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Testing the Effects of Peer Socialization versus Selection on Alcohol and Marijuana Use among Treated Adolescents

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Abstract

This study examined the relative influence of peer socialization and selection on alcohol and marijuana use among 106 adolescents who received a brief intervention. Adolescents were recruited between 2003 and 2007 and followed for 12 months as part of a SAMHSA-funded study. Cross-lagged panel models using four assessment points examined the longitudinal relationship between adolescent substance use and peer substance involvement separately for alcohol and marijuana. Consistent with community studies, there was evidence of both peer socialization and peer selection for alcohol use, and only evidence of peer selection for marijuana use. Implications for research and intervention are discussed.

Keywords

adolescent; substance abuse; peer socialization; peer selection; treatment

There is extensive evidence indicating that adolescents and their peers tend to have similar patterns of substance use and abuse (Kandel, 1978; McPherson, Smith-Lovin, & Cook, 2001; Popp, Laursen, Kerr, Stattin, & Burk, 2008). Two prevailing theories to account for the similarity in adolescent and peer substance use are socialization and selection. The peer socialization model posits that adolescents tend to adopt the beliefs, attitudes, and behaviors of their peers due to modeling and pressure to conform (e.g., Gardner & Steinberg, 2005; Harris, 1998). Meanwhile, the peer selection model theorizes that adolescents tend to select and affiliate with peers with similar beliefs, attitudes, and behaviors (e.g., Jaccard, Blanton, & Dodge, 2005). Despite well-documented evidence of both selection and socialization in community samples of adolescent substance abusers, their relative influence and applicability in clinical samples remains uncertain. In addition, recent studies have found differences in peer influences for alcohol and cigarette use (Kiuru, Burk, Laursen, Salmela-Aro, & Nurmi, 2010; Steglich, Snijders, & Pearson, 2010), suggesting that selection and socialization effects may vary by substance.

Consistent with the peer socialization model, peer substance use has been identified as a key proximal predictor of adolescent substance use in both cross-sectional (Kandel & Andrews, 1987; Pruitt, Kingery, Mirzaee, Heuberger, & Hurley, 1991) and longitudinal (Barnes,

Hoffman, Welte, Farrell, & Dintcheff, 2006; Windle, 2000) community studies. This relationship has been found in studies focused specifically on alcohol use (Marshall & Chassin, 2000), specifically on marijuana use (Bailey & Hubbard, 1991), and on composite indicators of adolescent substance use that include both alcohol and marijuana (Wills & Cleary, 1999). However, relatively few studies that have tested the effects of peer socialization have simultaneously examined or controlled for the effects of peer selection. In a study of over 2,400 6th to 9th graders, Wills and Cleary (1999) found that a composite measure of initial peer substance use (e.g., alcohol, marijuana, and cigarette use) predicted change in adolescent substance use, but that initial adolescent substance use did not predict change in peer substance use. Additional community studies have also found significant effects of peer socialization when controlling for the effects of selection (Sieving, Perry, & Williams, 2000; Urberg, Degirmencioglu, & Pilgrim, 1997).

Conversely, other community studies have found evidence of the importance of peer selection even when controlling for the effects of socialization. In one of the first longitudinal studies to test for a bi-directional relationship, Farrell and Danish (1993) evaluated early adolescents in the community three times over an 18 month period. This study demonstrated that earlier peer drug use (e.g., alcohol, marijuana and cigarette use) did not predict later adolescent drug use, whereas earlier adolescent drug use did predict later peer drug use. Similarly, Iannotti and colleagues (1996) followed early adolescents in urban school districts over 4 years using a composite measure of substance use. The investigators found predictive effects from adolescent substance use to peer use, but not from peer substance use to adolescent use. Several other recent longitudinal studies have also provided evidence that peer selection is at least as powerful as socialization in influencing similarity between adolescent and peer substance use (Knecht, Burk, Weesie, & Steglich, 2011; Poelen, Engels, Van Der Vorst, Scholte, & Vermulst, 2007).

