Published in final edited form as:

Psychol Addict Behav. 2008 December ; 22(4): 544–550. doi:10.1037/0893-164X.22.4.544.

Abstinence-Contingent Reinforcement and Engagement in Non-drug Related Activities among Illicit Drug Abusers

Randall E. Rogers¹, Stephen T. Higgins^{1,2}, Kenneth Silverman⁴, Colleen S. Thomas³, Gary J. Badger³, George Bigelow⁴, and Maxine Stitzer⁴

¹ Department of Psychiatry, University of Vermont

² Department of Psychology, University of Vermont

³ Department of Medical Biostatistics, University of Vermont

⁴ Department of Psychiatry & Behavioral Sciences, Johns Hopkins University School Medicine

Abstract

Methadone-maintained cocaine abusers (n = 78) were randomly assigned to a 52-week intervention of either (1) usual care only (UC), (2) take-home methadone doses contingent on cocaine- and opiate-negative results (THM), or (3) take-home methadone doses for cocaine- and opiate-negative results and monetary-based vouchers contingent on cocaine-negative urinalysis results (THM+V). Cocaine use was assessed by urinalysis on a thrice-weekly schedule. Frequency and enjoyability of non-drug related activities were assessed with the Pleasant Events Schedule (PES) at baseline, mid-, and end-of-treatment. The THM+V condition achieved the greatest abstinence from cocaine and opiate use, followed by the THM and UC conditions. The THM+V condition had the highest PES Frequency ratings at mid- and end-of-treatment, followed by the THM and UC conditions. There were significant differences between the THM+V and UC conditions on 10 of 12 PES subscales. Analyses revealed that abstinence mediated the effects of treatment condition on frequency ratings. There were no significant differences in Enjoyability ratings. These results suggest that when contingency-management interventions increase abstinence from drug abuse they also increase engagement in non-drug related activities in naturalistic settings.

Keywords

Substance Abuse; Treatment; Contingency Management; Pleasant Events; Cocaine

Introduction

Behavioral theory posits that environmental context is an important determinant of risk for substance use disorders. That is, the probability of drug use is predicted to increase as a function

Correspondence should be sent to the 1st author at the University of Vermont Substance Abuse Treatment Center, 1 South Prospect, Burlington, Vermont, 05401. rrogers@uvm.edu.

This research was conducted at the Johns Hopkins University School of Medicine Behavioral Pharmacology Research Unit, 5510 Nathan Shock Drive, Baltimore, Maryland 21224 and the University of Vermont Substance Abuse Treatment Center, 1 South Prospect, Burlington, Vermont, 05401.

Publisher's Disclaimer: The following manuscript is the final accepted manuscript. It has not been subjected to the final copyediting, fact-checking, and proofreading required for formal publication. It is not the definitive, publisher-authenticated version. The American Psychological Association and its Council of Editors disclaim any responsibility or liabilities for errors or omissions of this manuscript version, any version derived from this manuscript by NIH, or other third parties. The published version is available at www.apa.org/journals/adb

of decreased access to non-drug related sources of reinforcement or increased availability of drugs (Higgins, Heil, & Lussier, 2004; Vuchinich & Tucker, 1996).

This conceptualization of drug abuse has been supported by research demonstrating a robust relationship between availability of alternative, non-drug reinforcers and the probability of substance use. Laboratory studies with nonhumans and humans show drug self-administration varies inversely with availability of alternative, non-drug reinforcers (Carroll, 1985; Higgins, Bickel & Hughes, 1994; Higgins, Roll, & Bickel, 1996; Vuchinich & Tucker, 1988). Treatment outcome research shows that providing vouchers or other non-drug reinforcers contingent on negative urine toxicology increases abstinence from drug use (Lussier, Heil, Mongeon, Badger, & Higgins, 2006).

Aside from the contingency-management (CM) studies noted above, few published studies have examined the relationship between drug use and involvement with alternative, non-drug reinforcers in the natural environment. In part, this void in the literature is related to difficulties in measuring availability and involvement with non-drug reinforcers in naturalistic settings (Van Etten, Higgins, Budney, & Badger, 1998). Nonetheless, the limited literature that is available on this topic supports the existence of an inverse relationship between drug use and engagement in non-drug related activities among samples of college undergraduates (Correia, Benson, & Carey, 2005; Correia, Carey & Bosari, 2002; Correia, Carey, Simons, & Borsari, 2003; Correia, Simons, Carey & Borsari, 1998), psychiatric outpatients (Correia & Carey, 1999), and adults in outpatient treatment for cocaine dependence (Van Etten, et al., 1998). All but one of these studies are correlational, thereby precluding causal inferences about the relationships observed between drug use and engagement in non-drug related activities. These studies used an instrument called the Pleasant Events Schedule (PES), a 320-item self-report inventory designed to measure both the frequency and enjoyability of everyday activities (MacPhillamy & Lewinsohn, 1976). Demonstrating good psychometrics and having been used effectively in the study of depression and other psychological phenomena (Dobson & Joffe, 1986; MacPhillamy & Lewinsohn, 1982; Wierzbicki & Rexford 1989), the PES has proven to be a good starting point for estimating naturalistic reinforcement among drug abusers (Higgins, et al. 2004; Van Etten, et al., 1998).

