Published in final edited form as:
Addict Behav. 2007 December ; 32(12): 3054–3059. doi:10.1016/j.addbeh.2007.04.008.

Adolescent Smoking Networks: The Effects of Influence and Selection on Future Smoking

Jeffrey A. Hall, M.A. and
Annenberg School for Communication, University of Southern California, 3502 Watt Way, Los Angeles, CA 90089, Email: hallj@usc.edu

Thomas W. Valente, PhD
Department of Preventative Medicine, School of Medicine, University of Southern California, 1000 S. Fremont Ave., Building A Room 5133, Alhambra, CA 91803, phone: (626) 457-6678, fax: (626) 457-6699, email: tvalente@usc.edu

Abstract

Peer influence and peer selection have both been linked to the smoking behavior of adolescents. The present investigation uses network methodology to explore the simultaneous effects of both processes on adolescent smoking and smoking susceptibility over two time periods. Results suggest the effects of friendship selection in 6th grade on smoking behavior in 7th grade were primarily direct. Selecting users as friends in 6th grade predicted both smoking and smoking susceptibility in 7th grade, and selecting susceptible users predicted future friendship selection and peer influence. Influence processes were indirectly related to smoking. Smokers' influence in 6th grade predicts the selection of smokers as friends in 7th grade. Smokers' influence also demonstrated a protective effect when ties were not reciprocated. Implications for future research on adolescent smoking are discussed.

Keywords

Tobacco smoking; social influences; middle school students; risk factors; peer pressure; peer relations

Adolescent Smoking Networks: The Effects of Influence and Selection on Future Smoking

(1.1) Over the past few decades, cigarette smoking has become the most preventable cause of mortality and morbidity in the US. The Centers for Disease Control and Prevention estimate that 80% of all adult smokers begin smoking before they are 20 years old, and one of the strongest predictors of tobacco addiction in adulthood is experimentation with smoking during adolescence (Chen, Li, Unger, & Liu, 2003). Peers play an important role in smoking initiation during adolescence. The majority of adolescents report that they were with friends when they smoked their first cigarette (Hahn, Charlin, Sussman, Dent et al., 1990), and the largest meta-

Jeffrey A. Hall, M.A., Annenberg School for Communication, University of Southern California, 3502 Watt Way, Los Angeles, CA 90089, Email: E-mail: hallj@usc.edu All correspondence should be directed to the first author at the above address.

An earlier version of this manuscript was presented at the annual meeting of the International Communication Association, Dresden, Germany, 2006.

analysis of adolescent smoking demonstrated that peer tobacco use was one of the best predictors of tobacco use (Derzon & Lipsey, 1999). Although relationships between adolescents can be a risk factor for smoking, they also can be effective at influencing anti-smoking attitudes (Valente, Hoffman, Ritt-Olson, Lichtman, & Johnson, 2003).

It is important to understand how adolescents' peers affect smoking behaviors, so that smoking can be prevented. Many scholars believe that social influence is an important factor affecting adolescent tobacco use. Others disagree, however, and argue that selection, the tendency of adolescents to choose friends like themselves, accounts for the high correlation between smoking and smoking by one's friends. The relationship between the smoking behaviors of adolescents and their friends is likely to be a consequence of both peer influence and peer selection (Kirke, 2004; Urberg, Degirmencioglu, & Pilgrim, 1997). Adolescents choose their friends because of shared activities and are influenced by them to engage in activities, including smoking (Urberg et al., 1997). One possible way of further clarifying the roles of peers in smoking behavior is through social network analysis.

Social network analysis is a theoretical approach and a set of techniques and methods for data analysis (Monge & Contractor, 2003; Scott, 2000; Wasserman & Faust, 1994). Social network analysis proposes that individuals are influenced by the people with whom they have contact, and, in turn, they influence those to whom the individual is connected (Valente, Gallaher, & Mouttapa, 2004). Social network analysis has been used to study peer influence on smoking behavior for adolescents for over a decade (Chassin, Presson, & Sherman, 1984; Ennett & Bauman, 1993; Ennett, Bauman, & Koch, 1994). Resent research has demonstrated that when half of the members of a student's social network are smokers, the likelihood of smoking is increased two fold (Alexander, Piazza, Mekos, & Valente, 2001). Network analysis offers unique benefits for the study of tobacco use, such as more accurate report of peers' behavior and the possibility of exploring influence and selection processes over time. Social network methodology will help disentangle the relative strength of both selection and influence forces.

Peer Influence and Selection

(2.1) Peer influence has long been an accepted mechanism in smoking behavior, wherein an adolescent is pressured to smoke because of the influence of friends. In contrast to social network analysis, some research on peer influence and smoking does not measure an adolescent's friends' behavior, but instead asks the adolescent to estimate the prevalence of smoking among their friends. When students are asked to estimate friends' smoking attitudes and behaviors, peer influence and selection have emerged as important predictors of smoking (Engles, Knibbe, Drop, & de Haan, 1997; Fisher & Bauman, 1988; Wang, Fitzhugh, Eddy, Fu, & Turner, 1997). Although adolescents are quite likely to overestimate the prevalence of smoking in their social environment (Kobus, 2003), adolescents who perceived more smoking among their friends are at a greater risk of initiating that behavior (Urberg, Cheng, & Shyu, 1991). Although perceived prevalence is an important predictor of smoking attitudes, social network analysis offers the possibility of exploring the effects of selection and influence using peers' self reports, and investigating the relative impact of influence and selection directly rather than through perceptions.

