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EMPIRICAL RESEARCH

Drug Use Homophily in Adolescent Offenders' Close Friendship Groups

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Abstract

Adolescents who befriend drug using peers may be at risk for initiated and continued substance use. The present secondary data analysis examined how drug use homophily (i.e., similarity) in justice-involved boys' friendship groups relates to their subsequent substance use variety across a period of five years. Participants were 1216 first-time adolescent offenders ($M_{\text{age Baseline}} = 15.29$; 100% male). Multilevel model analyses revealed that, among participants who entered the study with a history of substance use, drug use homophily was associated with greater subsequent substance use variety. Among participants who entered the study without a history of substance use, this association was no longer significant. The findings have implications for guiding justice system programming aimed at decreasing adolescent offenders' substance use.

Keywords Adolescent substance use · Justice-involved adolescents · Homophily · Friend substance use

Introduction

Experimentation is prevalent in adolescence, and experimentation with substance use may be particularly problematic for the developing youth (Tucker et al., 2006). Although peers are not the only source of influence on adolescents' problem behaviors (Murray & Farrington, 2010), research suggests youths who have more delinquent and substance using peers are at a greater risk of initiating and continuing substance use themselves (Ennett et al., 2006; Wu et al., 2010). The increased risk for youths' illicit substance use may be further exacerbated among justice-involved adolescents, who have more opportunities to form friendships with deviant peers by virtue of their justice-involved status (Bonta & Andrews, 2017). Yet, adolescents' friendship groups are not necessarily entirely homophilous (i.e., similar) with respect to deviant behavior (Haynie, 2002), and a better understanding of the extent to which adolescents are similar to or different from their peers on such behaviors may offer additional insight into youths' decisions to engage in or desist from illicit substance use. That is, examining the association between drug use homophily and adolescents' subsequent substance use may offer novel insights into the role of friendship similarity in predicting justice-involved youths' problem behaviors beyond the mere number of deviant peers alone. Notably, though studies point towards a positive association between peer group homophily and problem behavior among community adolescents and young adults (Boman & Mowen, 2018; Ragan, 2020), much of the existing literature on justice-involved adolescents' substance use and friendship group homophily employs older datasets (i.e., data collected in the 1990s and early 2000s)—and many of the studies that have used more recent data have relied on restricted measures of substance use (e.g., only assessing use of alcohol and marijuana, assessing substance use in an overall measure of delinquency). The present study therefore seeks to add to extant literature on adolescent substance use by examining how drug use homophily in justice-involved adolescents' friendship groups relates to youths' subsequent

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substance use patterns, using recent data and capturing a wide range of substance use variety among participants.

Peer Influence and Adolescent Problem Behavior

Throughout adolescence, peers become an increasingly important source of influence on youths' attitudes and actions. Indeed, though family members' positive attitudes towards substance use have been shown to relate to adolescents' own substance use patterns, literature suggests deviant peers impart a particularly strong (direct) influence on youths' decisions to engage in or desist from substance use (Bahr et al., 2005). Peers have been shown to impact youths' initiation of cigarette use (Maxwell, 2002), willingness to engage in risk-taking (Gardner & Steinberg, 2005), and alcohol consumption (Nash et al., 2005). Additionally, research suggests greater peer drug use and delinquency are both associated with greater illicit substance use by the target adolescent (e.g., marijuana, ecstasy, cocaine; Wongtongkam et al., 2014), and, though early initiation of substance use (e.g., at 13 years of age) is not heavily prevalent, greater perceived peer substance use has been shown to be associated with greater likelihood of early first-time use (Trucco et al., 2011). What is less clear, however, is whether deviant peer influence operates differently among early substance users and substance users with a later onset. Given that justice-involved adolescents face greater exposure to deviant and substance-endorsing peers and attitudes—and given that such adolescents are particularly vulnerable to the detrimental impacts of substance use (e.g., impacts on mental health; Hussey et al., 2007)—it is important to thoroughly examine such associations in samples of justice-involved adolescents.

Changes in Friendships Throughout Adolescence

Regardless of justice system involvement, youths generally undergo a variety of developmental changes throughout adolescence, including changes in the characteristics of their peer relationships (Zarrett & Eccles, 2006). Indeed, recent findings from community samples suggest the similarity between youths' problem behaviors and the problem behaviors of their friends increases through mid-adolescence and then declines, irrespective of normative changes in delinquency throughout this developmental period (Richmond et al., 2018). As such, younger adolescents who use substances may be more inclined to seek out friendships with peers who are more similar to them on these problem behaviors, whereas older adolescents may be more open to forming friendships with peers who are less similar to them in this regard. However, changes in the similarity between youths and their friends do not operate solely on the basis of selection (i.e., through youths actively seeking out peers who are more like them). Indeed, some adolescents and young adults who associate with like others show increased engagement in substance use *after* establishing such affiliations, suggesting socialization processes are also taking place (Beardslee et al., 2018; Becker et al., 2019). In other words, adolescents' behaviors may additionally change as a result of peer influence. Notably, justice-involved adolescents face increased exposure to antisocial and drug endorsing peers and attitudes as a consequence of their justice system involvement (Bonta & Andrews, 2017), and such exposure may, in turn, provide more opportunity for deviant peer influence.

Adolescents' Close Friendship Groups and Behavioral Homophily

Adolescents who are exposed to more antisocial and drug endorsing peers may additionally be exposed to more salient deviant norms modeled within their peer groups, thereby increasing the potential for learned and reinforced deviancy. In criminological literature, for example, differential association theory refers to how people learn deviance through their interactions with others; one principle of this theory is that a person chooses to engage in delinquent behavior when he or she is exposed to more pro-criminal attitudes than anti-criminal attitudes (Sutherland, 1947). Applying differential association theory to youths' friendship groups and their initiation and continuation of substance use, it follows that adolescents who have more drug using friends as opposed to drug abstaining friends may be more at risk of engaging in illicit substance use themselves. Indeed, community youths who are exposed to more drug using and delinquent peers tend to have an increased rate of onset—as well as earlier onset—of alcohol and drug use (e.g., ecstasy; Light et al., 2013; Wu et al., 2010).