In the present study, the PES was used to examine changes in the frequency and enjoyability of activities among methadone-maintained patients enrolled in a randomized clinical trial investigating the efficacy of CM in reducing cocaine and opiate use (Silverman, Robles, Mudric, Bigelow, & Stitzer, 2004). CM reliably increases abstinence from drug use in patients with substance use disorders (Lussier, et al., 2006). Thus, the present study permitted a prospective, experimental examination of how engagement in non-drug related activities changes as patients achieve abstinence during treatment. It was hypothesized that the treatment condition that achieved the greatest abstinence would also have the greatest frequency of non-drug related, alternative activities, and that abstinent participants would have a greater frequency of non-drug related activities than non-abstinent participants regardless of treatment condition.

Methods

Participants

The seventy-eight study participants (26 in each of the three treatment conditions) were methadone-maintained patients who participated in a randomized clinical trial examining the efficacy of CM for cocaine and opiate abuse in Baltimore, Maryland (Silverman, et al., 2004). The methadone program accepted applicants who were (1) 18–50 years old, (2) provided an opiate positive urine sample at intake, (3) reported opiate use on 70% of the 30 days before intake and for half of the year preceding intake, (4) had prior methadone treatment at least one

year before intake, (5) had not been in study that evaluated voucher reinforcement, and (6) showed objective evidence of injection drug use. Applicants were excluded if they were pregnant, had a medical condition for which methadone was contraindicated, or had a serious psychiatric illness. Patients were eligible for the study if they provided cocaine-positive urine samples on 2 of the last 6 and 3 of the last 12 testing occasions of the 10-week baseline period (described below).

Participant characteristics have been reported previously (Silverman et al., 2004). Briefly, the majority were African-American (69%) and male (55%) with an average age of 39 years (SD = 6). All met diagnostic criteria for opiate dependence and 81% met criteria for cocaine dependence. There were no significant differences in participant characteristics assessed at baseline between those assigned to the three treatment conditions described below. The research procedures and consent form were approved by Institutional Review Boards of the Johns Hopkins School of Medicine and University of Vermont College of Medicine. All participants provided written informed consent.

Baseline Treatment and Screening

Patients completed a ten-week baseline phase during which methadone doses were adjusted, patients received weekly individual and group therapy sessions, and patients participated in urine-toxicology screens on Monday, Wednesday, and Friday. On the last day of the ten-week baseline, participants were stratified and randomly assigned to the treatment conditions.

Treatment Conditions

Participants were randomly assigned to one of three, 52-week treatment interventions: take-home methadone privileges plus vouchers (THM+V, N=26), take-home methadone privileges only (THM, N=26), and a usual-care control condition (UC, N=26). Participants were introduced to their respective treatment conditions on the last day of the ten-week baseline phase.

Take-Home Methadone Plus Voucher-Reinforcement Contingency—Participants in the THM+V condition continued receiving the standard services provided during the baseline period. In addition, participants could earn take-home methadone doses contingent on cocaine- and opiate-negative results of the thrice-weekly (M, W, F) urine toxicology testing. To earn the first take-home dose, participants had to provide three consecutive urine screens negative for cocaine and opiates. Thereafter, they received a single take-home methadone dose for each consecutive urine sample that was negative for cocaine and opiates for a maximum of three per week (M, W, F). If the participant provided a cocaine- or opiate-positive urine sample or failed to provide a scheduled sample, they did not receive a take-home dose and had to provide three consecutive cocaine- and opiate-negative samples to resume earning take-home doses.

Participants in this condition also could earn vouchers redeemable for retail items contingent on cocaine-negative urine screens on Monday, Wednesday, and Friday for the duration of the 52-week intervention. The vouchers were administered in accordance with an escalating schedule wherein the monetary value of the vouchers began at \$2.50 and increased by \$1.25 to a maximum of \$40.00 for every consecutive cocaine-negative urine screen (Higgins, et al., 1991). A \$10.00 bonus was given for three consecutive cocaine-negative urine screens until the voucher value reached the maximum of \$40.00. If the participant provided a cocaine-positive urine screen, the participant did not receive a voucher and the value of the next earned voucher was reset to \$2.50. The participant had to provide 9 consecutive cocaine-negative urine screens in order to reset the voucher value to the amount prior to the reset. Voucher earnings

could not be used to purchase weapons, cigarettes or alcohol, or to pay for recently obtained tickets or legal fines.

Take-Home Methadone Reinforcement Contingency—Participants in the THM condition continued receiving the standard services provided in the 10-week baseline phase. In addition, they could earn take-home methadone doses in the same manner described above. Subjects in the THM condition did not have the opportunity to earn vouchers.

Usual-Care Control Condition—Participants in the UC control condition continued receiving the standard services provided during the 10-week baseline phase. Patients in the UC control condition were not eligible for take-home methadone privileges or vouchers.

Urine-Toxicology Testing

Urine samples were collected on Monday, Wednesday, and Friday of each study week. Samples were observed directly and tested for appropriate temperature. Samples were screened for the presence of cocaine (benzoylecgonine) and opiates (morphine) using enzyme multiplication immunoassay (EMIT; Dade Behring Diagnostics Inc., St. Jose, California) and were considered positive when concentrations were ≥ 300 ng/ml.

Abstinence Outcome Measures

Abstinence results were reported previously (Silverman, et al., 2004). Results were reported in five blocks (ten-week baseline, treatment weeks 1–13, 14–26, 27–39, and 40–52) in the earlier report. Below we present them in three blocks (ten-week baseline, treatment weeks 1–26 and 27–52) to facilitate comparisons with results from the PES, which was administered at Baseline, week 26 and week 52.

