Twelve-Step Program Attendance and Polysubstance Use: Interplay of Alcohol and Illicit Drug Use*

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ABSTRACT. Objective: The primary aim of this study was to advance understanding of the efficacy of 12-step programs by determining the temporal relationships between alcohol and illicit drug use among 12-step program affiliates. **Method:** A total of 253 early 12-step affiliates without extensive histories of Alcoholics Anonymous (AA) attendance were recruited from substance use treatment and community-based AA. A majority of the sample met criteria for a diagnosis of alcohol dependence, reported lifetime use of illicit drugs, and reported illicit drug use in the 90-day period before recruitment. After informed consent, participants were interviewed at intake and in 3-month increments for 1 year. **Results:** Preliminary analyses indicated that 12-step attendance was predictive of reductions in substance use and that such reductions were not moderated by illicit substance use disorder diagnosis or alcohol

problem severity. Lagged hierarchical linear models indicated that illicit drug use was a robust predictor of later use of alcohol, although the frequency and intensity of drinking were contingent on whether participants sustained 12-step program affiliation. Alcohol use did not predict later illicit drug use among participants who sustained 12-step program participation. **Conclusions:** Findings suggest that 12-step participation may serve as a protective factor after substance use occurs. Although our results suggest that the initiation of illicit drug use may undermine efforts to achieve and sustain abstinence from alcohol, our findings do not suggest that alcohol use necessarily mobilizes relapse across different substances among 12-step program affiliates. (*J. Stud. Alcohol Drugs*, 72, 864–871, 2011)

MORE PEOPLE WITH SUBSTANCE USE problems go to community-based 12-step programs (e.g., Alcoholics Anonymous [AA], Narcotics Anonymous [NA]) than to formal treatment for help (Morgenstern et al., 2003), and most treatment providers in the United States encourage 12-step program involvement as an adjunct to treatment and as aftercare (Kelly et al., 2008). Understandably then, considerable research has been conducted to evaluate the magnitude and nature of the benefits of 12-step programs. In general, findings indicate that 12-step program attendance predicts increased abstinence from a variety of substances. For example, results from meta-analytic reviews and prospective studies indicate that AA attendance predicts reduced alcohol consumption and complete abstinence from alcohol (e.g., Emrick et al., 1993; Kaskutas et al., 2002; Tonigan and Rice, 2010; Tonigan et al., 1996). Likewise, participation in 12-step programs has been shown to predict reduced global drug use (e.g., Timko and Sempel, 2004; Timko et al., 2006; Witbrodt and Kaskutas, 2005) as well as the use of specific drugs such as marijuana, opiates, and psychostimulants (Carroll et al., 2000; Gossop et al., 2007; Toumbourou et al., 2002; Weiss et al., 2005; Worley et al., 2008).

Although different 12-step programs target problematic

use of different substances, all typically endorse complete abstinence from alcohol and all illicit drugs (e.g., Fiorenzine and Hillhouse, 2003). This is potentially an important benefit of such programs, given the increasing prevalence of polysubstance use disorders over the past 2 decades (Griffin et al., 2009). Along these lines, it is estimated that 64% of alcoholics also use illicit drugs (Tsuang et al., 1994), including marijuana (42%), cocaine (34%), and opioid drugs (20%), among others (Tonigan and Rice, 2010). Furthermore, roughly 50% of all alcoholics suffer from comorbid illicit substance use disorders (Ross, 1993), an estimate that is consistent with the comorbidity rate reported in the Alcoholics Anonymous Triennial Survey (1990).

Understandably, migration across 12-step sister programs is now common because of the changing patterns in substance use histories. For example, 41% of a sample of NA members reported that AA was the first 12-step program they were exposed to (Toumbourou et al., 2002). Likewise, 79% of participants in an outcome study of a treatment for cocaine dependence reported some mutual-help program attendance during a follow-up period (Weiss et al., 2000). Interestingly, no participant reported attending Cocaine Anonymous (CA) exclusively. Rather, about 19% of the sample reported attending CA, AA, and NA meetings; 40% attended both AA and NA meetings; and 19% attended only AA meetings. It is important to note that practical issues also influence migration across 12-step programs. Central to these issues is the accessibility of different 12-step program meetings, with AA meetings being the most accessible in terms of meeting locations and frequencies (Timko et al., 2006). Ultimately, such migration has made it difficult to

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speak of the effectiveness of a specific 12-step program with any confidence, and many investigators now combine frequency of attendance across 12-step sister programs as an index of exposure to 12-step programs (e.g., Timko et al., 2006; Witbrodt and Kaskutas, 2005).