Moreover, assessing only dyadic youth−peer relationships (as opposed to youths' associations with their friendship groups as a whole) appears to limit the explained variability in youths' behaviors (Kiesner et al., 2004). Specifically, given that adolescents' friendships are generally heterogeneous with regard to deviancy (see Haynie, 2002), it is important to assess adolescents' behaviors in response to peer influence within the holistic context of the friendship group. Adolescents tend to follow the social norms of the collective peer group (see Blanton & Burkley, 2008); consequently, youths whose peer groups contain predominantly substance using peers may have a harder time deviating from the established (drug use endorsing) norms of the group (Eisenberg et al., 2014). Taken together, such findings suggest a need to examine peer influence specifically in the context of youths' close friendship groups.

Further, these findings emphasize that the homophily of problem behaviors within the friendship group matters; that is, the extent to which a target adolescent is similar to or different from his or her close friends on problem behaviors may be an important predictor of the adolescent's continued engagement in such behaviors. Indeed, on the one hand, given that adolescents are particularly susceptible to peer influence (Steinberg & Monahan (2007)), youths who are similar to their friends on problem behaviors such as illicit substance use may be reinforced in their continued engagement in such behaviors; on the other hand, youths who are similar to their friends on abstaining from problem behaviors may be reinforced in their continued abstinence from engagement in such behaviors. Youths who are dissimilar to their close friends on problem behaviors may instead be tempted to change their behaviors or terminate the friendships, or they may face peer rejection as a result of not conforming to the norms of the collective peer group. Therefore, the number of drug using friends in the friendship group alone (i.e., the peer drug use ratio) may not be enough to explain why youths engage in or desist from substance use. In addition to understanding how friendship group composition may impact adolescents' decisions to use illicit substances, it is important to examine the similarity (i.e., homophily) of drug use between adolescents and their closest friends to better understand youths' decisions to engage in drug use, particularly among youths who are already involved with the justice system and face increased exposure to drug using peers.

Current Study

The present study sought to fill a gap in adolescent substance use literature by examining impacts of drug use homophily in adolescent offenders' close friendship groups on adolescents' own substance use patterns through the use of a recent dataset from a large longitudinal study, which included a measure of participant substance use variety that captured a wide range of substances. Given existing literature on deviant peer influence and adolescents' problem behaviors, it was hypothesized that greater drug use homophily in target adolescents' close friendship groups would be associated with greater subsequent substance use variety by the target adolescent, above and beyond the mere ratio of drug use within participants' friendship groups. Specifically, it was predicted that participants with greater drug use homophily within their close friendship groups would subsequently engage in a greater variety of substance use, even after accounting for age, ethnicity, category of the initial offense for which the adolescent came into contact with the juvenile justice system (i.e., drug, person, property, or other), socioeconomic status, processing type (i.e., the decision to formally process the adolescent through the juvenile justice system or divert the adolescent from justice system processing through informal means such as community service), participating site, and family criminality. Moreover, to better understand how peer influence operates among early substance users and users with a later onset, an exploratory analysis was run to assess this association among participants who entered the study with and without a history of substance use.

Method

The present study was conducted through secondary analyses of de-identified data from the Crossroads Study—a longitudinal study aimed at examining the effects of justice system involvement on first-time adolescent offenders. Study procedures were approved by the Institutional Review Boards of all participating sites, including the sites where data for the Crossroads Study was collected and the site where data was analyzed for the present study.

Procedure

Trained Research Assistants (RAs) obtained information about adolescents' pending intake hearings from court personnel at participating sites. Adolescents who met eligibility criteria (described below) were approached for study participation following their imposed dispositions (i.e., the final outcomes of their intake hearings). Youth assent was obtained from adolescents interested in study participation, and informed consent was obtained from their legal guardians. Adolescents and legal guardians were informed of the voluntary nature of the study and were assured their study participation—or lack thereof—would not influence their treatment within the juvenile justice system. Youths and their legal guardians were additionally informed that participants' responses were protected from court subpoena by a federally issued Privacy Certificate.

Adolescents were recruited for study participation between July 2011 and May 2013. Throughout the course of the five-year study, participants completed interviews with RAs on laptop computers in the community and in secure residences. Baseline interviews were completed within six weeks of the processing decision (i.e., the decision to formally or informally process the youth). Interviews from Baseline to Follow-Up 6 were completed at six-month intervals, and the remaining follow-up interviews were completed at one-year intervals. All nine waves of data (Baseline through Follow-Up 8) were utilized in the analyses of the present study.

Table 1 Participant demographics at baseline

	CA $n = 532$	PA $n = 533$	LA $n = 151$	Total $N = 1216$
Age (M/SD)	15.49 (1.22)	15.20 (1.34)	14.87 (1.20)	15.29 (1.29)
Race/ethnicity (%)				
Hispanic	78.4%	23.1%	11.3%	45.8%
Black	0.9%	65.3%	63.6%	36.9%
White	17.5%	9.9%	22.5%	14.8%
Other	3.2%	1.7%	2.6%	2.5%

Participants

A total of 1216 juveniles from Orange County, California (CA; $n = 532$), Philadelphia County, Pennsylvania (PA; $n = 533$), and Jefferson Parish (New Orleans), Louisiana (LA; $n = 151$) chose to enroll in the Crossroads Study. Data were collected across three sites to minimize the potential for local policies to confound the study's findings and to promote demographic diversity within the sample. The three participating sites additionally represented three culturally distinct regions within the United States: East, South, and West. To be eligible for study participation, adolescents had to: (1) be first-time male offenders, (2) speak English, (3) be between the ages of 13 to 17 years old at the time of arrest, and (4) have committed an eligible offense. Eligible offenses included charges associated with a 0.35 to 0.65 probability of formal versus informal processing of first-time adolescent offenders (e.g., theft of goods, simple battery, vandalism). Eligibility requirements included only first-time offenders to restrict variability in past offending and to ensure variability in justice system involvement following arrest. On average, participants were 15.29 years old at Baseline ($SD_{\text{Baseline}} = 1.29$, $range_{\text{Baseline}} = 13–18$). Most participants in the CA sample were Hispanic (78.40%), and most participants in the PA and LA samples were Black (65.30% and 63.60%, respectively); across all three sites, the largest racial/ethnic group was Hispanic (45.80%). Demographic statistics for all site locations and for the combined sample are reported in Table 1.

