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Clinical Trial of Abstinence-Based Vouchers and Cognitive–Behavioral Therapy for Cannabis Dependence

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Ninety cannabis-dependent adults seeking treatment were randomly assigned to receive cognitive–behavioral therapy, abstinence-based voucher incentives, or their combination. Treatment duration was 14 weeks, and outcomes were assessed for 12 months posttreatment. Findings suggest that (a) abstinence-based vouchers were effective for engendering extended periods of continuous marijuana abstinence during treatment, (b) cognitive–behavioral therapy did not add to this during-treatment effect, and (c) cognitive–behavioral therapy enhanced the posttreatment maintenance of the initial positive effect of vouchers on abstinence. This study extends the literature on cannabis dependence, indicating that a program of abstinence-based vouchers is a potent treatment option. Discussion focuses on the strengths of each intervention, the clinical significance of the findings, and the need to continue efforts toward development of effective interventions.

Keywords: cannabis, cognitive–behavioral, marijuana, treatment, contingency management

Demand for treatment for marijuana (cannabis)-related problems in the United States increased nearly twofold during the 1990s (Substance Abuse and Mental Health Services Administration, 2001). Whereas only five randomized, clinical trials examining the efficacy of treatment for adult cannabis dependence have been reported, these studies suggest that treatment efficacy appears comparable to that observed with other substances of abuse (Marijuana Treatment Project Research Group, 2004; McRae, Budney, & Brady, 2003). Cognitive–behavioral treatments such as relapse prevention, behavioral coping skills therapy, and motivational enhancement therapy appear efficacious. However, initial abstinence and relapse rates observed across these studies suggest that the majority of participants do not have positive outcomes, indicating that continued development and testing of more potent and cost-effective treatments remains a priority.

In a prior study, adding an abstinence-based voucher incentive program to a standard cognitive–behavioral therapy significantly improved marijuana abstinence rates during a 14-week treatment episode (Budney, Higgins, Radonovich, & Novy, 2000). The incentive program involved providing vouchers exchangeable for retail items contingent on marijuana abstinence documented with urinalysis monitoring. These findings were concordant with a growing literature showing that incentive-based interventions developed from principles of positive reinforcement can enhance outcomes when combined with other effective psychosocial and pharmacological interventions for substance dependence (Higgins, Heil, & Lussier, 2004). Budney et al. (2000), however, remains the only report on the efficacy of abstinence-based vouchers for cannabis dependence, and that study was limited by use of a relatively small sample size and did not include posttreatment follow-up assessments.

Recently, three studies on the treatment of cocaine dependence examined whether combining abstinence-based vouchers with other behavioral therapies improves outcomes. Community Reinforcement Approach therapy, an intensive, outreach-oriented behavioral therapy, plus vouchers enhanced psychosocial and substance use outcomes compared with vouchers alone in a 24-week intervention for primary cocaine dependence (Higgins et al., 2003). In the two other studies, both conducted in the context of methadone maintenance therapy for opiate dependence, combining cognitive–behavioral therapy with vouchers did not enhance outcomes during treatment compared with vouchers alone (Epstein, Hawkins, Covi, Umbricht, & Preston, 2003; Rawson et al., 2002). In the Epstein et al. (2003) study, there was suggestive evidence that during the posttreatment period, cognitive–behavioral therapy augmented the effects of the voucher program for measures of cocaine abstinence and employment. Also of interest, in both of these studies, a comparison of cognitive–behavioral therapy alone with vouchers alone failed to show robust differences, suggesting that vouchers delivered alone may function as a viable outpatient treatment alternative. Studies of the incremental effects of other behavioral therapies when added to vouchers or of vouchers alone have yet to be conducted with adults seeking treatment for cannabis dependence.

The present study was designed (a) to systematically replicate the findings of Budney et al. (2000), demonstrating the efficacy of

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vouchers for increasing marijuana abstinence when added to cognitive–behavioral therapy; (b) to determine the longer term, posttreatment effects of the voucher intervention; (c) to determine whether cognitive–behavioral therapy enhances the effect of the voucher program; and (d) to provide an initial evaluation of the efficacy of the voucher program when provided alone. A parallel-groups clinical trial compared three interventions: cognitive–behavioral therapy plus vouchers (CBT + V), cognitive–behavioral therapy alone (CBT), and abstinence-based vouchers alone (V). We hypothesized that CBT + V would increase marijuana abstinence during treatment compared with CBT and that this positive effect would be maintained during the 12-month posttreatment follow-up. We also hypothesized that CBT + V and V would engender equivalent rates of abstinence during treatment but that CBT + V would facilitate better maintenance of such effects during the follow-up period. Last, the comparisons of V with CBT were considered exploratory and were intended to provide initial information on how outcomes from a novel condition, that is, vouchers alone, compared with those from a commonly used form of cognitive–behavioral treatment.

Method

Participants

The study was conducted in compliance with the Institutional Review Board of the University of Vermont. Participants were 90 adults (69 men, 21 women) seeking treatment for cannabis dependence between December 1999 and October 2002 at a university-based outpatient clinic in Burlington, Vermont. Recruitment methods included newspaper ads, posters, and letters to professionals indicating that outpatient treatment was available for marijuana-related problems. For inclusion, participants had to be at least 18 years old, live within 45 min of the clinic, meet diagnostic criteria for current cannabis dependence (*Diagnostic and Statistical Manual of Mental Disorders;* 4th ed., text revision [*DSM–IV–TR*]; American Psychiatric Association, 2000), and have used marijuana in the past 30 days. Exclusion criteria were current dependence on alcohol or any other drug except nicotine, active psychosis or other severe psychiatric or medical disorder that would impede participation in outpatient counseling, legal problems for which incarceration was imminent, or unstable living arrangements that would hinder contact with the person during treatment or follow-up. Nineteen persons were excluded after or during the intake process on the basis of these criteria. Of these, 6 did not meet criteria for cannabis dependence; 6 were alcohol dependent; 2 were opiate dependent, 2 were likely to be incarcerated in the near future; 1 had active psychosis; 1 had a recent head injury; and 1 was unable to provide an address or phone number. An additional 19 persons completed an intake and were eligible but either decided not to enroll in the study or did not return for the informed consent for treatment and assignment meeting.

