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Cocaine Abusers with and without Alcohol Dependence Respond Equally Well to Contingency Management Treatments

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Abstract

Contingency management (CM) treatments are efficacious in treating cocaine abuse. Despite high prevalence rates of alcohol dependence (AD) among individuals with cocaine use disorders, relatively little data are available regarding whether cocaine abusing patients with AD have poorer treatment outcomes in general, or in response to CM treatments in particular, than cocaine abusers without AD. Using data from three randomized trials of CM for cocaine abuse, this study compared cocaine abusers ($N = 393$) with and without AD in terms of 1) abstinence during treatment and at the Month 9 follow-up, and 2) psychosocial adjustment during the 12-week treatment period and through the follow-up period. Compared to non-AD participants, AD participants had more lifetime years of cocaine and alcohol use, and they had greater severity of alcohol and psychiatric problems. CM was positively and significantly associated with longer durations of substance abstinence, regardless of AD status. Although not significantly associated with primary substance use treatment outcomes, the presence of AD was related to improvement in medical and alcohol-related problems during treatment, and these gains were maintained posttreatment. The results suggest that cocaine abusers benefit equally well from CM treatments, regardless of AD status, and that AD participants are able to offset greater baseline severity in some areas of psychosocial functioning during treatment and maintain these improvements posttreatment.

Keywords

treatment outcome; contingency management; alcohol dependence; cocaine abuse; cocaine dependence

Among individuals with cocaine use disorders, reports of comorbid alcohol dependence (AD) range as high as 57–88% (Higgins, Budney, Bickel, Foerg, & Badger, 1994; Wiseman & McMillan, 1996). Alcohol's perceived enhancement of cocaine's rewarding effects (Harris, Everhart, Mendelson, & Jones, 2003) and/or attenuation of adverse effects, including withdrawal (McCance-Katz, Kosten, & Jatlow, 1998), may at least partially explain the high rates of concomitant cocaine and alcohol use. Not surprisingly, comorbid use of these substances is associated with more severe cocaine use (Mengis, Maude-Griffin, Delucchi, & Hall, 2002; Raimo, Smith, Danko, Bucholz, & Schuckit, 2000) and more negative consequences related to cocaine use (Flannery, Morganstern, McKay, Wechsberg, & Litten, 2004; Higgins et al., 1994b). The impact of comorbid alcohol and cocaine disorders extends to areas of psychosocial functioning, including greater alcohol-related problems, family-

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related difficulties, and psychiatric severity (Flannery et al., 2004; Higgins et al., 1994b; Schmitz, Bordnick, Kearney, Fuller, & Breckenridge, 1997).

Despite these negative consequences, comorbid cocaine and alcohol use disorders do not necessarily detract from treatment outcomes. Neither baseline alcohol consumption, nor alcohol severity scores, predict sustained or point-prevalence abstinence from cocaine among individuals with cocaine use disorders completing 12-step or cognitive-behavioral outpatient group substance use treatment (Crits-Christoph et al., 2007; Mengis et al., 2002). Carroll, Rounsaville and Bryant (1993) noted similar 1-year posttreatment abstinence rates, as well as posttreatment cocaine use intensity, for cocaine dependent versus cocaine-alcohol dependent individuals following community-based inpatient or outpatient substance abuse treatment. Similarly, individuals with cocaine dependence achieved significant reductions from baseline cocaine use, regardless of AD status, following either relapse prevention or 12-step substance use treatment (Brower, Blow, Hill, & Mudd, 1994; Schmitz et al., 1997). Benefits of treatment extend to areas of psychosocial functioning for cocaine dependent individuals regardless of concurrent AD, with comparable posttreatment Addiction Severity Index (ASI) medical, employment, and psychiatric scores (Brower et al., 1994). Similarly, Schmitz et al. (1997) noted improvements in psychiatric symptomatology over the course of treatment for both diagnostic groups, although individuals with cocaine-alcohol dependence evidenced greater severity at each assessment point compared to those with cocaine dependence.

Heil, Badger, and Higgins (2001) examined treatment response of cocaine dependent individuals with and without AD who received either community reinforcement approach (CRA) therapy plus contingency management (CM) or one of four comparison conditions. CM is well established as an effective treatment for reducing cocaine use (see Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006). CM involves restructuring the environment to promote target behaviors (e.g., abstinence), typically through reinforcement using vouchers or prizes contingent upon verified achievement of target behaviors (Higgins, Budney, Bickel, & Foerg, 1994; Stitzer & Petry, 2006).