Pleasant Events Schedule (PES)

An assessment battery that included the PES was administered in week eight of the ten-week baseline period and weeks 26 and 52 of the 52-week intervention period (MacPhillamy & Lewinsohn, 1982). As was mentioned briefly above, the PES is a 320-item self-report inventory designed to measure the frequency and enjoyability of everyday activities and events and was used in the present study to measure the frequency of non-drug reinforcement that participants received in their natural environments. The PES was chosen because it has demonstrated acceptable test-retest reliability (0.81), concurrent validity (0.70), and predictive validity (0.65) (MacPhillamy & Lewinsohn, 1982), and has been shown to discriminate between cocaine-dependent outpatients and matched controls without drug abuse as well as between individuals with different levels of cocaine-dependence severity (VanEtten et al., 1998).

In accordance with the instructions in the PES (MacPhillamy and Lewinsohn, 1976), respondents rated the frequency of engagement in each activity in the past thirty days on a 3-point scale (1 = 0 times; 2 = 1–6 times; 3 = ≥ 7 times). They also rated the subjective enjoyability of each activity on a 3-point scale whether or not they had engaged in the activity (1 = Not Pleasant; 2 = Somewhat Pleasant; 3 = Very Pleasant). The reason for rating enjoyability even for events the respondent has not experienced is to identify all the events that subjects reported as being potentially enjoyable. As stated in the PES manual, it can be informative in terms of identifying potential reinforcers to identify activities the person would like to do but is not currently doing.

The PES is comprised of 11 empirically and rationally derived scales that represent a wide range of activities. The “All” scale consists of all 320 items and the subscales are classified as Social, Non-social, Masculine/Feminine, Extroverted/Introverted, Solitary, Passive Outdoor, Sexual, Mood Related, and General activities. The Masculine/Feminine and Extroverted/

Introverted scales are bidirectional. That is, lower scores indicate Masculine and Extroverted and higher scores indicate Feminine and Introverted. For the purposes of clarity and statistical analysis, these two bidirectional scales were separated into four individual scales in the present study: Masculine, Feminine, Extrovert, and Introvert.

The PES yields a Frequency score and an Enjoyability score. The Frequency score for the All scale is obtained by calculating the mean Frequency ratings of all 320 responses. Likewise, the Enjoyability score for the All scale is obtained by calculating the mean Enjoyability ratings across all 320 items. The subscales of the PES are comprised of subsets of PES items and are calculated in the same manner as for the All scale. For purposes of this paper, and consistent with Van Etten et al. (1998), the six explicitly substance-related items of the PES were excluded when calculating All-scale and subscale scores.

Other assessments conducted on the same schedule included the Addiction Severity Index (ASI, McLellan et al., 1985), the Situational Confidence Questionnaire (Annis & Graham, 1988), an HIV risk assessment (King, Kidorf, Stoller, & Brooner, 2000), a structured videotaped interview, and a urine-toxicology test. The Structured Clinical Interview for the DSM-III-R (Spitzer, Williams, Gibbon, & First, 1992) was conducted with each participant during week 3 of the baseline period. The current report focuses on the PES.

Statistical Methods

Chi square tests were used to compare treatment conditions on the percentage of participants that completed treatment and the percentage that completed the PES at each scheduled assessment. As has been previously reported (Silverman et al., 2004), abstinence analyses were based on an intent-to-treat sample of all participants who were randomly assigned to one of the three treatment conditions. Missing urine samples were considered drug positive. The percent of urine samples negative for both cocaine and opiates during the 10-week baseline period and during weeks 1–26 and weeks 27–52 of the 52-week intervention period were calculated for each participant. A repeated measures analysis of variance was conducted with treatment condition (UC, THM, and THM+V), and time (baseline, mid- and end-of-treatment) as factors.

The analyses for the current study focused on examining treatment differences in temporal patterns in PES Frequency and Enjoyability All scale and subscale scores. Hierarchical linear modeling (HLM Version 6, Scientific Software International Inc., Lincolnwood IL) was used to examine differences between treatment conditions and temporal patterns in PES frequency and enjoyability scales and subscales. Time (mid-treatment and end-of-treatment) was considered a Level-1 (within-subject) factor and treatment condition (UC, THM, and THM +V) was a level-2 (across-subject) factor. In addition, subjects' baseline scores for each measure were used as an additional level 2 factor. Missing values on the PES were not imputed and handled using the default methodology. User defined contrasts were used to perform global hypothesis tests for treatment effects and pairwise comparisons between conditions and across assessments. Treatment condition means at mid-treatment and end-of-treatment were estimated based on the appropriate linear combination of level-1 and level-2 derived coefficients.