Participants were compensated at a rate of $50.00 for the initial Baseline interview, after which compensation increased at a rate of an additional $15.00 for each successive interview. Across all three sites, 72.32% of eligible adolescent offenders chose to enroll in the study, and over 90% of participants remained involved in the study throughout all five years of data collection.

Measures

The present study utilized a measure of participant substance use, as well as participants' reports of the drug use histories of up to five of their closest friends. Although there is general agreement that perceptual measures of peer deviancy tend to overestimate the true amount of deviant behavior among adolescents' friends (Young et al., 2014), literature suggests that perceived social norms—including norms surrounding substance use—are related to youths' engagement in deviant behaviors (Meisel & Colder, 2020). Indeed, researchers report that youths' perceptions of peers' behaviors predict youths' own engagement in such behaviors, including initiation and continuation of substance use (D'Amico & McCarthy, 2006), and youths' perceptions of peer behaviors are stronger predictors of their own engagement in such behaviors as compared to peers' actual behaviors (Prentice & Miller, 1996).

Though some participants spent time in a locked residential facility or another institution throughout their participation in the study, the sample included young first-time offenders; therefore, their time spent in secure institutions, locked facilities, detentions, jails, or other residential treatment centers was also relatively low. Specifically, per participant reports, the average proportion of time spent in a secure facility (i.e., time spent in a secure facility since the previous interview divided by total time since the previous interview) ranged from 0.027 to 0.080 throughout the five years. Given that, on average, participants did not spend much time in secure settings that may have limited their access to substances, the measure of time spent in a secure facility was not included in the present analyses.

On each item of each administered measure, participants had an option to refuse to respond and an option to indicate that they did not know how to respond; such responses were coded as missing data for the purposes of the present study's analyses. All measures used for the present study, including scores for homophily of drug use within participants' friendship groups, were computed at each time point.

Participant Substance Use Variety

Participants' substance use was measured using the Substance Use subscale of the Substance Use/Abuse Inventory (adapted from Chassin et al., 1991), which considers youths' use of illegal drugs (e.g., marijuana, cocaine, etc.) and alcohol. The Substance Use subscale was adapted to capture participants' lifetime substance use at Baseline and substance use since the previous interview at all subsequent time points. Participants' substance use variety scores were calculated at each time point in the study—including the Baseline assessment—by summing the number of substances the participant reported having used at the corresponding time point and dividing by the total number of substances included in the Substance Use subscale. Substance use variety scores therefore represented the proportion of substances used at each time point out of a total of 13 substances (for a full list of the 13 substances, see

Appendix A). All scores, including the scores at Baseline, were used in the analyses. Variety—as opposed to frequency—of substance use was used for the purposes of the present study's analyses because the variety score allowed for an assessment in the heterogeneity of substance types across all possible substances, ensuring that the use of serious but infrequent substances was given more weight than would otherwise be given if frequency of substance use was used.

Drug Use Homophily

At each time point in the study, participants were asked to identify up to five of their closest friends at that time. For each endorsed friendship at each time point, participants were asked whether their friend had ever used drugs in their lifetime. Participants responded either "*Yes*" (1) or "*No*" (0) to indicate their perception of their friends' lifetime drug use. Drug use homophily for each participant–friend dyad was calculated using participants' responses on the Substance Use subscale of the Substance Use/Abuse Inventory and participants' responses on the follow-up item asking them about the drug use of each of their friends. Participant–friend dyads were counted as a match (1) on drug use homophily if the participant endorsed having used drugs and identified that his friend had also used drugs—or, conversely, if the participant did not endorse having used drugs and identified that his friend has never used drugs. Participant–friend dyads were counted a mismatch (0) on drug use homophily if the participant endorsed having used drugs and identified that his friend had not used drugs before, or if the participant did not endorse having used drugs but identified that his friend had used drugs before. Though participants were asked about whether they had used drugs either in their lifetime (at Baseline) or since the previous time point (at all subsequent interviews), participants responded only on their friends' lifetime use. Participant–friend dyad match scores were summed and then divided by the total number of participant–friend dyads in the group to produce a total score for drug use homophily at each time point. Participants with more homophilous friendship groups on drug use earned a score closer to 1, and those with less homophilous friendship groups earned a score closer to 0. It is important to emphasize that participants were able to endorse different friends at each time point, and, as such, participants were only asked about each friend's lifetime drug use, given that participants' endorsed friends at one time point might have been different from their endorsed friends at the previous time point.

Demographics

Demographic information included participant age, ethnicity, qualifying offense (i.e., the offense for which participants were initially arrested), and a measure of neighborhood conditions, which was used as a proxy for socioeconomic status. Qualifying offenses were coded as *person* (1), *property* (2), *drug* (3), or *other* (4). Neighborhood conditions (Neighborhood Conditions Measure; adapted from Sampson & Raudenbush (1999)) refers to the environment surrounding the adolescent's home. Participants indicated how often they had noticed signs of physical and social disorder in their neighborhoods (e.g., cigarettes on the street or in the gutters, people using needles or syringes to take drugs) using a 4-point Likert-type scale ranging from 0 ("*Never*") to 4 ("*Often*"). The total score was comprised of a mean score of all 21 items in the measure.

