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GENDER DIFFERENCES IN PEER INFLUENCE AND FRIEND SELECTION FOR ADOLESCENT DELINQUENCY, DRINKING, AND SMOKING

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ABSTRACT

Previous research has confirmed that friend selection and peer influence concurrently explain why adolescents tend to exhibit similar problem behaviors as their friends. However, substantially less work has considered whether gender moderates these relationships. In this study, I examine whether the selection and influence processes regarding three specific problem behaviors (delinquency, drinking alcohol, and smoking tobacco) operate differently for adolescent girls and boys. I consider whether girls or boys are more likely to select friends with similar problem behaviors as their own and whether one gender is more prone to influence from their friends' participation in such behaviors. Using SIENA software, I construct dynamic stochastic actor-based (SAB) models that are ideal for disentangling whether friends' behavior similarity is the result of selection or influence processes. I apply these models to five waves of respondent-nominated friendship data on students who participated in the PROSPER peers study, yielding a sample of over 13,000 adolescents who attended sixth through ninth grade in one of 26 U.S. school districts. The sample includes respondents from two consecutive grade cohorts, resulting in 51 complete friendship networks. Findings suggest that the problem behavior of both girls and boys can be explained by friend selection and peer influence; however, for certain problem behaviors, girls' experiences are particularly shaped by these processes. Compared to boys, the delinquent behavior of girls is more susceptible to influence from their friends and girls are more likely to select friends who have similar smoking behaviors as their own.

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1: INTRODUCTION

Adolescent problem behaviors, such as delinquency, drinking alcohol, and smoking tobacco, are strongly associated with increased mortality rates in both the short- and long-term. For instance, smoking is the leading cause of preventable death in the general American population (Johnson et al. 2014). Even though the vast majority of these deaths are experienced by older adults, nicotine addiction often is established during adolescence. Approximately 90% of adult smokers admit to having their first cigarette before age 19 (Bonnie, Stratton, and Kwan 2015). The Center for Disease Control and Prevention (2014) estimates that if current smoking rates continue, one out of thirteen of today's adolescents will eventually die from a tobacco-related illness. Adolescent drinking and delinquency also are responsible for thousands of preventable deaths. Underage drinking is associated with an increased risk of assault and higher levels of participation in risky sexual behavior (Cooper et al. 1994, Hingson et al. 2005). Furthermore, the mortality rates of delinquent youth are more than twice as high as those who are non-delinquent, primarily because of deaths caused by accidents or violence (Laub and Vaillant 2000). Curtailing adolescent problem behavior will not only reduce current adolescent mortality rates, but also decrease future rates as these youth age into adulthood.

Since adolescents tend to participate in similar problem behavior as their friends (Cohen 1977, Kandel 1978), we can gain a unique insight into adolescent delinquency and substance use by studying these behaviors from a social networks perspective. By considering how adolescents are embedded in structures of social relationships, we can better contextualize their individual experiences and actions. Scholars agree that adolescents tend to have similar behaviors as their friends as a result of two processes: peer influence and friend selection. Adolescents may initially select friends who already exhibit similar behaviors as their own or be influenced by friends to adjust their behavior so that it is more like that of the group (Osgood et al. 2013;

Osgood, Feinberg, and Ragan 2015, Mercken et al. 2010a). While previous work has considered how peer influence and friend selection operate in the general population, fewer studies have considered whether these processes vary on the basis of individual characteristics, such as gender. If scholars and practitioners continue to assume that all adolescents have the same experiences with peer influence and friend selection, their conclusions may fail to fully account for the diversity that characterizes adolescents' experiences with their peers. Prevention programs can be tailored to specifically combat the effects of either selection or influence and their impact could be broadened if they are better designed to meet the needs of a wide variety of adolescents (Gest et al. 2011). The current study seeks to better understand how influence and selection relate to adolescent problem behavior by focusing on whether adolescents' experiences with these processes are moderated by gender. Additionally, by considering three separate problem behaviors, this study aims to further our understanding of whether gendered experiences with influence and selection are consistent or variable across multiple problem behaviors.