A growing body of literature has suggested that there is a bi-directional relationship between adolescent and peer substance use in community samples, with particularly strong evidence in studies of alcohol use. Using a longitudinal random coefficients model, Curran, Stice, and Chassin (1997) tested the reciprocal effects of adolescent and peer alcohol use among 363 teenagers in the community. The investigators found that initial peer alcohol use was predictive of later increases in adolescent alcohol use and that initial adolescent alcohol use was predictive of later increases in peer alcohol use. Two more recent latent growth curve analyses in community samples by Bray and colleagues (2003) and Simons-Morton (2006) yielded similar results. Bray and colleagues (2003) followed over 6,000 teenagers over a 3-year period and reported effects of both socialization and selection on progression of alcohol use. Meanwhile, Simons-Morton (2006) assessed 2453 teenagers 5 times from 6th to 9th grade and found evidence of both socialization and selection on progression of drinking as well as on a composite measure of substance use. Selection and socialization processes in these community studies were small to medium in size (range from .10 to .68; Bray et al., 2003; Chassin, Rogosch, & Barrera, 1991; Simons-Morton & Chen, 2006).

Taken together, prior research suggests that the effects of selection are at least as important as the effects of socialization, with recent literature suggesting that both effects occur simultaneously. Evidence of bi-directional effects of selection and socialization has been

most consistently found in studies of adolescent alcohol use (Curran et al., 1997; Bray et al., 2003). However, a key limitation of extant research has been a focus on community samples. These studies have consequently provided information on factors related predominantly to an adolescent's *initiation* of substance use. To date, no studies have examined this relationship among treated adolescents. Exploring the longitudinal relationship in a treated sample would help to highlight factors related to an adolescent's *continuation* of substance use, thereby offering valuable information as to the importance of peer processes among adolescents with more established or entrenched patterns of use.

Another limitation of prior research has been a reliance on composite measures of adolescent substance use without examining the effects of specific substances. This has been particularly relevant to studies of adolescent marijuana use, which have tended to group adolescent marijuana use with other types of adolescent substance use. Evaluating the separate effects on alcohol and marijuana use is particularly valuable, as these represent the most common substances of abuse and have different trajectories of incidence among adolescents (Substance Abuse and Mental Health Services Administration, 2010).

The goal of the current study was to address the aforementioned limitations by examining the effects of peer socialization and selection separately for alcohol and marijuana use in a sample of treated adolescents. This study represents a secondary analysis of data collected by one of 36 sites participating in the Effective Adolescent Treatment (EAT) project, a multi-site study that tested the effectiveness of a brief evidence-based intervention for adolescent substance abuse over a 12 month period (SAMHSA, 2003). The focal intervention in the EAT project was motivation enhancement therapy/cognitive behavioral therapy (MET/CBT-5), a model that combines 2 sessions of motivation enhancement therapy with 3 sessions of cognitive behavioral therapy (Sampl & Kadden, 2001). Specific skills covered in MET/CBT-5 include a social support skill in which adolescents discuss and identify healthy supporters, and a refusal skill in which adolescents practice saying no to peers who abuse substances. In theory, the social support skill should be protective against the influence of peer selection, whereas the refusal skill should be protective against the influence of peer socialization. However, the Cannabis Youth Treatment study found that even though MET/CBT-5 significantly reduced frequency of adolescent substance use, only about 25% of treated adolescents attained a state of recovery (defined as no past month substance use, abuse, or dependence problems) at 12 months (Dennis et al., 2004). Thus, we expected that receipt of MET/CBT-5 would limit the effects of socialization and selection over time, but that treatment would not eliminate these effects entirely.

We had two primary hypotheses about the relationship between peer socialization and peer selection among adolescents who received MET/CBT-5. First, in harmony with prior community studies (Bray et al., 2003; Curran et al., 1997; Simons-Morton & Chen, 2006), we expected to find persistent effects of both peer socialization and peer selection over 12 months. We made the same prediction for both alcohol and marijuana use, due to the limited number of studies that have separately examined these substances. Second, we expected the selection and socialization effects to be small. This prediction was based on the fact that MET/CBT-5 skills were specifically designed to limit the effect of these processes.

