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A Comparison of Peer Influence Measures as Predictors of Smoking among Predominately Hispanic/Latino High School Adolescents

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Abstract

Purpose—Consistent evidence has shown that one of the most significant influences on adolescent smoking is peer influence. There is considerable variation, however, in how peer influence is measured. This study constructs social network influence and selection variables from egocentric and sociometric data to compare their associations with smoking with considerations of perceived smoking norms and adolescent popularity.

Methods—Longitudinal data were collected in 9th and 10th grades in October 2006 and 2007 from predominantly Hispanic/Latino adolescents in seven southern California schools among which 1,950 adolescents completed surveys at both waves. Both cross-sectional (separately for 9th and 10th graders) and longitudinal models were estimated.

Results—An ego-centric measure of perceived friend smoking was strongly and consistently associated with individual smoking (AOR 1.80, $p < 0.001$) whereas its sociometric counterpart of friend self-report smoking was only associated with smoking in 9th grade cross-sectional models (e.g., AOR=1.56, $p < 0.001$) and rarely in longitudinal models. Popularity, measured by proportion of nominations received by class size, was associated with smoking and becoming a smoker (AOR=1.67, $p < 0.001$) whereas perceived norms was not in longitudinal models. Friend selection was also associated with becoming a smoker (AOR=1.32, $p = 0.05$).

Conclusions—This study illustrates the utility of ego-centric data for understanding peer influence and underscores the importance of perceptions and popularity as mechanisms that influence adolescent smoking.

Keywords

social network analysis; peer influence; smoking; perceived smoking; smoking norms; friends

In spite of recent declines in smoking, it is still a leading cause of morbidity and mortality in the US and globally. Although many factors are associated with adolescent smoking, peer influence has been identified as a strong correlate, and perhaps cause of smoking initiation [1–6]. Research has sought to disentangle this peer influence primarily by distinguishing between adolescents' perceptions of their peers' smoking and their friends' actual self-reported smoking [7–9]; and by distinguishing between peer influence and peer selection [10–19]. Currently, there is no consensus as to which is the stronger correlate (or cause) of adolescent smoking; both influence and selection seem to operate.

Peer influence and selection are contextual, often dependent on the norms in the community, school or environment in which peers socialize [20]. Whether adolescent friendship networks influence behavior often depends on the norms within the group or community, and on the perception of these norms (whether accurate or not [21]). Perceived norms have been shown to be highly correlated with tobacco and other substance use, yet in most cases norms are measured in the absence of network analytic approaches which provide better measurement for the source of those perceptions. Although most researchers agree that peer influences and norms are important influences on adolescent smoking and other substance use [14, 22], there is considerable variation in how peer influences and norms are assessed [23]. For instance, peer influences have been measured based on adolescent's perception of friends' behavior [14, 24, 25]; or friends' report of their behavior [6, 19, 26–28]. Peer influence has also been measured based on friendship nominations from smokers [6, 13].

This study operationalizes peer influence using both ego-centric and sociometric measure social network analysis (SNA) methodology [18, 29]. The ego-centric network measure of peer influence is derived from asking respondents to name their friends (either full names or aliases) and then asking them to indicate which ones smoke (perceived friend smoking). Two variables are then constructed from this information: A count and a proportion. The sociometric network measure of peer influence is derived from asking respondents to name their friends and then using those friends' self-reports of smoking (friend self-report smoking). There variables are then constructed from this information: A count, a proportion, and a count of smokers who nominated the respondent (friend indegree self-report count). Note that the former two sociometric measures are based on outgoing friendship nominations while the third is based on incoming friendship nominations made to the respondent.

The various measures of peer norms and peer influence are designed to measure the extent to which an adolescent is embedded in a social context supportive of a particular behavior though they differ in their conceptualization of the context (the whole school versus the immediate peer group) and differ on whether they measure perceptions or the self-reports of friends' behaviors (ego-centric versus sociometric). We also include a measure of popularity calculated as the number of times each respondent was named as a friend divided by class size to determine if popularity effects are attenuated by peer influence measures. In sum, this study compares how different operationalizations of peer norms and peer influence are associated with smoking behavior

In addition to being influenced by their peers, adolescents often select friendships based on a desire to be with others that are like themselves. Specifically, smokers may select smoking friends [11, 30, 31]. In this study, selection occurs when new ties form between school years and the respondent changed his/her smoking status to match that of the new friend's. The analysis also controls for many background characteristics associated with smoking such as ethnicity, sex, age, and socio-economic status [32–35]. The significance of this study is, unlike other studies, it compares egocentric network measures (perceived friend behavior)

with sociometric ones (friend self-report behavior) in relation to adolescent smoking behavior.