In this paper, I first provide a detailed overview of the current state of the literature on gender variations in peer influence and friend selection processes. Then, I apply novel stochastic actor-based (SAB) models that can simultaneously account for changes in friendship structure and individual behavior to a large set of data on 51 unique adolescent friendship networks. In these models, I test whether there are significant differences between girls' and boys' experiences with selection and influence for three different problem behaviors: delinquency, drinking, and smoking. I end with a brief discussion of the implications of my findings and make suggestions for future areas of research.

2: LITERATURE REVIEW

2.1: Friendship homophily, influence, and selection

According to the principle of homophily, people prefer to associate with those whom they share similar characteristics, beliefs, and behaviors (McPherson, Smith-Lovin, and Cook 2001). While there is evidence for homophily in a variety of different relationships, it is particularly apparent within adolescent friendship groups. If a pair of adolescents are friends, both parties are likely to share common attributes, including similar participation in problem behaviors (Cohen 1977, Kandel 1978).

There are two general mechanisms that help to explain why problem behavior homophily is commonly observed within adolescent friend groups: peer influence and friend selection. Peer influence occurs when adolescents' attitudes and behaviors are shaped by those of their friends. Within a pair of friends, it is expected that at least one of the friends will adjust his or her behavior so that the pair becomes more homogeneous than it was before the relationship's inception (Kandel 1978). Friend selection, or the tendency for adolescents to form friendships with peers whom they are similar, simultaneously contributes to problem behavior homophily. If two adolescents share the same trait or characteristic, it is more likely that a friendship will form between the pair (Kandel 1978).

Initially, most scholars relied on influence theories to explain the phenomenon of adolescent problem behavior homophily. Sutherland's (1947) classic differential association theory argues that peers and intimates introduce individuals to "definitions," or behavior patterns, that can encourage problem behavior. If an individual is overwhelmed with definitions that promote delinquency or substance use, it increases his or her odds of participating in these same behaviors. Akers's (1973) social learning theory extends upon Sutherland's work by

further incorporating behavioral learning theories from psychology. Most notably, Akers argues that individuals learn to commit deviant acts through their interactions in social settings. Individual choices to participate in problem behavior are guided by their observations of how these behaviors are punished or reinforced by their peers. Both theories argue that adolescent friendship homophily is the result of influence processes. Influence from friends can be explicit, such as peer pressure to adopt a new behavior, but it tends to operate more implicitly. For instance, adolescents may change their behavior as an attempt to win acceptance from their peers or to gain social status (Simons-Morton and Farhat 2010).

Alternatively, Gottfredson and Hirschi's (1990) control theory posits that deviant youth seek out friends with similar problem behaviors as their own, suggesting that friend selection mechanisms are responsible for adolescent behavior homophily. According to this theoretical framework, adolescent problem behavior is not the result of influence processes. Instead, adolescents' decisions to experiment with delinquency and substance use are shaped by their individual self-control, or impulse regulation. Adolescents with low self-control are more likely to participate in problem behaviors and tend to seek out friends who exhibit similarly low levels of self-control. Because of these two associations, adolescents often participate in the same problem behaviors as their friends, and thus, the friend selection process, not peer influence, is responsible for behavior homophily observed within adolescent friend groups. It is worth further noting that when adolescents make new friends, they do not always hold explicit preferences for friends with similar problem behaviors as their own. Instead, friend selection on the basis of shared problem behavior tends to operate more implicitly. For instance, adolescents with similar interests and behaviors tend to participate in the same activities and spend more time interacting with one another, amplifying the probability that they become friends (Feld 1981).

Initially, empirical studies of adolescent problem behavior homophily were concerned with measuring the effects of peer influence and either controlled for friend selection or failed to recognize its existence (Mears, Ploeger, and Warr 1998; Urberg, Değirmencioğlu, and Pilgrim 1997). As social control theory has become more prominent, researchers have turned more attention to studying selection processes and found that the two processes have unique consequences for adolescents' experiences with delinquency and substance use. For instance, intervention programs should be organized differently if adolescent behavior homophily is the result of peer influence than if it is the result of friend selection (Gest et al. 2011).