Minimum likelihood allocation (Aickin, 1982) was used to randomly assign participants sequentially to one of the three groups while balancing across groups on two baseline characteristics that may influence outcome, legal involvement, and gender. The percentages of participants involved with the legal system were 27%, 37%, and 33%, and the percentages of women were 20%, 30%, and 20% in the V, CBT, and CBT + V groups, respectively.

Intake

A 2- to 3-hr intake assessment was performed by a bachelor's-level research assistant trained to administer the instruments through manual review, observation, and supervised practice interviews. On completion, eligible participants were scheduled to return to the clinic within 1 week to obtain informed consent to participate in the clinical trial and to initiate treatment. One of the project directors obtained informed consent. During the consent process, participants were (a) informed about the content of the three treatment conditions, (b) told that all treatment components were efficacious, and (c) told that this study was designed to further evaluate the components and various combinations of treatments. Immediately following the consent process, random assignment was generated, participants were informed of their treatment assignment, and treatment was initiated.

Measures. A structured drug-history interview was used to collect information on frequency, quantity, and patterns of substance use. A version of the Vermont Structured Diagnostic Interview that was modified for the *DSM–IV–TR* (4th ed.; Hudziak et al., 1993) was used to diagnose common Axis I disorders. The Psychoactive Substance-Use Disorders section of the Checklist was used to make all substance-use diagnoses. Diagnoses were confirmed and reviewed by a licensed psychologist. The Time-Line Follow Back (TLFB) interview was used to assess frequency of the use of marijuana, alcohol, and other substances 3 months prior to treatment and was then administered at all urine specimen collection contacts during treatment and posttreatment (Sobell & Sobell, 1992).

The Addiction Severity Index (5th ed.; ASI) is a structured interview that assesses substance use and areas of functioning commonly affected by substance abuse (McLellan, Alterman, Cacciola, Metzger, & O'Brien, 1992). Composite scores are calculated in seven areas (Medical, Employment, Alcohol Use, Drug Use, Legal, Family/Social Relationships, and Psychiatric). These scores are weighted combinations of items ranging from 0 to 1 that provide valid measures of problem severity during the 30 days prior to the assessment.

The Marijuana Problem Scale (MPS) assesses adverse consequences attributed to marijuana use (Stephens, Roffman, & Curtin, 2000). The MPS comprises 26 recent and lifetime problems associated with marijuana use that are summed to provide an index of problem severity. The Brief Symptom Inventory (BSI) is a 53-item inventory measuring psychiatric distress across nine subscales and three global indices of distress (Derogatis, 1993). The Beck Depression Inventory (BDI) is a 21-item instrument used to assess severity of depressive symptoms (Beck, 1987).

Urine Toxicology Monitoring of Drug Use

Urine toxicology monitoring during the 14-week treatment period involved twice weekly (Monday and Thursday, or Tuesday and Friday) testing. Specimens were obtained under same-gender staff observation and screened with an on-site Enzyme-Multiplied Immunoassay Technique (EMIT; Dade-Behring, San Jose, CA). All specimens were screened for 11-nor-Δ-9-THC-9-carboxylic acid (Δ-9-THC), the primary active metabolite of marijuana. The cannabinoid cutoff level for determining a positive sample was 50 ng/μl. One specimen every 2 weeks was screened for benzodiazepines, cocaine, opiates, and methamphetamine. Note that Δ-9-THC remains detectable in urine (50 ng/μl) for up to 2 weeks after discontinuation of marijuana use in heavy marijuana users (Hawks & Chiang, 1986); hence, there was an expected discrepancy between self-report and urinalysis results when participants began a period of marijuana abstinence following a period of heavy use. Of note, limited marijuana use (e.g., a slip) following a period of abstinence was likely to test positive for Δ-9-THC for approximately 3–5 days (Huestis, Mitchell, & Cone, 1996). Failure to submit a scheduled specimen was treated as a marijuana-positive result. In an effort to reduce the number of missed specimen collections, extensive outreach procedures were used including multiple phone calls, flexible daily scheduling, waiting as long as necessary at the clinic for specimen provision, offering to go to a participant's home or neutral site for collection, and use of excused absences and next-day scheduling in cases where legitimate conflicts were discussed proactively. Participants who failed to submit five consecutive specimens were considered dropouts and were discontinued from treatment ($n = 39$).

Treatment Conditions

Abstinence-based vouchers only (V). Individuals assigned to the V condition participated in an abstinence-based voucher program developed

for cocaine dependence (Budney & Higgins, 1998; Higgins et al., 1991) and adapted for use with marijuana-dependent patients (Budney et al., 2000). Following treatment assignment, the staff member who reviewed the informed consent met with the participant for approximately 15 min to provide the rationale for the voucher program and to review the abstinence contract. Participants were informed that similar voucher programs for other types of substance dependence have been demonstrated to have efficacy and that some experts believe that people who are motivated to change can do so on their own without prolonged treatment. The voucher program was described as a method to enhance and maintain initial motivation to abstain from marijuana use by providing a structure (urine monitoring) and incentive (vouchers) for doing so. The details of the program were provided in a written abstinence contract, reviewed by the staff member, and then signed by participants.

V participants received vouchers that had a monetary value each time they provided a marijuana-negative urine specimen. As discussed above, Δ-9-THC remains detectable in urine for up to 2 weeks in heavy marijuana users; thus, the abstinence contingency to earn vouchers did not start until Week 3 of treatment. Participants were informed about the need to remain abstinent for 2 weeks in order to achieve a marijuana-negative urinalysis test result in Week 3. During Weeks 1–2, participants in all treatment conditions received $5 vouchers for each urine specimen provided independent of the drug test results to encourage compliance with the urine-monitoring program.