Methods

Participants

Study participants and procedures have been described in prior publications (Authors removed for blinding, 2009, 2011). Adolescents, aged 13 to 21 years, were recruited between 2003 and 2006 from outpatient clinics, school or court counselors, treatment providers, and advertisements. To qualify, adolescents needed to meet diagnostic criteria for current cannabis or alcohol abuse or dependence (American Psychiatric Association, 2000), meet American Society for Addiction Medicine (ASAM): Patient Placement Criteria, 2nd Edition (Mee-Lee, Shulman, Fishman, Gastfriend, & Griffith, 2001) for outpatient treatment, and be willing and able to initiate treatment within 1 month of the initial assessment. Inclusion criteria were assessed via a structured interview (described in Measures). Exclusion criteria were minimal in order to maximize opportunities for participation and included conditions that would prohibit completion of a 2-hour structured interview (e.g., acute withdrawal, psychosis, cognitive impairment).

A total of 118 adolescents provided written consent (for adolescents aged 18 to 21 and parents of younger teens) and assent (for adolescents aged 13 to 17) for participation. Of these, 12 were excluded due to the aforementioned criteria. No significant differences were found between those excluded and the final sample of 106 adolescents on any of the study variables.

Mean age of the final sample was 17.1 ($SD = 2.1$), with 62% of participants under age 18. Eighty-one of the 106 adolescents (76%) were male and 84 (79%) were Caucasian. Seventy-five of the adolescents met criteria for substance abuse (72%) and 31 (28%) met criteria for substance dependence. Marijuana was identified as the primary substance of abuse by about two thirds of the sample (65%), with alcohol identified as the primary substance of abuse by the remaining third (35%). Adolescents reported socializing with an average of 10 peers ($M = 9.8$, $SD = 11.7$).

Measures

Trained interviewers administered the Global Appraisal of Individual Needs (GAIN; Dennis, Titus, White, Unsicker, & Hodgkins, 2002) at intake and at 3-, 6-, and 12-months post-intake. The GAIN is a structured biopsychosocial interview that measures client functioning across 8 broad domains (background, substance use, physical health, mental health, legal, risk behaviors, environment, vocational). Specific scales and items used in this analysis included measures of days of alcohol use, days of marijuana use, and peer substance involvement.

Days of alcohol and marijuana use—Adolescent reports of days of alcohol and marijuana use were assessed by two separate items in the GAIN Substance Use section. Using the Timeline Follow-Back Procedure (Sobell & Sobell, 1995), adolescents were asked to estimate the total number of days over the past 90 days that they had: 1) drank any alcohol, and 2) smoked any marijuana. These items focused on the number of days of use and did not consider extent or duration of use. In the Cannabis Youth Treatment experiment

(Dennis et al., 2004), a composite indicator of adolescent substance use based on adolescents' responses to these items was consistent ($\kappa = .7-.9$) with collateral reports and on-site urine screens across all time points.

Peer substance involvement—Peer substance involvement was evaluated using the GAIN's Social Risk Index (SRI). The SRI consists of 7 items that assess the proportion of peers the adolescent hangs out with socially who engage in substance use and substance-related behaviors such as truancy and illegal activity. Higher scores on the SRI scale indicate a higher level of peer involvement in substance use. The SRI items are intended to represent breadth rather than homogeneity, with the total number of items endorsed determining an individual's social risk. As a result, internal consistency is not a suitable method of measuring reliability (Bollen, 1984). In a prior analysis (Authors removed for blinding, 2011), we examined convergent validity between the SRI and well-validated measures of peer substance use (PSU) and peer tolerance of substance use (PTSU) from the Monitoring the Future study (Chassin et al., 1991). The SRI demonstrated convergent validity with the PSU scale across all 4 time points ($r = .27-.63, p < .05$) and with the PTSU scale across 3 of the 4 time points ($r = .41-.54, p < .001$).

Intervention

The intervention in the EAT project was Motivation Enhancement Therapy/Cognitive Behavioral Therapy – 5 sessions (MET/CBT -5; Sampl & Kadden, 2001), a manualized protocol that demonstrated effectiveness relative to 4 lengthier treatments in the Cannabis Youth Treatment project (Dennis et al., 2004). Sessions were 60 minutes each and delivered by master's level clinicians, typically on a weekly basis. The 2 MET sessions focused on building rapport and increasing the adolescent's motivation for change, while the 3 CBT sessions focused on skills needed to decrease substance use including reducing susceptibility to peer pressure (socialization) and building a network supportive of recovery (selection). On average, adolescents received 4.5 sessions ($SD = 1.5$), with 79% of adolescents receiving all 5 sessions.