Additional analyses were conducted to examine whether abstinence from both cocaine and opiates across the 52-week intervention period moderated the effect of treatment condition on PES Frequency ratings. For these analyses, each participant was categorized as either having achieved a 52-week abstinence rate of 50% or more (High Abstinence Group) or an abstinence rate less than 50% (Low Abstinence Group). The number of participants in each treatment condition who submitted greater than 50% negative screens was as follows: 2 of 26 in the UC condition; 9 of 26 in the THM condition; 17 of 26 in the THM+V condition. Thus, 40% of the participants who met criteria for high abstinence were in the UC and THM conditions, the

conditions that did not receive voucher-based incentives. As there was almost an even split in the High Abstinence group between participants who did and did not receive voucher-based incentives, we felt that an abstinence group-based analysis would be valuable and provide information that could supplement results of the treatment condition-based analysis. These repeated measures analyses of covariance were performed using SAS PROC MIXED (SAS Version 8.02, SAS Institute, Cary, NC). Baseline scores and Abstinence Group (High and Low) were used as covariates and treatment condition (UC, THM, and THM+V), time (mid-treatment and end-of-treatment) as factors. PROC MIXED was used in order to examine these factors sequentially (i.e. based on Type I Sums of Squares) in the order: baseline PES scores, abstinence group, and treatment condition. Statistical significance was determined based on $\alpha=.05$.

Results

Treatment Exposure/Missing Data

There were no significant differences between the three treatment conditions in the percentage of participants who completed treatment. Seventy-three percent, 62%, and 54% of patients in the THM+V, THM, and UC conditions completed the 52-week intervention period, respectively. Also, mean hours of counseling and mean methadone dose did not differ between treatment conditions. There were no significant differences between conditions at any assessment time in the percentage of participants who completed a PES (Table 1). An attempt was made to collect PES data even from participants who did not complete treatment.

Abstinence Outcome Measures

During the ten-week baseline period, the THM+V, THM, and UC conditions provided only 10%, 7%, and 8% cocaine- and opiate-negative urine screens, respectively. During the first half of the 52-week intervention period (weeks 1–26), patients assigned to the THM+V condition provided a significantly greater percentage of cocaine- and opiate-negative urine screens compared to those assigned to the THM and the UC conditions, and those assigned to the THM condition provided a significantly greater percentage of cocaine- and opiate-negative urine screens compared with those assigned to the UC condition. The same pattern of abstinence was observed during the second half of the 52-week intervention period (weeks 27–52) (Table 2).

Comparing PES Ratings Between Treatment Conditions

PES Frequency Ratings—There were no significant differences between the three treatment conditions at baseline (Table 3). Although not statistically significant, PES scores in the THM condition were elevated somewhat above those in the UC and THM+V conditions. To control for any possible influence of baseline PES scores, an analysis of covariance was conducted.

On the PES All scale and every subscale except the Solitary and Masculine subscales, there was a significant main effect of treatment condition ($ps \leq .05$) but no significant effect of time or interaction of treatment condition and time. On the All scale and every subscale, patients in the THM+V condition had the highest frequency ratings, those in the THM condition had intermediate ratings, and those in the UC condition had the lowest ratings (Table 4). Frequency ratings of patients in the THM+V condition were significantly greater than those in the UC condition on the All scale and each of the subscales except the Solitary and Masculine subscales. There were no significant differences between ratings of those in the THM+V and THM conditions or between those in the THM and UC conditions.

PES Enjoyability Ratings—Results from the repeated measures ANCOVA performed on PES enjoyability ratings at mid- and end-of-treatment revealed no evidence of significant main effects of treatment condition, time, or interactions of treatment condition and time (Table 5).

Analysis of Abstinence as a Moderator of the Treatment Effect

A repeated measures ANCOVA using abstinence group ($<$ or $\geq 50\%$ negative urine toxicology results) as a covariate was conducted in order to examine if abstinence moderated the effect of treatment condition on PES Frequency ratings in the prior analysis. Mean frequency ratings were significantly higher among patients in the High compared to the Low Abstinence groups on the All scale and each of the subscales ($ps \leq .05$), except on the Masculine and Extrovert subscales.

Discussion

The present study provides further evidence supporting an inverse relationship between drug use and frequency of engaging in alternative, non-drug-related activities. That is, self-reported frequency of engagement in non-drug related activities in the present study was graded across treatment conditions, with patients in the treatment condition with the greatest abstinence (THM+V) during the 52-week treatment intervention reporting the greatest activity frequency, those in the treatment condition with intermediate abstinence (THM) reporting intermediate activity frequency, and those in the treatment condition with the lowest abstinence (UC) reporting the lowest frequency of involvement with non-drug activities. These differences in activity levels extended across all but two of the PES subscales suggesting an association between drug abstinence and a general engagement in a wide variety of non-drug related activities. The experimental design used in the present study permits causal inferences regarding the influence of the CM interventions on the differences observed between treatment conditions in the frequency of engaging in non-drug related activities. Finally, the results from the analysis wherein abstinence level was used as a covariate suggested that abstinence moderated the effect of treatment condition on activity level. At least one prior report with cocaine abusers noted that during-treatment abstinence also mediates relationships between treatment with CM and increases in quality of life ratings (Petry, Alessi & Hanson, 2007).

The observation that CM in the present study increased both abstinence and reported frequency of involvement with potential sources of non-drug reinforcement is important because alternative, non-drug reinforcers may ultimately play an important role in competing with drug use and maintaining abstinence after treatment termination. Voucher-based CM has been demonstrated to increase post-treatment abstinence in several controlled trials (Higgins, Heil, Dantona, Donham, Matthews, & Badger, 2007; Higgins, Wong, Badger, Ogden, & Dantona, 2000) and efforts to identify predictors of post-treatment abstinence in CM trials have indicated that the duration of initial abstinence obtained during treatment is the best predictor (e.g., Higgins, Badger, & Budney, 2000; Petry, Alessi, Marx, Austin, & Tardif, 2005). The increased frequency of involvement with non-drug related activities observed in the present study, and an increase in quality of life in a prior study, may be mechanisms through which initial abstinence during treatment facilitates longer-term abstinence after treatment. Important challenges for future studies will be to better characterize the sequence of changes in drug use, activity levels, and quality of life ratings to assess whether increases in specific types of activities are especially important to sustaining longer-term abstinence.