Given that studies have shown smokers tend to overestimate friends' smoking we expect perceived friend smoking to have greater influence on adolescent self-smoking than actual friend self-report [7, 9]. Thus we hypothesize that perceived smoking will be more strongly associated with smoking than friends' self-reports. We also test additional hypothesis that popularity remains an independent predictor of smoking when peer influences are controlled for.

DATA AND METHOD

Survey data was collected from students attending seven predominately Hispanic/Latino high schools in the Los Angeles area in the fall of their 9th and 10th grade years in 2006 and October 2007. Some 3,218 students were invited to participate and 2,420 (75%) provided parental consent and student assent. Of those, 2,221 (92%) completed the survey in 9th grade. At one year follow up (10th grade), 1,950 (87.8%) completed the survey with 236 students no longer enrolled in the participating schools.

Outcome variable

Smoking was measured with a series of questions that assessed whether the student has ever tried smoking even one puff and how frequently the student smoked in the past 30 days. These questions were combined to generate one dichotomous ever smoked variable to deal with skewed distribution and attain enough statistical power.

Peer norms

Perceived Smoking Norms was measured by asking "out of 100 students of your age, how many do you think smoke cigarettes once a month or more?" Response categories were every decile with 1 equaling "none" and 11 equaling "about 100." *Perceived Friend Approval* was measured by asking "how would your five closest friends feel about you if you smoked one or more packs of cigarettes a day?" This question was asked only 10th grade students. Four response options from strongly disapprove (=1) to strongly approve (=4) were offered. There was considerable missing data for this question with 353 respondents missing and the mean value of 1.35 substituted.

Peer influence

To compute both egocentric measure of perceived friend smoking, and sociometric measure of friend self-report smoking, two pieces of information was used. The first piece of information was based on friendship network data. The name generator used for the network data was "Please think of your five BEST FRIENDS at THIS SCHOOL. Be sure to write your friend's real names and not their nicknames." Space was then provided for respondents to write in first and last names. Number of friends named is the total number of names provided in response to this question (*Number Friends Named*). The names were then matched with class rosters provided by the school and linked by ID codes. A subset of these names was in the same grade as the respondent and participated in the study. Number of friends in grade is the number that could be matched in the database (*Number in Grade (consented)*).

Perceived friend smoking was measured by asking "Has this person ever smoked a cigarette" for each friend named, and summing the responses (*Perceived Friend Count*); this quantity was then divided by the number of friends named to get a proportion (*Perceived Friend Proportion*). Three sociometric measures of friend self-report smoking were

constructed: A count of friend self-reports (*Friend Self-Report Count*), dividing this quantity by the number of friends named (*Friend Self-Report Proportion*), and a count of the smoking status for the students who nominated the respondent (*Friend Indegree Self-Report Count*). For these three measures, the mean value of friend smoking was imputed for those friends with missing data.

Popularity

Popularity was measured by counting the frequency each respondent was named as a friend by other respondents (indegree) divided by the number of students in the grade (*Nominations Received Proportion*).

Peer selection

Selection was measured by counting the number of new friendships the respondent (ego) formed with alters in which ego quit smoking and alter quit or never smoked; and ego started smoking and the alter also started or continued smoking (*Selectivity Count*).

Control variables

Control variables included were age, gender, ethnicity, academic performance, nativity, parents' education, and socioeconomic status (SES). Age (in years), gender, and ethnicity (Hispanic/Latino, White, Asian, and Other) were self-reported. Academic performance was measured on a nine point scale ranging from Mostly A's to Mostly F's. Nativity was measured by asking whether either of the parents were foreign born and whether the student was foreign born. Parents' education was calculated as the average of the father's and mother's education rated on a 6-point scale ranging from "8th grade or less" to "advanced degree." Socio-economic status was calculated by dividing the number of people in the respondent's household by the number of rooms in the household.

