Peer Influence on Marijuana Use in Different Types of Friendships

Joan S. Tucker, PhD, **Kayla de la Haye, PhD**, **David P. Kennedy, PhD**, **Harold D. Green Jr., PhD**, and **Michael S. Pollard, PhD**
RAND Corporation

Abstract

Purpose—Although a number of social network studies have demonstrated peer influence effects on adolescent substance use, findings for marijuana use have been equivocal. This study examines whether structural features of friendships moderate friends' influence on adolescent marijuana use over time.

Methods—Using one-year longitudinal data from the National Longitudinal Study of Adolescent Health, this paper examines whether three structural features of friendships moderate friends' influence on adolescent marijuana use: whether the friendship is reciprocated, the popularity of the nominated friend, and the popularity/status difference between the nominated friend and the adolescent. The sample consists of students in grade 10/11 at Wave I, who were in grade 11/12 at Wave II, from two large schools with complete grade-based friendship network data (*N* = 1612).

Results—In one school, friends' influence on marijuana use was more likely to occur within mutual, reciprocated friendships compared to non-reciprocated relationships. In the other school, friends' influence was stronger when the friends were relatively popular within the school setting or much more popular than the adolescents themselves.

Conclusions—Friends' influence on youth marijuana use may play out in different ways, depending on the school context. In one school influence occurred predominantly within reciprocated relationships that are likely characterized by closeness and trust, whereas in the other school adopting friends' drug use behaviors appeared to be a strategy to attain social status. Further research is needed to better understand the conditions under which structural features of friendships moderate friends' influence on adolescent marijuana use.

INTRODUCTION

Friend substance use is one of the most robust predictors of adolescent cigarette and alcohol use [1–4], but fewer studies have examined these socialization effects on marijuana use and the evidence has been mixed [5–9]. The findings for marijuana use may be more inconsistent, in part, because this behavior is likely to be more covert and confidential and

CORRESPONDING AUTHOR: Joan S. Tucker, PhD, RAND Corporation, 1776 Main Street, PO Box 2138, Santa Monica, CA 90407-2138, jtucker@rand.org, Telephone: 310-393-0411, x7519, Fax: 310-260-8175.

IMPLICATIONS AND CONTRIBUTIONS

Results suggest that friends' influence on marijuana use may play out differently depending on the school context. In some schools, peer influence on marijuana use may occur predominantly within closer (reciprocated) friendships, whereas in other schools adopting friends' drug use behaviors may be a strategy to attain social status.

so may occur in particular social contexts. Opportunities for peer socialization processes may therefore be limited to specific types of friendships. This study examines whether structural features of friendships moderate friends' influence on adolescent marijuana use over time.

Although adolescents are sometimes motivated to adopt the behaviors of desired friends in order to establish or strengthen these relationships, this may not be true for marijuana use given its illicit nature. When a risk behavior is not generally visible within the peer group, close friendships might be even more important and salient than desired friendships for proliferation of the behavior [10, 11]. Closer, more trusted friendships may be a main source of marijuana access for adolescents. Additionally, adolescents may be more likely to experiment with marijuana within these types of friendships because they feel safer and less concerned about getting caught. We examine whether friendship closeness moderates socialization effects on marijuana use, operationalizing 'close friendships' as those that are mutual/reciprocated based on friendship nominations.

Socialization effects on adolescent marijuana use may also be moderated by the social status of drug-using friends. Popular adolescents are more likely to use marijuana and other substances [12, 13], and to influence behavioral norms within their peer groups [2, 14, 15]. Thus, adolescents may be particularly susceptible to pro-drug influences from friends with relatively high social standing. Social learning theory and empirical evidence also suggest that adolescents adopt the behaviors of high status peers as a strategy for improving their own social standing [16, 17], indicating that status differences between adolescents and their friends are important to consider. Adolescents may be more likely to adopt the behaviors of friends who are more popular than themselves, compared to friends with comparable or lower popularity, because doing so has greater social benefits.