Unlike the studies discussed above, Heil et al. (2001) observed treatment by AD status interactions on treatment outcome. While individuals with cocaine-alcohol dependence had shorter treatment retention in the comparison conditions compared to those without AD, they stayed in treatment longer than those without AD when assigned to the CRA plus CM condition. For abstinence outcomes, the cocaine-alcohol dependence group submitted a greater proportion of cocaine negative samples compared to the cocaine dependent only group when treatment involved CRA plus CM. Abstinence rates were similar regardless of AD status in the comparison conditions.

Although the literature assessing the impact of AD on treatment outcomes among cocaine abusers is small, the available studies generally failed to identify treatment by AD status interaction effects with the exception of the Heil et al. (2001) study. The Heil et al. (2001) study was distinct from other published studies in the use of CM, which may account for the noted difference in treatment condition by AD status interactions. However, the ability to attribute these interaction effects to CM is limited; the observed improvements in retention and abstinence for cocaine-alcohol dependent participants may have been due to the combined use of the CRA with CM, rather than attributable to the effects of CM alone. Another possible contribution to the significant interaction effect in the Heil et al. (2001) study involves differences in use of disulfiram (included as part of CRA) across conditions. Participants in the control conditions were less likely to take disulfiram, perhaps explaining the poorer outcomes for AD participants in the control conditions for the Heil et al. (2001) study.

The purpose of the present study is to assess the impact of AD status on primary and secondary treatment outcomes for cocaine abusers receiving standard care as delivered in community-based treatment programs with and without CM. This study will aid in clarifying the impact of AD status on response to CM and standard care treatments. Specifically, the present study tested the hypothesis that CM treatment may be more beneficial than standard care for cocaine abusers with AD.

To this end, we examined abstinence-related outcomes and psychosocial adjustment according to AD status and treatment condition at two timepoints, end-of-treatment and a Month 9 follow-up. Consistent with the primary study findings (Petry et al., 2004; Petry, Alessi, Marx, Austin, & Tardif, 2005; Petry et al., 2006a), an overall benefit in treatment outcomes was expected for those assigned to CM compared to standard care. Given the Heil et al. (2001) findings, we predicted a potential significant interaction effect between AD status and treatment condition. We hypothesized that AD participants would achieve improved abstinence-related and psychosocial outcomes compared to non-AD participants when assigned to CM, and we predicted comparable outcomes across AD status groups for those assigned to standard care. We examined long-term effects using objectively-verified abstinence at the Month 9 follow-up and posttreatment change in ASI scores. We hypothesized that long-term abstinence rates would not differ by AD status, and any gains achieved in ASI scores during treatment would be maintained through the follow-up period.

Method

Participants

Participants ($N = 393$) across the three studies were recruited from new admissions to intensive outpatient treatment for substance abuse at four northeast community clinics. Content and structure of the intensive outpatient services were similar across clinics, and mean age, years of cocaine use, and education level of participants did not differ across clinics (all p 's $> .05$). Each of the studies (Petry et al., 2004; Petry et al., 2005; Petry et al., 2006a) involved randomization of participants to CM conditions or standard care (SC). In total, 278 participants were randomized to a CM condition and 115 to SC.

Inclusion and exclusion criteria were similar across studies, and inclusion criteria were purposely broad in order to increase generalizability of findings. Participants met past-year *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV*; American Psychiatric Association, 1994) criteria for cocaine abuse or dependence. All participants were 18 years of age or older, were able to comprehend study procedures, did not report uncontrolled psychopathology (e.g., active suicidal ideation, mania), and were not in recovery for pathological gambling (although there is no evidence of increased gambling with prize CM in research to date; Petry et al., 2006b). All participants provided written informed consent, approved by the university's Institutional Review Board. Baseline and demographic characteristics are presented in Table 1 for those with and without current AD. AD status (meets criteria, does not meet criteria) was established at baseline using *DSM-IV* criteria (APA, 1994).

Procedures

As noted above, the present analyses used a combined sample from several randomized clinical trials (Petry et al., 2004; Petry et al., 2005; Petry et al., 2006a). All three trials shared the primary aim of evaluating the efficacy of CM plus SC conditions compared to SC alone, and all produced results suggesting CM is a beneficial adjunct to SC. The SC conditions were consistent across the three studies, and the CM conditions varied from study to study (e.g., reinforcement of abstinence vs. activities). All studies paralleled one another in treatment

intensity and duration, follow-up duration, assessment measures and intervals, targeted population, and use of community clinics. The level of consistency across studies provided a rationale for combining SC conditions from each study, as well as combining CM conditions.