The following imputations to the mean or mode were made to account for missing data on specific items: 19 cases on age, 7 cases on academic performance, 41 cases on SES, 24 cases on perceived smoking norms, and 24 cases on perceived smoking norms at follow up. Attrition analysis showed that respondents lost to follow up: (1) had poorer academic achievement, (2) were less likely to have foreign born parents, (3) named fewer friends in their grade, and (4) had higher perceived friend smoking than those remaining in the study. Table 1 provides a listing of the various measures of peer norms, peer influence, and peer selection used in this study.

Several logistic regression models were conducted across four different sub-samples: (1) 9th grade only (cross-sectional); (2) 10th grade only (cross-sectional), (3) 10th grade initiation in which 9th grade smokers were removed (longitudinal), and (4) 10th grade dynamic in which 9th grade smoking status was entered as a covariate (longitudinal). For each population, models were estimated separately for each measure of egocentric and sociometric peer influence and peer selection with controls of measures of peer norms, friend nominations, popularity, and other sociodemographic variables. We analyze data cross-sectionally and then longitudinally. The rationale for analyzing both types of models is to explore how cross-sectional analyses can be misleading to predict smoking behavior.

RESULTS

Table 2 reports univariate statistics (means and percentages). In 9th grade, 25.6% of students reported smoking. Students named an average of 4.1 students in their school, with 1.75 of them being identified in their grade. The remaining students were either in different grades in the same school, in different schools, or could not be matched to a name in the grade

roster for another reason (e.g., incomplete name specified or illegible). Of the friends named, respondents indicated that 17.0% were smokers, providing a count of an average 0.71 perceived friend smokers per student. Among those friends who were also interviewed, the smoking rate was 27.0%, providing a count of an average 0.45 friend self-report smokers.

Over time, smoking increased to 28.10% in 10th grade among students in the study. Perceived smoking norms increased to 5.38 or 44% ($t=8.90$, $p<0.01$). The number of friends named decreased from 4.1 to 3.75 ($t=6.1$, $p<0.01$) yet the number in the same grade and identifiable increased from 1.75 to 2.37 ($t=11.9$, $p<0.01$). Both perceived smoking and the friend self-reported counts increased between waves as well as would be expected with an increase in individual smoking.

Cross-sectional analysis

Table 3 reports adjusted odds ratios from random effects logistic regression models adjusted for nesting within schools. For each of four sub-samples (9th grade only, 10th grade only, 10th grade initiation (9th grade non-smokers only), and 10th grade dynamic) cross-sectional or longitudinal models were estimated separately for each measure of egocentric and sociometric peer influence and peer selection variables: (1) *Perceived Friend Count*, (2) *Perceived Smoking Proportion*, (3) *Friend Self-Report Count*, (4) *Friend Self-Report Proportion*, (5) *Friend Indegree Self-Report Count*, and (6) *Selectivity Count*. Reported odds ratios of peer norms, friend nominations, and popularity were based on the model with egocentric measure of *Perceived Friend Count*.

In the cross sectional models (9th and 10th grade only) egocentric measures of perceived friend smoking, regardless of count (*Perceived Friend Count*) or proportion (*Perceived Friend Proportion*), were significantly associated with smoking. The magnitude of the *Perceived Friend Proportion* seems considerably higher with a larger SE. (e.g., AOR=17.94 for 9th grade only; AOR=15.34 for 10th grade only) since the scale is different the magnitude of the variables are not directly comparable. For the 9th grade only model, sociometric measures of friend self-report, regardless of count, proportion, or tie direction were significantly associated with smoking. None of these variables, however, was significant in the 10th grade only model.

Longitudinal analysis

Two longitudinal models were estimated, initiation in which 9th grade smokers were removed (10th Grade Initiation) and dynamic in which 9th grade smoking status was included as a predictor (10th Grade Dynamic). In both longitudinal models, when 9th and 10th grade perceived friend smoking were both included in the model, perceived friend smoking at 10th grade, regardless of count or proportion was significantly associated with smoking (e.g., AOR=1.84 for Initiation; AOR=1.83 for Dynamic for count, and AOR=15.34 for Initiation; AOR=17.58 for Dynamic for proportion). This indicates that an increase in perceived friend smoking was associated with becoming a smoker. Conversely, only the baseline friend self-report measured as a proportion had a significant association with smoking and only in the 10th grade initiation model (AOR=1.72).