Accordingly, more recent studies attempt to disentangle whether friendship selection or peer influence matter more in explaining adolescent problem behavior homophily. There is some evidence that selection processes contribute more heavily to explaining these behavioral similarities (Knecht et al. 2010, Mercken et al. 2010a), while others suggest that influence processes are primarily responsible for behavior homophily (Weerman 2011). However, the overwhelming consensus is that selection and influence are not mutually exclusive processes (Cohen 1977; Osgood et al. 2015). For instance, one cannot be influenced by his or her friends unless he or she initially selects them. The bulk of empirical research supports this claim, finding that selection and influence both notably contribute to adolescent problem behavior homophily (Burk, Kerr, and Stattin 2008; Ennett and Bauman 1992; Fisher and Bauman 1988; Osgood et al. 2013; Osgood et al. 2015; Schaefer, Haas, and Bishop 2012).

2.2: Gender variations in friendship

While many scholars have studied how selection and influence processes operate in the general population, few have considered how gender shapes individuals' experiences with these

processes. However, the existence of gender variations should be anticipated, since previous work has highlighted how boys' and girls' friendships differ in terms of both their structure and character. Boys' friendship networks tend to be more expansive, while girls' networks are smaller and primarily contain best friends (Benenson 1990). Friendship groups that predominately consist of female adolescents tend to be characterized by friendships that are reciprocated, transitive, and more stable over time (Kreager, Rulison, and Moody 2011). Furthermore, boys' friendships tend to be organized around participation in shared activities (Wright 1982), while girls' friendships are characterized by higher degrees of emotional investment and support as well as greater disclosure of intimate matters (Buhrmester and Furman 1987, Rose and Rudolph 2006).

There are three theoretical perspectives that can help explain why gender differences exist in friendships. First, the socialization perspective argues that gendered differences are not the result of inherent characteristics; instead, gendered behaviors and personality traits are acquired during childhood (Howard and Hollander 1997). Children learn gendered behavior by both intentionally and unconsciously modeling the actions of those around them as well as from reward systems that positively reinforce their adherence to gender roles (Bandura 1977, Chodorow 1978). Girls are socialized to be more cooperative and better attuned to social dynamics, while boys are taught to value objectivity and independence (Chodorow 1978). After gender norms are engrained during childhood, they continue to shape individuals' personalities and actions throughout their lives (Howard and Hollander 1997). Consequently, the socialization process may inform how adolescents create and maintain friendships with their peers; because of childhood gender socialization, adolescent girls' are more encouraged to value interpersonal connectedness than their male peers (Chowdorow 1978).

Second, social constructionist approaches argue that through our micro-level interactions, rituals, and symbols, we come to define our gender identity (Howard and Hollander 1997). While societal norms dictate what should be understood as masculine and feminine, it is ultimately the individual's choice on to how gender should be "performed," or displayed, to others. Of course, such a performance does not occur without consequences; if an individual's gender performance does not align with his or her sex category, one will inevitably face a variety of social and political repercussions (West and Zimmerman 1987). Accordingly, "doing gender" occurs within adolescent friendships. Adolescent girls are expected to be nurturing and disclose intimate matters with their friends, while boys are encouraged to minimize displays of emotion. Among their friends, adolescents can "perform" gender however they please, but failing to follow societal gender norms could have serious ramifications, including loss of popularity or targeting for aggression (Felmlee and Faris forthcoming). To avoid suffering from these consequences, the majority of adolescents enact gender in a way that complements their sex categorization.

The third perspective takes a structural approach to explain gender differences, arguing that social institutions shape gendered behaviors by unequally allocating resources to men and women (Howard and Hollander 1997). Gender itself can be understood as a social structure; even when individuals reject gender norms and male dominance, they are often forced to continue making gendered choices because of institutional pressures (Risman 1998). Individuals are systematically granted or forbidden access to opportunities on the basis of their gender, causing adolescent boys and girls to bring different past experiences and expectations into their friendships (Felmlee 1999). For instance, extracurricular athletics geared towards boys tend to reinforce values such as competition and achievement whereas those geared towards girls often

focus on emotional management (Eder and Parker 1987). By coming into contact with these institutional structures, boys and girls acquire gender-specific resources that differentially impact how they form and maintain friendships.

