

Brief article

Temporal relationship between substance use and delinquent behavior among young psychiatrically hospitalized adolescents

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Abstract

There is considerable evidence linking substance use and delinquent behavior among adolescents. However, the nature and temporal ordering of this relationship remain uncertain, particularly among early adolescents and those with significant psychopathology. This study examined the temporal ordering of substance use and delinquent behavior in a sample of psychiatrically hospitalized early adolescents. Youth ($N = 108$) between the ages of 12 and 15 years completed three assessments over 18 months following hospitalization. Separate cross-lagged panel models examined the reciprocal relationship between delinquent behavior and two types of substance use (e.g., alcohol and marijuana). Results provided evidence of cross-lagged effects for marijuana: Delinquent behavior at 9 months predicted marijuana use at 18 months. No predictive effects were found between alcohol use and delinquent behavior over time. Findings demonstrate the stability of delinquent behavior and substance use among young adolescents with psychiatric concerns. Furthermore, results highlight the value of examining alcohol and marijuana use outcomes separately to better understand the complex pathways between substance use and delinquent behavior among early adolescents. © 2012 Elsevier Inc. All rights reserved.

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1. Introduction

There is considerable evidence linking substance use and delinquency among adolescents (D'Amico, Edelen, Miles, & Morral, 2008; Doherty, Green, & Ensminger, 2008; Hayatbakhsh et al., 2008; Wanner, Vitaro, Carbonneau, & Tremblay, 2009). Although there are clear associations between these problem behaviors, their development and temporal ordering remain uncertain and may vary over the course of adolescence (Doherty et al., 2008; Marmorstein, Iacono, & Malone, 2010; Mason & Windle, 2002).

Understanding the onset and temporal ordering of these co-occurring problems is particularly important among younger adolescents with psychiatric problems because these youth experience elevated risk of developing both substance use and delinquency (Armstrong & Costello, 2002; King, Iacono, & McGue, 2004; Steiner & Cauffman, 1998; Teplin et al., 2005). Furthermore, few studies have separately investigated the longitudinal association for alcohol and marijuana use despite evidence that patterns of adolescent use vary by type of substance (Flory, Lynam, Milich, Leukefeld, & Clayton, 2004; Kosterman, Hawkins, Guo, Catalano, & Abbott, 2000). Thus, the goal of this study was to separately examine the longitudinal relationship between delinquency and alcohol and marijuana use, respectively, in a sample of psychiatrically hospitalized early adolescents, aged 12 to 15 years.

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Numerous studies have provided evidence that delinquent behavior leads to increased substance use (Doherty et al., 2008; Hayatbakhsh et al., 2008; Wanner et al., 2009). Two separate longitudinal investigations of middle-school students found that deviant behavior is a positive predictor of subsequent initiation of marijuana use (Henry, Thornberry, & Huizinga, 2009; van den Bree & Pickworth, 2005). In addition, a 5-year study of 429 youth demonstrated that increased delinquency at age 11 predicted increased alcohol use at age 16 for both boys and girls (Mason, Hitchings, & Spoth, 2007). Another study of high school students found that more frequent delinquent behavior in Grade 10 was associated with greater problem substance use in Grade 12, whereas substance use in Grade 10 was not associated with delinquent behavior in Grade 12 (Bui, Ellickson, & Bell, 2000). A prevailing theory to account for this relationship is that delinquent behavior provides both a peer group and social context that increase the propensity toward substance use (D'Amico et al., 2008; van den Bree & Pickworth, 2005).

Conversely, other community studies have provided data indicating that substance use predicts delinquent behavior (Ford, 2005; French & Dishion, 2003; Loeber & Farrington, 2000). For instance, Huang et al. (2001) followed fifth graders for 8 years and examined the reciprocal association between alcohol use and interpersonal aggression. Results indicated that alcohol use at age 16 years predicted interpersonal aggression at age 18 years, whereas aggression did not exert any predictive effects on subsequent alcohol use. Another longitudinal study of high-school-age students by Ford (2005) found that marijuana use predicted later delinquent behavior, but delinquency did not predict later marijuana use. Investigators have proposed several mechanisms by which substance use leads to delinquent behavior, including the acute effects of intoxication (Parker & Auerhahn, 1998), the need to obtain resources to support substance use (Goldstein & Herrera, 1995), and the weakening of prosocial bonds (Ford, 2005).