Social network methods have a rich history of exploring the simultaneous effects of influence and selection (Kobus, 2003). Using network data, Ennett and her colleagues (Ennett & Bauman, 1993; Ennett et al., 1994) question the assumption that the reason that smokers are often friends with other smokers is due exclusively to influence. Adolescent clique members who smoke tend to associate with each other, resulting in substantial similarity within cliques. Friendship cliques, therefore, are divided by smoking behavior, where smokers tended to identify other smokers as their friends and non-smokers associated with other non-smokers. Ennett and

Bauman (1993) reasoned that peer selection might be more operative than peer influence because non-smoking cliques might keep smokers from joining, and smokers tend to hang out with other friends who smoke. Aloise-Young, Graham, and Hansen (1994) extended this research when they found that teens are influenced not only by the actions of their existing friends but also by the behavior of their desired friends. When a clique is comprised of mainly smoking members, any non-member who attempts to gain entrance is likely to start smoking. If adolescents choose their friends based upon smoking behaviors, they, too, are likely to smoke, which creates an environment where not smoking or quitting smoking is more difficult (Jones, Schroeder, & Moolchan, 2004).

Longitudinal investigation into selection and influence and smoking has documented these effects over time. Urberg and colleages (1997) considered only friendships that endured over two years to study the effects of peer influence. The smoking behavior of a stable best friend and the behavior of all other friend nominations were compared to the individual's smoking behavior. Close friends, not friendship groups, influence the initiation of smoking – a finding also found in perceived prevalence research (e.g., Wang et al., 1997). This suggests that selection and influence are complementary processes that work to create peer context. Those who have tried cigarettes are more likely than those who have never smoked to know current users. This means if an adolescent has tried smoking s/he may be less apt to reject a friendship with current users than would a student who has never tried smoking. Selection accounts for much of the similarity in substance use between adolescent friends in that smokers may also actively select friendships with currently using peers (Chassin et al., 1984).

Most research on peer selection and influence has used network data from school-based studies, but the complementary effects of selection and influence have been demonstrated in non-school populations as well. Rather than only asking for friendship nominations, Kirke (2004) identified chains of substance use by asking adolescents whether the adolescents had been in the company of their peers when using tobacco. Through analysis of the naturally occurring networks, Kirke (2004) concluded that it “is more appropriate to conclude that similarity in the substance use of adolescents is due to both peer influence and selection” rather than one or the other (p. 25). For every pair of tobacco users, peer influence is occurring for both members – smokers influence each other. In maintaining these friendship links, each member of a dyad chooses to continue that relationship and in doing so they mutually encourage each other's substance use. These findings suggest that smoking behavior is a case of mutual causality; the actions of one person influences the actions of other friends in the network, which in turn reinforce the actions of the focal individual.

Social Network Measures

(3.1) Social network data are particularly useful for modeling health behaviors in a school context, especially when group composition data are needed (Valente et al., 2004). Studies have examined the position of a student in a classroom network and smoking behavior (Ennett & Bauman, 1993), the density and centrality of smokers, (Valente et al., 2004), and the use of adolescent leadership nominations to determine peer leaders in anti-smoking classroom activities (Valente et al., 2003). Two measures of network centrality are often used to represent the relative impact of influence and selection: out-degree nomination and in-degree nomination. In a school context, out-degree refers to the number of friends a student nominates. In-degree is the number of friendship nominations a student receives. Through social network analysis both the in- and out-degree of all students can be calculated. In addition, the smoking behaviors of the focal student, and the smoking behaviors of his/her friends can be determined. Both of these measures have been strongly linked to smoking in past research.

In-degree nominations function as peer influence because a student cannot choose to be selected by others. Adolescents are particularly concerned with being part of a social group, and adolescent groups often define themselves by smoking and non-smoking (Aloise-Young et al., 1994; Nichter, Nichter, Vuckovic, Quintero, & Ritenbagh, 1997). An increasing proportion of in-degree from intending smokers creates a climate where smoking is more acceptable and even desirable (Chassin et al., 1984; Ennett & Bauman, 1993). Once a student starts smoking with friends, smoking reinforces that friendship and the smoking behavior itself (Kirke, 2004). Therefore, peers influence both the initiation of smoking and the maintenance of it.

Methods

(4.1) Procedures

Parental and student consent was obtained through the use of consent forms sent home with students, and through students individually consenting to participate. Students completed a 160-item paper-and-pencil survey in their classrooms during a single class period (45-50 minutes), which provided demographic, ethnic, and psycho-social data. Trained data collectors, who were not previously acquainted with students, distributed and collected the surveys. Surveys were only identified by code number, not with the students' names or any identifying information. This procedure was duplicated a year later in participating schools.