Friend Drug Use Proportion

To ensure the present study's analyses accounted for drug use homophily in youths' friendship groups above and beyond merely having or not having drug using peers, friend drug use proportion was included in the models as a fixed covariate. In other words, friend drug use proportion allowed for a disentangling of drug use homophily from the sheer number of drug using friends alone. The friend drug use proportion measure was calculated at each time point by summing the number of drug using friends endorsed by each participant and dividing by the total number of friendships endorsed by the participant. The resulting proportions ranged from 0 (none of the endorsed friends used drugs) to 1 (all of the endorsed friends used drugs).

Formal and Informal Processing

Formal processing (1) refers to processing decisions that resulted in the youth's placement on supervised probation, while informal processing (0) refers to processing decisions that resulted in the youth's diversion from the juvenile justice system. Information on each participant's processing decision was obtained from official reports provided by the local probation departments in each county.

Participating Site

Participating sites were coded as 1 (*CA*), 2 (*PA*), and 3 (*LA*), and participating site was included as a covariate in the analyses to control for possible site effects. Participating site was not included as a Level 3 cluster variable given that only three sites were used in the analyses.

Family Criminality

Participants' endorsement of family criminality was included with the analyses as a control to account for potential familial influence. The Family Criminality measure was

Table 2 Descriptive statistics of main variables at each timepoint

Variable	M_0 (SD_0)	M_1 (SD_1)	M_2 (SD_2)	M_3 (SD_3)	M_4 (SD_4)	M_5 (SD_5)	M_6 (SD_6)	M_7 (SD_7)	M_8 (SD_8)
Friendships endorsed	3.38 (1.56)	3.13 (1.57)	2.97 (1.56)	2.86 (1.54)	2.70 (1.55)	2.51 (1.56)	2.52 (1.57)	2.36 (1.57)	2.28 (1.56)
Participant substance use variety	0.13 (0.15)	0.09 (0.13)	0.08 (0.12)	0.09 (0.12)	0.09 (0.12)	0.10 (0.12)	0.09 (0.12)	0.11 (0.13)	0.13 (0.13)
Drug use homophily	0.67 (0.39)	0.74 (0.37)	0.73 (0.38)	0.72 (0.39)	0.71 (0.40)	0.70 (0.40)	0.71 (0.40)	0.67 (0.42)	0.63 (0.43)
Friend drug use proportion	0.35 (0.40)	0.28 (0.38)	0.27 (0.38)	0.26 (0.38)	0.28 (0.40)	0.27 (0.39)	0.27 (0.39)	0.29 (0.40)	0.32 (0.41)

created for the purposes of the Crossroads Study. Participants were asked whether anyone in their family has ever been involved in criminal activity, to which they responded "*Yes*" (1) or "*No*" (0).

Analytic Strategy

The present study aimed to examine how homophily of drug use within adolescent offenders' friendship groups is related to adolescents' subsequent substance use. The hypothesis of the present study was tested in R version 4.0.3 (R Core Team, 2020) using multilevel modeling, given the nested structure of the data (i.e., time points nested within participants).

Associations between drug use homophily at time n and participant substance use variety at time $n + 1$ were tested using lagged multilevel models. Fixed predictors included drug use homophily, age, ethnicity, socioeconomic status, processing type, qualifying offense, participating site, and family criminality. To parse out the impact of drug use homophily—rather than simply measuring the number of participants' drug using friends—the proportion of drug using friends to total endorsed friends was additionally included in the tested models as a fixed covariate. Substance use variety at time n was also included as a fixed predictor to account for youths' substance use histories, and drug use homophily at time n was additionally included as a random Level 1 predictor. Participant was the only random factor used, and a random intercept by participant was included. Substance use variety at time $n + 1$ was used as the outcome variable in the tested models. Drug use homophily, friend drug use proportion, age, and socioeconomic status were person-centered. Results with p-values of 0.05 or lower were interpreted as significant. The multilevel models were fit using the lme4 package (Bates et al., 2015) with restricted maximum likelihood (REML) estimation and an unstructured variance-covariance matrix; p-values were calculated with Satterthwaite approximation using the lmerTest package (Kuznetsova et al., 2017). The REML estimation method allowed for the use of incomplete (i.e., missing) data without biasing the estimates. There were no convergence issues with the tested models.

Results

First, descriptive statistics are presented to characterize the extent of substance use variety among participants at each time point. Then, models testing the association between drug use homophily and subsequent substance use variety are presented.

Descriptive Statistics

Means and standard deviations of the number of friendships endorsed and all main variables are presented in Table 2. Participants endorsed an average of about three close friendships at Baseline ($M_{\text{Baseline friendships endorsed}} = 3.38$), and this number generally decreased throughout the course of the study. On average, participants at Baseline reported using a small proportion of the prompted substances ($M_{\text{substance use}} = 0.13$). At Baseline, participants reported that their friendship groups were relatively high on drug use homophily; in other words, on average, participants' close friendship groups had a fairly high proportion of friends that were similar to them on drug use out of the total number of close friendships they endorsed ($M_{\text{Baseline drug use homophily}} = 0.67$). The proportion of participants' friends that had drug use experience was moderate, with an average proportion of 0.35 at Baseline. Importantly, friend drug use proportion was only modestly correlated with drug use homophily ($r = 0.21$), suggesting that the measures of friend drug use proportion and drug use homophily were not assessing the same concept. Missing data on all main variables tended to increase with the length of the study, with missing data being less pronounced for measures associated with participants' substance use (e.g., substance use variety) than for measures associated with participants' friends' drug use (e.g., peer drug use ratio).