At least one study of adolescents in the community and two studies of juvenile detainees have found evidence of a bidirectional relationship between delinquent behavior and substance use (D'Amico et al., 2008; Dembo et al., 2002; Mason & Windle, 2002). Mason and Windle (2002) examined reciprocal associations between substance use and delinquency in high school students over a 2-year period. They found that delinquency predicted substance use at each of the four follow-up waves and that substance use predicted delinquency from Time 1 to Time 2. Of note, these results were significant for boys but not girls. In a study of high-school-aged juvenile detainees, Dembo et al. (2002) found two significant cross-lagged associations across three time points: Delinquent behaviors at baseline predicted substance use at 12 months, and substance use at 12 months predicted delinquent behaviors at 24 months. These results provided indication of bidirectional influences but did not support a consistent reciprocal association over the follow-

up period. More recently, D'Amico et al. (2008) investigated the relationship between substance use and delinquency among 449 juvenile offenders aged 13 to 17 years. Cross-lagged panel modeling indicated that adolescent substance use and delinquent behavior had significant bidirectional effects at each time point (e.g., baseline, 3 months, 6 months, and 12 months), suggesting that the reciprocal relationship was fairly stable over time.

In addition to producing mixed results, prior longitudinal studies have been subject to several limitations. First, studies have predominantly focused on adolescents in community samples (Bui et al., 2000; Ford, 2005; Henry et al., 2009; Mason & Windle, 2002) or those involved in the juvenile justice system (D'Amico et al., 2008; Dembo et al., 2002). To date, no studies have examined the longitudinal relationship in a sample of adolescents presenting for mental health treatment despite the fact that these youth are at increased risk for both substance use and delinquent behavior (Armstrong & Costello, 2002; King et al., 2004; Steiner & Cauffman, 1998; Teplin et al., 2005). In addition to occurring at higher rates, it is possible that these behaviors have different stability and reciprocal effects among adolescents presenting for mental health treatment. Following a clinical sample of adolescents could elucidate this relationship and provide information about postintervention processes, which could, in turn, inform further treatment development and enhancement.

Second, prior investigations have typically examined only alcohol use (Huang et al., 2001; Mason et al., 2007) or only marijuana use (Ford, 2005; Henry et al., 2009; van den Bree & Pickworth, 2005) or have created a composite measure of substance use (D'Amico et al., 2008; Mason & Windle, 2002). Yet, studies suggest that trajectories of adolescent substance use vary by the type of substance (Flory et al., 2004; Martino, Ellickson, & McCaffrey, 2008). For instance, Kosterman et al. (2000) separately examined the initiation of alcohol and marijuana use in a community sample and found significant differences in the slopes of the initiation trajectories over an 8-year period. Specifically, the slope of the initiation trajectory for alcohol use peaked prior to the age of 13 and then slowly declined, whereas the slope of the initiation trajectory for marijuana use remained relatively stable throughout adolescence.

Finally, studies with noncommunity samples (e.g., juvenile detainees) have predominantly included older adolescents (D'Amico et al., 2008; Dembo et al., 2002). Studies that focused on younger adolescents could offer information about the early development and interrelationship between these problem behaviors. This is particularly beneficial considering that early initiation of substance use has been associated with a range of deleterious outcomes including later substance dependence, Axis II comorbidity, and criminal involvement (Anthony & Petronis, 1995; Franken & Hendriks, 2000).

This study aimed to address the aforementioned limitations by examining the longitudinal association between

substance use and delinquency among younger adolescents, aged 12 to 15 years, following hospitalization for psychiatric concerns. Our primary hypothesis was that delinquent behavior and frequency of substance use would have reciprocal effects over the 18 months following hospitalization. Consistent with prior studies (Dembo et al., 2002; Ford, 2005), our secondary hypothesis was that both delinquent behavior and substance use would demonstrate significant stability over time. To extend prior research, we separately examined the longitudinal relationship between delinquency and frequency of use for the two most commonly abused substances among adolescents: alcohol and marijuana.