For each cannabinoid-negative specimen provided during Weeks 3–14, V participants earned vouchers with a predetermined, cash value that escalated in value across consecutive negative specimens. The first negative specimen was worth $1.50. The value of the voucher for each consecutive negative specimen increased by $1.50. To further increase the likelihood of continuous abstinence, the equivalent of a $10 bonus was earned each time two consecutive negative specimens were provided. Cannabinoid-positive specimens or failure to submit a scheduled specimen reset the value of vouchers back to their initial $1.50 value from which they could escalate again according to the same schedule. Submitting three consecutive negative specimens following a positive test returned the value to the level achieved prior to the positive test. Urine specimens positive for other substances did not affect voucher earnings.

Vouchers could not be lost once earned. An individual who provided all cannabinoid-negative urine specimens throughout Weeks 3–14 would earn vouchers worth $5.70 or $6.78 per day. Voucher earnings were redeemed for retail goods or services designated by the participant (e.g., movie pass, sports/hobby equipment, vocational classes, work materials). Staff had veto power over all purchases, and purchases that might encourage substance use were not approved (e.g., rock concert tickets, cigarettes).

V participants also received a self-help pamphlet, *A Guide to Quitting Marijuana* (Grenyer, Solowij, & Peters, 1996), and information on local self-help groups (e.g., Alcoholics Anonymous, Narcotics Anonymous, Rationale Recovery). These materials were also provided to participants in the other two treatment conditions to control for their potential influence on outcome. Contact with staff following the initial explanation session was limited to twice-per-week urine toxicology testing. At each visit, staff conducted a brief interview to assess for clinical crises and asked whether the participant wanted to make a purchase with their voucher earnings. Participants in all three groups received this brief assessment to control for clinical contact across interventions. V participants who were deemed at-risk for suicide during this assessment were referred to the clinic director for further evaluation and assistance. For other types of crises (e.g., housing, mental health), staff provided a community services referral guide consisting of a list of supportive services.

Cognitive–behavioral therapy (CBT). Participants assigned to the two treatment conditions that included individual cognitive–behavioral therapy (CBT and CBT + V) received 14 weekly, 50-min therapy sessions. Two alcohol dependence manuals, *Motivational Enhancement Therapy* and *Behavioral Coping Skill Treatment* (National Institute on Alcohol Abuse and Alcoholism, 1992a, 1992b), were adapted for cannabis dependence, integrated, and manualized. CBT participants (but not CBT + V or V participants) received $5 vouchers for each urine specimen provided independent of the test results to encourage compliance with the monitoring program and help equate retention across groups. CBT participants who attended all 28 urine toxicology visits earned vouchers worth $140.

Therapists for both treatments (CBT and CBT + V) were two master's-level clinicians with more than 8 years experience treating substance dependence. Therapist training involved manual review, practice cases, observation of training videotapes, modeling, and role play.

During the first session, the rationale for how cognitive–behavioral therapy might help the participant meet his or her goal of quitting marijuana use and the general efficacy of similar programs for other types of substance dependence was provided. An abstinence contract describing the urine-monitoring program was reviewed. The remainder of Sessions 1 and 2 involved motivational interviewing to enhance motivation to make changes in marijuana use. Sessions 3 through 8 focused on skills directly related to achieving and maintaining marijuana abstinence (e.g., dealing with urges, drug refusal, planning for high-risk situations). Sessions 9 through 14 focused on coping skills indirectly related to maintaining abstinence and were selected from a list of 17 skills-training modules.

Cognitive–behavioral therapy plus abstinence-based vouchers. CBT + V participants received the same abstinence-based voucher program described for V participants and the same therapy sessions described for CBT participants. The only difference from the CBT-alone condition was that during each session the therapist reviewed voucher earnings to date and discussed how the vouchers might be used to support treatment goals of positive lifestyle change and increasing drug-free activities.

Posttreatment Assessments

Research assistants who were not blinded to group conducted posttreatment assessments at the end of treatment and monthly for 12 months. The end-of-treatment, 3-, 6-, 9-, and 12-month assessments involved collection of a urine specimen, the ASI, MPS, TLFB, BSI, and BDI. At the month 1, 2, 4, 5, 7, 8, 10, and 11 assessments, participants completed the TLFB and provided a urine specimen only. For participants who missed an assessment, the TLFB was used to collect data on marijuana and other substance use since the last date of contact (Sobell & Sobell, 1992). Vouchers were not delivered to any groups during the posttreatment period; rather all participants received cash remuneration of $10 for each monthly assessment and $30 for each 3-month assessment completed. Participant compliance with the monthly assessments was poor (M = 54%, range = 48% – 64%) compared with the more extensive assessments performed every 3 months (M = 73%, range = 71% – 74%); hence, posttreatment analyses focused on the 3-, 6-, 9-, and 12-month assessments.

Data Analysis

Comparisons between treatment conditions on baseline characteristics were performed with one-way analysis of variance for continuous measures and chi-square tests for nominal measures (see Table 1). For all outcome analyses, an intent-to-treat approach was used in which all participants were included (N = 90). When appropriate, the outcome analyses statistically controlled for whether the participant was abstinent prior to entering treatment, as defined by self-report of one or more days of abstinence immediately prior to the day of the intake (see Table 1 for rates of abstinence prior to treatment across groups). This variable was entered as a covariate because it showed a strong relation to during-treatment outcome in a prior study (Moore & Budney, 2002).

We examined two similar primary outcome measures for during-treatment effects. The longest period of documented continuous marijuana abstinence achieved during treatment was computed with consecutive urinalysis results as markers (e.g., 7 consecutive negative specimens = 3.5 weeks of abstinence). Between-condition comparisons of such abstinence outcomes were examined with a 1 × 3 analysis of covariance (ANCOVA),