2.3 Gender variations in influence and selection

Due to the existing evidence on gender differences in adolescent friendship, there is reason to question whether girls and boys are similarly influenced by the behaviors of their peers. Since girls tend to report more intimate friendships, their behaviors may be more susceptible to influence from friends (Haynie, Doogan, and Soller 2014; Mercken et al. 2010b). Parents, teachers, and other trusted adults tend to reinforce the risky legal and health consequences associated with delinquency, drinking, and smoking. For an adolescent to forgo these warnings and experiment with problem behaviors, it may be necessary that equally trusted sources, such as intimate friends, share their positive experiences with these behaviors. Since girls tend to have more intimate friendship ties, they may be more prone to these friends' influences to participate in problem behaviors.

Relatedly, the structure of girls' friendship groups may foster an environment where individuals are more likely to be influenced by the problem behaviors of their friends. As noted previously, reciprocated friendships are more common in predominately female peer groups (Kreager, Rulison, and Moody 2011). In a reciprocated friendship, both adolescents acknowledge that the relationship exists and are thus, more likely to be both aware of and influenced by each other's participation in problem behaviors (Engels et al. 2004). Since girls' friendship ties are more likely to be reciprocated, it is reasonable to suspect that they would also be more likely to mimic their friends' delinquency, drinking, and smoking.

On the other hand, boys' friendships tend to be more hierarchically structured and characterized by greater levels of competition (Rose and Rudolph 2006). Since some conceptualizations of masculinity emphasize involvement in crime and drug abuse (Courtenay 2000), participation in such problem behaviors may be necessary for gaining and maintaining social status in male-dominated friendship groups. Furthermore, the hierarchical structure of these friendship groups may enable higher-status boys to effectively pressure their lower-status friends into adopting problem behaviors. Boys also tend to spend more time socializing with friends in public settings without adult supervision (McCarthy, Felmlee, and Hagan 2004), giving them more opportunities to collectively experiment with problem behaviors. Since girls tend to receive more supervision, they may have fewer opportunities to be influenced by friends' problem behavior participation (Haynie et al. 2014).

A breadth of empirical studies has considered whether peer influence processes vary between girls and boys; however, findings have been inconsistent. Previous research has shown that girls are more influenced by their friends' participation in violence (Haynie et al. 2014), delinquency (Weerman and Hoeve 2012), and cigarette use (Mercken et al. 2010b). Boys have been shown to be more influenced by their friends' feelings of internalized distress (Hogue and Steinberg 1995) and participation in delinquent acts (Mears et al. 1998, Piquero et al. 2005). Furthermore, several studies have found no evidence of gender moderating the relationship between friend influence and problem behavior (Burk et al. 2012, Light et al. 2013, Urberg et al. 1997).

Compared to the literature on gender differences in influence, substantially less work considers whether gender moderates adolescents' preferences to select friends who participate in similar problem behaviors as their own. Yet, the different nature of girls' and boys' friendships

may cause adolescents to have dissimilar experiences with friend selection processes. Since girls are shown to prefer more intimate friendships, they may also be more selective in who they chose as friends and especially prefer those who have similar interests as their own (Haynie et al. 2014).

Empirical evidence, again, has uncovered inconclusive findings on gender differences in friend selection. Haynie and her co-authors (2014) found that girls have a greater preference to select friends that participate in similar violent and delinquent behaviors as their own. Burk et al. (2012) found that in early adolescence, boys have a greater preference to select friends with similar drinking behaviors, but in late adolescence, girls have a stronger preference for same drinking behavior friends. In middle adolescence, no gender difference in friend selection was observed.