After providing informed consent, participants completed demographic and baseline questionnaires in an initial 2-hour interview. The drug use and pathological gambling modules of the Structured Clinical Interview for the *DSM-IV* (First, Spitzer, Gibbon, & Williams, 1996) and the ASI (McLellan et al., 1985) were administered. The ASI assesses psychosocial functioning in seven domains (alcohol use, drug use, medical, employment, legal, family/social relationships, and psychiatric). Composite scores, ranging from 0.00-1.00, provide information on problem severity for each domain, with higher scores indicating greater severity. After this assessment, eligible participants were randomly assigned to a treatment condition.

At baseline and throughout treatment, participants provided breath samples that were screened for alcohol using the Alco-sensor IV Alcometer (Intoximeters, St. Louis, MO) and urine samples that were tested for cocaine and opioids using OnTrak TesTstiks (Varian Inc., Walnut Creek, CA). Breath and urine specimen collection was scheduled for 3 days/week for weeks 1-3 (e.g., Monday, Wednesday, and Friday), 2 days/week for weeks 4-6 (e.g., Tuesday and Friday), and 1 day/week for weeks 7-12. While the scheduled number of samples was identical across all studies and conditions, total number of samples submitted during treatment differed by treatment condition (SC: $M = 9.25$, $SD = 5.30$; CM: $M = 11.90$, $SD = 6.00$), $F(1, 391) = 16.91$, $p < .001$, and study (Petry et al., 2004: $M = 9.34$, $SD = 6.09$; Petry et al., 2005: $M = 12.66$, $SD = 5.83$; Petry et al., 2006a: $M = 11.09$, $SD = 5.43$), $F(2, 390) = 10.73$, $p < .001$. Hence, we also present data with respect to proportions of negative samples, a variable unaffected by missing data. Sample submission rates were comparable for those with and without AD (AD: $M = 11.27$, $SD = 5.84$; non-AD: $M = 10.96$, $SD = 6.03$), $F(1, 391) = 0.26$, $p = .61$.

In addition to the baseline administration, research staff readministered the ASI and collected urine and breath samples at 3 and 9 months after study initiation. Participants received payments of \$30-\$35 for completing follow-up evaluations. Completion rates for the Month 3 follow-up were 81.2%, and 69.0% for Month 9. No differences in completion rates by AD status, treatment condition, or study were present for Month 3 or Month 9 (all p 's $> .05$).

Treatments

Full descriptions of SC and CM treatments are available from the main papers (Petry et al., 2004; 2005; 2006), and previously published papers using this combined sample (Petry, Alessi, & Hanson, 2007; Weinstock, Alessi, & Petry, 2007). We provide a brief overview here.

Standard Care—SC in all studies involved intensive outpatient substance abuse treatment, consisting of group therapy sessions covering topics such as relapse prevention, coping and life skills training, AIDS education, and 12-step treatment. The treatment included an intensive phase, with group sessions 3-5 days per week, lasting 2-4 weeks depending on needs of the client, and was followed by aftercare, consisting of one group per week for up to 12 months. In addition to standard treatment, participants submitted up to 21 breath and urine specimens during the 12-week study. Results were for research purposes only, and not shared with clinic staff.

CM treatment—Individuals in the CM conditions received the same SC as described above. In addition, abstinence, treatment goal-related activities, or both were monitored and reinforced. Abstinence was reinforced when samples tested negative for alcohol, cocaine, and opioids (reinforcement occurred only when all 3 substances were negative). Selected activities were consistent with each individual's treatment plan (e.g., if a goal was employment-related,

then the activity might be completing a job application), and objective verification was necessary for reinforcement (i.e., receipt; see Petry, Tedford, & Martin, 2001). In conditions for which both activities and abstinence were targeted, the reinforcement schedules were independent (e.g., failure to complete scheduled activities did not affect reinforcement for abstinence).

Data Analytic Procedure

The relationship between AD status and baseline variables was examined using independent *t*-tests (corrected *t*-values and degrees of freedom reported as needed) and χ^2 tests. Continuous dependent variables were not normally distributed; however, we used *t*-tests because these tests are robust to departures from normality when sample size is large (Lumley, Diehr, Emerson, & Chen, 2002). Analyses yielded similar results with nonparametric tests.