Table 1
Subject Characteristics at Intake

Variable	CBT	CBT + V	V
Demographics			
Male (%)	70	80	80
Race (% White)	97	90	100
Mean age in years (*SD*)	33.9 (9.5)	30.9 (10.3)	34.6 (11.0)
Years of education	13.1 (3.3)	13.1 (3.5)	12.3 (5.4)
Never married (%)	59	63	50
Full-time employment (%)	53	67	53
Monthly income ($)	1,400 (1,406)	1,097 (1,062)	1,385 (1,346)
Marijuana use			
Days used in prior 30 days (*SD*)	25.5 (7.4)	25.3 (8.0)	26.0 (6.2)
Times used per day (*SD*)	3.7 (2.2)	4.2 (3.0)	3.8 (2.2)
Years of regular use (*SD*)	14.7 (9.3)	11.3 (9.8)	15.3 (8.7)
No. of DSM–IV criteria met (*SD*)	4.7 (1.5)	4.9 (1.3)	5.0 (1.4)
Age at first use in years (*SD*)	14.4 (3.1)	15.0 (2.4)	14.8 (2.9)
Abstinence prior to treatment (%)[a]	33.3	20	23.3
Other substance use			
Days of alcohol use in past 30 days	6.4 (8.6)	5.7 (6.3)	8.3 (9.4)
Other drug use in past 30 days (%)	13	3	20
Previous treatment (%)	37	37	57
Addiction Severity Index[b]			
Alcohol	.10 (.13)	.09 (.10)	.11 (.11)
Drug	.25 (.09)	.23 (.09)	.24 (.08)
Employment	.29 (.22)	.29 (.24)	.29 (.24)
Family/Social	.32 (.32)	.19 (.12)	.23 (.27)
Legal	.09 (.21)	.07 (.12)	.11 (.20)
Medical	.24 (.35)	.17 (.28)	.20 (.36)
Psychiatric	.36 (.28)	.33 (.23)	.40 (.20)
Beck Depression Inventory	15.6 (12.0)	14.2 (11.7)	15.0 (12.1)
Global Symptom Index	1.1 (0.93)	1.0 (0.79)	1.1 (0.79)

Note. $n = 30$ per treatment condition. CBT = cognitive–behavioral therapy; V = abstinence-based vouchers. Variables without unit definitions reflect means (*SD*). No significant between-group differences were observed. [a] Self-reported one or more consecutive days of no marijuana use. [b] Scores range from 0 to 1, with higher scores indicating greater rates of problem behaviors.

with abstinence prior to treatment entered as the covariate. We performed subsequent planned pairwise contrasts between the three treatment conditions using adjusted means. The adjusted means and overall mean square error were used to compute effect sizes (means are presented in Table 2). For the other abstinence outcome measure, we computed the number of participants who achieved specific durations of continuous abstinence and compared distributions associated with continuous abstinence in the three groups using log-rank tests, again including abstinence prior to treatment as a covariate.

The primary measure of posttreatment outcome was documented (urinalysis confirmed) point-prevalence marijuana abstinence at each 3-month assessment time point. We used categorical modeling for repeated measures to examine treatment condition differences in percentage of participants abstinent across the assessment points (PROC CATMOD; SAS Institute, 1985). Continuous abstinence throughout the posttreatment assessments was also examined by comparing survival curves with Cox regression. Covariates were not included in these analyses.

For all the during- and posttreatment primary abstinence outcome analyses described above that were based on urine toxicology results, we regarded missing data (i.e., missing urine specimens) as positive for marijuana to provide a conservative estimate of use. We believe that the use of extensive outreach procedures for specimen collection (described above) results in the great majority of missing specimens being indicators of recent use. Thus, counting missing specimens as marijuana positive is the method most representative of the true estimate of this variable, is consistent with previous studies using these methods, and traditionally has been the recommended method for handling missing substance use data (Nathan & Lansky, 1978).

Table 2
During-Treatment Marijuana-Use Outcomes

Variable	CBT	CBT + V	V
Primary abstinence outcomes			
Weeks of continuous abstinence[a]	3.5 (3.2)	5.3 (4.7)	6.9 (5.4)
% of participants who achieved 6 or more weeks of continuous abstinence[a,b]	17%	40%	50%
% marijuana-negative urine specimens	32%	43%	55%
Secondary self-report measures			
No. days used during prior month[c]			
Intake	26.1 (8.9)	24.8 (8.9)	25.8 (8.9)
End of treatment	8.6 (9.2)	9.7 (9.1)	11.3 (9.7)
No. times marijuana used per day[c]			
Intake	3.7 (2.2)	4.2 (3.0)	3.8 (2.2)
End of treatment[a]	1.6 (1.6)	2.7 (3.0)	2.6 (2.5)
Marijuana Problem Scale[c]			
Intake	7.9 (4.0)	7.8 (4.8)	7.8 (4.4)
End of treatment	5.1 (4.7)	3.6 (4.9)	4.1 (4.5)

Note. Data for all analyses were based on all participants ($n = 30$ per treatment condition). CBT = cognitive–behavioral therapy; V = abstinence-based vouchers. Variables without unit definitions reflect means (*SD*), adjusted for abstinence prior to treatment.
[a] CBT vs. V comparison, $p < .05$. [b] CBT + V vs. CBT comparison, $p < .05$. [c] Significant main effect for time, $p < .01$.

To examine secondary marijuana use outcome measures (self-reports of marijuana use and times used per day, and the Marijuana Problem Scale), we used mixed-model repeated measures (i.e., hierarchical linear modeling), with abstinence prior to treatment entered as a covariate to examine during-treatment and posttreatment effects. The mixed models procedure (MIXED) allows for variance–covariance structure other than compound symmetry (Norusis, 2005).

For these secondary analyses, we used data from all cases; missing data were handled in the MIXED analyses designed for unbalanced repeated measures with missing data (i.e., autoregressive one-correlation structure). However, prior to performing analyses on the self-reported marijuana use data, the correspondence between self-report and urine toxicology results was examined in all cases for which both of these variables were not missing. Five cases were deemed invalid because participants self-reported no marijuana use in successive months, yet had multiple cannabinoid-positive urine tests. Hence, such days of marijuana use data for these participants (approximately 17% of values) were designated as missing in the subsequent MIXED analyses. Note that analyses performed with these contradictory self-report data included versus missing did not produce substantially different findings. Last, categorical modeling was used to examine rates of remission of cannabis dependence posttreatment. Here, missing values were defined as not in remission.

We examined other psychosocial functioning outcomes (ASI, BDI, and GSI scores) using 6 (intake and posttreatment assessments) × 3 (group) mixed-model repeated measures, with abstinence prior to treatment as the covariate. All cases were included, and missing data were handled in the MIXED analyses as described above.