These conflicting findings on the role of gender in influence and selection processes may be the result of several factors. For instance, previous studies have relied on different types of survey items to measure the behavior of one's friends. Some use respondents' perceptions of their friends' behavior (e.g. Piquero et al. 2005), but respondent perceptions have been shown to over-estimate similarity between friends and respondents (Hogset and Barrett 2010). Because of these biases, other studies have collected complete friendship network data by asking all students in a school or classroom to report both their individual behaviors and nominate their closest friends. However, complete network studies are not without their limitations. Studies that analyze complete network data tend to study small, non-representative samples. They tend to rely on data from one or two networks (e.g. Haynie et al. 2014), preventing us from studying how gender relates to peer influence and friend selection across a variety of social contexts. Scholars have applied numerous analytical techniques to test for gender differences in peer

influence and friend selection. Earlier studies often used lagged regression to piece apart the effects of influence from friend selection, while more recent work has employed SAB models (e.g. Osgood et al. 2015, Weerman and Hoeve 2012).

Because of these inconsistencies, my study considers whether girls or boys are more influenced by the problem behaviors of their friends. Relatedly, I aim to further our understanding of how gender moderates the relationship between problem behavior and friend selection. In other words, are adolescent girls or boys more likely to select friends who exhibit similar rates of delinquency, drinking, and smoking as their own? By analyzing a relatively large set of friendship networks for sixth through ninth graders, a period of time when adolescents are most likely to exhibit similar problem behaviors as their friends (Burk et al. 2012), my study will add considerable evidence to the current debate.

2.4: Variations in influence and selection by behavior

Studies that consider gender variation in selection and influence tend to base their conclusions on the analysis of a single problem behavior (e.g. Burk et al. 2012, Haynie et al. 2014, Mercken et al. 2010b). However, to better theorize why gender variations in selection and influence exist, it is necessary to consider whether these variations manifest similarly across a variety of different behaviors. The current study asks whether one gender is consistently more prone to peer influence or more apt to select friends with similar behaviors, regardless of the specific problem behavior of interest. The extent to which similar gender variations are observed across multiple problem behaviors would suggest that individuals' experiences with peer influence and friend selection are continuously shaped by gender socialization and construction.

On the other hand, gender variations in selection and influence may only be present in the analyses of certain problem behaviors. Such a finding would imply that a problem behavior's characteristics and the norms that surround it may be responsible for these gender differences. For instance, delinquent behavior, especially that which is violent, tends to be more normative for boys than it is for girls. Since it is not as socially acceptable for girls to get involved with delinquency, a delinquent may have more influence over a female friends' behavior than that of a male friend. Boys may be drawn to delinquency due to a wide variety of other factors, such as the perceptions of boys and men in the media. For girls to become involved in delinquency, the presence of a delinquent friend may be necessary, while boys may get involved regardless of their friends' behaviors (Haynie et al. 2014). On the other hand, current gender norms regarding tobacco use are not as strict. Though boys historically smoked at higher rates than girls, this gender gap has become virtually nonexistent in recent decades (US Department of Health and Human Services 2012). Because of similar smoking rates, girls' and boys' tobacco use may be equally influenced by the behaviors of their friends.

By considering three separate problem behaviors, the current study seeks to further understand whether gender differences in selection and influence are comparable across multiple problem behaviors. If gender differences in selection and influence exist, do they exist for all problem behaviors? Or are some problem behaviors particularly characterized by gender differences in selection and influence?

3: METHODS

3.1: Data

For my analysis, I utilize data on 13,214 students who participated in the Promoting School-Community Partnerships to Enhance Resilience (PROSPER) study. Students attended school in one of 28 small public school districts during their sixth through ninth grade years. Half of the districts were located in Iowa and the other half were in Pennsylvania. All participating districts are located in either rural or semi-rural communities, each enrolling between 1,300 and 5,200 students. To increase socio-economic diversity in the sample, it was required that at least 15 percent of students in each district qualified for free or reduced lunch. Furthermore, half of the districts were randomly selected to participate in a substance abuse prevention program. The program took place during students' sixth and seventh grade years and included both a school- and family-based component.

The data include five waves of panel data for two cohorts of students. One cohort began sixth grade in 2002 and the other started in 2003. Self-administered surveys were distributed at each school during the fall and spring of students' sixth grade years and during the spring of students' seventh through ninth grade years. Both response and retention rates remained relatively high throughout the survey. At each wave, 86 to 90% of eligible students participated. Students who were present at the first wave of the study participated in an average of 4.18 waves.