Also in the longitudinal models, popularity at 10th grade was associated with becoming a smoker (AOR=1.56 for Initiation; AOR=1.67 for Dynamic). Since 9th grade popularity was included in the models this indicates that increased popularity was associated with becoming a smoker. Notice also that the significant perceived smoking norms variable (*Perceived Smoking Norms-TI*) was no longer associated with smoking in the longitudinal models. *Perceived Friend Approval* (only in the 10th grade survey) was strongly correlated with

smoking initiation (AOR=1.49, $p<0.01$) and the dynamic model (AOR=1.44, $p<0.01$) when perceived friend smoking was omitted (these results were not shown in Table 3), but uncorrelated when perceived friend smoking was included.

The level of agreement between perceived friend smoking (ego-centric) and those friends' self-reports (sociometric) was high, varying from 76 to 79 percent at baseline. Much of this agreement, however, derived from reports of non-smoking for both perceived and self-report. When restricted to positive reports of smoking on both perceived and self-report the rates of agreement were considerably lower, 7–10 percent. Confirmed smoking was not more strongly associated with the respondent's smoking than perceived smoking. In other words, respondents did poorly at estimating the smoking status of their friends when those friends smoked, yet this inaccuracy had little association with smoking.

Selectivity analysis

Table 4 reports the smoking status at both time points for the respondent (ego) and his/her friend (alters) for all newly formed friendships in the data. Of the 3,938 new ties formed from 9th to 10th grade, 1,822 (46.3%) were between an ego who never smoked and an alter who also never smoked; 451 were between an ego who never smoked and an alter who became a smoker; 403 were between an ego who became a smoker and an alter who never smoked; and so on. There were 309 new links formed between 9th and 10th grade in which the respondent changed smoking status: 86 (=80 + 6) in which ego quit smoking and 223 (=126 + 97) in which ego started smoking. Selection links were defined as new links from a respondent who changed their smoking status to be congruent with their friend (*Selectivity Count*). For example, one set of selection links is the 126 ties formed from non-smokers who became smokers to friends who also became smokers. Thus there are 309 (=126+97+80+6) selection links and this count can be aggregated to each respondent providing an average selectivity count of 0.19.

Returning to Table 3, the adjusted odds ratio for selection count was 1.32 ($p=0.05$) in the dynamic model which was almost significant at the $\alpha=0.05$ level. This result indicates that respondents who changed smoking status and made new friends with others whose smoking status was consistent with their own were more likely to become a smoker. It is important to note that there may be variations in how selection is calculated, a point we return to in the discussion.

DISCUSSION

This study set out to clarify and compare measures of peer norms, peer influence and selection, on adolescent smoking. The results generally supported the hypothesis that egocentric measures of perceived friend smoking were more strongly associated with smoking than the sociometric ones based on friends' self-report. These conclusions are tempered by some limitations.

First the data from this study were collected, by design, from schools that are predominately Hispanic/Latino and so may not be generalizable to schools of different ethnicities or different ethnic distributions. Second, the schools are located in an urban metropolitan area which may bias both the network and behavioral data. Third the network data were collected by asking respondents to write the names of their closest friends regardless of whether they attend the same school or are in the same grade. Consequently, the friendship networks measured here are sparser than school-based friendships measured in other networks.

Despite these limitations, important conclusions both substantive and methodological are derived from this analysis. Substantively, perceived peer smoking was consistently and

strongly associated with individual smoking in all models. This finding corroborates other studies which have shown that perceived peer use is strongly associated with behavior, perhaps above the association demonstrated from peer self-reports [7, 8]. The source of this association stems from two factors: (a) respondents could name any friend being unconstrained by boundaries imposed by the researcher and thus perhaps reported on important (perhaps older) relationships that are salient, (b) respondents project their own behaviors onto that of their friends' behaviors. This finding also might imply that adolescents are more likely to smoke if they believe their friends smoke, but many adolescents' beliefs about their friends' smoking are inaccurate, or at least inaccurately reported.

Second, popularity was associated with smoking in dynamic models (longitudinal logistic regression analysis), corroborating previous findings that popular students become smokers earlier than less popular ones [1, 36]. The dynamic model results here further underscore that the behavior of popular peers may strongly influence the community norms and subsequent behaviors of other adolescents.

Third, peer norms are poor substitutes for peer influence as predictors of smoking behavior. In the absence of perceived peer influence questions, perceived norms and peer approval were strongly associated with smoking in cross-sectional and dynamic analyses. Yet once perceived friend smoking and friend self-report were added to the models, perceived smoking norms were no longer associated with smoking. It seems that estimating peer influence is more accurate when respondents refer to specific others rather than general ones.