2. Methods

2.1. Procedures and participants

The research methods used in this study have been described in a prior publication (Prinstein et al., 2008). Participants in the initial study were 143 psychiatrically hospitalized adolescents between the ages of 12 and 15 years. Adolescents were recruited from a psychiatric inpatient facility in the northeastern United States between 2001 and 2005. All adolescents admitted to the unit were eligible for study participation, provided that they had no clinically evident cognitive impairment which would preclude completing a structured interview (e.g., no active psychosis or mental retardation). Participation involved completion of a comprehensive assessment battery at baseline and up to five follow-up sessions.

Over the recruitment period, a total of 246 adolescents matching the study inclusion criteria were admitted to the unit. At the time of data collection, about 40% of all admissions were discharged or transferred within 1–2 days. This short treatment duration was because of a variety of factors (e.g., vacancies at local facilities, insurance specifications) and did not serve as an indicator of diagnostic severity or socioeconomic status. Consistent with approved human ethics procedures, adolescents were approached for the study after clinical personnel had gained permission from the parent/guardian, typically on the second day following admission. Consent was requested from 183 adolescents who were identified as eligible prior to discharge. A total of 162 (88.5%) provided consent, and 143 of these (88.3%) remained on the unit long enough to complete the intake battery. The current analysis includes 108 adolescents who completed the baseline substance use measures. Administration of the substance use measure commenced after study recruitment was underway, and these data were not collected for the first 35 adolescents.

Participants in the final sample were predominantly female (68%) and Caucasian (7%), with modest representation of adolescents identifying as Hispanic (6%) or other/multiracial (14%). The average age was 13.5 years ($SD = 0.74$ years). About 31% of adolescents lived with only their biological

mother, 21% lived with both biological parents, 19% lived with a biological mother and stepparent, and the remaining youth lived with either a biological father only, extended family, or in foster or temporary care. Based on administration of the National Institute of Mental Health (NIMH) Diagnostic Interview for Children (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), the most common type of mental health diagnosis in this sample was a disruptive behavior disorder (56%), supporting our focus on delinquent behavior. Other common diagnoses included depressive disorders (32%), anxiety disorders (24%), and posttraumatic stress disorder (16%). The most common length of stay for adolescents in the final sample was 5 to 7 days.

2.2. Measures

This study uses measures of adolescent substance use, delinquent behavior, and depression. These measures were administered at baseline, 9 months, and 18 months.

2.2.1. Health Risk Behaviors Questionnaire

Frequency of substance use was assessed via the Health Risk Behaviors (HRB) Questionnaire. The HRB is a self-report measure based on the Youth Risk Behavior Surveillance System (Kann et al., 2000). To address our study hypotheses, we examined two items assessing alcohol use frequency (days of any alcohol use and days of five or more drinks) and one item assessing marijuana use frequency (days of any marijuana use). Each item accounted for the adolescent's lifetime history of use and level of use over the past 30 days. Responses were scored on Likert scales, with options ranging from 0 (*never used*) to 5 (*used 10 or more of the past 30 days*). In the 1999 Youth Behavior Risk Survey, the items used in this study demonstrated substantial test–retest reliability (kappa values = 0.68–0.76) in a sample of 4,619 adolescents across 20 states (Brener et al., 2002).

2.2.2. Delinquency Behavior Questionnaire

The Delinquency Behavior Questionnaire (DBQ) is a 12-item self-report measure of externalizing symptoms that was adapted from the Self-Reported Delinquency Interview (Elliott, Huizinga, & Ageton, 1985). Items in the DBQ assessed the frequency of adolescents' participation in illegal and delinquent behaviors commonly included in measures of externalizing symptomatology, such as engaging in a physical fight, damaging property, setting fires, carrying a weapon, skipping class, and cheating on a test. Adolescents rated how often they had done each behavior over the past year on a 5-point Likert scale. An overall score was calculated as the sum of the individual items, with higher scores indicating more delinquent behavior. In an analysis of the full study sample (Prinstein et al., 2008), the mean score across items demonstrated significant correlations with conduct disorder symptoms reported on the NIMH Diagnostic Interview Schedule for Children, Version IV (Shaffer et al., 2000) by both adolescents ($r = .78, p < .001$) and their

parents ($r = .29, p < .01$). Internal consistency in this sample was .88.

