of decision making. Neuropsychologia 2000;38:1180–1187. [PubMed: 10838152]

Kazdin, AE. Research Design in Clinical Psychology. Fourth. Allyn & Bacon; Boston, MA: 2003.

Kirby KN, Marakovic NN. Delay-discounting probabilistic rewards: Rates decrease as amounts increase. Psychonomic Bulletin & Review 1996;3:100–104.

Krueger RF, Hicks B, Patrick CJ, Carlson S, Iacono WG, McGue M. Etiologic connections among substance dependence, antisocial behavior, and personality: Modeling the externalizing spectrum. Journal of Abnormal Psychology 2002;111:411–424. [PubMed: 12150417]

Leigh BC. Peril, chance, and adventure: Concepts of risk, alcohol use and risky behavior in young adults. Addiction 1999;94:371–383. [PubMed: 10605866]

Lejuez CW, Read JP, Kahler CW, Richards JB, Ramsey SE, Stuart GL, Strong DR, Brown RA. Evaluation of a behavioral measure of risk-taking: The Balloon Analogue Risk Task (BART). Journal of Experimental Psychology: Applied 2002;8:75–84. [PubMed: 12075692]

Lejuez CW, Simmons BL, Aklin WM, Daughters SB, Dvir S. Behavioral and self-report personality predictors of HIV-risk behaviors in a sample of treatment seeking drug users. Addictive Behaviors 2004;36:23–30.

McLellan AT, Lewis DC, O'Brien CP, Kleber HD. Drug dependence, a chronic medical illness: Implications for treatment, insurance, and outcome evaluation. Journal of the American Medical Association 2000;284:1689–1695. [PubMed: 11015800]

Rao H, Korczykowski M, Pluta J, Hoang A, Detre JA. Neural correlates of voluntary and involuntary risk taking in the human brain: An fMRI study of the Balloon Analog Risk Task (BART). NeuroImage 2008;42:902–910. [PubMed: 18582578]

Tarter RE, Kirisci L, Mezzich A, Cornelius JR, Pajer K, Vanyukov M, Gardner W, Blackson T, Clark D. Neurobehavioral disinhibition in childhood predicts early age at onset of substance use disorder. American Journal of Psychiatry 2003;160:1078–1085. [PubMed: 12777265]

Vorhold V, Giessing C, Wiedemann PM, Schütz, Gauggel S, Fink GR. The neural basis of risk ratings: Evidence from a functional magnetic resonance imaging (fMRI) study. Neuropsychologia 2007;45:3242–3250. [PubMed: 17681357]

Winters KC, Fawkes T, Fahnhorst T, Botzet A, August G. A synthesis review of exemplary drug abuse prevention programs in the United States. Journal of Substance Abuse Treatment 2007;32:371–380. [PubMed: 17481460]

Zuckerman M, Kuhlman DM. Personality and risk-taking: Common biosocial factors. Journal of Personality 2000;68:999–1029. [PubMed: 11130742]

Table 1

Means, standard deviations, and baseline comparisons of pre-post group and post only group, as well as percentages of individuals acknowledging polysubstance use

	Pre-post (n=41) M (SD)	Post only (n=40) M (SD)	Test Statistic
Age	38.0 (10.3)	41.0 (9.0)	$t(63) = 0.37$
Gender (% Male)	83.3%	85.8%	$\chi^2(1) = 0.46$
Total Household Income	$21,200 (22,400)	$20,300 (25,200)	$\chi^2(1) = 1.34$
Ethnicity (% African American)	94.8%	95.0%	$\chi^2(1) = 0.84$
Marital/Relationship Status (% Single)	72.9%	69.7%	$\chi^2(1) = 0.77$
Employment Status (% Unemployed)	81.7%	78.8%	$\chi^2(1) = 0.79$
Education Level			$\chi^2(3) = 0.53$
None	02.1%	09.1%	
Some High School	29.2%	30.3%	
High School Graduate/GED	37.5%	36.3%	
Some College/College Graduate	10.4%	12.1%	
Acknowledging Polysubstance Use	26.7%	25.4%	$\chi^2(1) = 0.44$

Note. All test statistics non-significant ($p > .05$).

Table 2
Change in relationships across primary variables of interest at pre- and post-treatment

	Pre M (SD)	Post M (SD)	Test Statistic
Delay Discounting	07.3 (0.8)	07.1 (0.7)	$t(34) = 0.70$, $\eta_p^2 = .01$
Eysenck Impulsiveness	09.3 (4.5)	08.8 (4.2)	$t(34) = 0.80$, $\eta_p^2 = .01$
BART score	41.7 (11.8)	32.8 (13.6)	$t(34) = 3.55^*$, $\eta_p^2 = .30$

$^*p < .01$.

Table 3

Change on post-treatment scores for the Pre-post and Post-only group to determine practice effects of repeated administration of measures

Measure	Pre-Post Group Post M (SD)	Post-Only Post M (SD)	Test Statistic
Delay Discounting	07.1 (0.7)	04.3 (0.3)	$F(1,49) = 0.55$, $\eta_p^2 = .03$
Eysenck Impulsiveness	08.8 (4.3)	08.7 (6.1)	$F(1,49) = 0.35$, $\eta_p^2 = .01$
BART score	32.8 (13.6)	33.9 (11.8)	$F(1,48) = 0.05$, $\eta_p^2 = .01$

Note. All test statistics non-significant ($p > .05$).