A second implication of the changing substance use histories of 12-step program affiliates is that investigations of the efficacy of these programs now involve evaluating outcomes in terms of broad arrays of different classes of substances. However, the integration of these outcome measurements to describe 12-step program-related benefit has proven to be complex. One strategy has been to investigate and report alcohol and illicit drug use separately, allowing readers to evaluate program effectiveness based on their intended purposes (e.g., Timko et al., 2006). Alternatively, some studies have involved combining alcohol and illicit drug use into unitary nominal or ordinal abstinence-based outcome measures (e.g., Tonigan and Rice, 2010; Weisner et al., 2003; Witbrodt and Kaskutas, 2005). Although these approaches may enable evaluation of the effectiveness of 12-step programs in attenuating all alcohol and drug use, they obscure possibly important temporal interactions between use of different classes of substances. For example, Tonigan and Rice (2010) found that 41% of an AA-recruited sample reported being abstinent from alcohol use at their 6-month follow-up interviews. However, a smaller percentage of the sample (31%) was abstinent from use of alcohol, marijuana, and cocaine during the same follow-up period. It is not clear whether illicit drug use preceded or followed alcohol use. Clearly, this information is crucial to understanding the nature and course of relapse among 12-step program affiliates.

We believe that a better understanding of the temporal interplay between consumption of different classes of substances among 12-step program members is important. Surprisingly, there has been little research into how the use of one substance among 12-step program members may catalyze cascading use or relapse across different substances. Despite a large body of literature concerning drug-drug interaction effects, cross-sensitization, and cross-tolerance, we are not aware of any studies that have addressed the question of whether the use of illicit drugs precipitates alcohol use (and vice versa) among 12-step program affiliates. Mengis et al. (2002) reported the most relevant findings, and, interestingly, the focus of their study represents the antithesis of attempting to understand how the use of one substance may kindle the use of other substances. Specifically, they investigated how reductions in alcohol use predicted abstinence from crack cocaine among cocaine-dependent adults. They found that reductions in alcohol use by Week 4 of therapy were predictive of abstinence from cocaine during the subsequent 4 weeks of treatment, as well as at Weeks 8, 12, and 26. Whether the finding that cessation of one substance drives later reductions in a second substance can be general-

ized to the opposite situation of promotion of substance use is unknown.

The primary objective of this study was to investigate the temporal relationships between alcohol and illicit drug use among participants exposed to 12-step programs. To this end, we investigated how binary and continuous measures of alcohol use predicted measures of illicit drug use (and vice versa) over a 12-month period of 12-step program affiliation. As a preliminary step, we investigated the benefit of 12-step attendance in predicting subsequent substance use, paying careful attention to controlling for the influence of concurrent treatment and participant motivation for change regarding substance use. To inform our primary objective, we also investigated, in advance, the potential moderating effects of alcohol problem severity and illicit substance use disorder diagnosis on later alcohol and illicit drug use.

Method

Participants

As part of a larger investigation of behavioral change among early 12-step affiliates (R01AA014197; J. Scott Tonigan, principal investigator), participants were recruited from community-based AA and outpatient substance use treatment programs. To evaluate behavior changes unconfounded by history of help-seeking or extended abstinence, exclusionary criteria included more than three lifetime substance use treatment experiences, more than 16 weeks of continuous prior AA attendance, with "continuous" being defined as attending at least one AA meeting per week over a 4-month period, and alcohol abstinence period of 12 months or more following recognition of a problem with alcohol. It was required that participants met *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000), criteria for alcohol abuse or dependence, had consumed alcohol in the 3 months before their enrollment, and had attended at least one AA meeting in the 3 months before their enrollment. Meeting DSM criteria for an illicit substance use disorder was not an exclusionary criterion.