For the purpose of my analysis, it was necessary to omit students who attended certain schools. One community did not allow for the collection of friendship network data, another experienced a fire during the course of the study, and one cohort joined the study a year late.

After making these omissions, my sample includes roughly 9,000 students per wave. All students hail from one of 51 school networks.

Though the PROSPER dataset is not nationally representative, there are important benefits to the current study. Most notably, it includes data on over fifty complete friendship networks. In each wave of the survey students were asked, "who are your best and closest friends in your grade?" They were allowed to nominate up to two "best friends" and as many as five "other close friends." Since participants were not provided a class roster and were instead asked to recall their friends' names from memory, two coders, aided by a computer program, matched nominations to actual respondents with a 98% concordance rate. 83% of the nominations were successfully tied to other students in the study and 14.7% appeared to be for students who were either in another grade level or attended a different school. Only 1.9% of names could not be matched because there existed multiple possible matches and 0.4% of names were implausible (i.e. names of celebrities). For the purpose of this study, only within school and within grade friendship nominations will be considered.

3.2: Variables

All three dependent variables, delinquency, drinking, and smoking, are based on individuals' responses to survey questions. The measure I use for delinquency combines student responses from twelve different survey questions related to delinquent activity, following previous work by Elliot, Huizing, and Menard (1989). Students were asked to report how many times they skipped class, got into physical fights, stole property, vandalized, etc. in the past year. Students responses for all twelve questions varied from 1= *never* to 5 = *5 or more times*. Using a technique criminologists refer to as variety scoring, I summed the number of events that each

adolescent admitted to participating in at least one time in the past year (Sweeten 2012). This resulted in a measure ranging from 0 to 12, with 0 indicating no delinquent activity and 12 indicating maximum involvement. Furthermore, because the delinquency measure was positively skewed, it was necessary to recode these variables into four categories: *no delinquency* (delinquency variety score = 0), *one delinquent activity in the past year* (score = 1), *moderate delinquency* (score = 2 or 3), and *high delinquency* (score = 4 through 12). Similar categorizations of delinquency have been used in previous literature (see Osgood et al. 2015).

Individual drinking and smoking were measured from students' responses to the following survey questions: "During the past month, how many times have you had beer, wine, wine coolers, or hard liquor?" and "During the past month, how many times have you smoked any cigarettes?" Students response ranged from 1= *none* to 5 = *more than once per week*. Because initial rates of drinking and smoking were extremely low, it was necessary to recode students' past month participation into three ordered categorical measures: 0 = *none*, 1= *once in the past month*, and 2 = *more than once in the past month*.

A dummy variable for gender was included in all of the analyses where 1 = *boy*. Additionally, several control variables were included that have been shown to influence either changes in individual problem behavior or changes in friendship structure (Osgood et al. 2015). Controls include binary measures for race (1 = *white*), family structure (1 = *lives with both biological parents*), and whether the student experienced a school transition or merger during the previous wave (1 = *experienced a transition/merger*). Measures for family relations, school bonding/adjustment, and sensation seeking were created by averaging the subscale responses for related survey questions (following Simons et al. 1991 and Zuckerman 1994).[1] All measures are

[1] The family relation measure averaged four questions, the school bonding/adjustment averaged eight questions, and the sensation seeking averaged three questions.

coded so that higher values indicate better family relations, greater school bonding/adjustment, and a higher propensity for sensation seeking, or risk taking.

3.3: Plan of Analysis

SAB models and SIENA*:* For this study, I test my research questions using SAB (Stochastic Actor-Based) models constructed with SIENA (Simulation Investigation for Empirical Network Analysis) statistical software (Snijders 2001; Steglich, Snijders, and Pearson 2010). This analytic technique is ideal for studying how friend selection and peer influence vary among subgroups, because it offers solutions to three of the primary issues that arise when analyzing panel network data. First, it is well-documented that the individuals in a social network do not operate independently (Wasserman and Faust 1994). Since most statistical techniques, such as regression, assume that observations are independent, these methods are considered to be inappropriate for the analysis of network data. Second, SAB models allow one to control for alternative processes that also drive network evolution. These alternative processes include reciprocity, or the tendency to nominate a friend who previously nominated you, and transitivity, or the tendency to become friends with your friends' friends. Analytic techniques that do not account for these endogenous network processes may overstate adolescents' preferences for choosing friends with similar problem behavior as their own (Steglich et al. 2010).