2.3. Missing data

Of the 108 adolescents who completed the baseline substance use measures, 83 (77%) completed the 9-month assessment, and 81 (75%) completed the 18-month assessment. Seventy-eight adolescents (72%) completed both assessments. Comparisons between those adolescents with and without missing data did not reveal any significant differences between the groups on age, gender, days of alcohol use, days of marijuana use, or delinquent behavior, providing no indication of attrition bias. Full information maximum likelihood (FIML) estimation, a method that has been shown to generate unbiased parameter estimates when data are missing at random (Enders, 2001), was used to handle missing data. Although FIML is robust to data missing at random, there is mixed support for its robustness with nonnormality. All analyses were therefore conducted using the Yuan and Bentler (2000) correction for multivariate nonnormality.

2.4. Analysis plan

Prior to testing the study hypotheses, baseline correlations among the study variables were calculated. In addition, we tested for differences among the predictors as a function of standard demographic variables (e.g., gender, age, ethnicity). These analyses were conducted to determine whether demographic variables were significantly associated with the dependent variables and needed to be retained in the model. The two alcohol use measures, days of any alcohol use and days of high-volume drinking (e.g., five or more drinks per day), demonstrated a very large, significant correlation ($r = .93, p < .001$), suggesting that examining both variables would provide redundant information. We therefore focused on days of alcohol use to be consistent with days of marijuana use and conducted analyses on days of high-volume drinking to test the robustness of our findings.

To test the study hypotheses, cross-lagged panel models were estimated. Cross-lagged panel modeling is frequently used to assess the causal direction between variables in data derived from nonexperimental, longitudinal research designs (Finkel, 1995). Two sets of models were constructed: one with days of alcohol use as a dependent variable and a second with days of marijuana use as a dependent variable. All analyses were conducted in MPlus version 6.0 (Muthen & Muthen, 2010).

We began by estimating a baseline model that freely estimated all paths between delinquent behavior and days of use. Next, we estimated increasingly constrained models to obtain the most parsimonious model fit. Constraints were systematically added to the baseline model to reflect the assumption that similar effects should be stable over time. We first added constraints on the stability effects for each variable

(e.g., the stability of delinquent behavior from baseline to 9 months was set equal to the stability from 9 to 18 months), then on the within time-point residual correlations (e.g., the residual correlation of delinquent behavior and days of use at 9 months was set equal to the residual correlation at 18 months), and finally on the cross-lagged effects (e.g., the cross-lagged effect of delinquent behavior on days of use from baseline to 9 months was set equal to the cross-lagged effect from 9 to 18 months). Using the chi-square difference test, we compared the baseline model to the constrained models. Because there were two time intervals, each model comparison involved a 1 degree of freedom change.

Fit of each cross-lagged panel model was evaluated using three conventional indexes: chi-square, root-mean-square error of approximation (RMSEA), and comparative fit index (CFI). Chi-square analysis tests the hypothesis that the specified model fits the observed covariances, with p values greater than .05 indicating acceptable fit. Relative to chi-square, RMSEA and CFI are indices that are less influenced by model parameters such as sample size and number of variables. Consistent with conventional criteria (Hu & Bentler, 1999), RMSEA values less than .08 and CFI values greater than .9 were viewed as indicating acceptable fit to the data.

3. Results

3.1. Preliminary analyses

Table 1 displays the means, standard deviations, and item distributions of the substance use and delinquency variables across all three time points. At each assessment, the mean scores for frequency of alcohol and marijuana use reflect relatively infrequent use. However, the item distributions indicate that a substantial proportion of these early adolescents had used illicit substances. At baseline, 49% of the sample reported a lifetime history of alcohol use, and 43% reported a lifetime history of marijuana use. The proportion of youth reporting a lifetime history of alcohol use steadily increased 14% over the two follow-up assessments. By contrast, the proportion of youth reporting a lifetime history of marijuana use remained stable between baseline and 9 months and then increased 15% between the 9- and 18-month assessments.