Missing Data

The EAT project aimed to test the effectiveness of MET/CBT-5 under real world conditions, and as such, recruitment was designed to maximize opportunities for participation. Recruitment was allowed to continue until the end of the study period (February 2006), provided that there was sufficient time for participants to complete the treatment protocol. Consequently, adolescents recruited in the final 12 months of the protocol were only eligible for those follow-up assessments due before the end of the study period. Although the follow-up rates of *eligible* adolescents exceeded 85% at each time point, final retention was limited by the recruitment schedule: 85% at 3 months, 72% at 6 months, and 54% at 12 months. As noted in a prior publication (Authors removed for blinding, 2011), 75% of all missing records (71 out of 95) were from adolescents who enrolled less than 12 months before the end of the study period.

Using the Bonferroni correction, two sets of paired t-tests compared those adolescents with and without missing data on age, gender, days of alcohol use, days of marijuana use, and

peer substance involvement. These analyses compared: a) adolescents with or without complete longitudinal data on all of the study variables at baseline, b) adolescents who did or did not complete the 12 month assessment across the first 3 time points. In both sets of analyses, no differences were found between those with or without full data, providing no evidence of attrition bias. The lack of attrition bias in these two sets of analyses and the high proportion of missing data due to administrative drop out suggest that data were missing at random (MAR). Full information maximum likelihood (FIML) estimation, a method that has been shown to generate unbiased parameter estimates when data are MAR (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 non-normality. All analyses were therefore conducted in MPlus version 7.0 (Muthén & Muthén, 1988 – 2012) using the Yuan and Bentler (1998) correction for multivariate non-normality.

Analytic Approach

Prior to testing the study hypotheses, we conducted two sets of preliminary analyses. First, we examined descriptive statistics over time and baseline associations among the study variables. We used Pearson's correlation coefficients to test for correlations among the primary variables (e.g., days of alcohol use, days of marijuana use, peer substance involvement) and t-tests to examine whether these primary variables differed as a function of categorical demographic variables (e.g., gender, age, ethnicity). The t-tests were conducted to determine whether the demographic variables needed to be retained in the model. Second, we transformed the count variables (e.g., days of alcohol use, days of marijuana use) using the square root transformation, an approach that is often recommended to reduce non-normality of data that are counts of occurrences (Osborne, 2002). We followed the recommendations of Osborne (2002) and first moved the minimum value of the distribution to 1.0 by adding 1.0 to each score.

To test the study hypotheses, two separate cross-lagged panel models examined the longitudinal relationship between adolescent substance use and peer substance involvement: one including days of alcohol use and the other including days of marijuana use. These models utilized the transformed substance use variables. For each model, we began by estimating a baseline model that freely estimated all paths between days of adolescent use and peer substance involvement. We allowed adjacent residuals to be correlated with one another, and we examined modification indices over 3.84 (corresponding to a one degree of freedom test; Bagozzi & Youjae, 1988) to assess whether any lagged effects longer than 3 months should be included (e.g., lagged effects of days of alcohol use at baseline on days of alcohol at 6 or 12 months). 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 each variable's stability effects (e.g. the stability of days of alcohol use from baseline to 3 months was set equal to the stability from 3 to 6 months), then on the within time-point residual correlations (e.g. the residual correlation of days of alcohol use and peer substance involvement at 3 months was set equal to the residual correlation at 6 months), and finally on the cross-lagged effects (e.g. the cross-lagged effect of days of alcohol use on

peer substance involvement from baseline to 3 months was set equal to the cross-lagged effect from 3 to 6 months).

Using the Satorra-Bentler adjusted chi-square, we compared the baseline and constrained models. For each model, fit was assessed using three indices: chi-square, root-mean-square-error of approximation (RMSEA), and comparative fit index (CFI). We aimed for chi-square p -values greater than .05, RMSEA values under .08, and CFI values over .90 (Hu & Bentler, 1999). All other statistical tests were considered significant if the two-tailed p -value was less than .05.