Procedures

All procedures and assessments were approved by the institutional review board at the University of New Mexico (UNM Protocol #24028). Participants underwent breath alcohol testing to ensure that their estimated blood alcohol concentrations did not exceed .05 during consent or any interview. Following the consent process, participants completed a urine toxicology screen, semi-structured interviews, and self-report questionnaires. Participants were reevaluated every 3 months for 1 year, as well as at 18 and 24 months after intake. Although the constructs of interest were evaluated

only through the first year, the veracity of self-reported illicit drug use was evaluated up to the 24-month follow-up interview. Participants did not receive treatment as a part of the study, although treatment referrals were made by attending staff if they deemed it warranted or on participant request. Retention rates for the 3-, 6-, 9-, 12-, 18-, and 24-month follow-up interviews were 94%, 94%, 94%, 92%, 90%, and 86%, respectively.

Assessments

Substance use. Alcohol and illicit drug use data were acquired using the Form 90 (Miller, 1996). Test-retest reliabilities of self-reported days of abstinence from alcohol use (intraclass correlation coefficient [ICC] = .85), drinks per drinking day (ICC = .71), and total alcohol consumed (ICC = .82) on the Form 90 have been reported (Tonigan et al., 1997). Westerberg et al. (1998) further demonstrated that the reliabilities of data concerning self-reported use of marijuana (ICC = .79), cocaine (ICC = .75), and opiates (ICC = .80) were also adequate.

Six substance use outcome measures were computed using Form 90. *Percentage days alcohol use* was defined as the number of days alcohol was used in a period divided by the total number of days in that assessment period, which was converted to a percentage. *Percentage days illicit drug use* was calculated similarly (days use / days in assessment period $\times$ 100), with the highest frequency of use across classes of illicit drugs being used as the numerator. This is a conservative estimate of drug use days when multiple drugs were used in a period but on different days (i.e., it only accounts for the drug used most frequently in a period). *Inclusive percentage days illicit drug use* was defined as the sum of the numbers of days each class of illicit drug was used in a period divided by the total number of days in that period, which was converted to a percentage. This is a more liberal measure of drug use than percentage days illicit drug use when multiple drugs were used during a period (i.e., it accounts for all illicit drug use, regardless of whether multiple drugs were used on the same day). *Reporting alcohol use* was defined as the number of participants who reported having used any alcohol during a period, and *reporting drug use* was defined as the number of participants who reported having used any illicit drugs during a period (both binary measures were coded 1 = *abstinent*, 0 = *use of alcohol or illicit drugs*, respectively). *Drinks per drinking day* was defined as the total number of drinks consumed in a period divided by the number of days on which alcohol was consumed.

Recent use of cocaine, methamphetamine, marijuana, and opiates was evaluated using the iCassette Drug Screen-4 Panel Test (i-DOA-1145; Instant Technologies, Inc., Norfolk, VA). If a participant reported no illicit drug use, care was taken to ensure that a positive drug screen did not reflect medication compliance (e.g., methadone [Dolophine and

others]). This was done by comparing self-reported use of prescribed medical and psychiatric medications on Form 90 with drug screen results.

Help-seeking behaviors. Readiness for behavioral change was evaluated using the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES; Miller and Tonigan, 1996), a 19-item self-report measure that yields three scales: (a) ambivalence (four items; ICC = .82), (b) problem recognition (seven items; ICC = .94), and (c) taking steps (eight items; ICC = .91). We used the problem recognition scale to represent participant readiness for change because, unlike the taking steps scale, it is an unambiguous measure of motivation that does not include assessment of change behaviors. Form 90 was used to acquire frequency data about formal and informal health care service use. Nonoverlapping number of days of formal treatment (residential and outpatient) for alcohol, drug, and emotional problems were summed and divided by the total number of days in the assessment period to derive a percentage of days of formal treatment in an assessment period. Likewise, the number of days of 12-step program attendance in an assessment period was divided by the total number of days in an assessment window to compute the percentage of days that 12-step meetings were attended. This strategy is an effective and psychometrically sound method to use Form 90 frequency counts when the actual number of days in an assessment window varies across individuals (Tonigan et al., 1997; Westerberg et al., 1998).