This paper builds on our previous work examining friendship networks influences on marijuana use in two large, demographically distinct high schools [8]. Adolescent marijuana initiation was significantly predicted by the frequency of friends' marijuana use in one school, and marginally associated in the other school. Additionally, there were positive, albeit non-significant trends in both schools indicating that the frequency of adolescents' past month use was predicted by how frequently their friends used this drug. To investigate whether socialization effects may be stronger under certain social conditions, the present study examines three structural features of friendships as moderators of friends' influence on adolescent marijuana use: (a) whether the friendship is reciprocated, (b) the popularity of the nominated friend among their school peers, and (c) the relative popularity of the friend compared to the adolescent. Popularity in this study is derived from friendship nominations rather than based on perceived popularity, and thus reflects likeability rather than social visibility or dominance [18]. Given the illicit nature of marijuana use, we hypothesized that adolescents' marijuana use would be more strongly predicted by their friends' marijuana use when the friendship was closer (i.e., reciprocated; see [19]). Based on the idea that adolescents are motivated to adopt the substance use behaviors of their friends to attain greater social status, we hypothesized that adolescents' marijuana use would be more strongly predicted by their friends' marijuana use when the friends were popular within the broader peer group (i.e., friends had a higher number of school-based friendship nominations relative to their school peers), as well as when the friends were relatively more popular than the adolescent (i.e., friends had a higher number of school-based friendship nominations relative to the adolescent).

METHODS

Sample

The National Longitudinal Study of Adolescent Health is a study of adolescent health conducted in the U.S. [20], with participants recruited from a school-based probability sample of adolescents in Grades 7–12. Friendship nominations were collected at Wave I (1995) and Wave II (1996), providing longitudinal information on the friendship networks of participants. The current study uses data from two of the 16 schools in the "saturated school sample" that was developed by inviting *all* enrolled students in select schools to complete baseline in-home interviews (the remaining 14 schools were excluded because they were too small, had too much missing data, or had very low rates of marijuana use). These two schools were notably different: one has a large, ethnically heterogeneous student body and is located in a major metropolitan area (School 1); the other has a smaller student body that is predominantly white and is located in a mid-sized town (School 2). Information on adolescents' substance use and friendships in these saturated schools provide us with the rare opportunity to explore drug use in the context of *complete* school-based friendship networks over time.

We limited our analysis to grade-level cohorts captured at Wave I and Wave II in both of these schools: participants in grade 10/11 at Wave I, who were in grade 11/12 at Wave II (or participants who met these criteria at either wave, to retain the maximum amount of information on the social network structure). This resulted in a total sample of N=1612, nested in two schools (School 1: n=1193, mean age=16.34; School 2: n=419, mean age=16.47). Retention rates at Wave II were 88.1% in School 1 and 87.4% in School 2. New students were not added at Wave II. Study procedures were approved by the institution's Internal Review Board.

Measures

Friendships—Respondents were asked to name five best male and five best female friends. School-based friends who also participated in the study were coded with their respective identification numbers (out-of-school nominations were given specific codes). Only friendship nominations among participants in the current sample were included in subsequent analyses (i.e., friends were also survey respondents) so that friends' self-reported marijuana use was available. Due to errors in Wave I data collection, 5% of the current sample could only nominate one male and one female friend; students with "limited nominations" at were dummy-coded and this was included as a control in all models.

Friend reciprocity, an attribute of friendship dyads, was defined as a mutual friendship, where both participants nominated each other as a friend at a given wave. *Friend popularity*, an attribute of participants' nominated friends, was defined based on the total number of friendship nominations received by a nominated friend at a given wave (i.e., friend indegree, with "indegree" referring to the number of friend nominations received by a respondent at a given wave). *Popularity difference*, an attribute of the respondent, was defined based on the difference in number of friend nominations received (i.e., indegrees) between adolescents and each of their nominated friends. Because we are interested in youth who nominated friends that were *more popular* than they were, we only summed indegree difference scores when the friend's indegree was *higher* than the respondent's indegree (all other indegree differences were treated as 0). We computed two variations of this measure: 1) the original continuous variable capturing summed indegree differences between respondents and their friends; and 2) a dichotomous variable identifying respondents at the 75th percentile of this continuous scale (i.e., who nominated friends who were much more popular than they were).