MANCOVA examined the relationship between AD status and primary end-of-treatment outcomes (available for 100% of participants), with longest duration of abstinence (LDA) and the proportion of negative samples submitted as dependent variables. LDA was operationally defined as the greatest number of consecutive weeks (range = 0-12) during treatment of objectively verified abstinence from alcohol, cocaine, and opioids. Positive samples for one or more drugs, unexcused absences, or missed samples broke the chain of abstinence. The proportion of negative samples submitted (for cocaine, alcohol, and opioids) was calculated with the actual number of samples submitted in the denominator, such that missing samples did not impact the proportion. Independent variables included AD status (non-AD, AD) and treatment condition (SC, CM). Covariates for all multivariate analyses were identified by significant baseline differences between AD status groups and relevance to current analyses. For all multivariate analyses, the identified covariates included clinic, age, and years of cocaine use.

MANCOVA also examined change in the 7 ASI scores (Month 3 ASI scores minus baseline ASI scores), with AD status and treatment condition as independent variables. Cases with incomplete ASI data (*n* = 5) and 11 outliers (*z* > 3.29) were excluded. Correlations among change scores did not exceed recommended guidelines (Tabachnick & Fidell, 2001).

Posttreatment abstinence was examined using urine/breath specimen results collected at Month 9. To constitute negative, the sample tested negative for alcohol, cocaine, and opioids. Logistic regression examined predictors of abstinence at Month 9. Covariates (clinic, age, and years of cocaine use), AD status, treatment condition, and the AD status by treatment condition interaction were entered into the equation at Step 1, followed by LDA and the LDA by AD status interaction at Step 2. LDA was included as length of abstinence has been identified in previous research (Higgins, Badger, & Budney, 2000; Petry et al., 2005) as a reliable predictor of later abstinence. We conducted the logistic regression twice, first using the available data (*n* = 244), and second with all missing samples coded as positive specimens (*N* = 393). Three potential influential cases (standardized residuals > 3.0) were excluded from the available data analysis, and two were excluded from the missing coded positive analysis.

Lastly, posttreatment change in ASI scores was examined in a parallel analysis of the 7 ASI change scores, this time looking at change from the end of treatment through the last follow-up (Month 9 ASI scores minus Month 3 ASI scores). Eleven outliers were excluded. All analyses were completed using SPSS for Windows (v.15).

Results

Baseline Characteristics

Differences on baseline and demographic variables by AD status are presented in Table 1. Compared to non-AD participants, AD participants were older and had more years of cocaine use. As expected, AD participants evidenced more years of drinking to intoxication (examined in regular drinkers only) and higher ASI alcohol scores. For the remaining ASI scores, AD participants had significantly higher psychiatric scores and a trend ($p = .06$) of more severe ASI medical scores compared to non-AD participants.

End-of-Treatment Outcomes

AD Status and Treatment Outcomes—Multivariate analyses, controlling for clinic ($p = .02$), age ($p = .43$), and years of cocaine use ($p = .68$), indicated a significant effect of treatment condition on treatment outcomes, Pillai's Trace = 0.072, $F(2, 385) = 14.97$, $p < .001$. Table 2 provides the descriptive statistics. AD status was not significantly associated with treatment outcomes either as a main effect, Pillai's Trace = 0.011, $F(2, 385) = 2.21$, $p = .11$, or as an interaction with treatment condition, Pillai's Trace = 0.000, $F(2, 385) = 0.07$, $p = .93$. Further, total value of earned reinforcement in the CM condition did not differ by AD status (non-AD: $M = \$202.88$, $SD = 298.84$; AD: $M = \$176.64$, $SD = 217.98$), $t(278) = 0.84$, $p = .40$. Treatment condition, however, was significantly related to LDA in the univariate follow-up tests, with CM participants achieving longer durations of abstinence than those in SC, $F(1, 386) = 25.11$, $p < .001$. The proportion of negative drug screens did not differ significantly by treatment condition, $F(1, 386) = 0.37$, $p = .55$.