Baseline associations among the study variables are depicted in Table 2. Days of any alcohol use and days of marijuana use were moderately correlated ($r = .65, p < .01$), and both were correlated with delinquent behavior (alcohol use, $r = .52, p < .01$; marijuana use, $r = .53, p < .01$). None of the study variables were significantly correlated with age. Using paired t tests, there were no gender or ethnic differences in frequency of alcohol use, frequency of marijuana use, or delinquent behavior at baseline. Because gender, age, and ethnicity were not associated with any of the dependent variables, these demographic variables were not

Table 1
Descriptive statistics for the substance use variables and delinquent behavior at each wave for psychiatrically hospitalized early adolescents

Variable	Study wave		
	Baseline (<i>N</i> = 108)	9 months (<i>n</i> = 83)	18 months (<i>n</i> = 81)
Alcohol frequency, <i>M</i> (<i>SD</i>)	1.04 (1.39)	1.08 (1.39)	1.30 (1.40)
Never used	55 (51)	36 (43)	30 (37)
Lifetime use, 0 of past 30 days	23 (21)	27 (32)	24 (29)
Lifetime use, 1–2 of past 30 days	15 (14)	9 (11)	12 (15)
Lifetime use, 3–5 of past 30 days	5 (5)	4 (5)	8 (10)
Lifetime use, 6–10 of past 30 days	6 (6)	2 (2)	5 (6)
Lifetime use, 10+ of past 30 days	4 (4)	5 (6)	3 (4)
Marijuana frequency, <i>M</i> (<i>SD</i>)	0.87 (1.33)	0.80 (1.25)	1.11 (1.44)
Never used	61 (57)	48 (59) ^a	36 (44)
Lifetime use, 0 of past 30 days	25 (23)	18 (22)	27 (33)
Lifetime use, 1–2 of past 30 days	10 (9)	4 (5)	3 (4)
Lifetime use, 3–5 of past 30 days	3 (3)	6 (7)	7 (9)
Lifetime use, 6–10 of past 30 days	5 (5)	4 (5)	4 (5)
Lifetime use, 10+ of past 30 days	4 (4)	1 (1)	4 (5)
Delinquent behavior questionnaire, <i>M</i> (<i>SD</i>)	21.08 (9.09)	18.16 (8.72)	16.95 (5.40)

Note. Values are expressed as number (percentage) unless otherwise indicated. Percentages may not sum to 100 because of rounding.

^a Because of varying *ns* at the different follow-up periods, the percentage of adolescents reporting *never used* increased slightly from baseline to 9 months.

retained in the final models. Replication of the models controlling for these demographic variables revealed an identical pattern of results with regard to statistical significance and effect sizes; however, the inclusion of these variables resulted in less favorable fit indices, supporting their exclusion from the final model.

3.2. Temporal effects of substance use and delinquent behavior

To test the study hypotheses, two cross-lagged panel models were estimated to assess the reciprocal relationship between delinquent behavior and frequency of alcohol and marijuana use, respectively, across three waves of data. Results of the two models are reported below.

3.2.1. Frequency of alcohol use

The baseline model that freely estimated the stability effects, within time-point correlations, and cross-lagged effects for days of alcohol use and delinquent behavior demonstrated excellent fit to the data, $\chi^2(4) = 4.44$, $p = .35$, CFI = 1.00, RMSEA = 0.03. Model comparisons with the chi-square difference test indicated that adding constraints on the stability and cross-lagged effects did not significantly affect

model fit. However, adding constraints on the within time-point correlations significantly reduced the fit of the model, $\Delta\chi^2(1) = 11.33$, $p < .001$, suggesting that the associations between deviant behavior and days of alcohol use were not stable over time. Thus, the final, most parsimonious model was estimated with this equality constraint released: $\chi^2(8) = 8.59$, $p = .38$, CFI = 1.00, RMSEA = 0.03.