Moderators. To inform our primary analyses, we investigated how diagnosis of an illicit substance use disorder and alcohol problem severity might moderate 12-step program-related benefit. The Structured Clinical Interview for DSM Disorders—Research Version (First et al., 1997) was used to determine illicit substance use disorder diagnoses across six drug categories. For our purposes, participants meeting criteria for abuse or dependence for at least one illicit substance were classified with “substance abuse” and “substance dependence,” respectively. A composite measure was used to define alcohol problem severity (high vs. low severity). The composite variable was based on responses on the Alcohol Dependence Scale (ADS; Skinner and Horn, 1984) and the Short Inventory of Problems (SIP; Miller et al., 1995). We applied a median split to classify scores as either “high” or “low” for each of the two measures. Participants with scores below the median on both the ADS and the SIP were considered to have low alcohol problem severity. All others were considered to have high alcohol problem severity (i.e., when one or both of a participant’s scores on the ADS and SIP were above the median).

Statistical analyses

Time-lagged hierarchical linear models (HLMs; Raudenbush and Bryk, 2002) were evaluated to assess the influence

of 12-step attendance on later substance use (i.e., percentage days 12-step program attendance at intake, and at 3-, 6-, and 9-month follow-ups were used to predict substance use measures collected at 3-, 6-, 9-, and 12-month follow-ups). Restricted maximum likelihood estimation was used, and data were centered at the 6-month follow-up. For the two binary measures of substance use, reporting alcohol use and reporting drug use, we used procedures described by Raudenbush and Bryk (2002), and used a Bernoulli sampling model and a logit link function. Six HLMs were evaluated, one for each of the following dependent measures: (a) percentage days alcohol use, (b) percentage days illicit drug use, (c) inclusive percentage days illicit drug use, (d) reporting alcohol use, (e) reporting illicit drug use, and (f) drinks per drinking day. Each HLM had two time-varying covariates, both collected at intake as well as at 3-, 6-, and 9-month follow-ups: (a) percentage formal treatment days and (b) the problem recognition scale from the SOCRATES. Lagged HLMs were also used to investigate time-ordered relationships between alcohol use and illicit drug use. One set of analyses involved determining the predictability of illicit drug use, using alcohol use as a predictor; a second set of analyses involved determining the predictability of alcohol use, using illicit drug use as a predictor. Data were centered at 6 months. Modeling of time was restricted to a linear function because of the limited number of assessment points ($n = 5$). We used PASW Statistics (Version 18.0.0; SPSS Inc., Chicago, IL) and HLM (Version 6.0; Scientific Software International Inc., Lincolnwood, IL) to conduct our analyses.

Results

Participants

A total of 253 participants were recruited. Nineteen (7.5%) cases had missing item responses on one or both of the measures used to calculate our moderating variable alcohol problem severity (SIP and ADS) and were thus excluded from our analyses. Preliminary analyses were conducted to establish the optimal context to achieve our primary aim. We first excluded eight participants from all analyses because they reported no lifetime illicit drug use (at intake) and no such use during the study. We felt that these null values might inflate relationships of interest. Second, the accuracy of our results depended on the veracity of self-report. Given this, 37 additional participants were excluded because results from urine drug screens indicated illicit drug use that was not reported. Overall, 45 (17.7%) participants were excluded from our analyses because of the strong potential that their inclusion would bias our results. Comparing the included and excluded participants, only one significant between-group difference emerged across 15 demographic, substance use, and help-seeking variables. Relative to included par-

ticipants, excluded participants reported significantly higher rates of institutionalization (e.g., incarceration) in the 90 days before their enrollment in the study ($t = -2.273$, $p = .024$; $d = -.328$).