Marijuana use—A continuous measure of past month marijuana use was based on respondents' report of the number of times they used in the past 30 days. To create a more normally distributed dependent variable suitable for longitudinal social network models, it was rescaled by taking the log of the number, adding a constant of 1, and rounding to the nearest whole number. This recoded scale represents the following categories of past month use: 0=*none*, 1=*1 to 3 times*, 2=*4 to 11 times*, 3=*12 to 32 times*, 4=*33 times or more*.

Control attributes—Analyses controlled for Wave I dichotomous measures of gender (1=male) and grade (1=older grade cohort), a categorical measure of race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, Asian, Other), and the highest level of education attained by either parent (parent report; 1=*<high school*, 2=*high school or trade school*, 3=*some college*, 4=*college graduate*).

Analytic method

Co-evolution of friendship networks and marijuana use was modeled using stochastic actor-based (SAB) models for social networks and behavior [21–23]. Models were estimated that account for factors predicting friendship choices (including the role of marijuana use), and that also test for effects of friends' marijuana use on adolescent marijuana use. Model covariates included the control attributes listed above, as well as structural network effects. Three types of effects were included to test for effects of marijuana use and respondent covariates on friendship network dynamics: the effect of the variable on the tendency to nominate friends (variable ego); the effect of the variable on the tendency to receive friend nominations (variable alter, with a squared alter effect included if the variable was continuous to capture non-linearity); and an effect to determine if friendships were more likely among peers who were similar on this variable ("same variable" if dichotomous, or "similar variable" if continuous). All effects included in the final models control for each other. See de la Haye et al. [8] for more detail on these base co-evolution models.

To address the specific aims of this study, we added parameters to these base models testing for interactions between friend influence on marijuana use and the three structural friendship characteristics of interest (i.e., reciprocity, friend popularity, popularity difference). Friend influence on marijuana use was tested using a parameter that assesses the impact of friends' marijuana use on changes to adolescent use. The parameter is referred to as the "total similarity effect", as it is based on the *sum* of similarity scores between adolescents and their friends; a greater difference in summed scores between adolescents and their friends is particularly influential [24]. This effect was selected over other potential specifications of friend influence because it consistently converged across the models and was statistically significant in score tests. Interactions between the friend influence effect and each of the structural friendship characteristics were score tested one at a time in three separate models. To accurately assess these moderating effects on friend influence, the models also controlled for the moderating role of friend characteristics on the effect of selecting friends with similar marijuana use (moderators of selection were included in the model when significant).

The RSiena 4.0 software [24] was used to implement these models, and a Method of Moments procedure was used to estimate model parameters, whereby parameter vectors are adjusted to improve model fit through a series of simulations. Missing data are treated as non-informative and imputed within the RSiena software to allow for meaningful simulations [24]. As estimates for the parameters are approximately normally distributed, they are tested for significance based on a t-ratio (estimate divided by the standard error).

RESULTS

Descriptive Results

As shown in Table 1, lifetime marijuana use increased over one year from Wave I to Wave II in both School 1 (from 37.2% to 45.0%) and School 2 (from 48.8% to 59.4%). Approximately 20% of students in School 1 reported past month use at each of Waves I and II, compared to 29.9% (Wave I) and 24.9% (Wave II) of students in School 2. Information on marijuana use is missing for approximately 20% of the sample at Wave II due to attrition; however, based on the available information, 7.8% of students in School 1 and 10.6% of students in School 2 initiated marijuana use between Wave I and Wave II.

Table 2 provides information on characteristics of the school friendship networks. Students made up to 10 friend nominations (the survey limit; mean = 2–3) and received as many as 18 friend nominations. The friend reciprocity index, or proportion of friendship nominations that were reciprocated, ranged across waves from .27–.34 in School 1 and .42–.43 in School 2. The friend transitivity index, or proportion of friends who share another common friend, ranged from .21–.24 across schools and waves. Finally, students had an average of 1 stable friendship across waves, indicating a high turnover of friends [although some of these "terminations" can be attributed to missing friendship nominations data at Wave II (School 1=19.9%, School 2=12.6%)].