Results

Participants

Sociodemographic, substance use, and psychosocial functioning data for the three groups are presented in Table 1. The participants were primarily Caucasian men (77%), with a mean age of 33.1 years. The majority reported at least a high school education or its equivalent (83%) and were employed full-time (58%). Most participants had extensive histories of regular marijuana use (M = 13.8 years), used marijuana almost daily (M = 25.6 days per month), and smoked multiple times per day (M = 3.9 smoking episodes per day). Participants met a mean of 4.8 *DSM–IV* criteria for marijuana dependence. The majority (72%) had not sought treatment for marijuana use previously. Approximately half of the participants were current cigarette smokers.

Acceptability and Retention

Treatment acceptability rates, defined as providing 3 or more urine specimens (more than 1 week of participation), did not differ significantly across treatment conditions: for CBT, 87%; for CBT + V, 87%; and for V, 83%, $\chi^2(2, N = 90) = 0.18$, $p = .91$. No differences were observed in mean (*SD*) number of weeks retained in treatment: 9.3 (5.2) for CBT, 10.7 (5.3) for CBT + V, and 9.5 (5.8) for V, $F(2, 87) = 0.56$, $p = .57$. Nor did the mean (*SD*) number of therapy sessions differ between CBT and CBT + V: 8.8 (5.0) for CBT and 9.6 (4.9) for CBT + V, $t(58) = 0.68$, $p = .50$.

Therapist Effects

Each therapist provided treatment to participants in both therapy conditions. There were no significant differences between therapists (main effect for therapist) across conditions on number of therapy sessions attended ($p = .44$), percentage of urine specimens provided ($p = .35$), or number of weeks of continuous abstinence ($p = .98$).

During-Treatment Marijuana Use

Primary marijuana abstinence outcomes. Of the 28 urine tests scheduled during treatment, the mean (*SD*) number of specimens provided across treatment conditions was comparable: 17.9 (11.0) for V, 17.5 (9.8) for CBT, and 19.2 (9.7) for CBT + V, $F(2, 87) = 0.23$, $p = .80$. Table 2 and Figure 1 present marijuana abstinence outcomes observed during the 14-week treatment period. We observed a main effect for treatment condition on mean weeks of documented continuous marijuana abstinence, $F(2, 84) = 3.05$, $p = .05$. Planned pairwise contrasts indicated that V engendered significantly more abstinence than did CBT ($p = .02$, $d = 71$). CBT + V showed more abstinence than CBT, but this difference was not statistically significant ($p = .20$, $d = .39$). Last, the comparison of V with CBT + V did not show a significant effect ($p = .32$, $d = .31$), suggesting that CBT did not enhance the effect of V during treatment.

The other primary abstinence outcome measure, percentage of participants who achieved specific durations of continuous mari-

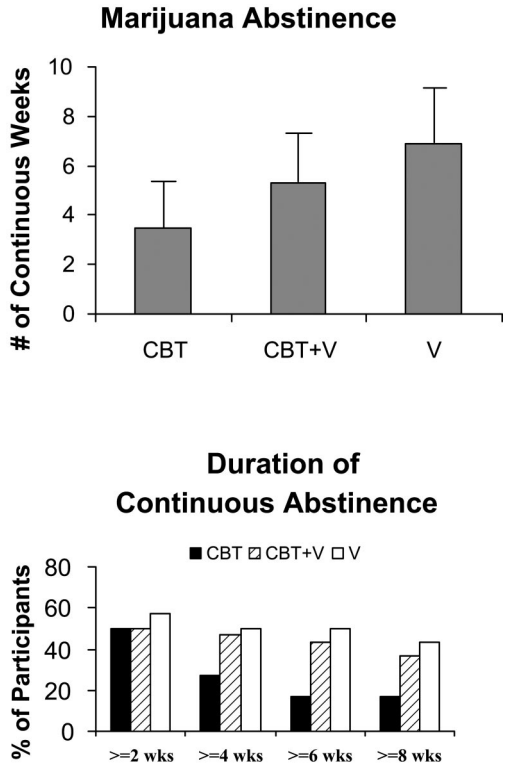

Figure 1. During-treatment abstinence. Top: Mean number of consecutive weeks of abstinence achieved during treatment documented by urinalysis results. Treatment condition effect was significant ($p < .05$), and post hoc pairwise comparisons showed significant differences between abstinence-based vouchers (V) and cognitive–behavioral therapy (CBT) but not between CBT + V and V or between CBT and CBT + V. Bottom: Percentages of participants in each treatment condition who achieved specific durations of continuous marijuana abstinence during treatment. Treatment condition effect was significant ($p < .05$).

juana abstinence during treatment, showed similar between-condition differences (Figure 1, bottom panel). Across the periods of continuous abstinence examined (at least 2, 4, 6, and 8 weeks), a main effect for group was observed, log-rank $\chi^2(2, N = 90) = 5.98$, $p = .05$. Planned pairwise contrasts indicated significantly greater abstinence rates for V than for CBT ($p = .02$), again demonstrating an effect of V during treatment. CBT + V showed greater rates of abstinence than CBT, but this difference was not statistically significant ($p = .10$). CBT + V and V alone did not differ significantly, again suggesting that CBT did not enhance during-treatment abstinence rates when added to V. Table 2 presents an example of abstinence rates by treatment condition for one specific period examined, equal to or greater than 6 weeks of abstinence. V showed greater 6-week abstinence rates than CBT, and CBT + V showed greater rates than CBT alone ($p < .05$; odds ratios = 6.0 [1.7–21.0] and 4.07 [1.2–14.4], respectively). Last, overall percentage of marijuana-negative urine specimens showed a nonsignificant trend toward group differences: 32.2%, 43.2%, and 55.5% for CBT, CBT + V, and V, respectively, $F(2, 84) = 2.44$, $p = .09$:.

