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Adolescent Smoking Networks:

The Effects of Influence and Selection on Future Smoking

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Abstract

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Peer influence and peer selection have both been linked to the smoking behavior of adolescents.

The present investigation uses social network analysis 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 smokers as friends in 6th grade predicted both smoking and

smoking susceptibility in 7th grade, and selecting susceptibles 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.

Key Words: Tobacco smoking; social influences; middle school students; risk factors; peer

pressure; peer relations

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(1.1) Peers play an important role in smoking initiation during adolescence. The majority of adolescents were with friends when they smoked their first cigarette (Hahn, Charlin, Sussman, Dent et al., 1990), and peer tobacco use is one of the best predictors of adolescent tobacco use (Derzon & Lipsey, 1999; Alexander, Piazza, Mekos, & Valente, 2001). Selection and influence are complementary processes that create peer context, which can encourage or deter tobacco use (Kirke, 2004; Urberg, Degirmencioglu, & Pilgrim, 1997). Smoking behavior is a case of mutual causality; the actions of one person influence the actions of others, which in turn reinforce the actions of the focal individual (Chassin, Presson, & Sherman, 1984). Social network analysis (SNA) is a theoretical approach and a set of techniques and methods for data analysis (Wasserman & Faust, 1994). The present study uses SNA, regression analysis and structural equations modeling to evaluate the relative strength of selection and influence on adolescent smoking over two time periods.

Methods

(2.1) Procedures & Participants. 1,960 adolescent students completed a 160-item survey in their classrooms, which provided demographic, tobacco use, and psycho-social data. This procedure was duplicated one year later in six participating schools with 61 classrooms ($N = 880$). The students in this analysis were 53.8% female, 12.2 years of age, and were 38% Latino, 23% Asian-American, 2% African-American, 20% Caucasian, and 17% other.

(2.2) Measures. Network data were collected by asking students to nominate their five best friends in the classroom. Two measures of network centrality were used to represent the impact of influence and selection: out-degree represents peer selection (the number of friends a student nominates) and in-degree represents peer influence (the number of friendship

nominations a student receives) (Valente, 1995). Smokers were identified as a student who had tried smoking, even one puff. 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 nominations was used rather than the absolute number of nominations made and received to control for classroom size. For each student, smokers' influence was calculated by dividing total nominations from smokers by total nominations received and selecting smokers was calculated by dividing total nominations to smokers by total nominations sent (see Figures 1). Similarly, the proportion of in- and out-degrees to students who are susceptible to smoke was calculated. Construction of degree-weighted network exposure variables correspond to influence and susceptibility measures in network diffusion models (Valente, 2005).

Results

(3.1) 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). Adjusted odds ratios (AOR) are reported. Results indicate that smokers' influence in 6th grade predicts selecting smokers in 7th grade (AOR = 21.66, $p < .05$).

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 smokers in 6th grade (AOR = 27.05, $p < .05$) and selecting susceptible smokers 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 smokers 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. Susceptible smokers' influence predicted intent to smoke (AOR = 3.31, $p < .01$).

(3.2.1) Structural Equations Modeling

The data were imported into LISREL 8.7 and missing data were imputed using multiple imputation. 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 and two additional paths were added to test relationships between 7th grade variables: smokers' influence predicted susceptible smokers' influence, and selecting users predicted selecting susceptible users.

(3.2.2) Post Hoc Analysis

The model was modified in two steps in the post hoc analysis. 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. Two new paths were added to the model, as guided by the modification indices: selecting smokers in 7th grade to smokers' influence in 7th grade and susceptible smokers' influence in 6th grade to smoking susceptibility in 6th grade. The model resulting from the addition of these paths yielded a significant decrease in χ^2 ($\chi^2_{diff} = 111.73$, $df = 2$, $p < .001$), the new paths were significant. The goodness-of-fit of the model

improved by adding these paths, and the overall model fit was good (GFI = .97, CFI = .94, RMSEA = .055). The model was not revised further, resulting in the final model (Figure 2).

Discussion

(4.1) The present study explored the role of peer influence and selection in adolescent smoking behavior over two time periods. This study demonstrates the benefits of SNA in unpacking the relative impact of selection and influence, and the importance of exploring peer processes through a longitudinal design. Results indicate that peers impact both immediate and future smoking behavior and influence the development of friendship networks. In 6th grade, selection processes (nominating smokers as friends) predicted future smoking and susceptibility to smoke, controlling for smoking in 6th grade. Results confirm other research on adolescent smoking that suggests that peer smoking precedes smoking initiation (Chassin et al., 1984; Urberg et al., 1997). Sixth grade peer influence processes (being nominated by smokers) shaped 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.

One unexpected finding suggests that smokers' influence in 6th grade 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 him/her. In-degree ties from other students are often mutual; they are often reciprocated by an out-degree nomination. Although in-degrees from smokers are positively correlated with smoking, once out-degree nominations are controlled for, only the non-reciprocated ties remain. Non-reciprocated in-degree nominations from smokers are protective, indicating that non-

smokers do not want to be influenced by these peers. When a non-smoking adolescent chooses not to reciprocate a friendship tie from a smoker, results indicate the student decreases her/his chances of smoking by keeping her/his friendship environment undiluted by smokers' influence.

Over the long-term, however, nominations received from smokers can increase the chance of future smoking indirectly through the future friendship environment. Specifically, smokers' influence in 6th grade predicts the selection of smokers in 7th grade. If a student is picked by smokers to be their friend in 6th grade, by 7th grade that student is likely to choose more smokers as friends. Future research might explore whether this model – from peer influence to peer selection to smoking – can be demonstrated consistently over multiple time periods. 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, may result in an increased chance of selecting smokers in the future, which could result in tobacco use.

(4.2) The final SEM model helps to illustrate our findings. The reduced form of the path models suggest that while selecting users directly impacts smoking, selecting susceptible users 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, Schroeder, & Moolchan, 2004). The present findings suggest that selecting susceptible smokers as friends precedes smoking behavior and future intent to smoke.

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