Statistical Models

Before reporting on the focal interaction effects between friendship characteristics and influence, we first report on the predictors of change in friendships and marijuana use that are included as controls in the models. Overall, the estimated SAB models (Tables 3–5) show consistent predictors within each school.

Friendship dynamics—In both schools, friendships were predicted by structural features of the social network including the tendency to reciprocate friend nominations (reciprocity), to become friends with friends' of current friends (transitive triplets, transitive ties), and to befriend peers who made *few* friend nominations and thus were selective about their friendships (negative outdegree popularity square root). Overall there was a tendency to avoid make arbitrary nominations (negative outdegree). In School 1, the significant negative 3-cycles effect captures an aversion to cyclical friendship triads, and thus a preference to form local friendship hierarchies. Friendships were also based on respondent attributes that were included as controls. In School 1, students preferred to befriend peers of the same gender, race/ethnicity, and grade, as well as peers in higher grades (grade alter) and whose parents had more education (parent education alter). Students with these same attributes – in higher grade levels (grade ego), and with more highly educated parents (parent education ego) – also tended to make fewer friend nominations. In School 2, students tended to befriend peers in the same grade, but no other control attributes predicted friendships.

To accurately model the influence of friends on adolescent marijuana use, we included model parameters that account for the role of marijuana use in friend selection. In both schools there were significant effects indicating that students befriended peers whose marijuana use was similar to their own (similar marijuana use). In School 2, students with higher values on the marijuana use scale were also more likely be nominated as a friend (marijuana use alter). None of the interactions between friendship characteristics and the effect of selecting friends with similar marijuana use were significant, and so these were not retained in the final models.

Marijuana use dynamics—The second component of the model simultaneously predicted marijuana use dynamics while controlling for predictors of friend selection. The linear and quadratic shape effects model the overall distribution of the dependent variable: the negative linear effect coupled with the positive quadratic effect indicate that there was an overall tendency towards low values on this scale, but that there was also a pull towards a U-shaped distribution with actors moving towards high or low values (rather than the mean). In School 1, marijuana use was negatively predicted by parent education, meaning that students were more likely to adopt or maintain high levels of marijuana use if their parents had less education. In School 2, marijuana use was positively predicted by grade, indicating that students in the older grade cohort were more likely to adopt or maintain higher levels of marijuana use.

Over and above the effects describe above, we tested for interactions between friend influence on marijuana use and the structural features of friendships that were of interest. Direct effects of friends' marijuana use on adolescent marijuana use were first tested in each model (friend influence), and were not statistically significant in either school. Interactions between friend influence and friend characteristics were then added to the model. In some instances the main non-significant friend influence effect was dropped when it was too highly correlated with the interaction term and thus compromised model convergence, but only if the interaction term was found to be significant or marginally significant in the score tests.

Role of friend reciprocity on friend influence (Table 3)—In School 1, there was a significant positive interaction between friends' influence on marijuana use and friend reciprocity. Thus, adolescents tended to adopt the drug use behaviors of their mutual friends, while there was no evidence that they adopted the behaviors of friends who did not also nominate them as a friend. This interaction effect was in the similar direction in School 2, but not statistically significant.

Role of friend popularity on friend influence (Table 4)—The interaction between friend popularity and friends' influence on marijuana use was positive in both schools, but only statistically significant in School 2. In School 2, adolescents were likely to adopt the marijuana use behaviors of their more popular friends.

**Role of differences in popularity between friends on friend influence (Table 5)
—**The interaction between friend influence on marijuana use and friends' popularity difference (continuous measure) was not statistically significant in either school. However, when the popularity difference was dichotomized using the 75th percentile (where 1=students with the greatest difference in popularity relative to their friends), the interaction was positive and significant in School 2 (estimate=12.89, SE=4.05, p=.001). This effect indicates that adolescents were more likely to adopt the marijuana use behaviors of their friends when there was the greatest difference in popularity relative to their friends. However, this finding should be interpreted with caution due to the large value of this estimate and large standard error.