Sample characteristics

Of the 189 participants included in our primary analyses, 67% ($n = 127$) were male and 64% ($n = 121$) were Hispanic. A majority of the participants was unemployed (65%, $n = 123$), and, on average, participants had 12.9 ($SD = 2.7$) years of formal education and were 39.1 ($SD = 9.7$) years of age. At intake, all participants reported some AA attendance (about one meeting every 6 days), and 55.6% ($n = 105$) indicated concurrent substance use disorder treatment. On average, participants drank 17.5 ($SD = 12.0$) standard drinks per drinking day. About 68% ($n = 129$) of the participants reported using illicit drugs in the 90-day period before recruitment, and they used illicit drugs, on average, 33.7% ($SD = 43.6$) of these days. About 42% ($n = 80$) of the participants met diagnostic criteria for an illicit substance use disorder (abuse = 4%, $n = 7$; dependence = 39%, $n = 73$). Based on their ADS and SIP scores, 62.4% ($n = 118$) participants were classified as high alcohol problem severity and 37.6% ($n = 71$) as low problem severity. Results from a 2×2 chi-square indicated that classification as high–low alcohol problem severity was unrelated to diagnosis of an illicit substance use disorder, $\chi^2(1) = 0.103$, $p = .764$.

As shown in Table 1, participants reported substantial help seeking during the course of the study. A slight majority of the sample reported attending at least some formal treatment during the first 6 months of the study. Likewise, 81.5% ($n = 154$) reported attending 12-step meetings at the 3-month follow-up (100% at intake because of eligibility criteria), a percentage that decayed steadily to 56.6% ($n = 107$) at the 12-month follow-up. We observed large reductions over 12 months on all measures of substance use. Described as pre–post effects sizes for the continuous measures, drinks per drinking day declined half a standard deviation ($d = .59$), and the decline in percentage days alcohol use was large ($d = .86$). The pre–post change in percentage days illicit drug use was moderate ($d = .31$), whereas inclusive percentage days illicit drug use declined substantially between intake and the 12-month interview ($d = .74$).

Preliminary analyses investigated the extent to which our six measures of substance use were redundant. Scores on percentage days alcohol use and drinks per drinking day acquired at the 6-month follow-up interview were significantly correlated, $r(189) = .458$, $p < .001$, as were the values acquired at the 12-month follow-up interview, $r(181) = .359$, $p < .001$. However, values for these measures acquired at baseline were not significantly correlated. Values reported for percentage days alcohol use and percentage days illicit drug use at the 6-month, $r(189) = .215$, $p = .003$, and 12-month,

TABLE 1. Help-seeking and substance use ($N = 189$): means (SD) or frequencies (%) are reported

Variable	Intake	0–3 months	3–6 months	6–9 months	9–12 months
Percentage days 12-step program attendance	17.9 (19.7)	30.4 (33.0)	20.0 (25.8)	16.6 (24.2)	16.9 (24.7)
Number attending 12-step programs	189 (100.0%)	154 (81.5%)	133 (70.4%)	117 (61.9%)	107 (56.6%)
Percentage days formal treatment	8.2 (16.0)	12.6 (21.1)	10.0 (20.6)	6.2 (12.3)	6.1 (14.9)
Number attending formal treatment	105 (55.6%)	117 (61.9%)	99 (52.4%)	83 (43.9%)	73 (38.6%)
Reporting alcohol use	189 (100.0%)	109 (57.7%)	114 (60.3%)	107 (56.6%)	106 (56.1%)
Percentage days alcohol use	46.6 (30.6)	21.8 (33.4)	19.4 (30.0)	21.6 (32.8)	19.9 (31.7)
Drinks per drinking day	17.5 (12.0)	13.0 (10.8)	12.1 (8.5)	11.8 (8.9)	11.3 (8.8)
Percentage days illicit drug use	33.7 (43.6)	15.4 (28.1)	19.2 (30.4)	18.0 (29.5)	21.4 (36.1)
Reporting illicit drug use	129 (68.3%)	84 (44.4%)	97 (51.3%)	91 (48.1%)	86 (45.5%)
Inclusive percentage days illicit drug use	39.1 (54.0)	18.7 (36.7)	24.8 (40.4)	23.3 (39.0)	26.6 (43.7)

$r(181) = .177, p < .017$, follow-up interviews were significantly correlated, although values for the measures acquired at intake were not. An identical pattern was observed for values on percentage days alcohol use and inclusive percentage days illicit drug use.