Finally, traditional statistical techniques that analyze panel data cannot account for the fact that the evolution of friendship ties and individual behavior are continuous processes. Since panel data only provide measurements taken at discrete time points and there will always be uncertainty about what happened between waves of data. For instance, the following scenario represents a potential consequence of solely relying on discrete time points to measure selection

and influence processes: at time 1, student A, a non-smoker, is friends with student B, a smoker. At time 2, student A and B are still friends, but now student A has also picked up smoking. From only considering these two time points, one would conclude that student B's behavior influenced student A to begin smoking. However, it is possible that during the period between the two time points, the friendship between students A and B dissolved, student A picked up smoking due to factors other than student B's influence, and then, because of their similar smoking behavior, students A and B rekindled their friendship. The second possibility would provide evidence that, instead of influence processes, observed selection mechanisms contributed to the smoking homophily. By simulating how both friendships and behaviors change between waves, SAB models allow us to make better informed conclusions about the strength of selection and influence processes while still relying on observed panel data.

SAB models consist of two components that operate simultaneously: one models changes in friendship and the other models changes in individual behavior participation. Each component uses data from the first wave as starting values and simulates the evolution of either friendship or behavior by allowing randomly-selected individuals to make forward-looking changes. Within the network evolution model, each randomly-selected student can form a new friendship, dissolve a pre-existing friendship, or make no changes. For analyzing evolution in the behavioral change model, it is necessary that the behavior of interest be coded as an ordered categorical variable. Selected individuals increase their behavior by one unit, decrease their behavior by one unit, or keep their behavior at the same level. Changes in friendship or behavior are guided by the Markov property, meaning that they are only dependent on the current state of the simulation, not those that preceded it (Snijders 2001).

These individual decisions are governed by user-specified parameters. An individual's behavior will only shift if such a change is understood to be more preferable than his or her current state. Furthermore, after each change is made, estimates for parameters are revised to reflect the model's evolution. As soon as the simulated estimates reflect those in the observed data, the process stops and parameter estimates of structural and behavioral change can be evaluated. These parameter estimates can be exponentiated and then interpreted as odds ratios. For a more detailed discussion of SAB models and dynamic network simulations, refer to Snijders (2001) and Steglich et al. (2010).

Included parameters: The SIENA program requires users to specify which parameters are evaluated in each SAB model. These parameters can fall into two general categories: network evolution parameters and behavioral change parameters. Network parameters include measures of friendship preference; some of the network parameters are purely structural and others are based on individuals' attributes. In the following models, I include network parameters related to my research questions as well as those commonly used as controls for friendship selection.

First, I include several parameters to control for well-established network processes. These parameters are included to reduce bias in the friend selection estimates. The *density parameter* controls for the tendency of individuals to form friendship ties. In large friendship networks, this parameter tends to be negative since it is highly unlikely for an individual to be friends with all of his or her peers. The density parameter reflects the costliness of friendship ties and can be interpreted like an intercept parameter in a logistic regression. The *reciprocity parameter* controls for the tendency of individuals to reciprocate friendships nominations and the *transitivity triplets parameter* controls for the preference to nominate friends of friends. The *transitive reciprocated friendship parameter* can be understood as an interaction between the two

aforementioned parameters; it measures whether transitive nominations tend to be reciprocated. Block (2015) warns that failing to include this parameter biases the reciprocity and transitive triplet parameters by making them artificially low. The *indegree popularity parameter* and *in-in degree assortativity parameters* are often considered concordantly. The indegree popularity parameter measures individuals' inclinations for preferential attachment, or the tendency for popular students to receive more nominations and further increase their popularity. On the other hand, the in-in degree assortativity parameter measures individual's preferences for degree assortative friendships, or friendships between peers of similar popularity levels. Finally, I include the *outdegree-trunc parameter* which is reported as an inverse. Negative outdegree-trunc coefficients indicate that individuals have a tendency make zero friendship nominations.