(4.2) Participants

The principals of schools that participated in the first year of data collection were given the option of participating in the following year. Some schools elected to participate in the follow up year and others did not. The decision to remain in the study was not an individual respondent one, rather made by the school principal. The participants for the present research were selected out of the initial data set based upon a number of criteria: availability of smoking data from 6^{th} and 7^{th} grade, and network data from 6^{th} and 7^{th} grade. Network data was collected at the classroom level, and six schools had elected to collect network data for both years. Sixty-one classrooms from six different schools were included in the final analysis (N = 880).

Network data were collected by asking students to nominate their five best friends. This collection method has two limitations. The first is that students may have more than five best friends. However, in other school-based research, (i.e., Urberg et al, 1997), average number of nominations was between 4 to 5 even when 10 were allowed. Nominating more than five friends would also allow participants to write down the names of fellow students who were merely acquaintances rather than real friends (Aloise-Young et al., 1994). The second limitation that cannot be overcome was that all network data is confined to the boundaries of the classroom, so a complete network for the school could not be created from this sampling technique. Network analyses were conducted on all students from both years, to ensure that data on the proportion of in- and out-degree that are smokers was as complete as possible.

The students in this analysis were 53.8% female, the average age was 12.2 years, and students were 38% Latino, 23% Asian-American, 2% African-American, 20% Caucasian, and 17% other.

(4.3) Measures

From social network data, the number of friendship nominations (in-degree) were identified for every student as well as the number of friends nominated (out-degree). Smokers were identified as a student who had tried smoking, even one puff, which is consistent with other tobacco research (i.e., Chen et al., 2003). Students were identified as susceptible smokers when they refused to indicate they would not smoke over the next year (Pierce, Choi, Gilpin, Farkas,

& Merritt, 1996). The proportion of in- and out- degree choices was used rather than the absolute number of nominations made and received to control for classroom size. For each class, the proportion of in-degree who smoke (i.e., smokers' influence) was calculated by dividing total nominations from smokers by total nominations (see Figure 1). For each class, the proportion of smokers chosen (selecting users) was calculated by dividing total nominations to smokers by total out-degree nominations (see Figure 2). In addition, the proportion of in- and out-degrees to students who are susceptible to smoke in the future was also calculated. Variables for both years were created using the same procedures.

Past smoking behavior is a consistent predictor of future smoking (Derzon & Lipsey, 1999). Smokers were identified as a student who had tried smoking, even one puff. Smoking susceptibility is also a strong predictor of future smoking behavior (Tyc, Hadley, Allen, Varnell et al., 2004), and was also included in network influence and selection measures.

Results

(5.1) The data were analyzed twice, first estimating odds ratios in STATA and second using structural equations modeling in LISREL. Sixth grade network measures and smoking behavior were used to predict network measures and smoking behavior in 7th grade, controlling for gender, age, ethnicity, having a parent foreign born, a parent graduated from college, socio-economic status estimated by the number of rooms in the house, and within school co-variation (Table 1). We reported adjusted odds ratios (AOR) for relationships of interest. Results indicate that being selected by smokers predicts selecting smokers in 7th grade (AOR = 21.66, $p < .05$). The relationship between susceptible smokers' influence in 6th grade and selecting smokers in 7th grade approached significance (AOR = 2.78, $p < .10$), as did the relationship between susceptible smokers influence in 6th grade and selecting users in 7th grade (AOR = 3.19, $p < .10$).

Network measures from 6th grade were used to estimate smoking and smoking susceptibility at 7th grade, controlling for the covariates specified above. Table 2 shows that smoking in 7th grade was positively predicted by selecting users in 6th grade (AOR = 27.05, $p < .05$) and susceptible smokers influence in 6th grade (AOR = 4.20, $p < .05$), but was negatively predicted by smoker's influence (AOR = 0.03, $p < .05$). Smoking in 6th grade predicted smoking in 7th grade (AOR = 19.23, $p < .01$). Smoking susceptibility in 7th grade was predicted by selecting users in 6th grade (AOR = 20.27, $p < .05$), but negatively predicted by smoker's influence in 6th grade (AOR = .02, $p < .01$).

Finally, network measures from 7th grade were used to estimate smoking behaviors in 7th grade, controlling for the covariates (Table 3). Susceptible smokers' influence predicted intent to smoke (AOR = 3.31, $p < .01$). None of the 7th grade network measures predicted smoking in 7th grade.

(5.2.1) Structural Equations Modeling

The data were imported into LISREL 8.7 and missing data were imputed using multiple imputation. To be conservative in data analysis, a covariance matrix was calculated used in all structural equations calculations (Byrne, 1998) (Table 4). All year one variables, with the exception of smoking susceptibility were considered exogenous variables, and all year two variables were considered endogenous variables. The paths found to be significant in the logistic regression analyses were estimated in the theoretic model and two additional paths were added to test relationships between 7th grade variables. Specifically, smokers' influence was allowed to predict susceptible smokers' influence, and selecting users was allowed to predict selecting susceptible users. The results indicate that the theoretic model was significant ($\chi^2 = 258.20$, $df = 40$, $p < .01$), which means that the data do not fit the model well. The

theoretical model was a significant improvement from the null model (χ^2 = 1983.9, *df* = 55). Tests of the global model suggest that the model fit is adequate (CFI = .86, GFI = .95, RMSEA = 0.0079).