The results of the present study are consistent with prior results from controlled laboratory research and correlational studies conducted in the natural environment (Carroll, 1985; Correia & Carey, 1999; Correia, Carey, & Borsari, 2002; Correia, Simmons, Carey, Borsari, 1998; Higgins, Bickel, and Hughes, 1994; Van Etten, Higgins, Budney, & Badger, 1998) showing significant inverse relationships between drug use and involvement with non-drug related

reinforcers. To our knowledge, the present study is the first experimental study in a clinical population showing that treatment-produced increases in abstinence from cocaine and opiate use are positively associated with increases in involvement with non-drug related alternative activities in the natural environment. We are aware of only one prior experimental study examining relationships between drug use and frequency of involvement with alternative activities in the natural environment, which was conducted with a non-clinical sample (i.e., college students). Results from that study offered mixed support for an inverse relationship between substance use and engagement in non-drug activities (Correia, Benson, & Carey, 2005). A sample of college students who reported substance use in the past 28 days were randomized to either a “substance use reduction” (SR) condition where they were instructed to decrease the number of substance use days by 50% in the next month, an “activity increase” (AI) condition where they were instructed to increase the number of days of exercise or creative activities by 50% in the next month, or a no-change control condition where they received no instructions about substance use or activity level. Participants in the SR condition reported a decrease in days of drug and alcohol use and quantity of alcohol consumed, but also a decrease in the number of days of exercise and creative activities, which runs counter to the hypothesized inverse relationship. Participants in the AI group reported an increase in the number of days of exercise and creative activities and a decrease in days of drug use and quantity of alcohol consumed consistent with the hypothesized inverse relationship. Participants in the control condition showed no change in substance use or activity measures. Those results provide only limited evidence for covariation between drug use and engagement with alternative reinforcers in the natural environment, and suggest that increases in involvement with non-drug reinforcers may be more likely to be associated with decreases in drug use than decreases in drug use are associated with increases in involvement with alternative activities. Differences between studies in terms of the populations involved and the presence or absence of bio-chemical verification of changes in drug use make comparisons difficult, but at a minimum the results underscore how little is known scientifically about how drug use and participation in alternative, non-drug-related activities covary in the natural environment.

Interestingly, while PES frequency ratings differed between the treatment conditions in the present study, enjoyability ratings did not. These results are similar to those from prior, correlational research, which showed that differences between cocaine abusers versus non-abusers were in the frequency of engagement in rather than the potential enjoyability of non-drug activities (Van Etten, et al., 1998). Results from both studies suggest that non-drug using activities may potentially function as reinforcers even among people who are continuing to abuse drugs. They also suggest that the frequency of engaging in particular activities is a more sensitive method of differentiating abusers from non-abusers than is the perceived potential enjoyability of such activities.

In summary, this study adds to the literature by using an experimental design to provide evidence that as substance abusers treated with CM achieve abstinence, they also report increases in the frequency with which they engage in alternative sources of potential non-drug reinforcement. More specifically, this study provides the first demonstration that CM therapy increases both drug abstinence and activity level, which could be important to facilitating abstinence that can be sustained after the therapeutic intervention is discontinued.

Acknowledgments

This research was supported by National Institute on Drug Abuse, National Institutes of Health Grants P50 DA09258, K05 DA00050, T32 DA07209, DA RO1 DA13107, and T32 DA007242. Special thanks to Liam Harmon for administering the voucher program and coordinating the overall study. Thanks to the pharmacy, physician, nursing, and counseling staff of the methadone clinic at the Behavioral Pharmacology Research Unit for providing excellent participant care and assistance in implementing this protocol.