12-step program-related benefit

Time-lagged HLMs were evaluated to determine if the percentage of days of 12-step program attendance predicted substance use outcome measures, analyses that included two time-varying covariates: (a) participant motivation and (b) concurrent formal treatment. Frequency of 12-step attendance significantly predicted reductions in percentage days alcohol use ($b = -0.15$; $t = -3.84, p < .001$) and drinks per drinking day ($b = -0.03$; $t = -2.38, p < .018$) over the course of 12 months. Likewise, frequency of 12-step attendance significantly predicted alcohol abstinence on our binary measure, reporting alcohol use ($b = 0.02$; $t = 4.11, p < .001$). Frequency of 12-step program attendance also significantly predicted drug abstinence on our binary measure, reporting drug use ($b = 0.01$; $t = 2.81, p < .006$) but did not predict either percentage days illicit drug use ($b = -0.05$; $t = -1.22, p < .225$) or inclusive percentage days illicit drug use ($b = -0.07$; $t = -1.30, p < .193$). Neither alcohol problem severity nor illicit substance use disorder diagnosis moderated the effect of 12-step program-related benefit on any substance use outcome measure.

Temporal relationships between alcohol and illicit drug use

Lagged HLMs were evaluated to determine if illicit drug use predicted subsequent alcohol use (and vice versa) over the course of 12 months. Regarding illicit drug use (Months 0, 3, 6, and 9) predicting alcohol use (Months 3, 6, 9, and 12), each of three illicit drug use measures was separately evaluated in predicting one of three alcohol measures (nine lagged HLMs). Lagging was then reversed to assess how, if at all, alcohol use predicted illicit drug use, again resulting in nine analyses. The results of these analyses are presented in Table 2. Percentage days illicit drug use, inclusive percentage days illicit drug use, and reporting drug use each signifi-

cantly predicted subsequent reporting alcohol use. Regarding the binary measures of illicit drug and alcohol use measures, participants who reported having used any illicit drugs were 2.5 times more likely to report having used alcohol at a later follow-up relative to those participants who did not report earlier illicit drug use. Likewise, more frequent use of illicit drugs measured two ways predicted lower probability of alcohol abstinence (percentage days illicit drug use: $b = -0.011$; inclusive percentage days illicit drug use: $b = -0.008$). In contrast, reporting drug use did not predict subsequent percentage days alcohol use or drinks per drinking day. However, higher values on percentage days illicit drug use were predictive of more drinking days at a later time ($b = 0.081$). Unexpectedly, higher values on inclusive percentage days illicit drug use predicted significant reductions in later drinks per drinking day ($b = -1.42$). We examined each of the time-ordered links in the overall lagged effect (e.g., intake to

TABLE 2. Lagged prediction of alcohol use by illicit drug use and vice versa ($N = 189$)

Variable	b	t	p
Illicit drug use predicting alcohol use			
Reporting drug use			
Percentage days alcohol use	-4.086	-1.89	.059
Drinks per drinking day	0.014	1.47	.14
Reporting alcohol use	0.900	4.33	.001
Percentage days illicit drug use			
Percentage days alcohol use	0.081	2.43	.034
Drinks per drinking day	0.019	1.82	.19
Reporting alcohol use	-0.011	-3.17	.002
Inclusive percentage days illicit drug use			
Percentage days alcohol use	0.043	-1.64	.102
Drinks per drinking day	-1.42	-2.00	.045
Reporting alcohol use	-0.008	-3.23	.002
Alcohol use predicting illicit drug use			
Percentage days alcohol use			
Reporting drug use	-0.007	-2.11	.035
Percentage days illicit drug use	-0.018	-0.55	.585
Inclusive percentage days illicit drug use	-0.017	-0.40	.688
Drinks per drinking day			
Reporting drug use	0.011	1.48	.140
Percentage days illicit drug use	-0.215	-2.40	.017
Inclusive percentage days illicit drug use	-0.219	-1.92	.055
Reporting alcohol use			
Reporting drug use	0.543	2.59	.010
Percentage days illicit drug use	-1.209	-0.51	.609
Inclusive percentage days illicit drug use	-1.815	-0.650	.516

3 months, 3 months to 6 months, and so forth) to investigate this unexpected effect. These post hoc analyses indicated that the effect of increased inclusive percentage days illicit drug use predicting reduced drinking intensity was strongest from baseline to the 3-month follow-up and thereafter decayed to nonsignificance.