As shown in Fig. 1, significant and moderately large stability effects were found for both days of alcohol use and delinquent behavior following hospitalization. In addition, the association between days of alcohol use and delinquent behavior was significant at 9 months, but not at 18 months. At baseline, the association between days of alcohol use and delinquency is simply a correlation. At later time points, the association is a residual correlation, which is the partial correlation of the measures when controlling for earlier time points. The lack of a significant correlation at 18 months indicates that any shared variance between days of alcohol use and delinquent behavior was accounted for by the prior two time points. Despite evidence of significant associations, and counter to our hypothesis, no predictive effects were found between days of alcohol use and delinquent behavior across adjacent waves of data. An identical pattern of significant stability effects and nonsignificant cross-lagged effects was found when replicating these analyses using days of high-volume drinking rather than days of alcohol use.

3.2.2. Days of marijuana use

The baseline model that freely estimated the stability and cross-lagged effects for days of marijuana use and delinquent behavior demonstrated excellent fit to the data, $\chi^2(4) = 5.47$, $p = .24$, CFI = 0.99, RMSEA = 0.06. Model fit was not affected by adding equality constraints on the stability effects, the within time-point associations, or the cross-

Table 2

Baseline correlations among the substance use variables, delinquent behavior and age for psychiatrically hospitalized early adolescents

Variable	1	2	3	4
1. Frequency of alcohol use				
2. Frequency of marijuana use	.65 *			
3. Delinquent behavior (DBQ)	.52 *	.53 *		
4. Age	.16	.12	.02	

* $p < .01$.

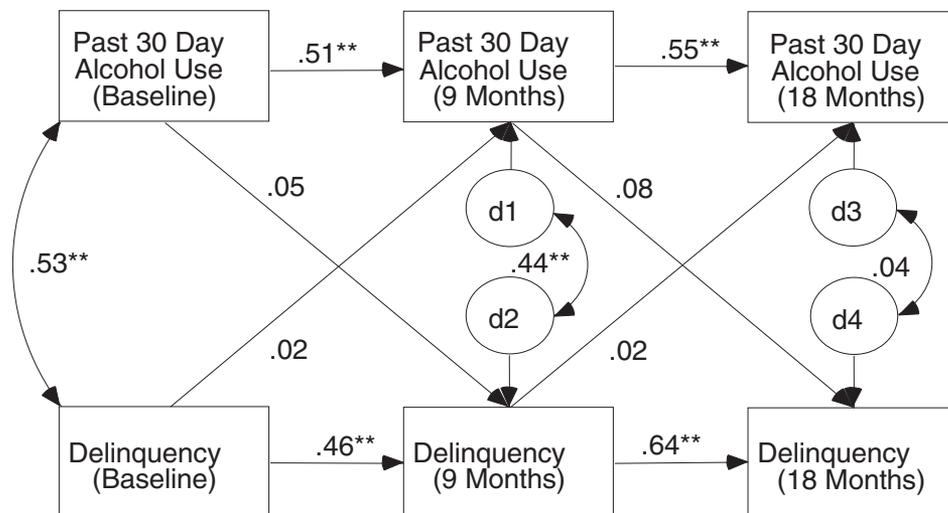


Fig. 1. Cross-lagged panel model for the temporal relationship between frequency of alcohol use and delinquent behavior. Parameter estimates are standardized values. * $p < .01$, ** $p < .001$.

lagged effects from days of marijuana use to delinquent behavior. However, adding equality constraints on the cross-lagged effects from delinquent behavior to days of marijuana use had a significant, negative effect on model fit, $\Delta\chi^2(1) = 7.60, p < .01$. This suggests that the effect of delinquent behavior on subsequent marijuana use was not stable over the 18-month follow-up period. The final model was estimated with this constraint released and demonstrated the most parsimonious fit: $\chi^2(8) = 12.15, p = .14, CFI = 0.98, RMSEA = 0.07$.