Table 3 Models for drug use homophily and subsequent substance use variety

Effect	Model 1			Model 2		
	Estimate (SE)	95% Confidence interval		Estimate (SE)	95% Confidence interval	
		Lower bound	Upper bound		Lower bound	Upper bound
Fixed effects						
Intercept	0.096***	0.090	0.101	0.121***	0.105	0.135
	(0.003)			(0.007)		
Age				0.010*** (0.001)	0.008	0.012
Site						
PA				−0.037*** (0.005)	−0.048	−0.027
LA				−0.034*** (0.006)	−0.045	−0.021
Ethnicity						
Black				−0.041*** (0.006)	−0.052	−0.030
Hispanic				−0.037*** (0.005)	−0.047	−0.027
Other				−0.028** (0.011)	−0.048	−0.007
Offense category						
Person				−0.014* (0.006)	−0.025	−0.003
Property				−0.011* (0.005)	−0.021	−0.000
Other				−0.010 (0.007)	−0.023	0.003
Formal processing				0.001 (0.003)	−0.005	0.008
Family criminality				0.006 (0.003)	−0.001	0.013
SES				−0.003 (0.002)	−0.008	0.001
Participant substance use variety at time n				0.412*** (0.011)	0.383	0.450
Friend drug use proportion				−0.017*** (0.004)	−0.025	−0.008
Drug use homophily at time n				0.023*** (0.003)	0.016	0.030
Random effects						
Intercept variance	0.003			0.002		
Slope variance				0.001		
Residual variance	0.007			0.007		

Note. Model 1 represents an intercept-only model with no predictor variables; Model 2 represents a full model with drug use homophily entered as a random slope and the remaining independent variables entered as fixed covariates

*$p \leq 0.05$. **$p \leq 0.01$. ***$p \leq 0.001$

Table 4 Effect of drug use homophily on subsequent substance use variety

Source	Numerator df	Denominator df	*F*	Significance (*p*)
Age	1	5875.3	140.164	<0.001
Site	2	531.3	27.246	<0.001
Ethnicity	3	507.1	23.917	<0.001
Offense category	3	523.3	2.309	0.076
Processing type	1	516.0	0.118	0.731
Family criminality	1	7429.0	3.140	0.076
SES	1	6001.2	1.968	0.161
Participant substance use variety at time *n*	1	4396.2	1502.380	<0.001
Friend drug use proportion	1	4360.6	17.548	<0.001
Drug use homophily at time *n*	1	787.9	46.262	<0.001

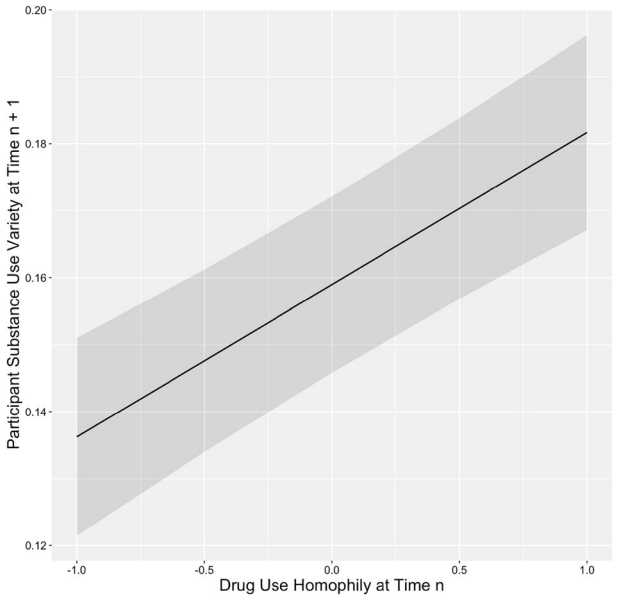

Fig. 1 Drug Use Homophily Predicting Subsequent Substance Use. *Note*. Greater drug use homophily was associated with greater subsequent substance use variety. The bands represent the upper and lower limits of the 95% confidence intervals

Does Drug Use Homophily Predict Adolescents' Subsequent Substance Use?

The effect of drug use homophily on subsequent substance use variety was examined using lagged multilevel models. An intercept-only model was first tested to determine if multilevel modeling would be an appropriate analysis given the present data. The ICC associated with participant was 0.52, suggesting a large proportion of the total variance was associated with the individual, justifying the use of a multilevel modeling framework—as opposed to using a single level model—for the present study's analyses.

The full model which included all predictor variables revealed that, even after accounting for the proportion of drug using friends and consistency in participant substance use behavior over time, drug use homophily at time n was a significant predictor of participants' subsequent substance use variety at time $n + 1$, above and beyond participants' substance use variety at time n, F (1 787.9) = 46.262, $\beta =$ 0.023, $p =< 0.001$. Additionally, age, participating site, ethnicity, and person and property offense categories were all significantly related to participants' subsequent substance use variety. Unsurprisingly, participant substance use variety at time n was a strong predictor of participant substance use variety at time $n + 1$, and participants whose first offense was a person or property offense reported less drug use than participants whose first offense was drug related. Further, the proportion of drug using friends was significantly related to participants' subsequent substance use variety, though this association was not as strong as the association between drug use homophily and subsequent substance use variety. To review the estimates of the variance components associated with the fixed and random effects, see Table 3. To review the F statistics and significance information, see Table 4. Figure 1 depicts a graphical representation of the full model.

Does Peer Influence Operate Differently among Early Users and Users with Later Onset?

Given that match scores on the drug use homophily measure could represent either youth–peer similarity in engagement in drug use or youth-peer similarity in abstinence from drug use, a follow up exploratory analysis was conducted to examine whether drug use homophily predicted participants' subsequent substance use differently among youths who endorsed having used substances prior to the start of the study and those who did not endorse having used substances prior to the start of the study.