Two of the three alcohol use measures significantly predicted later illicit drug use when drug use was defined as a binary outcome. Here, the presence of any drinking (*yes/no*) significantly increased the odds of any illicit drug use at a later time by 1.7, whereas increased frequency of drinking significantly increased the probability of later use of illicit drugs ($b = -0.007$). Of the remaining six lagged tests, only one achieved statistical significance: increased drinks per drinking day was predictive of fewer percentage days illicit drug use. Repeating the post hoc strategy to separately examine each link in the overall time-ordered effect, we found that the effect of increased drinking intensity on reducing percentage days illicit drug use was strongest from baseline to 3-month follow-up ($r = -.15$, $p < .034$) and was nonsignificant at the 6- and 9-month follow-ups.

Post hoc and parallel analyses were conducted to assess the temporal relationships between illicit drug and alcohol use for only those participants who reported 12-step program participation at both baseline and at the 12-month follow-up interview ($n = 107$). Among these participants, none of the alcohol use measures significantly predicted any measure of subsequent illicit drug use. In contrast, all three illicit drug use measures predicted subsequent alcohol use. Reporting drug use predicted later reporting alcohol use ($b = 0.89$; $t = 2.80$, $p < .006$) such that alcohol use was 2.4 times more likely with prior illicit drug use. Likewise, fewer percentage days illicit drug use was predictive of reduced reporting alcohol use at a later time ($b = 0.01$; $t = 2.26$, $p < .024$). Of the remaining six analyses, only percentage days illicit drug use predicted later increases in drinking intensity.

Discussion

Large reductions in alcohol and illicit drug use among participants were observed across the 12 months of the study, and frequency of 12-step program attendance was a significant factor accounting for these reductions, even after controlling for concurrent formal treatment and motivation. This finding is consistent with results from less rigorously designed studies. Our results indicate that 12-step programs are useful resources supporting reduced use of different classes of substances during initial efforts to change behavior. It is important to note that, although 12-step program attendance predicted whether participants would subsequently use illicit drugs, it did not predict the frequency of such use.

One robust temporal linkage was identified between alcohol and illicit drug use among 12-step program affiliates. In the total sample, as well as among participants who

reported having attended at least one 12-step meeting at intake and the 12-month follow-up interview, illicit drug use significantly predicted the violation of alcohol abstinence. Conversely, our findings were inconsistent with respect to illicit drug use predicting the frequency and intensity of subsequent alcohol use. We suspect that this inconsistency reflects differences in sustaining 12-step program affiliation. With one exception, among participants who sustained 12-step program participation, illicit drug use was unrelated to frequency and intensity of alcohol consumption. This was not the case for participants who reported no 12-step attendance at the 12-month interview. For these participants, frequency of illicit drug use was a positive predictor of the frequency and intensity of subsequent alcohol use.

Our findings concerning how alcohol use may kindle subsequent illicit drug use were less clear. In the total sample, whether participants used alcohol significantly predicted whether they subsequently used illicit drugs. Similarly, increased frequency of drinking predicted whether they subsequently used illicit drugs. Interestingly, we found that drinking intensity significantly predicted subsequent reductions in frequency of illicit drug use. We found that this effect was transient, occurring only in the first 3 months of study participation. Thereafter, drinking intensity was largely unrelated to frequency of subsequent illicit drug use. A very different picture emerged between alcohol use and later illicit drug use when only participants who reported 12-step program attendance at the 12-month follow-up were considered. When doing so, no measure of alcohol use predicted any measure of illicit drug use.