AD Status and Psychosocial Functioning—Results of the 2 (AD status: non-AD, AD) X 2 (treatment: SC, CM) MANOVA assessing the relation of these independent variables to change in the 7 ASI scores during the treatment period (baseline through end of treatment) suggested a significant effect of AD status, Pillai's Trace = 0.16, $F(7, 295) = 7.80$, $p < .001$, after controlling for clinic ($p = .03$), age ($p = .87$), and years of cocaine use ($p = .58$). Subsequent univariate analyses showed significant effects of AD status on ASI medical, $F(1, 301) = 11.32$, $p < .001$, and ASI alcohol, $F(1, 301) = 21.10$, $p < .001$, change scores. AD was associated with improved ASI medical scores ($M = -0.14$; $SE = 0.03$) versus a slight increase (worsening) in scores from baseline to 3-month follow-up among those without AD ($M = 0.03$, $SE = 0.04$). AD participants also demonstrated a decrease in alcohol-related problems ($M = -0.14$, $SE = 0.02$), compared to little change over time in the non-AD participants ($M = -0.02$, $SE = 0.02$). Neither treatment condition, Pillai's Trace = 0.03, $F(7, 295) = 1.50$, $p = .17$, nor the AD status by treatment condition interaction, Pillai's Trace = 0.04, $F(7, 295) = 1.52$, $p = .16$, were significant.

Posttreatment Outcomes

AD Status and Abstinence at Month 9—Table 2 presents the raw or unadjusted percentages of negative samples submitted at Month 9 by AD status and treatment condition. Results of the logistic regression using available specimen data ($n = 244$) to predict abstinence at Month 9 indicated that Step 1 (clinic, age, years of cocaine use, treatment condition, AD status, and AD status by treatment condition interaction) was statistically significant, $\chi^2(8, n = 242) = 24.78$, $p = .002$, but accounted for little variance (Nagelkerke $R^2 = 0.142$). The addition of Step 2 (LDA and the LDA by AD status interaction) resulted in an overall improvement to the model (Step 2: $\chi^2(2, n = 242) = 34.26$, $p < .001$; Overall Model: $\chi^2(10, n = 242) = 59.04$, $p < .001$). Model fit was acceptable, with Hosmer and Lemeshow goodness-of-fit $\chi^2(8) = 10.15$, $p = .26$, and the classification accuracy for the overall model was 77.7%. Significant predictors included years of cocaine use and LDA. For each additional year of cocaine use, odds of submitting a negative specimen decrease by a factor of 0.95, 95% CI for OR: 0.905-0.998,

Wald $\chi^2(1) = 4.22, p = .04$. LDA was positively associated with negative urine/breath sample results at Month 9. For every 1 week increase in LDA, odds of submitting a negative specimen increased by a factor of 1.38, 95% CI for OR: 1.18-1.61, Wald $\chi^2(1) = 15.99, p < .001$.

Results of the second logistic regression, using the full sample with missing data coded as positive specimens, indicated that both Step 1, $\chi^2(8, n = 391) = 17.58, p = .03$, and Step 2, $\chi^2(2, n = 391) = 62.09, p < .001$, were statistically significant. The overall model, $\chi^2(10, N = 391) = 79.67, p < .001$, accounted for 24.7% of the variance and correctly classified 70.6% of the sample. Model fit was acceptable, with Hosmer and Lemeshow goodness-of-fit $\chi^2(8) = 6.15, p = .63$. Among individual predictors, years of cocaine use and LDA were again significantly associated with abstinence at Month 9. For every 1 year increase in length of cocaine use, odds of submitting a negative sample again decreased by 5%, OR = 0.95, 95% CI for OR: 0.92-0.98, Wald $\chi^2(1) = 8.19, p < .004$. As weeks of continuous abstinence increased, the odds of submitting a negative specimen increased by a factor of 1.32, 95% CI for OR: 1.21-1.45, Wald $\chi^2(1) = 15.99, p < .001$. While not significant, trends of significance were present for AD status ($p = .07$, non-AD participants were 2.34 more likely to submit a negative specimen than AD participants) and the LDA by AD status interaction ($p = .06$). To more carefully assess the pattern of the potential LDA by AD status interaction, separate logistic regressions were conducted for AD and non-AD participants using the remaining predictor set. LDA accounted for numerically more variance in predicting abstinence among AD than non-AD participants (AD: 31.6%, non-AD: 19.5%). The addition of LDA to the model also resulted in a numerically larger increase in classification accuracy for AD participants (60.7% to 73.8%) than non-AD participants (63.2% to 69.2%). Odds ratios for LDA were 1.34 (95% CI: 1.22-1.47) for AD participants and 1.17 (95% CI: 1.08-1.27) for non-AD participants.