DISCUSSION

Results from this study suggest that structural features of friendships moderate friends' influence on adolescent marijuana use over a one-year period, but that these processes may vary across different school contexts. In examining whether the socialization effect on marijuana use differed as a function of relationship closeness, we found that this effect was stronger within mutual, reciprocated friendships (compared to non-reciprocated friendships). Adolescents may feel more comfortable offering illegal drugs to their peers, or trying illegal

drugs when offered by their peers, within the context of closer, more trusted friendships. An important caveat is that the socialization effect on marijuana use was moderated by friendship reciprocity in School 1 only, a relatively large school characterized by fewer friend nominations and fewer stable friendship ties compared to School 2. The difference between schools raises the possibility that close friends may be especially important socialization agents for drug use within larger and less cohesive school environments. This is a possibility worth further investigation as it may have important implications for the delivery of school-based drug prevention programs.

We also examined whether socialization effects on marijuana use differed according to the social status of the friends engaging in drug use. Results indicated that adolescents were more likely to be influenced by friends who were relatively popular among their peers, as well as friends who were considerably more popular than themselves. These results suggest that adopting friends' marijuana use behavior may be a strategy to attain social status, an explanation which seems particularly plausible given that the effect was found only in the school (School 2) where marijuana use was associated with receiving more friendship nominations and thus popularity (as indicated by the positive 'marijuana use alter' effect in Tables 3–5). In the school where marijuana use was unrelated to popularity, adolescents were no more likely to adopt the marijuana use behavior of popular friends than those with lower social status.

Study limitations include only examining within-school friendships and future work would benefit from considering other types of within-school and outside-of-school peer relationships. In addition, only two schools could be included in our analyses and we were unable to test for school or broader setting-level effects that moderate network and behavior dynamics. Finally, the SAB modeling assumption that actors make decisions about relationship and behavior changes given the state of the entire network [21] is not ideal for these data in that adolescents are unlikely to be aware of the characteristics of all of their school peers. To partially address this issue, we included an actor attribute for grade to model the high likelihood of relationships among grade-mates. SAB models for larger networks that restrict actor decisions to their local settings are under development [25, 26] and will be better suited for the analyses of large networks.

Despite significant advances in research on peer influences on substance use, many studies have assumed that influence effects are homogenous across the peer group. Recent literature reviews on peer/behavior dynamics [2] have urged researchers to consider how these influence processes might differ for particular youth, relationship types, and contexts. This study shows that school context matters in terms of understanding peer influence on marijuana use [13]. In certain types of schools – possibly those characterized as large and less cohesive – peer influence on marijuana use may occur predominantly within reciprocated (i.e., closer, trusted) friendships. In other types of schools, adopting friends' drug use behaviors may be a strategy to attain social status. Further research that samples multiple social networks is needed to evaluate the conditions under which particular structural features of friendships moderate friends' influence on adolescent marijuana use, as well as determine whether these findings generalize to other types of substance use.

Acknowledgments

data files from Add Health should contact Add Health, Carolina Population Center, 123 W. Franklin Street, Chapel Hill, NC 27516-2524 (addhealth@unc.edu).

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TABLE 1

Individual Descriptive Statistics

| Characteristic | School 1 (N = 1193) | | School 2 (N = 419) | |
	Wave I N = 1193	Wave II N = 1051	Wave I N = 419	Wave II N = 366
Gender (% male)	51.3		56.8	
Race/ethnicity (%)				
Hispanic	39.7		1.0	
Non-Hispanic white	23.1		98.8	
Non-Hispanic black	24.7		0.0	
Asian	33.0		1.4	
Other	1.3		0.0	
Parent education (%)[a]				
Less than high school	24.6		3.9	
High school	20.2		32.5	
Some college or trade school	29.3		34.8	
Graduate of college/university	19.2		28.9	
Mean number of outside-of-school friends	1.9		1.3	
Limited nominations (%)[b]	5.3	0.0	4.8	0.0
Past month marijuana use (%)[c]				
None	79.3	80.3	70.1	75.1
1 to 3 times	9.5	8.6	14.2	10.3
4 to 11 times	5.1	5.5	6.7	4.0
12 to 32 times	4.8	4.1	6.0	8.9
33 times or more	1.4	1.5	2.2	1.7

[a] Parent education had 307 missing cases in School 1, and 114 cases missing in School 2.