When considered together, our findings suggest the counterintuitive conclusion that 12-step program participation may serve a protective function after substance use occurs. Specifically, sustained 12-step program affiliation appeared to sever the linkage between alcohol use and later illicit drug use. Relatedly, whether participants used illicit drugs predicted later use of alcohol for all participants, but illicit drug use among 12-step program affiliates did not lead to increased frequency of alcohol use as it did for nonaffiliates. These findings are inconsistent with predictions of the abstinence violation effect (Marlatt and Gordon, 1985), which is frequently applied to explain relapse among individuals in abstinence-based treatment programs (e.g., Tonigan et al., 1998). Specifically, underlying the abstinence violation effect is the belief held by an individual that any use of a "prohibited" substance will result in a "full" relapse, one that will cascade across a number of different substances (among polysubstance users). This self-fulfilling prophecy has received mixed support, at best (e.g., O'Donnell, 1984). Nevertheless, it is fundamental to how relapse is viewed by 12-step program affiliates and treatment providers in the United States. Clearly, abstinence violation effect predictions are consistent with 12-step ideology regarding loss of control and powerlessness over substance use. The reasons for the

inconsistency between our findings and predictions based on 12-step ideology are not clear. It is clear that 12-step programs' social networks encourage complete abstinence, which is an important factor in previous attempts to explain 12-step program-related benefit (Bond et al., 2003; Kaskutas et al., 2002; Laudet et al., 2004). We think it is unlikely that the use of alcohol or illicit drugs breaches the social contract between a 12-step program member and the 12-step program social network, at least initially. In fact, the prescribed steps of 12-step programs explicitly state that their members are to offer aid to a suffering alcoholic/addict. We suspect that access to, and support from, 12-step programs' social networks account for the protective effect reported here.

This study had notable strengths as well as some limitations. The strengths of the study include the substantial effort made to identify and exclude study participants from the analyses who, because of the absence of an illicit drug use history or lack of convergence between self-report and urine toxicology reports, might have biased our findings. Relatedly, we intentionally recruited participants with limited prior AA histories to assess linkages of interest, unconfounded by past learning. In addition, our follow-up rates were consistently high, semi-structured interviews and self-report measures had demonstrated psychometric merit, and the calendar-based alcohol and illicit drug use data provided an estimate of continuous day-by-day behavior over a 12-month period.

A few study limitations should be noted. Foremost, lifetime exposure to 12-step programs other than AA was not considered in study exclusion criteria. It is possible that some participants had limited AA histories yet extensive histories in other 12-step programs (e.g., NA). We regard this possibility to be slight, however. Specifically, investigations into migration patterns across 12-step programs show that it is relatively uncommon for 12-step attendance not to include attendance at AA meetings, if only for practical reasons. Relatedly, the assessment tools in this study did not enable discrimination between AA attendance and attendance at other 12-step program meetings. Although participants were recruited on the basis of attending AA, migration across 12-step sister programs occurs (e.g., Weiss et al., 2000), and it is likely that some participants attended other 12-step programs. As such, we have intentionally spoken of 12-step program-related benefit rather than AA-related benefit. To enable comparisons with results from other studies, we used frequency of 12-step program meeting attendance to indicate the influence of 12-step mutual-help programs on substance use outcomes. However, there is evidence that involvement in, commitment to, and practice of 12-step program-prescribed behaviors are better predictors of outcomes than sheer meeting attendance (McCradly and Tonigan, 2009; Tonigan, 2008).

In sum, we investigated the temporal interplay between alcohol and illicit drug use among participants exposed to 12-step programs. We believe that consideration of both

classes of substances is important when judging the efficacy of 12-step programs because of increases in rates of comorbid alcohol and substance use disorders among adults in 12-step programs. Although requiring replication, our findings indicate that illicit drug use predicts later alcohol use among early 12-step program affiliates, regardless of whether they sustain affiliation. The nature and severity of subsequent alcohol use, however, appear to depend on whether an individual sustains 12-step program meeting attendance. Likewise, continued 12-step program meeting attendance appeared to moderate the linkage between first consuming alcohol and later illicit drug use. Here, reports of sustained meeting attendance were predictive of no association between alcohol and illicit drugs, whereas alcohol use was a significant predictor of later illicit drug use by 12-step disaffiliates. Factors accounting for this protective effect of 12-step programs after substance use has been initiated require further attention. In short, when complete alcohol abstinence is desired, the prudent recommendation is that one should abstain from illicit drug use. However, our findings also indicate that, when alcohol use occurs among polysubstance-using 12-step program affiliates, the subsequent use of illicit drugs is not an inevitable event.

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