Fourth, our results indicated that peer selection was associated with smoking in the dynamic model. Students who became smokers were more likely to form friendships with smokers (either initiators or continuing smokers) than students who did not become smokers. An interpretation then of these data is that students are influenced to smoke if they have friends who smoke and will have a preference for forming friendships with smokers if they become a smoker.

In this study, peer selection was a count of the number ties a respondent (ego) formed when he/she (1) quit and his/her friend (alter) never smoked or quit; and (2) started and his/her friend started or continued to smoke. Selection can also be conceived of instances in which only dynamic behavioral changes for ego and alter are counted (e.g., ego and alter both quit smoking), or all instances when the ties are dynamic and behavioral states of ego and alter are congruent at time two (as measured in this study). Further, research in how different measures of selection operate seems warranted.

Methodologically, this study has important proscriptions for future school-based studies of adolescent smoking and substance use behavior. First, care should be taken to insure that data collection procedures can produce connected and sufficiently dense networks. In this study, we asked respondents to name friends in their school rather than their grade or classroom. In this setting, although the response rate within grade was quite high, only 42.7% at baseline and 63.2% at follow up of those named were also respondents in the database, despite extensive efforts to match names with slightly different spellings, nicknames, etc. These lower than expected numbers resulted in rather sparse sociometric networks. Possible remedies for this problem are to expand the number of names requested, thus increasing respondent burden, or to restrict the naming of friends to within grade or classroom, thus limiting the potential relevance of friendships. Another option would be to attempt to survey all the students named by respondents, even those in other grades, but this

would require significantly more staff effort and would cause inconvenience for school personnel.

Second, the results highlight the value of collecting ego-centric data along with sociometric information. By asking respondents to indicate whether their friends smoked, the study demonstrated a strong and robust association between individual smoking and perceived friend smoking. If the study had only asked for sociometric data, and not collected information on the respondents' perceptions of peer behavior, researchers would have concluded that the data were inadequate to demonstrate peer influence.

In conclusion, these data provide further support that peer influence and social context affect adolescent smoking behavior. Adolescents become smokers by having smoking friends and smokers will make friends with smokers. Popular students initiated smoking earlier than their less popular peers. This was not a product of being exposed to more peer smoking, rather was a function of popularity alone. Prior research has shown that social networks can be used to create more effective interventions [37]. This study underscores the need to continue designing peer based behavior change programs.

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Table 1

Study Measures of Peer Norms, Popularity, Peer Influence, and Peer Selection

Variable	Definition	How Measured
Peer Norms		
Perceived Smoking Norms	Respondents' perceptions of how many of their peers, out of 100, smoke.	Survey Item
Perceived Friend Approval	Respondents' perceptions of how many of their five closest friends would feel if they smoked 1 or more packs of cigarettes a day	Survey Item (10 th grade only)
Friend Nomination		
Number Friends Named	Number of friends named in response to the question, who are your closest friends in this school.	Up to 5 written full names
Number in Grade (consented)	Number of friends named who also completed the survey.	5 names matched to respondents
Popularity		
Nominations Received Proportion	Number of times each respondent was named as a friend by other respondents divided by class size.	Indegree count divided by class size
Peer Influence		
	<i>Perceived friend smoking (egocentric)</i>	
Perceived Friend Count	Number of the respondent's friends he/she thinks smoke.	Number of up to 5 friends respondent thought smoked
Perceived Friend Proportion	The percentage of the respondent's friends he/she thinks smoke.	Proportion of up to 5 friends respondent thought smoked
	<i>Friend self-report smoking (sociometric)</i>	
Friend Self-Report Count	The self-reported smoking of the respondent's friends, as a count.	For those named, number self-reported smoking
Friend Self-Report Proportion	The self-reported smoking of the respondent's friends, as a proportion.	For those named, proportion self-reported smoking
Friend Indegree Self-Report Count	Number of other smoking students who nominated the respondent.	Number of smokers who named respondent as a friend
Peer Selection		
Selectivity Count	Number of new friendships the respondent formed when the respondent quit smoking and the friend quit or never smoked; and the respondent started smoking and the friend also started or continued smoking.	Number new friends that have the same smoking status at time 2

Table 2

Study Sample Characteristics: Percentage or Means (SD)