Examining the local level relationships of the initial model reveals that most of the paths identified by the AOR estimates were also significant in the path model. Smokers' influence in 6th grade predicted selecting users in 7th grade (β = .15). Selecting susceptible users in 6th grade predicted selecting users in 7th grade (β = .09). The relationships between 6th grade network measures and smoking and smoking susceptibility were also supported. Selecting users in 6th grade predicted smoking susceptibility in 7th grade (β = .22) and marginally predicted smoking in 7th grade (β = .12). Smokers' influence in the 6th grade negatively predicted smoking susceptibility (β = -.39) and the path between smokers' influence in 6th grade and smoking in 7th grade was marginally negative (β = -.24). Finally, smoking in 6th grade predicted susceptibility to smoke in 6th grade (β = .39) and smoking in 7th grade (β = .27).

Susceptible smokers' influence failed to predict both smoking in 7th grade. Susceptible smokers' influence in 6th grade failed to predict selecting susceptible smokers in 7th grade, but this path was only marginally significant in the AOR analyses.

The relationships between 7th grade network measures and smoking behaviors were strongly supported. Smokers' influence strongly predicted susceptible smokers' influence in 7th grade (β = .53). Selecting users strongly predicted selecting susceptible users in 7th grade (β = .37). In addition, the selecting susceptible smokers predicted smoking in 7th grade (β = .25). Susceptible smokers' influence predicted smoking susceptibility in 7th grade (β = .13). Smokers' influence in 7th grade strongly predicted susceptible smokers' influence in 7th grade (β = .53), and selecting users in 7th grade strongly predicted selecting susceptible users in 7th grade (β = .37). The intent to smoke in 7th grade was predicted by smoking in 7th grade (β = .41). Smoking susceptibility in 6th grade failed to predict smoking in 7th grade.

(5.2.2.) Post Hoc Analysis

The model was modified in two steps in the post hoc analysis. In the interest of creating a more parsimonious model and removing irrelevant paths, three non-significant paths were deleted: Susceptible smokers' influence in 6th grade and 7th grade smoking; susceptible smokers' influence in 6th grade and selecting susceptible smokers in 7th grade; smoking susceptibility in 6th grade and smoking in 7th grade. Although the deletion of these paths increased the χ^2 value slightly as expected, the increase was not significant (χ^2_{diff} = 1.45, *df* = 3, *p* = *n.s.*). The goodness-of-fit of the model was not changed substantially by deleting the non-significant path (CFI = .87, GFI = .96, RMSEA = 0.0076).

Next, two new paths were added to the model. As guided by the modification indices produced from analysis of the parsimonious model, the following beta path was added: selecting users in 7th grade to smokers' influence in 7th grade was added. This path demonstrates that nominating smokers predicts being nominated by smokers, a finding supported by past data on the reciprocity of smoking ties (Kirke, 2004). The model resulting from the addition of this path yielded a significant decrease in χ^2 (χ^2_{diff} = 89.45, *df* = 1, *p* < .01). The new path was also significant (β = .37), and did not change the significance levels of other paths. The goodness-of-fit of the model showed some improvement by adding this path, and the overall model fit was adequate (GFI = .97, CFI = .92, RMSEA = .059). Second, susceptible smokers' influence in 6th grade predicted smoking susceptibility in 6th grade was added. No 6th grade network indicators were allowed to predict 6th grade susceptibility in the theoretic model. This path demonstrates that being selected by those who intend to smoke increases the chances of the individual intending to smoke. The model resulting from the addition of this path yielded a significant decrease in χ^2 (χ^2_{diff} = 22.73, *df* = 1, *p* < .01). The new path was also significant

(β = .29), and did not change the significance levels of other paths. The goodness-of-fit of the model showed some improvement by adding this path, and the overall model fit was adequate (GFI = .97, CFI = .94, RMSEA = .055). Byrne (1998) cautions researchers against over-fitting. The modification indices recommended the addition of paths that would further demonstrate the reciprocity of smokers' influence and selecting users in 7th grade. Although the fit of the model may increase, these paths do not offer much theoretical benefit. Therefore, the model was not revised further.

The theoretic model was changed by deleting three non-significant paths, and adding two paths recommended by the modification indices, resulting in the final model (Figure 3). The final goodness-of-fit statistics suggest an adequate fit to the data. Although the final model was still significant (χ^2 = 155.60, *df* = 41, $p < .01$), it was below the recommended 5 χ^2/df ratio (χ^2/df = 3.8) (Wheaton, Muthen, Alwin, & Summers, 1977).

Discussion

(6.1) The present investigation sought to explore the role of peer influence and selection in smoking behavior over two time periods. In 6th grade, selection processes appeared to have a direct impact on future smoking and intent to smoke, while influence processes tended to shape 7th grade peer environment, which indirectly affected smoking susceptibility. These results reinforce prior research (e.g., Kirke, 2004; Urberg et al., 1997) that points to the complimentary roles of selection and influence, and point to the importance of exploring peer processes through a longitudinal design. Peers impact both immediate and future smoking behavior and influence the development of friendship networks.