Secondary marijuana use outcomes. Table 2 presents the intake and end-of-treatment adjusted means for the secondary marijuana use measures. The mixed-model 2 (time) × 3 (treatment condition) analysis comparing self-reported days of marijuana use across the month prior to intake with the month prior to the end of treatment revealed no treatment condition ($p = .71$) or interaction ($p = .63$) effects. A significant effect for time, $F(1, 88) = 135.9$, $p < .001$, indicated that all treatment conditions reduced marijuana use from intake to the end of treatment. Similarly, the number of times marijuana was used per day on days that use was reported showed a significant time effect, $F(1, 82) = 57.9$, $p < .001$, but no treatment condition ($p = .70$) or interaction ($p = .46$) effects were observed. Scores on the MPS were consistent with these other measures showing a significant effect only of time, $F(1, 84) = 27.1$, $p < .001$, suggesting that all conditions evidenced decreased marijuana-associated problems.

Posttreatment Outcomes

Primary marijuana abstinence outcomes. Table 3 presents primary marijuana abstinence outcomes during the posttreatment assessment period. The proportion of posttreatment assessments obtained did not differ significantly by treatment condition at any assessment. Categorical modeling for repeated-measures (PROC CATMOD) was performed to evaluate treatment and time effects associated with point-prevalence estimates of marijuana abstinence across the assessments. The main effect for treatment condition did not reach statistical significance at the .05 level, $\chi^2(2, N = 90) = 4.68$, $p = .10$. A significant effect of time was observed, suggesting that abstinence levels across treatment conditions tended to decrease across follow-up assessments, $\chi^2(4, N = 90) = 9.74$, $p = .03$. No significant Condition × Time interaction emerged, $\chi^2(8, N = 90) = 7.65$, $p = .47$. Planned pairwise contrasts showed that CBT + V engendered significantly greater posttreatment abstinence levels than did CBT alone, $\chi^2(1, n = 60) = 4.22$, $p = .04$; odds ratio = 2.45 (1.01–5.93), suggesting that CBT + V maintained its positive during-treatment effect. V and CBT did not differ ($p = .74$), suggesting that the during-treatment abstinence effect observed with V was not maintained. Last, CBT + V showed a trend toward greater posttreatment abstinence rates than did V alone $\chi^2(1, N = 60) = 3.04$, $p = .08$; odds ratio = 2.17 (0.91–5.17), suggesting that the cognitive–behavioral therapy was important for maintaining the abstinence effect of the vouchers.

Table 3
Posttreatment Marijuana Abstinence and Associated Problems

Variable	CBT	CBT + V	V
Study participation: No. participants who completed assessments			
End of treatment	26	26	24
3 month	22	21	23
6 month	22	21	23
9 month	21	22	21
12 month	24	21	22
Primary abstinence outcomes: % of participants abstinent across each follow-up assessment (point prevalence)			
Mean across assessments[a,b]	20	38	23
End of treatment	30	43	40
3 month[a,c]	20	43	17
6 month[d]	13	33	23
9 month[d]	13	33	17
12 month[b]	23	37	17
Secondary marijuana-use outcomes			
% of participants in full remission across each assessment			
Mean across assessments[a,b]	28	44	27
End of treatment	40	47	40
3 month	27	47	27
6 month	23	40	30
9 month	20	50	10
12 month	30	37	27
Days of marijuana use during prior 30 days			
Mean across assessments[c]	13.6 (18.2)	11.1 (16.7)	16.4 (16.4)
End of treatment	8.6 (9.2)	9.7 (9.1)	11.3 (9.7)
3 month	10.9 (14.0)	9.9 (12.9)	15.2 (13.3)
6 month	13.8 (14.1)	11.6 (13.2)	18.2 (13.3)
9 month	16.6 (14.3)	11.5 (13.4)	19.1 (13.3)
12 month	18.3 (15.7)	12.5 (13.9)	18.1 (13.6)

Note. Data for all analyses are based on all participants ($n = 30$ per treatment condition). CBT = cognitive–behavioral therapy; V = abstinence-based vouchers.
[a] CBT + V versus CBT comparison, $p < .05$. [b] CBT + V versus V comparison, $p < .10$. [c] CBT + V versus V comparison, $p < .05$. [d] CBT + V versus CBT comparison, $p < .10$.

We examined rates of continuous abstinence throughout posttreatment by comparing survival curves with Cox regression. Overall differences between conditions was not significant, $\chi^2(2, N = 90) = 1.86$, $p = .39$ (Figure 2, bottom panel).

Secondary marijuana use outcomes. A 3 (treatment) × 5 (time) mixed-model repeated-measures analysis with abstinence prior to intake entered as a covariate was used to examine continuous measures. For days of self-reported marijuana use, a significant effect of time, $F(4, 252) = 3.57$, $p < .01$ suggested increased days of use over the posttreatment period in all three treatment conditions (see Table 3). No treatment condition ($p = .15$) or interaction effects ($p < .73$) emerged. For the measure indicating the number of times marijuana was used per day that use was reported, no significant time ($p < .94$), treatment condition ($p =$

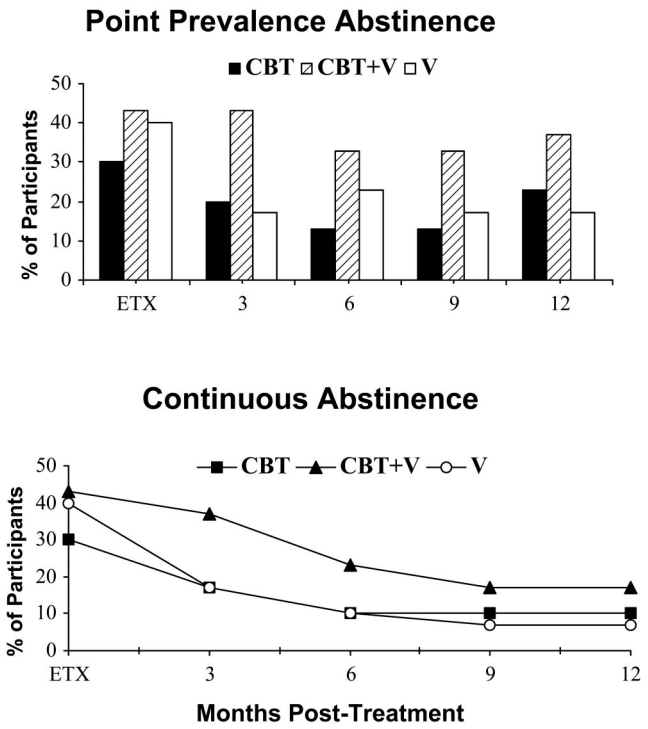

Figure 2. Posttreatment abstinence. Top: Point-prevalence percentage of participants who were abstinent (provided a cannabinoid-negative urine specimen) at the end of treatment (ETX) and at each follow-up assessment. Bottom: Percentage of participants who sustained continuous abstinence throughout the follow-up period.