As shown in Fig. 2, significant and moderately large stability effects were found for both days of marijuana use and delinquent behavior. Residual correlations between days of marijuana use and delinquent behavior were significant at both follow-up points, indicating that there was considerable unique

variance between the variables at each time point that was not accounted for by earlier occasions. In partial support of our hypothesis, delinquent behavior at 9 months had a significant cross-lagged effect on days of marijuana use at 18 months. Days of marijuana use did not have cross-lagged effects on delinquent behavior. Hence, the model suggests that in this sample of hospitalized youth, delinquent behavior at 9 months predicted subsequent marijuana use, but marijuana use did not predict subsequent delinquent behavior.

4. Discussion

This study examined the longitudinal relationship between delinquent behavior and frequency of use for the two

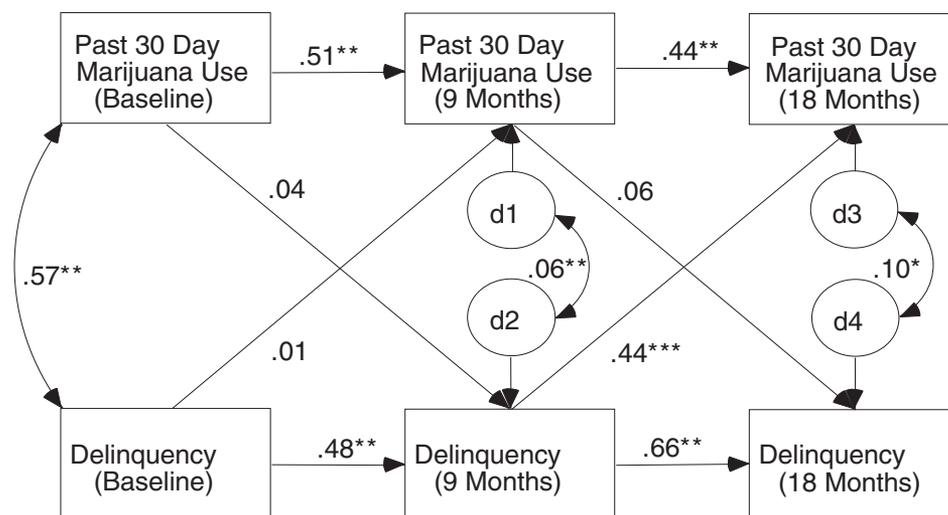


Fig. 2. Cross-lagged panel model for the temporal relationship between frequency of marijuana use and delinquent behavior. Parameter estimates are standardized values. * $p < .01$, ** $p < .001$.

most common illicit substances—alcohol and marijuana—among adolescents following psychiatric hospitalization. Rates of alcohol and marijuana use in this sample of early adolescents are significantly higher than those reported in national community samples of youth (Johnston, O'Malley, Bachman, & Schulenberg, 2010; Substance Abuse and Mental Health Services Administration, 2010b). For example, the 2010 Monitoring the Future Study's survey of eight graders found that 35.8% and 17.3% reported a lifetime history of alcohol and marijuana use, respectively (Johnston et al., 2010), versus reported rates of 49% and 43% in the current sample. Furthermore, the 2009 National Survey of Drug Use & Health found that 14.7% and 7.3% of 12- to 17-year-olds reported any past-month use of alcohol and marijuana use, respectively, relative to rates of 28% and 20% in the current sample. These high lifetime and past-month rates of alcohol and marijuana use (see Table 1) are consistent with the rates of substance use reported in other psychiatric samples of adolescents (Deas-Nesmith, Campbell, & Brady, 1998; Martin, Milich, Martin, Hartung, & Haigler, 1997). It is also noteworthy that there were substantial increases in substance use rates over the 18-month follow-up period despite the fact that most in this sample received mental health treatment ($M = 8.1$ sessions, $SD = 4.7$ sessions) following discharge from the hospital (Spirito et al., 2011).