Results

Preliminary Analyses

Descriptive statistics over time and baseline associations among the three primary variables (e.g., days of alcohol use, days of marijuana use, peer substance involvement) are depicted in Table 1. Paired t -tests were used to compare rates of use by substance and to examine rates of use over time. At baseline, adolescents in the sample had used marijuana on significantly more days ($M = 32.82$, $SD = 31.37$) than they had used alcohol over the past 90 days ($M = 13.33$, $SD = 14.31$), $t(105) = 5.65$, $p < .001$. By the 12 month follow up, adolescents in the sample had significantly reduced their days of marijuana use relative to baseline ($t(56) = -4.61$, $p < .001$). By contrast, adolescents in the sample significantly reduced their days of alcohol use between the baseline and 3 month assessment ($t(89) = -3.66$, $p < .001$), but by 12 months, days of alcohol use were no longer significantly different than baseline ($t(56) = .04$, $p > .05$).

The bivariate correlation matrix revealed that the two days of use variables were not correlated, indicating that frequency of adolescent alcohol use and frequency of marijuana use were not significantly related in the current sample. Each of the substance use variables demonstrated a small correlation with peer substance involvement in the expected direction, such that higher days of use were associated with higher peer substance involvement. T -tests indicated no gender, age, or ethnic differences in days of alcohol use, days of marijuana use, or peer substance involvement. Therefore, these demographic variables were not retained in the models.

Test of Directional Effects

Cross-lagged panel modeling was used to test for directional effects between days of substance use and peer substance involvement over time. Separate models were conducted for days of alcohol use and days of marijuana use. The following results are reported using the square root transformation of the two days of substance use variables. Replication of the models using the non-transformed substance use variables produced an identical pattern of results with regards to effect sizes and statistical significance.

Days 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 peer substance involvement fit the data well, $\chi^2(8) = 13.38$, $p = .43$, CFI = .97, RMSEA = .08. Model comparisons with the chi-square difference test indicated that adding constraints on

the within time-point residual correlations, cross-lagged effects between variables, and stability effects for peer substance involvement did not affect model fit. However, adding stability effects for days of alcohol use significantly reduced the fit of the model, $\chi^2(2) = 13.34, p < .01$. Further testing revealed that releasing the equality constraint on the path from days of alcohol use at 3 months to days of alcohol use at 6 months resulted in the best fitting model, indicating that this stability coefficient was significantly different from the others. In addition, examination of modification indices revealed one lagged effect with an index greater than 3.84: this index suggested that fit would be improved if a lagged effect from days of alcohol use at 0 months to days of alcohol use at 12 months was added to the model. Inclusion of this lagged effect did indeed improve model fit, $\chi^2(1) = 15.84, p < .001$. Thus, the final model was estimated with this lagged effect included: $\chi^2(16) = 20.81, p = .19$, CFI = .98, RMSEA = .05.

The final model for days of alcohol use and peer involvement is depicted in Figure 1. Significant and moderate to large stability effects were found for both adolescent days of alcohol use and peer substance involvement. Consistent with our hypothesis, there was evidence of a bidirectional relationship between peer substance involvement and adolescent alcohol use across all three waves of data. The cross-lagged effects between the two variables were generally small in size. Hence, the model provides evidence of both peer socialization (peer substance involvement influencing adolescent alcohol use) and peer selection (adolescent alcohol use predicting peer substance involvement) for alcohol use following brief intervention.

Days of Marijuana Use—The baseline model that freely estimated the stability effects, within time-point correlations, and cross-lagged effects for days of marijuana use and peer substance involvement demonstrated excellent fit, $\chi^2(8) = 6.68, p = .57$, CFI = 1.00, RMSEA = .00. Model comparisons with the chi-square difference test indicated that adding constraints on the within time-point residual correlations, cross-lagged effects between variables, and stability effects for both variables did not affect model fit. In addition, the modification indices did not reveal any lagged effects longer than 3 months to consider for inclusion in the model. Thus, the final, most parsimonious model was estimated as a fully constrained model with no lagged effects longer than 3 months: $\chi^2(18) = 22.82, p = .19$, CFI = .98, RMSEA = .05.

The final model for days of marijuana use and peer involvement is depicted in Figure 2. Significant and moderate to large stability effects were found for both adolescent days of marijuana use and peer substance involvement. In partial support of our hypothesis, days of marijuana use had significant, small cross-lagged effects on peer substance involvement across all three waves of data. However, peer substance involvement did not have significant cross-lagged effects on adolescent days of marijuana use. Hence, counter to the model for days of alcohol use, this model provides evidence of peer selection (days of adolescent marijuana use influencing peer substance involvement), but not evidence of peer socialization (peer substance involvement predicting days of marijuana use).