.31), or interaction effects ($p = .15$) were observed, indicating that the reduction in intensity of use observed during treatment was maintained posttreatment across conditions. The MPS also showed no treatment condition, time, or interaction effects, indicating that the reduction in problems observed during treatment was maintained over the course of the follow-up.

The proportion of participants in remission for cannabis dependence, defined as having no *DSM–IV* dependence symptoms for at least 1 month, showed a marginal main effect for treatment condition ($p = .09$) and no significant time ($p = .16$) or interaction ($p = .22$) effects. Planned pairwise contrasts indicated that remission levels in CBT + V were higher than V ($p = .05$); CBT + V was marginally higher than CBT ($p = .07$); and V and CBT did not differ ($p = .87$). Table 3 shows remission rates at each assessment.

Secondary psychosocial outcome measures. The ASI Drug, Employment, Family/Social, Legal, Medical, and Psychiatric Scales all showed significant main effects for time ($p < .05$), suggesting improvement in these areas across all three conditions. No significant effects for treatment condition or Treatment ×Time interactions were observed for any of these scales. The ASI Alcohol Severity scale showed a significant treatment condition effect ($p < .05$) but not a time or interaction effect. Note that across all conditions and assessments, the Alcohol Severity scale score was very low, as persons with significant alcohol problems were excluded from the study. Significant effects of time on the BDI and the Global Symptom Index of the BSI ($p < .01$) indicated improved psychiatric functioning over the course of treatment and follow-up in all conditions. No treatment condition or interaction effects were observed on either measure. Data are not presented for these secondary outcomes but are available from the author on request.

Discussion

Abstinence-based vouchers engendered greater rates of marijuana abstinence during treatment in comparison with a commonly used cognitive–behavioral therapy for cannabis dependence. This positive effect on abstinence was robust when V was delivered alone (V vs. CBT comparison), and a positive, albeit statistically nonsignificant, voucher effect was observed with the combined cognitive–behavioral therapy and voucher treatment (CBT + V vs. CBT). The cognitive–behavioral therapy did not add to the initial abstinence outcomes engendered by the vouchers (V vs. CBT + V comparison). Such findings are consistent with prior studies demonstrating a positive effect of abstinence-based vouchers on initiation of cocaine abstinence that was not enhanced by adding cognitive–behavioral therapy (Epstein et al., 2003; Rawson et al., 2002).

Findings on posttreatment abstinence supported the converse. This study extended prior findings by demonstrating that cognitive–behavioral therapy enhanced the maintenance of the voucher effect achieved during treatment. CBT + V evidenced higher abstinence rates during follow-up than did V, despite V engendering equivalent or greater abstinence during treatment. CBT + V also showed greater posttreatment abstinence than did CBT, suggesting that cognitive–behavioral therapy helped maintain the initial positive effect of adding vouchers to CBT during treatment. Moreover, the equivalence of CBT and V during the posttreatment period, after observing clearly greater abstinence rates for V during treatment, provided further support for the positive maintenance effects of CBT. The motivational enhancement and coping skills training components of CBT designed to increase motivation for abstinence and to prevent relapse may be the mechanism for its positive effect on maintenance. These data are consistent with prior studies of cocaine dependence (Higgins et al., 1994; Higgins, Wong, Badger, Ogden, & Dantona, 2000), which demonstrated that vouchers increased initial abstinence when added to other behavioral therapies and that such gains were maintained when the vouchers were discontinued. In sum, the present results suggest that integration of V and CBT provided overall better abstinence outcomes over time than either intervention delivered alone. That said, some during- and posttreatment analyses of abstinence outcomes did not reach traditional levels of significance, and comparisons of most nonabstinence-based outcomes did not show robust differences between treatment conditions. Below, we comment on a few methodological and clinical issues important to interpreting these findings in light of existing literature on contingency management and other behavioral therapies for cannabis and other substance dependence disorders.

Although the during-treatment effect of vouchers on abstinence was robust when delivered alone, the comparison of CBT + V with CBT showed only marginal and statistically nonsignificant differences across abstinence measures (although moderate effect sizes were observed). In a prior study, this same comparison clearly showed greater initial abstinence rates for CBT + V (Budney et al., 2000); hence, discussion of why more robust results were not observed here seems warranted. We believe the expla-

nation is likely twofold. In the present study, but not in the prior study, vouchers ($5 value) contingent on attendance of urine toxicology screens were provided to the CBT group to ensure equivalent retention and treatment contact between treatment conditions. Cursory comparison of the two studies indicates that this contingency may have marginally improved outcomes achieved with CBT (*M*s = 3.3 vs. 2.3 weeks of continuous abstinence), whereas abstinence achieved with CBT + V remained the same (unadjusted $M = 4.8$ weeks in both studies). Providing vouchers for attendance may have a positive, albeit less potent, effect on marijuana-use outcomes than providing vouchers for abstinence (Sinha, Easton, Renee-Aubin, & Carroll, 2003). Second, the present study was statistically underpowered to detect potentially important differences between CBT and CBT + V. Power calculations based on findings from the initial study indicated that 42 participants per treatment condition were needed to provide 80% power to detect an expected twofold difference in mean weeks of continuous abstinence at a .05 alpha level. With the 30 per condition who participated, the observed power for a treatment effect for the continuous weeks of abstinence measure was only 57%. Note that additional participants were not enrolled because of unforeseen administrative and fiscal factors.