The major goal of this study was to examine the relative impact of peer influence and selection on smoking behavior and on the composition of a friendship environment. The sociometric data utilized in the present research parceled out the relative predictive value of selection and influence over two time periods. By mapping adolescents' social environments in 6th and 7th grades and employing structural equations modeling to investigate the simultaneous effects of influence and selection, the present research suggests that influence appears to be a process that affects the composition of peer networks, while selection of users as friends more directly impacts tobacco use. The present results confirm Alexander and colleagues' (2001) findings that the proportion of network members who are smokers or susceptible smokers are important predictors of adolescent behavior, and further demonstrates the benefits of network methodology in unpacking the relative impact of selection and influence over time.

Selecting users as friends in 6th grade predicted both smoking and smoking susceptibility in 7th grade, controlling for smoking in 6th grade. These results confirm other research on adolescent smoking that suggests that peer smoking precedes smoking initiation (Chassin et al, 1984; Fisher & Bauman, 1988; Urberg et al., 1997). Choosing smokers as friends appears to have a direct and strong effect on future smoking behavior and future susceptibility to smoke. Peer influence from smokers in 6th grade, however, negatively predicted 7th grade smoking and smoking susceptibility. These findings may be a function of reciprocity.

Reciprocity effects can be estimated with network data because the researcher has access to the self-report data of the student and the friends they nominate and those that nominate them. Ties from other students, or in-degrees, are often mutual. That is, they are reciprocated by an out-degree nomination. The path model suggests that selecting users as friends predicts being selected by users. Although in-degrees from smokers are positively correlated with smoking, once out-degree nominations are controlled for, only the non-reciprocated ties remain. This suggests that non-reciprocated in-degree nominations from smokers are protective, indicating that non-smokers do not want to be influenced by these peers. If a non-smoking adolescent

chooses not to reciprocate a friendship from a smoker, s/he decreases her/his chances of smoking by keeping his/her friendship environment undiluted by smokers' influence. These findings help to clarify why members of a reciprocal friendship often have the same smoking behaviors (Aloise-Young et al., 1994). Rejecting ties from those with dissimilar smoking behaviors maintains the smoking environment wherein an adolescent behaves.

However, in-degree nominations can increase the chance of future smoking indirectly. Specifically, smokers' influence in 6th grade predicts the selection of smokers in 7th grade, controlling for selection of users in 6th grade. Although non-reciprocated nominations from smokers in 6th grade can have a protective effect on smoking behavior in 7th grade, over the long-term, being nominated by smokers may increase the chances of future smoking behavior through the future friendship environment. As Aloise-Young and colleagues (1994) point out, new friendships are as influential as old ones. Our results suggest that if smoking students pick a 6th grader to be their friend, by 7th grade s/he is likely to choose more smokers as friends. It is possible that reciprocating friendship ties from 7th graders may lead to future smoking, as 6th grade selection leads to 7th grade smoking, but these data are not available in the present investigation. Our findings suggest that while both selection and influence are operative, the impact of both processes is dependent on the students' grade level and prior network environment.

(6.2) The final SEM model helps to illustrate our findings. As prior research has demonstrated, (e.g., Derzon & Lipsey, 1999), past smoking behavior is a consistent and strong predictor of future smoking and future susceptibility to smoking. Path modeling also offers a clear representation of direct and indirect effect of selection and influence. Being selected by users in 6th grade strongly predicts nominating users and susceptible users in 7th grade. Note that this can also be a protective function: students who are surrounded by non-smoking peers, are likely to continue to have non-smokers as friends in the future. However, being selected by smoking peers in 6th grade increases the chance of reciprocating and continuing to receive those nominations from smokers and susceptible smokers in 7th grade.

Selection of smokers and susceptible smokers increases the chances of smoking and intending to smoke. The reduced form of the path models suggest that while selecting users directly impacts smoking, selecting susceptible users directly relates to smoking and creates a peer environment that affects future smoking behavior. Why does selecting friends who are susceptible to smoking have such a strong effect? Smoking susceptibility represents a desire to start smoking. Other research demonstrates that attitudes toward future smoking are reinforced within a group of friends, linking friendship to anticipated behavior (Jones et al., 2004; Unger & Chen, 1999). The present findings suggest that selecting smokers as friends precedes smoking behavior and future intent to smoke. In addition to impacting future smoking behaviors and susceptibility, selecting those who intend to smoke reinforces smoking behavior both through reciprocation of friendship and by behavior change.

(6.1) Limitations and Directions

The most important limitation to this project is its reliance on classroom level network data. This simply does not account for students whose best friends are outside the class. Despite this limitation, our findings confirm other research on selection and influence in a natural setting (Kirke, 2004). These findings also reflect the importance of exploring the relative affects of influence and selection at different points in the development of adolescents.