Discussion

The current study tested the relative influence of peer selection and socialization on use of the two most common illicit substances – alcohol and marijuana – among adolescents receiving a brief substance use intervention. Results of this analysis were fully consistent with our primary hypotheses for alcohol use and partially consistent with our hypotheses for marijuana use. For alcohol use, we found a significant reciprocal relationship between adolescent substance use and peer substance involvement over the 12 month period. Across all three time points, there was evidence of both peer socialization (peer substance involvement predicting adolescent alcohol use) and peer selection (adolescent alcohol use predicting peer substance involvement). By contrast, for marijuana use, there was only evidence of significant selection effects, but not evidence of socialization effects. In line with our expectations, the effect sizes of selection and socialization were small for both substances.

Although prior research has not specifically compared this longitudinal relationship for alcohol and marijuana use, our findings are consistent with prior research comparing alcohol and cigarette use. For instance, a recent study by Kiuru and colleagues (2010) followed 1419 secondary students in the community for 12 months and found that similarity in adolescent and peer cigarette use was only influenced by selection, whereas similarity in alcohol use was influenced by both selection and socialization. In their discussion of the literature, the investigators further note that most studies of adolescent cigarette use have found stronger evidence of peer selection than of peer socialization (e.g., de Vries, Candel, Engels, & Mercken, 2006; Ennett & Bauman, 1994), whereas studies of adolescent alcohol use often point to a bidirectional relationship (e.g., Curran et al., 1997; Popp et al., 2008). When considering the current findings in the context of this prior research, it is possible that peer processes associated with adolescent marijuana use are more similar to those associated with cigarette use than those associated with alcohol use. This theory would suggest that even though adolescent marijuana and alcohol use frequently co-occur (McCurley & Snyder, 2008), the peer processes affecting use may vary by substance or route of administration (e.g., smoking versus drinking). In addition, the consistency of our results with community studies suggests that similar peer processes may influence both the initiation and the continuation of substance use.

The distinct pattern of results for adolescent alcohol and marijuana use suggests that the typical approach of analyzing a composite measure of substance use may mask important differences in related peer processes. Furthermore, it is important to note that MET/CBT-5 appeared to have differential effectiveness by substance. For marijuana, adolescents maintained a significant reduction in their days of marijuana use over 12 months. By contrast, for alcohol, adolescents reduced their days of alcohol use within the first 3 months, but did not maintain this reduction by the end of the 12 month period. A question for future studies would be whether peer socialization and selection effects can help to explain these differences in treatment effectiveness over time. For instance, it would be interesting to explore whether the presence of both socialization and selection effects might explain why MET/CBT-5 was not associated with enduring reductions in alcohol use over the 12-month period.

The current findings highlight important clinical implications for adolescents who receive MET/CBT-5. Regarding marijuana use, our results suggest that MET/CBT-5 could potentially be strengthened by including additional skills or intervention focused on improving adolescents' selection of peers. Examples of potentially helpful skills might include: identifying healthy supporters, challenging the perception that smoking marijuana is socially desirable, evaluating pros and cons of affiliating with specific peers, and social skills to initiate new friendships.

With regard to alcohol, our results suggest that adolescents might benefit from additional interventions designed to target both peer selection and peer socialization. In addition to the aforementioned skills to improve peer selection, it might be beneficial to incorporate skills focused on resisting peer pressure to drink. While MET/CBT-5 contains a generic refusal skills session (focused on alcohol or other drugs), adolescents might benefit from additional practice refusing alcohol specifically. Booster sessions after the first few months might also be beneficial to help adolescents maintain any reductions in their frequency of drinking.

Limitations

Several limitations should be taken into account when interpreting the results of the current study. A primary limitation was the small sample size and significant loss of data by 12 months. The fact that we found a significant and similar pattern of results at 12 months and 3 months indicates that the results were stable over time. When paired with the large proportion of missing data due to administrative constraints, the results support our use of FIML estimation and retention of all available data. In addition, our ability to detect significant effects within a small sample attests to the strength of the observed associations; however, it is noteworthy that the small sample size increases the possibility that parameter estimates are unstable.