A new variable was created using binary predictor coding to discern whether participants had or had not endorsed using

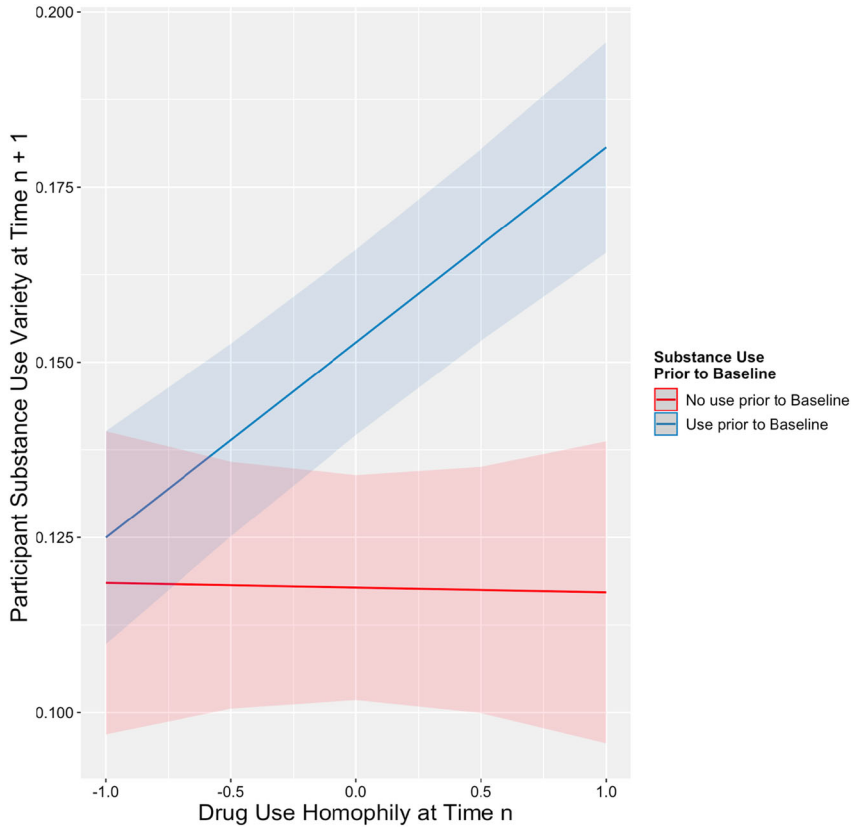

Fig. 2 Drug Use Homophily and Subsequent Substance Use Variety Among Prior Users and Non-Users. *Note*. Among participants who endorsed having used substances prior to the start of the study, greater drug use homophily at time n was associated with greater subsequent substance use variety. Among participants who did not endorse having used substances prior to the start of the study, this association was not significant. The bands represent the upper and lower limits of the 95% confidence intervals

substances prior to the study's Baseline assessment. An interaction term was then created between the binary predictor variable representing endorsed drug use and the variable representing drug use homophily. As such, among participants who were coded as 1 for having used substances prior to the start of the study, Baseline drug use homophily within their friendship group represented similarity with regard to endorsement of drug use. Among participants who were coded as 0 for not having used substances prior to the start of the study, Baseline drug use homophily instead represented similarity with regard to abstinence from drug use. The interaction term allowed for an assessment of how the association between drug use homophily and participants' subsequent substance use variety differed depending on whether participants entered the study with or without a history of substance use. In other words, this interaction term demonstrated differences between early users and later onset users in the present study's sample.

The model revealed that the association between drug use homophily at time n and participant substance use at time $n+1$ significantly differed among youths who endorsed having used substances prior to the start of the study and those who did not, $F\ (1\ 772.3) = 11.766$, $\beta = 0.029$, $p < 0.001$. Among participants who endorsed using substances prior to the start of the study (for whom drug use homophily reflects youth−peer similarity in engagement in drug use), greater drug use homophily was associated with greater subsequent substance use variety. Among participants who did not endorse using substances prior to the start of the study (for whom drug use homophily reflects youth-peer similarity in abstinence from drug use), greater drug use homophily at time n was not associated with subsequent substance use variety. See Fig. 2 for a graphical representation of the results. For the full results of this model, see Appendix B.

Discussion

Researchers have long posited that friendships are an important—and beneficial—component to socialization in adolescence (Crosnoe (2000)). However, some socialization by peers may have a detrimental impact on youths' behaviors. Indeed, studies suggest having more substance using friends is associated with greater substance use progression by target adolescents (Simons-Morton & Chen, 2006). Further, justice system involvement often places young offenders in closer proximity to delinquent and substance using peers (Chassin, 2008)—both groups which have been shown to impact youths' drug and alcohol use (Wu et al., 2010; Zapolski et al., 2019). It is therefore important to examine the characteristics of adolescent offenders' friendships in an effort to better understand their decisions to engage in or desist from substance use. Yet, while substantial research has explored how

similarity between friends may relate to the problem behaviors of justice-involved youths, prior findings are limited to older data and restricted measures of substance use. The present study's results, which were examined using recent data and a substance use measure assessing a wide variety of substances, suggest that friendships of justice-involved adolescents may, indeed, be an important source of substance use socialization, just as prior research has suggested they are for community youths.

In line with the present study's hypothesis, homophily of drug use appeared to predict adolescent offenders' subsequent substance use variety. Specifically, homophily of drug use was positively related to youths' own use of substances, such that greater homophily of drug use in participants' close friendship groups was associated with a greater variety of substance use by participants at the subsequent time point. These findings fall in line with prior literature, which suggests youths who have friends who use illicit substances (e.g., marijuana) are likely to use substances themselves (Pearson et al., 2006).