[b] Participants who were only able to nominate 1 male and 1 female friend.

[c] Log transformation (+1 constant) of the number of times marijuana was used in the past 30 days, rounded to the nearest whole number. Scores of 5 and 6 (which represent frequency of marijuana use in the past month of 90 times or more) have been recoded into the category of 33 times or more.

TABLE 2

Network Descriptive Statistics

Characteristic	School 1 (*N* = 1193)		School 2 (*N* = 419)	
	Wave I	**Wave II**	**Wave I**	**Wave II**
% missing nominations	2.3	19.9	1.7	12.6
M friends nominated	2.0	1.8	3.4	3.2
Range of friend nominations made	0 – 10	0 – 10	0 – 10	0 – 10
Range of friend nominations received (popularity)	0 – 15	0 – 8	0 – 18	0 – 13
M, Range of popularity difference	5.4 (0 – 44)		10.4 (0 – 57)	
Friend reciprocity index	.27	.34	.43	.42
Friend transitivity index	.21	.23	.24	.23

	School 1	School 2
M stable friendship ties	0.59	1.26
M new friendship ties	0.78	1.45
M friendship ties dissolved	1.04	1.74
Jaccard coefficient	.25	.28

Note. The reciprocity index is the proportion of friendship nominations that were reciprocated. The transitivity index is the proportion of 2-paths (friendship ties between AB and BC) that were transitive (friendship ties between AB, BC, *and* AC). The Jaccard index measures the amount of network change between consecutive waves, and expresses quantitatively whether the data collection points are not too far apart. Values of 0.3 or greater are ideal, so that assumptions that the network change process is gradual are met[22].

TABLE 3

Friendship Network and Past Month Marijuana Use Dynamics: Interaction Between Friend Influence and Friendship Reciprocity

Model parameter	School 1			School 2		
	P.E.	SE	*p* value	P.E.	SE	*p* value
Friendship network dynamics						
Rate parameter	8.52	0.71	-	15.33	0.99	-
Effects of network structure						
Outdegree	**−4.89**	0.19	.000	**−2.96**	0.18	.000
Reciprocity	**3.11**	0.11	.000	**2.18**	0.12	.000
Transitive triplets	**0.70**	0.08	.000	**0.20**	0.08	.016
3-cycles	**−1.09**	0.13	.000	−0.12	0.17	.484
Transitive ties	**1.30**	0.15	.000	**1.25**	0.11	.000
Outdegree popularity (sqrt)	**−0.49**	0.08	.000	**−0.31**	0.10	.003
Effects of covariates						
Gender ego	0.11	0.06	.070	0.04	0.06	.487
Gender alter	0.03	0.05	.553	0.03	0.05	.549
Same gender	**0.32**	0.06	.000	0.09	0.05	.089
Same race/ethnicity	**1.17**	0.07	.000			-
Grade ego	**−0.14**	0.06	.021	−0.08	0.07	.233
Grade alter	**0.19**	0.06	.002	0.11	0.07	.091
Same grade	**0.41**	0.05	.000	**0.35**	0.06	.000
Parent education ego	**−0.07**	0.03	.012			NS
Parent education alter	**0.08**	0.03	.004			NS
Parent education sq. alter	0.01	0.03	.684			NS
Similar parent education	0.20	0.11	.078			NS
Rate limited nominations	**−0.76**	0.31	.013	−0.24	0.54	.664
Limited nominations ego	0.24	0.19	.196	**0.49**	0.24	.040
Effects of marijuana use						
Marijuana use ego	−0.01	0.08	.860	0.10	0.06	.102
Marijuana use alter	−0.19	0.43	.652	**0.49**	0.24	.040
Marijuana use sq. alter	0.14	0.14	.314	0.41	0.31	.195