In the present research the reciprocity of friendship nominations appeared to play a considerable role on smoking behavior. Future research might explore whether non-reciprocated ties from smokers can play a protective function, as our results suggest. If so, health practitioners may be well advised to continue to pursue interventions that focus on

refusal of tobacco and refusal of relationships from tobacco users. In addition, future research might develop the model of smoking influence and selection processes over three or more time periods. Fisher and Bauman (1988) cautioned the predictive value of peer influence and selection depends upon the grade and age of the student. Results suggest that selection of users in 6th grade precedes smoking in 7th grade, and that being selected by smokers in 6th grade leads to increasing the proportion of smokers chosen as friends in 7th grade. It is possible that reciprocating friendship ties from smoking 7th graders may lead to 8th grade smoking, but these data are not available in the present investigation. Future research might explore whether this model – from peer influence to peer selection to smoking – can be demonstrated consistently over time. If so, the protective effect of being selected by smokers may be time dependent. That is, non-reciprocated ties can be protective at one time period, but if they persist, they may result in an increased chance of selecting smokers in the future, which in turn could eventually result in tobacco use. Selection and influence are both important processes, but when and how they impact smoking will require further investigation.

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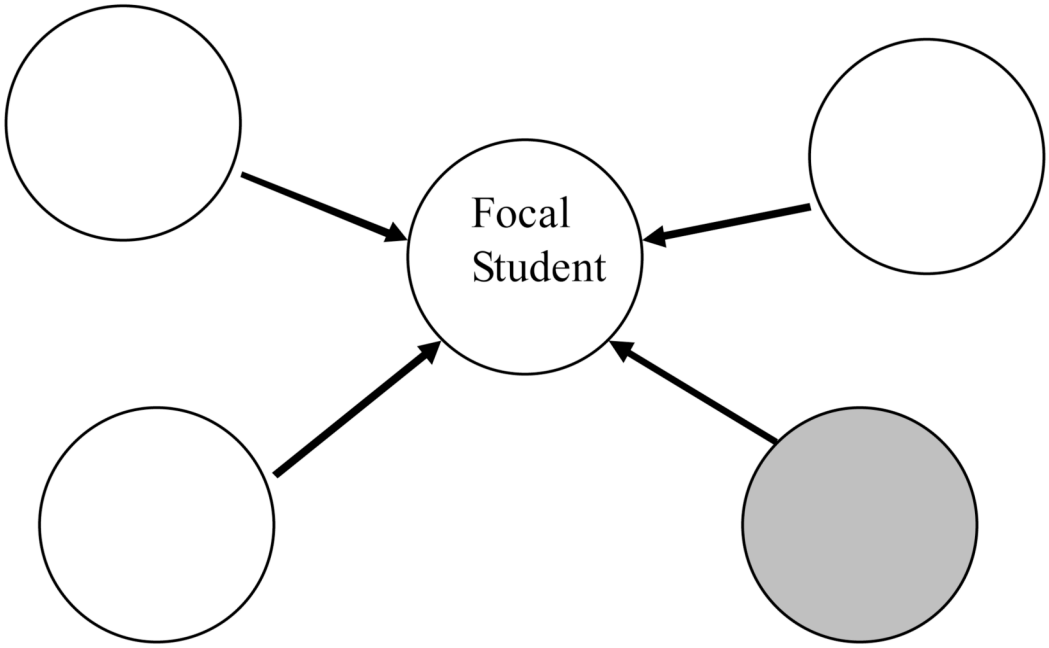

Figure 1.
Smokers' Influence If the focal student is chosen by four other students as a friend, and one of those students are smokers and three are not, then this student's proportion in-degree from smokers (smokers' influence) is .25.