The current findings were also limited by the scope of the measures and assessment period. The substance use measures focused on days of use, and did not consider severity of use. Similar to many prior studies testing the effects of peer socialization and peer selection, our measures were also limited by self-report of substance use and peer substance involvement. Adolescent perceptions of peer substance involvement might be inaccurate and it is possible that corroborated accounts of peer substance use would produce a different pattern of results. Future studies should attempt to use social networking analysis to test the convergence and relative influence of adolescents' perception of peer substance use relative to peers' actual substance use. The recent study by Kiuru and colleagues (2010) compared network-based analyses with more conventional analytic approaches and found similar results, providing preliminary support for the type of conventional analyses conducted in this study.

Finally, this study did not measure adolescents' substance use prior to treatment. While prior community studies have generally found small to moderate effect sizes of selection and socialization, we found evidence of small effect sizes. These results supported our hypotheses, but were not sufficient to determine whether treatment altered the relationship between adolescent and peer substance use. Future longitudinal studies with repeated

assessments prior to, during, and following treatment are needed to address this important question.

Notwithstanding these limitations, this study was the first to examine the processes of selection and socialization simultaneously among a treated sample. Our results were consistent with those found in significantly larger community studies, supporting the robustness of these processes in influencing adolescent substance abuse.

Conclusion

The current study addressed limitations of prior studies by simultaneously examining the effects of peer selection and socialization in a sample of adolescents receiving evidence-based treatment for substance abuse. Results revealed a differential pattern of results for alcohol and marijuana that was consistent with prior community studies that separately examined drinking and cigarette smoking: drinking was influenced by both peer selection and socialization, whereas smoking was influenced more strongly by peer selection. These findings suggest that interventions targeting alcohol use might benefit from emphasizing skills to help teens resist peer pressure and select friends more carefully, whereas interventions targeting marijuana use might benefit from placing particular emphasis on skills to promote better peer selection. Furthermore, the current results highlight the value of separately examining specific substances in order to better understand the complex pathways between adolescent and peer substance use.

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Glossary

<i>Peer selection (or “selection”)</i>	The tendency of adolescents to select and affiliate with peers with similar beliefs, attitudes, and behaviors. This is one of two competing theories to explain the association between adolescent and peer substance use, and suggests that adolescent substance use predicts subsequent peer substance use
<i>Peer socialization (or “socialization”)</i>	The tendency of adolescents to adopt the beliefs, attitudes, and behaviors of their peers due to social modeling and pressure to conform. This is one of two competing theories to explain the association between adolescent and peer substance use, and suggests that peer substance use predicts subsequent adolescent substance use
<i>Peer substance involvement</i>	The proportion of peers the adolescent spends time with socially who engage in substance use and substance-related behaviors such as truancy and illegal activity

Cross-lag panel modeling

A modeling technique that enables testing the bi-directional relationship between two variables across multiple time points. The approach enables testing of both stability effects (e.g., the effect of variable X at Time 1 on variable X at Time 2) and cross-lagged effects (e.g., the effect of variable X at Time 1 on variable Y at Time 2, as well as the effect of variable Y at Time 1 on variable X at Time 2) over time

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Figure 1.

Cross-lagged model estimating the longitudinal relationship between days of adolescent alcohol use and peer substance involvement. Parameter estimates are standardized values. $N = 106$, * $p < .01$, ** $p < .001$.

Figure 2.

Cross-lagged model estimating the longitudinal relationship between days of adolescent marijuana use and peer substance involvement. Parameter estimates are standardized values.

$N = 106$, * $p < .01$, ** $p < .001$.

Table 1
Descriptive statistics over time and baseline correlations for substance use variables and peer substance involvement

Variable	Means and Standard Deviations				Baseline Correlations		
	Baseline (n = 106)	3 month (n = 90)	6 month (n = 76)	12 month (n = 57)	1	2	3
1. Days of alcohol	13.33(14.3)	8.46(10.7)	9.20(10.3)	14.50(15.7)	1		
2. Days of marijuana	32.82(31.87)	17.67(26.8)	19.61(28.7)	17.79(27.6)	-.08	1	
3. Peer substance	15.04(3.4)	14.21(4.2)	14.41(3.8)	13.86(4.1)	.20*	.19*	1

Note: N = 106,

*
p < .05