Model parameter	School 1			School 2		
	P.E.	SE	p value	P.E.	SE	p value
Similar marijuana use	**1.53**	0.52	.003	**1.03**	0.22	.000
Marijuana use dynamics						
Rate	4.32	0.80	-	4.04	0.95	-
Shape effects						
Linear shape	**−1.70**	0.12	.000	**−1.41**	0.14	.000
Quadratic shape	**0.38**	0.04	.000	**0.38**	0.05	.000
Effects of individual covariates						
Male			NS			NS
Grade			NS	**0.35**	0.16	.025
Race/ethnicity			NS			NS
Parent education	**−0.13**	0.06	.035			NS
Effects of friends						
Friends' marijuana use (*influence*)			NS			NS
Friends' marijuana use (*influence*) * Friendship reciprocity	**1.14**	0.52	.028	0.51	0.45	.254

Note. P.E. = parameter estimate. SE = standard error. NS = not statistically significant. Parameters in bold are significant at the $p < .05$ level. All control effects were score tested during the forward model specification, and only effects found to be marginally or statistically significant ($p < .1$) were retained and estimated in the models. Effects listed as non-significant were found to be non-significant predictors in this forward selection process and so were not estimated in the final model.

TABLE 4

Friendship Network and Past Month Marijuana Use Dynamics: Interaction Between Friend Influence and Friend Popularity

Model parameter	School 1			School 2		
	P.E.	SE	*p* value	P.E.	SE	*p* value
Friendship network dynamics						
Rate parameter	8.50	0.63	-	15.45	0.99	-
Effects of network structure						
Outdegree	**−4.92**	0.21	.000	**−3.02**	0.15	.000
Reciprocity	**3.13**	0.13	.000	**2.18**	0.13	.000
Transitive triplets	**0.70**	0.07	.000	**0.21**	0.09	.017
3-cycles	**−1.09**	0.13	.000	−0.12	0.16	.444
Transitive ties	**1.31**	0.13	.000	**1.24**	0.10	.000
Outdegree popularity (sqrt)	**−0.49**	0.08	.000	**−0.29**	0.08	.000
Effects of covariates						
Gender ego	0.11	0.07	.100	0.04	0.06	.526
Gender alter	0.03	0.06	.616	0.03	0.05	.559
Same gender	**0.33**	0.05	.000	0.09	0.05	.090
Same race/ethnicity	**1.17**	0.06	.000			-
Grade ego	**−0.14**	0.07	.035	−0.08	0.07	.250
Grade alter	**0.19**	0.06	.001	0.11	0.06	.078
Same grade	**0.42**	0.05	.000	**0.36**	0.06	.000
Parent education ego	**−0.07**	0.03	.035			NS
Parent education alter	**0.08**	0.03	.004			NS
Parent education sq. alter	0.01	0.03	.638			NS
Similar parent education	0.20	0.11	.078			NS
Rate limited nominations	**−0.78**	0.38	.042	−0.25	0.48	.610
Limited nominations ego	0.25	0.20	.204	**0.50**	0.19	.008
Effects of marijuana use						
Marijuana use ego	−0.01	0.10	.905	0.09	0.06	.103
Marijuana use alter	−0.27	0.65	.684	0.37	0.20	.064
Marijuana use sq. alter	0.16	0.21	.444	−0.09	0.08	.267

Model parameter	School 1			School 2		
	P.E.	SE	*p* value	P.E.	SE	*p* value
Similar marijuana use	**1.49**	0.39	.000	**1.04**	0.29	.000
Marijuana use dynamics						
Rate	4.30	0.48	-	3.89	0.78	-
Shape effects						
Linear shape	**−1.68**	0.11	.000	**−1.27**	0.14	.000
Quadratic shape	**0.38**	0.03	.000	**0.39**	0.05	.000
Effects of individual covariates						
Male			NS			NS
Grade			NS	**0.33**	0.17	.048
Race/ethnicity			NS			NS
Parent education	**−0.15**	0.05	.004			NS
Effect of friends						
Friends' marijuana use *(influence)*			NS			NS
Friends' marijuanause *(influence)* * Friend popularity	0.12	0.09	.189	**0.15**	0.07	.041

Note. P.E. = parameter estimate. SE = standard error. NS = not statistically significant. Parameters in bold are significant. Parameters in bold are significant at the *p* < .05 level. All control effects were score tested during the forward model specification, and only effects found to be marginally or statistically significant (*p* < .1) were retained and estimated in the models. Effects listed as non-significant were found to be non-significant predictors in this forward selection process and so were not estimated in the final model.