The clinical significance of the outcome differences observed across treatment conditions warrants comment. Notably, the most robust findings during treatment were differences in duration of documented continuous abstinence (i.e., the explicit target of the voucher intervention), whereas other secondary measures such as days of self-reported marijuana use, changes in the marijuana-related problems, and ASI psychosocial functioning scales did not differ significantly across conditions. We have argued elsewhere that continuous abstinence achieved during treatment is an important marker for positive longer-term abstinence outcomes (Budney et al., 2000; Higgins, et al., 2000). The present data provide some support for this contention. CBT + V engendered greater continuous abstinence during treatment and subsequently evidenced better abstinence outcomes and greater rates of remission of dependence during follow-up than did CBT.

That said, the observation that CBT + V did not evidence superior outcomes on other nonabstinence outcome measures raises the issue of the relative importance of abstinence versus moderate use outcomes in the treatment of cannabis abuse or dependence. Both treatments showed significant improvement across most secondary outcome measures, suggesting comparable levels of general psychosocial functioning, as indicated by the measures used in this study. Such findings reflect a need for careful thought regarding (a) appropriate primary outcome measures examined in clinical trials of cannabis dependence, (b) evaluation of treatments that target moderate versus abstinence goals, and (c) the methodological and clinical concerns inherent in the empirical examination of such issues. For example, the current study and experimental intervention (abstinence-based voucher intervention) were designed to focus primarily on abstinence outcomes. However, one must wonder why between-groups marijuana use outcomes did not more closely parallel abstinence outcomes. Explanations for this observation include the possibility that the interventions produce different patterns of reduction in cannabis use or differentially influence the validity of self-reports of use. Clearly, future studies are needed to determine the importance of achieving substantial periods of abstinence versus substantial reductions in use and to improve our understanding of how specific interventions influence the reliability and validity of various outcome measures.

The comparison of V alone with CBT alone provided a number of interesting findings. With V, we were initially concerned that many participants would reject the idea of not receiving some type of counseling. However, very few participants verbally expressed disappointment when they received their assignment to V, and the rate of acceptance and treatment retention did not differ between the treatment conditions. This observation was consistent with studies on cocaine abuse in methadone-maintained patients who showed no differences in retention between V alone and cognitive–behavioral therapy (Epstein et al., 2003; Rawson et al., 2002) and with a study on primary cocaine dependence that found no difference in acceptability when comparing V alone with the community reinforcement approach plus V (Higgins et al., 2003).

Also consistent with prior studies, V was significantly more effective for engendering during-treatment abstinence than was CBT; yet, approximately equal proportions of V and CBT participants were abstinent at each posttreatment assessment, suggesting comparable longer term outcomes. The two aforementioned cocaine abuse studies also observed that V alone engendered greater abstinence than did cognitive–behavioral therapy alone during treatment but found no between-groups differences posttreatment (Epstein et al., 2003; Rawson et al., 2002). Finding no posttreatment differences between V and a treatment with known efficacy (CBT) is suggestive of the potency of V. One methodological procedure to be aware of when considering the efficacy of V was that participants received approximately 15 min of staff contact time immediately prior to beginning treatment. Whether the duration or content of this introductory meeting contributed to the effect of V is not known. Moreover, the version of CBT used in the present study differed from previously examined cognitive–behavioral treatments, most notably in its integration of twice-weekly urine toxicology results with the counseling sessions. How this addition might affect outcomes is also not clear.

A last comment regarding the CBT versus V comparison was our somewhat surprising failure to observe positive effects of CBT in other areas of psychosocial functioning given its focus on coping skills relevant to mood management, social support, and other targeted areas of psychosocial adaptation. The lack of an observed effect in these areas is congruent with prior studies. A 9-session behavioral therapy for adult cannabis-dependent outpatients did not improve scores on similar psychosocial functioning measures in comparison with a 2-session motivational therapy (Marijuana Treatment Project Research Group, 2004), and the two cocaine studies that compared V and CBT observed no clear enhancement of psychosocial outcomes with CBT (Epstein et al., 2003; Rawson et al., 2002). Perhaps a more intensive behavioral therapy intervention such as the community reinforcement approach may be necessary to gain additional benefits in psychosocial functioning over and above what might be achieved with abstinence-based vouchers alone (Higgins et al., 2003).

The differences and similarities in outcome across the three treatment conditions prompt contemplation on the practical issues of implementation and cost-effectiveness. Although no a priori plan was made to examine cost in this study, the examination of two individual treatment components compared with their combination allows for some general comment. Evaluation of cost-effectiveness must relate to the previous discussion on clinical significance. To establish whether it is cost-effective to add the

cost of V (potential of $570 in vouchers, personnel time to manage the purchases, and urinalysis) to CBT depends on how "clinically significant" one views the observed differences in abstinence rates between CBT and CBT + V. Conversely, it seems clear that adding CBT to V has clinical importance. The remaining question here is, What is the most cost-effective method for doing so? Is a full course of CBT needed? Should it be provided concurrent with V or later in the process? Also, if we could predict who could receive optimal benefit from either CBT or V alone, treatment-matching strategies would improve the overall cost effectiveness of providing these outpatient alternatives for cannabis dependence. Future studies seeking to maximize outcome and cost- effectiveness might also focus on the effect of increasing or decreasing the magnitude of the vouchers, alternative methods of delivering vouchers or CBT (computer or telephone-based methods), or other methods of providing positive reinforcement (Petry & Simic, 2002).

Regarding other limitations of the study, we remind the reader that the present study was conducted primarily with a Caucasian population, with the great majority being male, and in a university-based research clinic. These factors may limit the generalizability of the findings to other settings or populations. However, previous studies of similar interventions in ethnically diverse, metropolitan populations (e.g., Copeland, Swift, Roffman, & Stephens, 2001; Epstein et al., 2003; Marijuana Treatment Project Research Group, 2004; Rawson et al., 2002) suggest that these limitations would not likely have a strong influence on the comparative results.

In conclusion, the present findings suggest that abstinence-based vouchers delivered with or without adjunct cognitive–behavioral therapy are an effective alternative intervention for cannabis dependence. That said, outcomes achieved even with the combination CBT + V treatment have much room for improvement in that only about half of the participants achieved substantial periods of abstinence during treatment, and the majority continue to use and report associated problems throughout the year following treatment. Continued efforts to developand evaluate effective treatments for cannabis dependence appear warranted.

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