It is important to note, however, that a match on drug use homophily for one participant could have represented the youth and peer both endorsing drug use, while a match on drug use homophily for another participant could have represented the youth and peer both abstaining from drug use. The present study's analyses were therefore adjusted to account for youths who did and did not endorse having used substances prior to the start of the study, and it was found that the association between drug use homophily and subsequent substance use variety differed among the two groups. That is, among youths who endorsed having used substances prior to the start of the study, greater drug use homophily was associated with greater subsequent substance use variety; however, among youths who did not endorse having used substances prior to the start of the study, this association was no longer present.

These results suggest that, for youths who enter the justice system with a prior history of substance use, it may be particularly important to form friendships with substance-abstaining peers—and, importantly, young offenders who have a history of substance use prior to entering the justice system may benefit from policies aimed at strengthening their relationships with non-using peers to discourage their own substance use. However, youths who enter the justice system without a history of substance use may benefit from interventions aimed at other criminological needs (e.g., family relationships). These findings may be particularly appropriate to apply in jurisdictions where adolescents with substance use histories constitute a majority of youths involved with the justice system, as such settings may inadvertently facilitate youths' continued substance use through deviant peer associations.

It is also important to note that these findings should be interpreted with caution, as there are several limitations to the interpretation of the results. First, the data for the present study did not lend itself to a disentangling of selection and socialization effects. It may be that greater homophily within justice-involved adolescents' friendship groups represents greater selection of similar friends rather than socialization by friends on problem behaviors. However, the present findings represent changes in adolescent offenders' behaviors across time, therefore suggesting that socialization processes are, at least partially, captured in the results. Researchers who wish to further explore whether homophily of adolescent offenders' close friendships is indicative of selection or socialization may wish to follow a procedure wherein measures of bidirectional peer endorsement are used to disentangle impacts of selection and socialization on homophily through a complete network analysis approach (see Turanovic & Young, 2016). As the data for the present study only included responses from youths rather than from both youths and their peers, it was not possible to assess bidirectional peer endorsement in the present study's analyses.

Second, the study's sample included only youths who were either diverted from the juvenile justice system or placed on formal probation—both situations wherein the offender is able to remain relatively active within the community. As such, future studies are needed to examine how additional degrees of justice system involvement (e.g., incarceration in a residential facility) may impact youths' social development and exposure (and susceptibility) to peer influence in the context of close friendships. Additionally, the present study's sample only included boys; future research should aim to examine substance use homophily and subsequent substance use among justice-involved girls as well to promote a thorough understanding of this association among adolescents more generally.

Third, a small number of the youths in the present study included family members in their list of closest friends. As family members and peers may impart a different kind of influence on an adolescent's behaviors, future studies that follow a similar design may wish to restrict friend nominations to non-familial relationships to ensure that the results represent only non-familial peer influence.

Fourth, participant substance use was measured in two different ways: lifetime use (measured at Baseline) and use since the previous interview (measured at each timepoint following the Baseline interview). However, participants' friends' substance use was measured as lifetime use only. Therefore, homophily of drug use within participants' friendship groups represented whether the participant was similar to—or different from—their close friends with regard to the participant's use of drugs since the previous interview and their friends' lifetime substance use. Although results could have differed had participant–friend dyads been more directly assessed as matches on both lifetime use and use since the previous interview, the data

unfortunately did not allow for such an assessment given that participants were only asked about each friend's use over the lifetime and were given the option to nominate different friends at each time point if they wished to do so. However, capturing the similarity of drug use endorsement (or abstinence) within participants' close friendship groups with regard to the participant's use since the previous interview allowed for a longitudinal analysis examining how similarity of engagement in drug use (with regard to the participant's most recent decisions to engage in or desist from substance use) was associated with participants' use at a subsequent point in time. Future research should ensure that data collection captures participants' friends' substance use through a time-varying measure as well.

Fifth, participants' substance use was captured through a measure of substance use variety out of a total of 13 possible substances used; friends' drug use, however, was captured through one item asking participants whether each endorsed friend had ever used drugs. As such, the present study did not necessarily assess for homophily with regard to the *type* of substance used by participants and their close friends. Instead, the present findings reflect homophily of drug use endorsement more generally—that is, the findings captured whether youths and their close friends were similar on having ever used any drugs (thus having arguably more permissive attitudes towards drug use). Though future studies may benefit from assessing homophily of drug use in such a way as to capture similarity on the type of drug used by participants and their friends, findings from the present study suggest that, even when examined in the context of more broadly defined homophily, associations between homophily of drug use and subsequent substance use variety do exist.

Last—and perhaps most crucial—the present study's analyses were not built on causal models; therefore, causal effects cannot be interpreted from these findings. The analyses did incorporate temporal precedence as a component of causality (i.e., by assessing how homophily at one time point predicts youths' problem behaviors at the following time point). However, though temporal precedence is, indeed, one element of causality, it is not a sufficient element and causality cannot be interpreted on this requirement alone. Future research may benefit from extending the plan of analysis to a causal design.

Despite the acknowledged limitations, the present study also had several important strengths. The study included a large sample with recent data collected from three separate sites in distinctly different geographical locations (California, Pennsylvania, and Louisiana), and participants were ethnically diverse. Further, the sample included only first-time adolescent offenders. As such, though causal effects cannot be interpreted from the findings, the results do represent changes in adolescent offenders' drug use homophily and subsequent substance use that are co-occurring with youths' first experiences with the juvenile justice system. Additionally, to parse out the association between drug use homophily and subsequent substance use, the proportion of drug using friends to total endorsed friends was accounted for in the analyses. As a result, the findings from the present study suggest that drug use homophily in young offenders' friendships is associated with their subsequent substance use, above and beyond simply the proportion of drug using peers alone. The present study also examined the close friendships of juvenile offenders (rather than just their peer relationships), and, although close friends may impart a different extent of influence onto the developing adolescent, studies assessing close friend relationships of adolescent offenders are currently limited.