References

- Annis, HM.; Graham, JM. Situational Confidence Questionnaire (SCQ) user's guide. Toronto, Ontario, Canada: Addiction Research Foundation; 1988.
- Carroll ME. Concurrent phencyclidine and saccharin access: Presentation of an alternative reinforcer reduces drug intake. *Journal of the Experimental Analysis of Behavior* 1985;43:131–144. [PubMed: 3981084]
- Correia CJ, Benson TA, Carey KB. Decreased substance use following increases in alternative behaviors: A preliminary investigation. *Addictive Behaviors* 2005;30:19–27. [PubMed: 15561446]
- Correia CJ, Carey KB. Applying behavioral theories of choice to substance use in a sample of psychiatric outpatients. *Psychology of Addictive Behaviors* 1999;13:207–212.
- Correia CJ, Carey KB, Borsari B. Measuring substance-free and substance-related reinforcement in the natural environment. *Psychology of Addictive Behaviors* 2002;16:28–34. [PubMed: 11934083]
- Correia CK, Carey KB, Simmons J, Borsari B. Relationships between binge drinking and substance-free reinforcement in a sample of college students: A preliminary investigation. *Addictive Behaviors* 2003;28:361–368. [PubMed: 12573686]
- Correia CK, Simmons J, Carey KB, Borsari B. Predicting drug use: application of behavioral theories of choice. *Addictive Behaviors* 1998;25:705–709. [PubMed: 9768306]
- Dobson KS, Joffe R. The role of activity level and cognition in depressed mood in a university sample. *Journal of Clinical Psychology* 1986;42:264–271. [PubMed: 3958195]
- Higgins ST, Badger GJ, Budney AJ. Initial abstinence and success in achieving longer term cocaine abstinence. *Experimental and Clinical Psychopharmacology* 2000;8:377–386. [PubMed: 10975629]
- Higgins ST, Bickel WK, Hughes JR. Influence of an alternative reinforcer on human cocaine self-administration. *Life Sciences* 1994;55:179–187. [PubMed: 8007760]
- Higgins ST, Delaney DD, Budney AJ, Bickel WK, Hughes JR, Foerg F, Fenwick JW. A behavioral approach to achieving initial cocaine abstinence. *American Journal of Psychiatry* 1991;148:1218–1224. [PubMed: 1883001]
- Higgins ST, Heil SH, Dantona R, Donham R, Matthews M, Badger GJ. Effects of varying the monetary value of voucher-based incentives on abstinence achieved during and following treatment among cocaine-dependent outpatients. *Addiction* 2007;102:271–281. [PubMed: 17222282]
- Higgins ST, Heil SH, Lussier J. Clinical implications of reinforcement as a determinant of substance use disorders. *Annual Review of Psychology* 2004;55:431–461.
- Higgins ST, Roll JM, Bickel WK. Alcohol pretreatment increases preference for cocaine over monetary reinforcement. *Psychopharmacology* 1996;123:1–8. [PubMed: 8741948]
- Higgins ST, Wong C, Badger JG, Ogden D, Dantona R. Contingent reinforcement increases cocaine abstinence during outpatient treatment and 1 year of follow up. *Journal of Consulting and Clinical Psychology* 2000;68:64–72. [PubMed: 10710841]
- King VL, Kidorf MS, Stoller KB, Brooner RK. Influence of psychiatric comorbidity on HIV risk behaviors: Changes during drug abuse treatment. *Journal of Addictive Diseases* 2000;19:65–83. [PubMed: 11110066]
- Lussier J, Heil SH, Mongeon JA, Badger GJ, Higgins ST. A meta-analysis of voucher-based, reinforcement therapy for substance use disorders. *Addiction* 2006;101:192–203. [PubMed: 16445548]
- McLellan AT, Luborsky L, Cacciola J, Griffith J, Evans F, Barr HL, O'Brien CP. New data from the Addiction Severity Index: Reliability and validity in three centers. *Journal of Nervous and Mental Diseases* 1985;173:412–423.
- MacPhillamy, DJ.; Lewinsohn, PM. Manual for the Pleasant Events Schedule. University of Oregon; 1976. Unpublished manuscript
- MacPhillamy DJ, Lewinsohn PM. The pleasant events schedule: studies on reliability, validity, and scale intercorrelation. *Journal of Consulting and Clinical Psychology* 1982;50:363–380.
- Petry NM, Alessi SM, Hanfson T. Contingency management improves abstinence and quality of life in cocaine abusers. *Journal of Consulting and Clinical Psychology* 2007;75:307–315. [PubMed: 17469888]

- Petry NM, Alessi SM, Marx J, Austin M, Tardif M. Vouchers versus prizes: contingency management treatment of substance abusers in community settings. *Journal of Consulting and Clinical Psychology* 2005;73:1005–1014. [PubMed: 16392974]
- Silverman K, Robles E, Mudric T, Bigelow GE, Stitzer ML. A randomized trial of long-term reinforcement of cocaine abstinence in methadone-maintained patients who inject drugs. *Journal of Consulting and Clinical Psychology* 2004;72:839–854. [PubMed: 15482042]
- Spitzer RL, Williams JB, Gibbon M, First MB. The Structured Clinical Interview for DSM-III-R (SCID). I: History, rationale, and description. *Archives of General Psychiatry* 1992;49:624–629. [PubMed: 1637252]
- Van Etten ML, Higgins ST, Budney AJ, Badger GJ. Comparison of the frequency and enjoyability of pleasant events in cocaine abusers vs. non-abusers using a standardized behavioral inventory. *Addiction* 1998;93(11):1669–1680. [PubMed: 9926530]
- Vuchinich, RE.; Tucker, JA. The molar context of alcohol abuse. In: Green, L.; Kagel, J., editors. *Advances in Behavioral Economics*. Vol. 3. Norwood, NJ: Ablex; 1996.
- Vuchinich RE, Tucker JA. Contributions from behavioral theories of choice to an analysis of alcohol abuse. *Journal of Abnormal Psychology* 1988;97:181–195. [PubMed: 3133403]
- Wierzbicki M, Rexford L. Cognitive and behavioral correlates of depression in clinical and nonclinical populations. *Journal of Clinical Psychology* 1989;45:872–877. [PubMed: 2613896]

Table 1

Number (percent) of participants who completed a Pleasant Events Schedule

	Overall (n=78)	UC (n=26)	THM (n=26)	THM+V (n=26)	p-value
Baseline	75 (96%)	25 (96%)	24 (92%)	26 (100%)	.77
Mid-treatment	59 (76%)	17 (65%)	21 (81%)	21 (81%)	.37
End-of-treatment	56 (72%)	15 (58%)	22 (85%)	19 (73%)	.11

Table 2

Percentage of urine samples that were negative from cocaine and opiates across baseline, mid-, and end-of-treatment for intent-to-treat sample (N=78).