AD Status and Psychosocial Functioning—Results of the 2 (non-AD, AD) X 2 (SC, CM) MANCOVA examining posttreatment change in ASI scores (Month 9 minus Month 3) indicated that none of the multivariate tests were significant (AD status: Pillai's Trace = 0.03, $F(7, 231) = 1.14, p = .34$; Treatment: Pillai's Trace = 0.04, $F(7, 231) = 1.35, p = .23$; AD status X treatment interaction: Pillai's Trace = 0.03, $F(7, 231) = 1.01, p = .43$), after controlling for clinic ($p = .10$), age ($p = .42$), and years of cocaine use ($p = .47$). Although degree of change was not significant between AD status or treatment condition, change scores generally indicated stability or modest improvements (up to -0.06 change) during the posttreatment interval.

Discussion

Consistent with the primary studies (Petry et al., 2004; Petry et al., 2005; Petry et al., 2006a) and with the CM literature (e.g., Lussier et al., 2006; Prendergast et al., 2006), the addition of CM to other forms of substance abuse treatment resulted in longer durations of continuous objectively-verified abstinence. AD status did not impact this association between treatment condition and duration of abstinence, suggesting that the presence of a comorbid AD diagnosis does not interfere with treatment gains. Neither treatment condition nor AD status had an effect on the proportion of negative samples submitted. However, the high overall rate of percent of negative samples submitted leads to a ceiling effect, making further improvement in this index difficult to achieve. Results from this study add to the extant literature (Brower et al., 1994; Carroll et al., 1993; Schmitz et al., 1997) by suggesting that cocaine abusing individuals with and without comorbid AD comparably benefit from CM treatment.

Our results somewhat contrast the findings of Heil et al. (2001), who found participants with AD obtained similar or worse treatment outcomes in control conditions, but better treatment outcomes in CM conditions, than participants without comorbid AD. Methodological variations between these studies may have contributed to differing results. First, sample

characteristics differed between the Heil et al. (2001) and present studies. In the Heil et al. (2001) report, individuals with opioid or sedative dependence were excluded from participating, and their sample was predominately Caucasian. Our sample did not exclude for other substance dependence diagnoses, and minorities represented over 65% of the sample. Second, as noted previously, access to disulfiram differed between conditions, perhaps contributing to poorer outcomes in the control conditions, and leading to the significant treatment condition by AD status interactions found in the Heil et al. (2001) report. Last, the improved outcomes for AD participants compared to non-AD participants in the CRA plus CM condition in the Heil et al. (2001) study may be a result of synergistic effects from combined use of CRA and CM, rather than attributable to the use of CM alone. The use of differing CM plus 'other substance abuse treatment' combinations across studies may partially explain the disparate findings regarding interaction effects.

In the present study, AD participants showed greater improvements in ASI alcohol and ASI medical problems during the treatment interval compared to non-AD participants. These changes can be attributed largely to overcoming the greater severity of problems in the alcohol and medical domains at baseline for AD participants. Although posttreatment changes did not differ by AD status or treatment condition, the scores generally indicated maintenance of gains over time or slight improvements through the posttreatment interval. These improvements during treatment, and the stability of gains in ASI scores over time, are encouraging clinically.

Consistent with prior studies (Higgins et al., 2000; Petry et al., 2005), LDA predicted posttreatment abstinence. The trend of significance for the LDA by AD status interaction suggested that length of continuous abstinence achieved during treatment may be important for participants with AD in predicting posttreatment abstinence. However, interpretations of this finding must be made with caution as the value only approached significance, and it was limited to the analysis with missing data coded as positive specimens. While cautious, we note the similarity of this interaction between LDA and AD status and the results of the Heil et al. (2001) study. Length of LDA achieved during treatment had a more substantial (numerically, but not significant statistically) and positive impact for AD participants than that observed for non-AD participants. These data suggest that interventions effective in increasing LDA during treatment, while effective for both AD and non-AD participants, may have greater impact on AD participants. Thus, results from this study may have clinical appeal. They suggest that patients with multiple SUDs may benefit at least as well as patients with only one SUD from interventions such as CM that extend LDA.