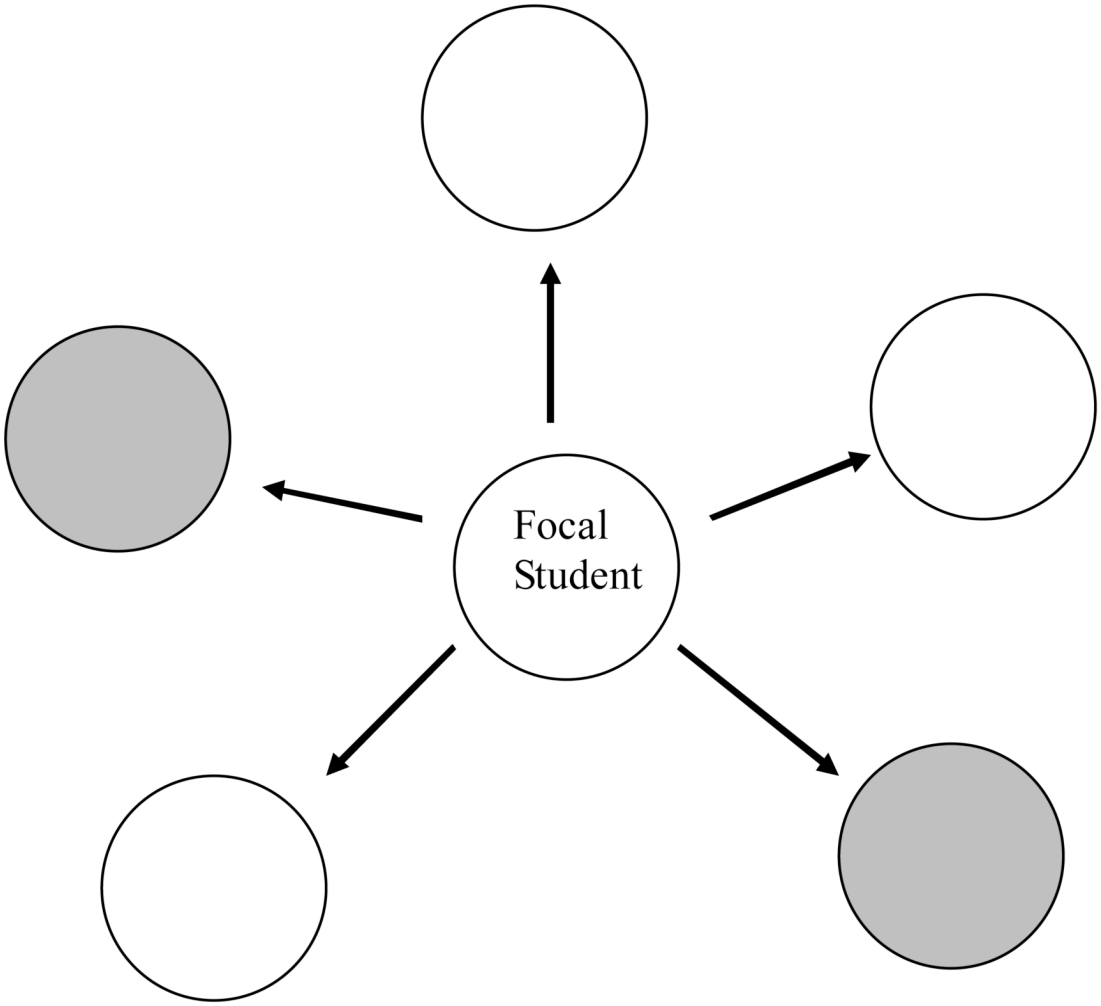

Figure 2.
Selecting Users If the focal student chooses five friends, and two of those friends are smokers and three are not, then this student's proportion out-degree to smokers (selecting users) is .40.