<u>Treatment Condition</u>	<u>Baseline</u>	<u>Intervention</u>	
		<u>Weeks 1–26</u>	<u>Weeks 1–52</u>
Usual Care (n = 26)	7.8	13.7	14.1
THM (n = 26)	7.1	35.8 *	31.7 *
THM+V (n = 26)	10.1	53.0 *†	60.4 *†

* Within each timepoint, mean is significantly different than Usual Care Control (p<0.05).

† Within each timepoint, mean is significantly different than Take-home Methadone (p<0.05). **Bold** Within each timepoint, mean is significant different than baseline for that treatment condition (p<0.05).

Table 3

PES subscales at baseline.

PES Scales	UC	THM	THM+V	p-value
Frequency Scales				
All	0.69 ± 0.38	0.84 ± 0.42	0.63 ± 0.28	.13
General	0.68 ± 0.38	0.81 ± 0.40	0.62 ± 0.27	.16
Social	0.84 ± 0.45	0.97 ± 0.43	0.74 ± 0.36	.15
Non-social	0.91 ± 0.40	1.00 ± 0.40	0.88 ± 0.33	.51
Masculine	0.36 ± 0.38	0.55 ± 0.49	0.29 ± 0.26	.06
Feminine	0.92 ± 0.45	1.00 ± 0.45	0.87 ± 0.34	.55
Extrovert	0.62 ± 0.42	0.76 ± 0.45	0.56 ± 0.28	.20
Introvert	0.53 ± 0.40	0.72 ± 0.45	0.50 ± 0.30	.10
Solitary	1.25 ± 0.59	1.21 ± 0.51	1.15 ± 0.40	.79
Passive Outdoor	0.78 ± 0.48	1.04 ± 0.49	0.79 ± 0.38	.08
Sexual	0.90 ± 0.55	1.06 ± 0.46	0.84 ± 0.49	.28
Mood-related	0.98 ± 0.44	1.10 ± 0.40	0.94 ± 0.36	.35
Enjoyability Scales				
All	0.91 ± 0.43	1.01 ± 0.33	0.99 ± 0.37	.59
General	0.90 ± 0.43	0.98 ± 0.33	0.96 ± 0.39	.72
Social	0.99 ± 0.47	1.07 ± 0.35	1.01 ± 0.40	.76
Non-social	0.97 ± 0.42	1.07 ± 0.33	1.06 ± 0.34	.58
Masculine	0.64 ± 0.41	0.74 ± 0.40	0.68 ± 0.41	.72
Feminine	1.08 ± 0.47	1.15 ± 0.38	1.16 ± 0.39	.78
Extrovert	0.81 ± 0.36	0.89 ± 0.37	0.89 ± 0.38	.67
Introvert	0.76 ± 0.46	0.96 ± 0.41	0.91 ± 0.47	.27
Solitary	1.18 ± 0.52	1.26 ± 0.39	1.22 ± 0.38	.81
Passive Outdoor	1.02 ± 0.56	1.23 ± 0.45	1.13 ± 0.45	.33
Sexual	1.13 ± 0.59	1.26 ± 0.48	1.22 ± 0.49	.66
Mood-related	1.22 ± 0.53	1.34 ± 0.38	1.26 ± 0.41	.60

Table 4

Estimated PES Frequency scores ($\pm$ SEM) for each of the three treatment conditions based on regression coefficients derived using HLM using Baseline PES scores as a level 1 factor.