Conclusion

Substance use in adolescence has been shown to have detrimental impacts, and such impacts are especially pronounced among justice-involved adolescents (Schubert et al., 2011). Importantly, adolescents' friendship groups tend to be heterogeneous with regard to peers' engagement in problem behaviors such as substance use (Haynie, 2002). It is therefore crucial to examine how peer influence—a known predictor of adolescent deviant behavior—operates within the context of justice-involved youths' close friendship groups. The present study sought to contribute to existing research and improve the understanding of adolescent development by examining how drug use homophily within justice-involved youths' close friendship groups relates to subsequent substance use variety, as well as by examining whether (and how) this association differs between early substance users and users with later onset. Findings suggest that greater homophily of drug use is associated with greater subsequent substance use variety among youths entering the justice system, and there may be differences in the initiation and continuation of substance use between youths with and without a substance use history. Indeed, among adolescents who entered the justice system without a substance use history, having more close friends who were similar to them on having used substances was not associated with subsequent substance use; however, among adolescents who entered the justice system with a substance use history, having more close friends who were similar to them on having used substances was associated with more subsequent substance use. Given justice-involved youths' vulnerability to substance use and abuse (Chassin, 2008), as well as their increased risk for detrimental consequences associated with substance use (Hussey et al., 2007), these findings suggests youths who enter the justice system with a history of substance use may need additional interventions that could help target their social skills (e.g., resistance to peer influence) and drug use behaviors. Importantly, the results from the present study lay the groundwork for future research

aimed at integrating legal and developmental perspectives to examine how social processes contribute to young offenders' engagement in problem behaviors such as initiated and continued substance use.

Author's Contributions A.D.D. conceived of the present study, participated in the interpretation of the data, performed the statistical analysis, and drafted the manuscript; A.G.T. consulted in the design and coordination of the present study, assisted with data collection for the original study from which this secondary data analysis was run, participated in the interpretation of the data, and reviewed and provided feedback on the manuscript; H.I.V.-E. participated in the interpretation of the data, consulted on and reviewed the statistical analysis, and reviewed and provided feedback on the manuscript; L.S. conceptualized and carried out data collection for the original study from which this secondary data analysis was run, participated in the interpretation of the data, and provided feedback on the manuscript; P.J.F. conceptualized and carried out data collection for the original study from which this secondary data analysis was run, participated in the interpretation of the data, and provided feedback on the manuscript; E.E.C. conceptualized and carried out data collection for the original study from which the secondary data analysis was run, participated in the interpretation of the data, and reviewed and provided feedback on the manuscript. All authors read and approved the final manuscript.

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Data Sharing and Declaration The data that support the findings of this study are available, but restrictions apply to the availability of these data, which were used under license for the current study and thus are not publicly available. However, data are available from the authors upon reasonable request and with permission.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval Ethics approval was obtained from the Institutional Review Boards of the University of California, Irvine, Temple University, Louisiana State University, and the University of Texas at El Paso.

Informed Consent Informed consent was obtained from parents or legal guardians.

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Appendix A: Thirteen Substances Listed in Substance Use/Abuse Subscale

1) Alcohol; 2) marijuana or hashish; 3) sedatives or tranquilizers; 4) stimulants (amphetamines); 5) cocaine; 6) opiates; 7) ecstasy; 8) hallucinogens; 9) inhalants; 10) amyl nitrate, odorizers, or rush; 11) own prescription medication (unauthorized use); 12) others' prescription medication (unauthorized use); 13) other drugs.

Appendix B: Full Results from Exploratory Model

Table 5

Table 5 Models for drug use homophily and subsequent substance use variety among early users and later onset users

Effect	Estimate	(SE)	95% Confidence interval	
			Lower bound	Upper bound
Fixed effects				
Intercept	0.082***	(0.008)	0.065	0.098
Age	0.010***	(0.001)	0.008	0.011
Site				
PA	−0.030***	(0.005)	−0.040	−0.019
LA	−0.023***	(0.006)	−0.035	−0.011
Ethnicity				
Black	−0.038***	(0.006)	−0.049	−0.027
Hispanic	−0.036***	(0.005)	−0.046	−0.026
Other	−0.029**	(0.011)	−0.050	−0.008
Offense category				
Person	0.001	(0.006)	−0.010	0.012
Property	0.004	(0.005)	−0.007	0.014
Other	0.002	(0.007)	−0.011	0.015
Formal processing	0.000	(0.003)	−0.006	0.007
Family criminality	0.006	(0.003)	−0.001	0.013
SES	−0.003	(0.002)	−0.008	0.002
Participant substance use variety at time n	0.387***	(0.011)	0.359	0.422
Friend drug use proportion	−0.017***	(0.004)	−0.026	−0.009
Drug use homophily at time n	−0.001	(0.007)	−0.015	0.014
Drug use prior to Baseline	0.035***	(0.004)	0.027	0.043
Drug homophily × drug use prior to Baseline	0.029***	(0.008)	0.012	0.045
Random effects				
Intercept variance	0.002			
Slope variance	0.001			
Residual variance	0.007			

*$p \le 0.05$, **$p \le 0.01$, ***$p \le 0.001$

Table 6

Table 6 Effect of drug use homophily and subsequent substance use variety among early users and later onset users

Source	Numerator df	Denominator df	*F*	Significance (*p*)
Age	1	6087.8	133.410	<0.001
Site	2	607.5	15.674	<0.001
Ethnicity	3	586.1	21.446	<0.001
Offense category	3	600.7	0.211	0.889
Processing type	1	596.6	0.005	0.942
Family criminality	1	7452.9	3.146	0.076
SES	1	6190.4	1.635	0.201
Participant substance use variety at time *n*	1	5443.8	1260.413	<0.001
Friend drug use proportion	1	4607.1	18.494	<0.001
Drug use homophily at time *n*	1	790.2	10.979	<0.001
Drug use prior to baseline	1	642.3	77.196	<0.001
Drug use homophily × drug use prior to baseline	1	772.3	11.766	<0.001

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