Results of the current analysis provided partial support for our primary hypothesis for marijuana use frequency but not for alcohol use frequency. The cross-lagged panel model for frequency of marijuana use found that delinquent behavior at 9 months predicted subsequent marijuana use, whereas marijuana use did not predict subsequent delinquent behavior. These results were consistent with prior research demonstrating a unidirectional predictive relationship between delinquency and later substance use (Bui et al., 2000; Mason et al., 2007), as well as other studies that failed to demonstrate a robust reciprocal relationship (Dembo et al., 2002; Mason & Windle, 2002). In contrast to prior studies, we found that the effects of delinquent behavior on subsequent marijuana use were not stable over time. In the current sample, the effect of delinquent behavior on marijuana use was small and insignificant in the first 9 months following hospitalization and became moderate and significant over the next 9 months. This inconsistency may reflect the relatively young age of our sample, as well as variability in the initiation of marijuana use over time. Based on adolescent self-report, lifetime history of marijuana use increased more substantially between the 9- and 18-month follow-ups (increase of 15%), when the mean age of the sample was approaching 15 years, than between the baseline and the 9-month follow-up. Variability in marijuana initiation rates has also been found in large national samples, which have shown a steady increase in incidence rates between the ages of 13 and 17 years (Substance Abuse and Mental Health Services Administration, 2010a). Although it would be remiss to infer developmental relationships from a

small sample, our pattern of results supports the notion that both the initiation of marijuana use and the relationship between delinquent behavior and marijuana use may vary across the developmental period.

Counter to our expectations and prior research (Huang, White, Kosterman, Catalano, & Hawkins, 2001; Mason et al., 2007), no predictive effects were found between alcohol use and delinquent behavior over time. Consistent with prior studies (Kosterman et al., 2000), lifetime rates of alcohol use were higher than lifetime rates of marijuana use in this sample, suggesting that alcohol use may be more normative and less influenced by delinquent peers among early adolescents. It is also important to consider that the correlations between alcohol and delinquent behavior were not stable over time. Despite evidence of significant and moderate associations at baseline and 9 months, the within time-point association was small and insignificant at the 18-month follow-up. An identical pattern was found when examining the days of high-volume drinking variable. These data suggest that by the 18-month assessment, shared variance between days of alcohol use and delinquent behavior was fully accounted for by earlier occasions. The lack of an association by 18 months may reflect the stability of these externalizing behaviors in this sample of early adolescents. Further research with larger samples and more frequent assessment intervals is needed to confirm these findings.

Study findings must be interpreted within the context of several limitations. First, the study relied on self-report data to measure delinquent behavior, which is often assessed using parent report and may have led to the underestimation of this behavior. Substance use was also measured via self-report and not corroborated. Second, the small sample size may have limited power to detect significant effects. The fact that we found a significant, modest effect of deviant behavior at 9 months on subsequent marijuana use attests to the strength of the association. However, the small sample size increases the likelihood that the parameter estimates might be unstable. Third, the analysis focused on frequency of alcohol and marijuana use and did not consider severity of use or other types of substance use. Of note, the same pattern of results was found when examining days of alcohol use and days of high-volume use, suggesting that the observed results are likely robust to measures of heavier substance use. Finally, it is possible that unmeasured variables might account for the relationship between delinquent behavior and substance use. For instance, Mason et al. (2007) found that the relationship between alcohol use and delinquency was partially mediated by peer substance use.

It is somewhat premature to derive intervention implications from this study because of the naturalistic, nonexperimental design. Nevertheless, the present findings lend preliminary support for using interventions targeting delinquency among young adolescents with significant mental health concerns as a means of not only addressing problem behavior but also potentially preventing the onset of later

marijuana use. This study also supports educating parents of early adolescents with emotional and behavioral problems about the consistently high rates of substance use and substance initiation as they transition from middle school to high school, which approximates the age range of this sample. Future research is needed to test potential mediators underlying the relationship between delinquency and substance use among early adolescents with significant psychopathology to determine the best approach for intervention with this vulnerable population. Potential mediators may include those related to parenting (e.g., monitoring, communication, involvement), peer relationships (e.g., deviant peer affiliations), or other domains. Moreover, the differential pattern of effects for marijuana and alcohol highlights the need for future studies to examine these substances separately to better understand the complex pathways between delinquency and use among adolescents.

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