PES Scales	Mid-Treatment			End-of-Treatment		
	UC	THM	THM+V	UC	THM	THM+V
All	0.59 $\pm$ 0.04 ^a	0.82 $\pm$ 0.09 ^{ab}	1.03 $\pm$ 0.10 ^b	0.70 $\pm$ 0.10 ^a	0.85 $\pm$ 0.09 ^{ab}	0.95 $\pm$ 0.09 ^b
General	0.59 $\pm$ 0.05 ^a	0.80 $\pm$ 0.08 ^{ab}	0.99 $\pm$ 0.10 ^b	0.67 $\pm$ 0.09 ^a	0.83 $\pm$ 0.08 ^{ab}	0.92 $\pm$ 0.09 ^b
Social	0.71 $\pm$ 0.07 ^a	0.94 $\pm$ 0.10 ^{ab}	1.18 $\pm$ 0.10 ^b	0.82 $\pm$ 0.11 ^a	0.96 $\pm$ 0.09 ^{ab}	1.09 $\pm$ 0.10 ^b
Non-social	0.83 $\pm$ 0.04 ^a	0.99 $\pm$ 0.08 ^{ab}	1.20 $\pm$ 0.09 ^b	0.85 $\pm$ 0.09 ^a	1.02 $\pm$ 0.08 ^{ab}	1.09 $\pm$ 0.09 ^b
Masculine	0.28 $\pm$ 0.05 ^a	0.49 $\pm$ 0.09 ^a	0.71 $\pm$ 0.13 ^a	0.47 $\pm$ 0.11 ^a	0.55 $\pm$ 0.11 ^a	0.60 $\pm$ 0.11 ^a
Feminine	0.81 $\pm$ 0.05 ^a	1.02 $\pm$ 0.10 ^{ab}	1.25 $\pm$ 0.08 ^b	0.89 $\pm$ 0.11 ^a	1.05 $\pm$ 0.09 ^{ab}	1.16 $\pm$ 0.09 ^b
Extrovert	0.54 $\pm$ 0.05 ^a	0.75 $\pm$ 0.09 ^{ab}	0.96 $\pm$ 0.11 ^b	0.71 $\pm$ 0.12 ^a	0.80 $\pm$ 0.10 ^{ab}	0.88 $\pm$ 0.11 ^b
Introvert	0.55 $\pm$ 0.06 ^a	0.74 $\pm$ 0.09 ^{ab}	0.94 $\pm$ 0.10 ^b	0.60 $\pm$ 0.11 ^a	0.81 $\pm$ 0.09 ^{ab}	0.87 $\pm$ 0.10 ^b
Solitary	1.17 $\pm$ 0.10 ^a	1.18 $\pm$ 0.11 ^a	1.42 $\pm$ 0.08 ^a	1.15 $\pm$ 0.10 ^a	1.25 $\pm$ 0.09 ^a	1.28 $\pm$ 0.10 ^a
Passive Outdoor	0.73 $\pm$ 0.08 ^a	0.95 $\pm$ 0.10 ^{ab}	1.18 $\pm$ 0.09 ^b	0.78 $\pm$ 0.11 ^a	0.99 $\pm$ 0.09 ^{ab}	1.13 $\pm$ 0.11 ^b
Sexual	0.84 $\pm$ 0.10 ^a	1.00 $\pm$ 0.10 ^{ab}	1.31 $\pm$ 0.10 ^b	1.01 $\pm$ 0.15 ^a	1.03 $\pm$ 0.11 ^{ab}	1.17 $\pm$ 0.11 ^b
Mood-related	0.92 $\pm$ 0.05 ^a	1.08 $\pm$ 0.10 ^{ab}	1.34 $\pm$ 0.08 ^b	0.98 $\pm$ 0.09 ^a	1.12 $\pm$ 0.09 ^{ab}	1.22 $\pm$ 0.10 ^b

^{a,b} Group means within timepoint sharing a common letter are not significantly different based on pairwise contrasts.

Table 5

Estimated PES Enjoyability scores ($\pm$ SEM) for each of the three treatment conditions based on regression coefficients derived using HLM using Baseline PES scores as a level 1 factor.

PES Scales	Mid-Treatment			End-of-Treatment		
	UC	THM	THM+V	UC	THM	THM+V
All	0.83 $\pm$ 0.08	0.94 $\pm$ 0.09	0.93 $\pm$ 0.08	0.68 $\pm$ 0.09	0.91 $\pm$ 0.07	0.92 $\pm$ 0.11
General	0.80 $\pm$ 0.09	0.91 $\pm$ 0.09	0.90 $\pm$ 0.08	0.64 $\pm$ 0.09	0.88 $\pm$ 0.07	0.90 $\pm$ 0.11
Social	0.90 $\pm$ 0.08	0.99 $\pm$ 0.10	1.02 $\pm$ 0.09	0.72 $\pm$ 0.10	0.98 $\pm$ 0.08	0.98 $\pm$ 0.11
Non-social	0.90 $\pm$ 0.06	1.01 $\pm$ 0.09	1.00 $\pm$ 0.08	0.78 $\pm$ 0.10	0.98 $\pm$ 0.07	0.96 $\pm$ 0.10
Masculine	0.57 $\pm$ 0.09	0.68 $\pm$ 0.09	0.61 $\pm$ 0.08	0.44 $\pm$ 0.10	0.67 $\pm$ 0.08	0.60 $\pm$ 0.08
Feminine	0.92 $\pm$ 0.09	1.10 $\pm$ 0.11	1.08 $\pm$ 0.09	0.78 $\pm$ 0.10	1.06 $\pm$ 0.08	1.07 $\pm$ 0.12
Extrovert	0.73 $\pm$ 0.07	0.82 $\pm$ 0.09	0.78 $\pm$ 0.08	0.60 $\pm$ 0.09	0.85 $\pm$ 0.08	0.78 $\pm$ 0.09
Introvert	0.79 $\pm$ 0.09	0.88 $\pm$ 0.11	0.91 $\pm$ 0.10	0.65 $\pm$ 0.09	0.83 $\pm$ 0.08	0.87 $\pm$ 0.13
Solitary	1.17 $\pm$ 0.07	1.12 $\pm$ 0.11	1.19 $\pm$ 0.10	1.06 $\pm$ 0.13	1.25 $\pm$ 0.10	1.13 $\pm$ 0.12
Passive Outdoor	0.95 $\pm$ 0.10	1.05 $\pm$ 0.11	1.06 $\pm$ 0.10	0.78 $\pm$ 0.12	1.04 $\pm$ 0.11	1.04 $\pm$ 0.13
Sexual	1.09 $\pm$ 0.12	1.12 $\pm$ 0.13	1.18 $\pm$ 0.11	1.02 $\pm$ 0.15	1.13 $\pm$ 0.11	1.09 $\pm$ 0.14
Mood-related	1.13 $\pm$ 0.09	1.21 $\pm$ 0.11	1.26 $\pm$ 0.09	1.01 $\pm$ 0.12	1.18 $\pm$ 0.09	1.21 $\pm$ 0.13