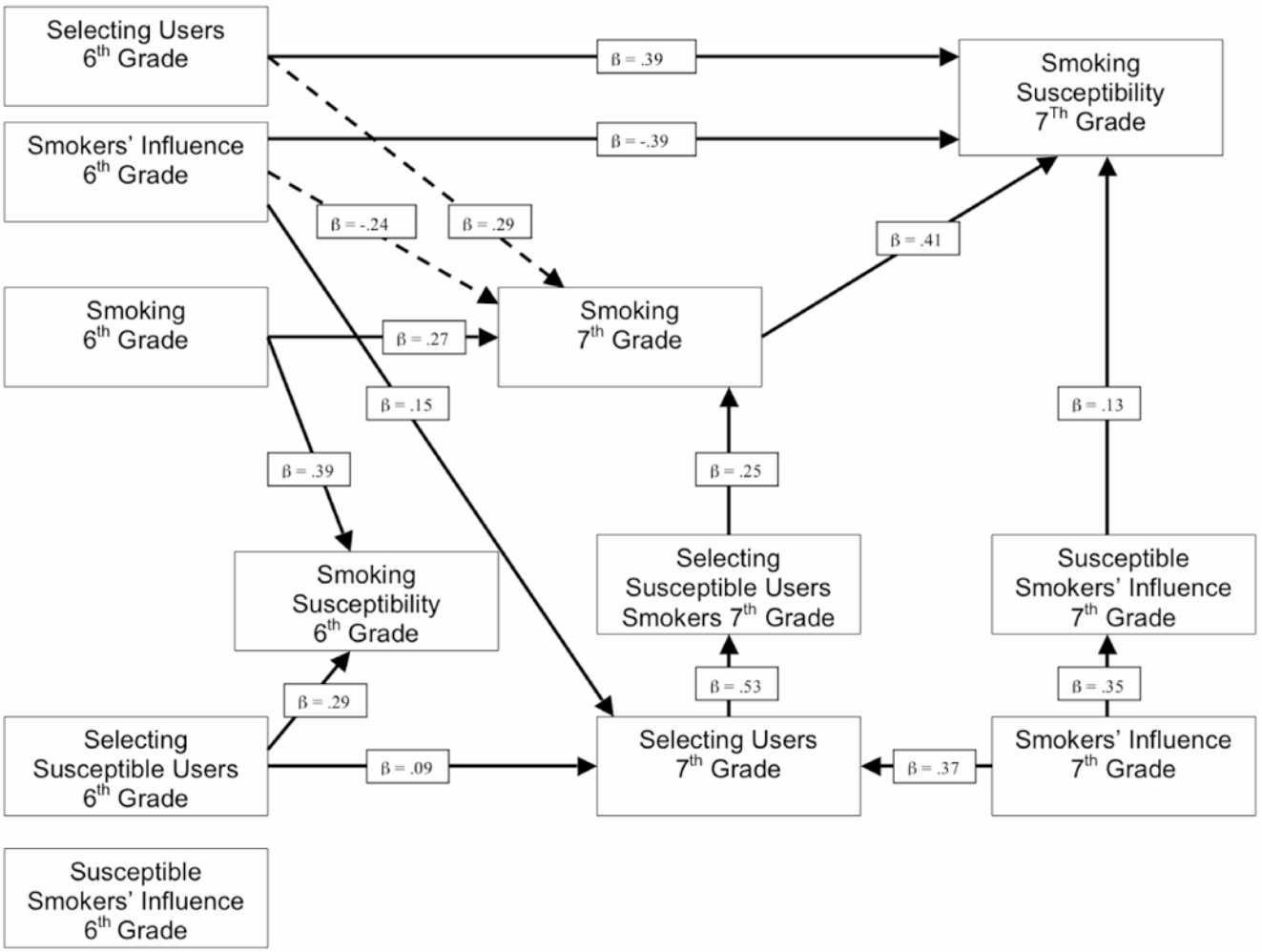

Figure 3.
Final SEM Model. Marginally significant pasts dashed.

Table 1

Adjusted Odds Ratio Estimates for Year 1 Network Measures on Year 2 Network Measures

	Year 2 Network Measures							
	Smokers' Influence		Susceptible Smokers' Influence		Selecting Users		Selecting Susceptible Users	
Year 1 Network Measures	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**	**AOR**	**95% CI**
Smokers' Influence	1.81	(.23-194.74)	3.43	(.45-25.90)	21.66*	(1.14-412.)	3.99	(.19-84.16)
Susceptible Smokers' Influence	1.24	(.38-4.01)	.63	(.20-1.96)	1.13	(.44-2.89)	2.78+	(.91-8.45)
Selecting Users	1.81	(.17-19.90)	.97	(.08-12.29)	.62	(.00-85.25)	9.83	(.61-157.6)
Selecting Susceptible Users	.66	(.07-6.16)	1.23	(.31-4.84)	3.19+	(.85-12.09)	.40	(.08-1.89)
N	635		631		548		549	

Note: + $p < .10$,

* $p < .05$,

** $p < .01$.

AOR results reported controlling for gender, age, ethnicity, having a parent foreign born, a parent graduated from college, socio-economic status estimated by the number of rooms in the house, and within school co-variation.

Table 2

Adjusted Odds Ratio Estimates for Year 1 Network Measures on Year 2 Smoking Behaviors

	Year 2 Smoking Measures			
	Smoking		Intent to Smoke	
Year 2 Network Measures	**AOR**	**95% CI**	**AOR**	**95% CI**
Smokers' Influence	.03**	(.01-.05)	.02**	(.00-.17)
Susceptible Smokers' Influence	4.20*	(1.08-16.38)	.80	(.34-1.89)
Selecting Users	27.05*	(4.53-161.40)	20.27**	(11.16-36.82)
Selecting Susceptible Users	.51	(.09-2.89)	1.24	(.72-2.13)
Intent to Smoke	--	--	1.80	(1.43-2.27)
Smoke	19.23**	(5.75-64.30)	--	--
	587		702	

Note: + $p < .10$,

* $p < .05$,

** $p < .01$.

AOR results reported controlling for gender, age, ethnicity, having a parent foreign born, a parent graduated from college, socio-economic status estimated by the number of rooms in the house, and within school co-variation

Table 3

Adjusted Odds Ratio Estimates for Year 1 Network Measures on Year 2 Smoking Behaviors

	Year 2 Smoking Measures			
	Smoking		Intent to Smoke	
Year 1 Network Measures	**AOR**	**95% CI**	**AOR**	**95% CI**
Smokers' Influence	1.98	(.14-28.72)	.75	(.12-4.72)
Susceptible Smokers' Influence	.32	(.08-1.31)	3.31**	(1.95-5.62)
Selecting Users	.48	(.19-1.19)	.10	(.00-1.88)
Selecting Susceptible Users	12.73	(.55-292.64)+	.80	(.22-2.90)
Intent to Smoke Year 1	--	--	.68	(.45-1.67)
Smoke Year 1	8.51**	(1.85-39.25)	--	--
	451		537	

Note: + $p < .10$,

* $p < .05$,

** $p < .01$.

AOR results reported controlling for gender, age, ethnicity, having a parent foreign born, a parent graduated from college, socio-economic status estimated by the number of rooms in the house, and within school co-variation

Table 4

Covariance Matrix

–												
Susceptible Smokers' Influence 6th	.03											
Smokers' Influence 6th	.02	.03										
Selecting Susceptible Users 6th	.01	.01	.02									
Selecting Users 6th	.01	.01	.01	.03								
Intent to Smoke 6th	.00	.00	.00	.00	.15							
Smoking 6th	.00	.00	.01	.00	.06	.13						
Susceptible Smokers' Influence 7th	.00	.00	.00	.00	.00	.00	.06					
Smokers' Influence 7th	.00	.00	.00	.00	-.00	.00	.01	.01				
Selecting Susceptible Users 7th	.00	.00	.00	.01	.01	.00	.03	.00	.05			
Selecting Users 7th	.00	.00	.00	.00	.00	.00	.00	.01	.00	.01		
Intent to Smoke 7th	-.00	-.01	.00	.00	.01	.01	.02	-.00	.02	.00	.19	
Smoking 7th	-.00	-.00	.00	.00	.01	.02	.00	.00	.00	.00	.02	.06