	9 th Grade	10 th Grade
N	1,950	1,950
Ever Smoked	25.60%	28.10%
Hispanic	79.54%	--
White	6.87%	--
Asian	6.51%	--
Other	7.08%	--
Academic Performance	3.67 (1.88)	3.99 (1.93)
Boys	41.4%	--
Age	14 years	15 years
Foreign Born	12.92%	--
Parent Foreign Born	80.62%	--
Parent Education	2.68 (1.08)	--
SES (People/Rooms)	1.42 (0.75)	--
Peer Norms		
Perceived Smoking Norms	4.55 (2.82)	5.38 (2.60)
Perceived Friend Approval	--	1.35 (0.55)
Friend Nominations		
Number Friends Named	4.10 (1.55)	3.75 (1.90)
Number in Grade (consented)	1.75 (1.42)	2.37 (1.82)
Popularity		
Nominations Received Proportion	0.54 (0.57)	0.57 (0.60)
Peer Influence		
<i>Egocentric measure</i>		
Perceived Friend Count	0.71 (1.19)	0.85 (1.35)
Perceived Friend Proportion	0.17 (0.27)	0.22 (0.31)
<i>Sociometric measure</i>		
Friend Self-Report Count	0.45 (0.70)	0.58 (0.83)
Friend Self-Report Proportion	0.27 (0.30)	0.33 (0.29)
Friend Indegree Self-Report Count	0.40 (0.72)	0.53 (0.83)
Peer Selection		
Selectivity Count		0.10 (0.42)

Academic Performance was measured on a nine point scale ranging from Mostly A's (=1) to Mostly F's (=9). Parents' education was calculated as the average of the fathers' and mother's education rated on a 6-point scale ranging from "8th grade or less" to "advanced degree." SES was measured by number of people who live in the household divided by the number rooms in the household (excluding kitchen and bathrooms). Perceived smoking norms of 4.55 indicate a perception that 35% of their peers smoked.

Table 3

Results of Adjusted Odds Ratios for Logistic Regression Models (Random Effects) for both Cross-sectional and Longitudinal Analyses.

	Cross-sectional analysis		Longitudinal analysis	
	9 th Grade Only	10 th Grade Only	10 th Grade Initiation	10 th Grade Dynamic
N	1,950	1,950	1,450	1,950
9 th Grade Smoking	NA	NA	NA	12.27 ^{***} (1.92; 9.03, 16.67)
Peer Norms				
Perceived Smoking Norms-T1	1.08 ^{***} (0.02; 1.04, 1.12)	NA	0.99 (0.03; 0.92, 1.05)	0.99 (0.03; 0.94, 1.04)
Perceived Smoking Norms-T2	NA	1.01 (0.02; 0.96, 1.05)	1.00 (0.03; 0.94, 1.07)	1.00 (0.03; 0.95, 1.06)
Perceived Friend Approval-T2	NA	1.08 (0.12; 0.87, 1.33)	1.05 (0.16; 0.79, 1.40)	1.04 (0.13; 0.82, 1.32)
Friend Nominations				
Number Friends Named-T1	0.94 (0.04; 0.87, 1.02)	NA	1.01 (0.06; 0.89, 1.14)	1.00 (0.05; 0.90, 1.10)
Number Friends Named-T2	NA	1.06 (0.05; 0.97, 1.16)	1.00 (0.07; 0.88, 1.14)	1.18 ^{**} (0.06; 1.07, 1.31)
Number in Grade (consented)-T1	0.92 (0.05; 0.83, 1.02)	NA	0.97 (0.07; 0.84, 1.12)	1.04 (0.06; 0.92, 1.17)
Number in Grade (consented)-T2	NA	0.96 (0.04; 0.88, 1.05)	1.00 (0.06; 0.88, 1.13)	0.96 (0.05; 0.87, 1.07)
Popularity				
Nominations Received Proportion-T1	1.13 (0.13; 0.90, 1.41)	NA	0.90 (0.16; 0.63, 1.27)	0.75 ⁺ (0.11; 0.57, 1.00)
Nominations Received Proportion-T2	NA	1.40 ^{**} (0.15; 1.13, 1.72)	1.56 ^{**} (0.25; 1.14, 2.13)	1.67 ^{***} (0.22; 1.29, 2.17)
Peer Influence				
<i>Egocentric measure</i>				
(1). Perceived Friend Count-T1	1.88 ^{***} (0.09; 1.71, 2.07)	NA	1.06 (0.09; 0.90, 1.25)	0.99 (0.06; 0.88, 1.12)
(1). Perceived Friend Count-T2	NA	1.95 ^{***} (0.09; 1.78, 2.15)	1.84 ^{***} (0.12; 1.61, 2.09)	1.83 ^{***} (0.10; 1.63, 2.04)
(2). Perceived Friend Proportion-T1	17.94 ^{***} (3.86; 11.77, 27.37)	NA	1.43 (0.53; 0.69, 2.95)	1.00 (0.27; 0.59, 1.71)
(2). Perceived Friend Proportion-T2	NA	23.51 ^{***} (5.15; 15.30, 36.13)	15.34 ^{***} (4.67; 8.45, 27.85)	17.58 ^{***} (4.52; 10.61, 29.11)
<i>Sociometric measures</i>				
(3). Friend Self-Report Count-T1	1.56 ^{***} (0.14; 1.31, 1.86)	NA	1.27 ⁺ (0.16; 0.99, 1.63)	1.08 (0.11; 0.88, 1.32)
(3). Friend Self-Report Count-T2	NA	1.07 (0.08; 0.93, 1.24)	0.88 (0.09; 0.71, 1.09)	0.92 (0.08; 0.76, 1.09)
(4). Friend Self-Report Proportion-T1	2.16 ^{***} (0.38; 1.53, 3.05)	NA	1.72 [*] (0.43; 1.05, 2.82)	1.17 (0.24, 0.78, 1.76)