The large, heterogeneous sample of substance abusers, the broad inclusion criteria for study participation, and the use of multiple clinics support the generalization of study results to community-based treatment settings. The use of objectively-verified abstinence and ample power to detect effects are additional strengths. Our study was limited in the length of posttreatment follow-up interval, and future studies would benefit from longer follow-up periods. Our comparisons focused on those with or without current AD, and lifetime AD status was not assessed. Further, follow-up completion rates, while acceptable, were rather low. Although AD status and treatment condition were not significantly related to the availability of posttreatment data, missing data are a limitation and should be considered in interpretation of results.

In summary, CM was positively and significantly associated with longer duration of abstinence from alcohol, cocaine, and opioids, regardless of AD status. AD participants showed improvements in medical and alcohol-related problems during treatment, and these changes were maintained through the posttreatment interval. These data are consistent with the majority of reports suggesting that cocaine abusers with AD respond well with various treatment

approaches, and specifically support the use of CM treatments in cocaine abusers with and without AD.

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Table 1
Baseline and Demographic Characteristics by Alcohol Dependence (AD) Status

Variables	AD (<i>n</i> = 208)	Non-AD (<i>n</i> = 185)	Statistic (df)	<i>p</i>
Treatment Condition (%)			$\chi^2(1) = 0.001$	.98
Standard Care	29.3	29.2		
Standard Care + CM	70.7	70.8		
Study (%)			$\chi^2(2) = 7.83$	.02
Petry et al. (2004)	26.5	35.1		
Petry et al. (2005)	34.1	38.4		
Petry et al. (2006a)	39.4	26.5		
Age	37.5 (8.0)	34.6 (7.9)	$t(391) = -3.58$	< .001
Gender (% Male)	52.4	47.6	$\chi^2(1) = 0.92$	.34
Race (%)			$\chi^2(2) = 3.68$	.16
African American	49.1	56.2		
Caucasian	38.9	29.7		
Other	12.0	14.1		
Marital Status- Never Married (%)	51.9	55.1	$\chi^2(1) = 0.17$	.68
Employment- Full/Part Time (%)	63.9	69.7	$\chi^2(1) = 0.06$	.81
Median Income (IQR)	\$3000 (11855)	\$4000 (14550)		
Years of Education	11.6 (1.9)	11.6 (1.5)	$t(391) = 0.26$	.80
Years of Regular Alcohol Use [†]	20.1 (8.9)	13.8 (8.5)	$t(359) = -6.78$	< .001
Years of Regular Cocaine Use	11.9 (7.9)	9.7 (6.9)	$t(391) = -2.92$	.004
Addiction Severity Index Scores				
Alcohol	0.34 (0.23)	0.10 (0.14)	$t(342) = 12.74$	< .001
Drug	0.16 (0.09)	0.16 (0.09)	$t(391) = 0.25$	.81
Medical	0.25 (0.35)	0.19 (0.32)	$t(391) = -1.89$	.06
Employment	0.74 (0.29)	0.71 (0.30)	$t(391) = -1.04$	.30
Legal	0.14 (0.20)	0.12 (0.21)	$t(391) = -0.92$	.36
Family/Social	0.20 (0.22)	0.18 (0.23)	$t(391) = -0.85$	.39
Psychiatric	0.31 (0.23)	0.25 (0.24)	$t(380) = -2.36$	.02

Notes. Values denote means (standard deviations) unless otherwise indicated. Except for Recent Alcohol Use and Years of Regular Alcohol Use, comparisons are made with the full data set, changes in *t*(d.f.) reflect use of corrected tests for variance inequality.

[†]Excluded non-regular drinkers in the Non-alcohol dependent group, reduced *n* = 154.

Table 2
Treatment Outcomes by AD Status and Treatment Condition

Primary Treatment Outcomes	Alcohol Dependent		Non-alcohol Dependent	
	Standard Care (n = 61)	CM (n = 147)	Standard Care (n = 54)	CM (n = 131)
Longest Duration of Abstinence (weeks) ^a	3.0 (3.0)	5.0 (8.0)	3.0 (4.0)	5.0 (11.0)
Proportion Negative Samples ^b	0.88 (0.26)	0.87 (0.24)	0.79 (0.36)	0.83 (0.30)
Month 9 Follow-up				
% Negative Samples (available data)	84.8 (n = 33)	71.9 (n = 89)	69.2 (n = 39)	69.9 (n = 83)
% Negative Samples (missing coded positive)	45.9 (n = 61)	43.5 (n = 147)	50.0 (n = 54)	44.3 (n = 131)

Notes. CM = Contingency management plus standard care.

^aUnadjusted mean (standard deviation).

^bMedian (interquartile range).