TABLE 5

Friendship Network and Past Month Marijuana Use Dynamics: Interaction Between Friend Influence and Difference in Popularity Between Friends

Model parameter	School 1			School 2		
	P.E.	SE	p value	P.E.	SE	p value
Friendship network dynamics						
Rate parameter	8.52	0.51	-	15.41	1.01	-
Effects of network structure						
Outdegree	−4.92	0.54	.000	−3.00	0.16	.000
Reciprocity	3.12	0.29	.000	2.18	0.14	.000
Transitive triplets	0.70	0.16	.000	0.21	0.08	.012
3-cycles	−1.09	0.16	.000	−0.13	0.18	.474
Transitive ties	1.30	0.24	.000	1.24	0.10	.000
Outdegree popularity (sqrt)	−0.49	0.11	.000	−0.29	0.08	.000
Effects of covariates						
Gender ego	0.11	0.06	.065	0.04	0.06	.486
Gender alter	0.03	0.07	.663	0.03	0.06	.606
Same gender	0.33	0.05	.000	0.09	0.05	.080
Same race/ethnicity	1.17	0.10	.000			-
Grade ego	−0.14	0.09	.094	−0.08	0.07	.239
Grade alter	0.19	0.05	.000	0.12	0.06	.075
Same grade	0.42	0.07	.000	0.36	0.05	.000
Parent education ego	−0.07	0.05	.125			NS
Parent education alter	0.08	0.05	.096			NS
Parent education sq. alter	0.01	0.04	.713			NS
Similar parent education	0.19	0.14	.160			NS
Rate limited nominations	−0.76	0.75	.311	−0.25	0.50	.591
Limited nominations ego	0.25	0.41	.539	0.50	0.21	.018
Effects of marijuana use						
Marijuana use ego	−0.02	0.16	.909	0.09	0.05	.049
Marijuana use alter	−0.26	1.63	.873	0.39	0.22	.071
Marijuana use sq. alter	0.16	0.53	.764	−0.10	0.09	.282

Model parameter	School 1			School 2		
	P.E.	SE	p value	P.E.	SE	p value
Similar marijuana use	**1.49**	0.51	.004	**1.02**	0.27	.000
Marijuana use dynamics						
Rate	4.35	0.84	-	4.05	1.01	-
Shape effects						
Linear shape	**−1.58**	0.13	.000	**−1.32**	0.16	.000
Quadratic shape	**0.37**	0.05	.000	**0.39**	0.05	.000
Effects of individual covariates						
Male			NS			NS
Grade			NS	**0.33**	0.16	.035
Race/ethnicity			NS			NS
Parent education	−0.14	0.09	.128			NS
Effect of friends						
Friends' marijuana use (*influence*)	0.85	0.47	.069	0.53	0.33	.109
Friends' marijuanause (*influence*)* Popularity difference	−0.02	0.03	.500	0.01	0.03	.709

Note. P.E. = parameter estimate. SE = standard error. NS = not statistically significant. Parameters in bold are significant. Parameters in bold are significant at the $p < .05$ level. All control effects were score tested during the forward model specification, and only effects found to be marginally or statistically significant ($p < .1$) were retained and estimated in the models. Effects listed as non-significant were found to be non-significant predictors in this forward selection process and so were not estimated in the final model.

The interaction between friend influence on marijuana use, and difference in popularity between friends, was also tested using a dichotomous variable for popularity difference at the 75th percentile (1= greatest difference). The interaction was not significant in school 1, but was statistically significant in school 2 (estimate = 12.89, SE = 4.05, $p = .001$).