	Cross-sectional analysis		Longitudinal analysis	
	9 th Grade Only	10 th Grade Only	10 th Grade Initiation	10 th Grade Dynamic
(4). Friend Self-Report Proportion-T2	NA	1.31 (0.23; 0.92, 1.86)	0.87 (0.23; 0.52, 1.46)	0.90 (0.19; 0.59, 1.38)
(5). Friend Indegree Self- Report Count-T1	1.42 ^{***} (0.12; 1.20, 1.67)	NA	1.22 (0.16; 0.95, 1.58)	1.16 (0.12; 0.95, 1.41)
(5). Friend Indegree Self-Report Count-T2	NA	1.11 (0.08; 0.96, 1.29)	0.93 (0.11; 0.75, 1.17)	0.97 (0.09; 0.81, 1.16)
Peer Selection				
(6). Selectivity Count	NA	NA	NA	1.32 ⁺ (0.19; 1.00, 1.75)

⁺ p<0.1;

^{*} p<0.05;

^{**} p<0.001;

^{***} p<0.001.

Note: Parentheses indicate SE; upper, and lower 95% CIs. Reported odds ratios of peer norms, friend nominations, and popularity were based on the model with egocentric measure of Perceived Friend Count.

“10th Grade Initiation” refers to the model in which 9th grade smokers were removed, and “10th Grade Dynamic” refers to the model in which 9th grade smoking status was entered as a covariate. Each model controls for demographic and socioeconomic variables of age, gender, ethnicity, academic performance, nativity (both students’ and parents’ foreign born status), parents’ education, and SES (number of people divided by number of rooms in household).

Table 4

Rates of Tie Formation by Smoking Status for Ego (Respondent) and Alters (Nominated Friends).

Time		Time 2				
	Ego		No		Yes	
		Alter	No	Yes	No	Yes
Time 1	No	No	1,822 (46.3%)	451 (11.5%)	403 (10.2%)	126 (3.2%)
		Yes	74 (1.9%)	334 (8.5%)	29 (0.7%)	97 (2.5%)
	Yes	No	80 (2.0%)	37 (0.9%)	255 (6.5%)	104 (2.6%)
		Yes	6 (0.2%)	16 (0.4%)	20 (0.5%)	84 (2.1%)

Note: Shaded cells indicate selection on friendship in which the smoking status of the respondent and his/her friend are the same at time 2 (Selectivity Count). Total of 3,938 new ties were formed from 9th to 10th grade. 1,822 ties were formed between an ego who never smoked and an alter who also never smoked; 451 were between an ego who never smoked and an alter who became a smoker; 403 were between an ego who became a smoker and an alter who never smoked; and so on. Selection links were defined as new links from a respondent who changed their smoking status to be congruent with their friend (*Selectivity Count*). For example, one set of selection links is the 126 ties formed from non-smokers who became smokers to friends who also became smokers. Thus there are 309 (126+97+80+6) selection links and this count can be aggregated to each respondent.