I then include several attribute-based network parameters that capture the tendency for friendships to form on the basis of individuals' attributes. The *ego parameter* measures whether a specified individual-level attribute is associated with higher odds of making nominations, or higher sociability. For instance, a positive *male ego parameter* would indicate that boys are more likely to nominate friends than are girls, while a negative value would indicate that girls are more sociable. Alternatively, the *alter parameter* considers whether an attribute is associated with higher odds of receiving more friendship nominations, or greater popularity. A positive *male alter parameter* would suggest that boys are more likely to receive friendship nominations, while a negative parameter would suggest that girls are more popular. Finally, the *similarity* and *same parameters* measure the preference for individuals to select friends who have similar attributes as their own. These parameters can be understood as modeling friendship selection processes. The *similarity parameter* is used for continuous attribute variables and the *same parameter* is used for categorical variables. A positive *same gender parameter* indicates that boys have higher odds

of nominating male peers than female peers. In each of the SAB models, I include all three attribute-based network parameters for the problem behaviors of interest as well as for gender and race.

Finally, several behavioral parameters were included in my SAB models. Unlike the network parameters discussed previously, these parameters are included to measure individuals' tendencies to change their level of participation in the behavioral outcome variable. To measure the effect of peer influence I include the *average alter parameter*, which measures how the average behavior level of a respondent's friends relates to the respondent's odds of participating in the behavior. A positive value for this parameter indicates that as the average behavior participation of one's friends' increases, so do an individual's odds of participating in the behavior. Such a finding would give evidence of peer influence. As controls, I also include several *effect from attribute parameters* that measure how specified attributes relate to problem behavior participation. For instance, if the *effect from male gender parameter* coefficient is positive, it would indicate that all else being equal, boys have greater odds than girls for increasing their participation in the behavior of interest.

To explore my research questions, it is necessary to include two parameter interactions in my SIENA models. I interact the *problem behavior of average alter* parameter with the respondent's gender to test for gender differences in the susceptibility to peer influence. To test for gender differences in selection, I interact the parameter for *problem behavior similarity* with respondent's gender.

Meta-analysis: For the purpose of my study, I applied SAB models to all 51 networks in my sample. Since SIENA models only a single network at a time, it was necessary to run analyses on each network individually. I applied three sets of SAB models on all 51 networks

with a different problem behavior (delinquency, drinking, or smoking) as the behavioral outcome variable for each of the sets.

Only models that reached convergence were included in the final analysis.[2] Some network models were unable to converge for certain problem behaviors due to low rates of participation and behavioral change. Because of this, it was necessary to omit one network from the final analysis for delinquency, three from the drinking analysis, and fifteen from the smoking analysis. Previous work that has applied SIENA to multiple networks has taken a similar approach (see Osgood et al. 2015).

To aggregate the SIENA findings for each individual network, I performed a three-level random effects meta-analysis. The first level represents the individual networks and includes variance terms calculated from the results of my SIENA models. The second level is the cohort, accounting for differences between the experiences of the first and second cohorts that participated in the study, and the third level is the school district. To run my meta-analysis, I use HLM software.

[2] For the purpose of this study, the following conditions were necessary for convergence: convergence *t*-ratios between -0.10 and 0.10, overall maximum convergence ratios less than or equal to 0.25, and reasonable standard errors.

4: RESULTS

4.1: Descriptive findings

Descriptive statistics for the entire sample are presented in Table 1. Girls made up slightly more of the sample than boys and the sample was predominately white. Rates of problem behavior were relatively low throughout the course of the study. For instance, 9.86% of students reported part-month smoking and 20.27% reported past-month drinking. Delinquency, however, was reported more frequently, with 43.51% of the sample reporting any past-year delinquency.

Average measures of problem behavior by both wave and gender are provided in Table 2. Average levels of problem behavior participation increased for both girls and boys during the course of the study. Boys continuously had significantly higher mean levels of delinquency than girls, as confirmed by a paired *t*-test. However, delinquency participation increased more rapidly for girls than it did for boys. Across all waves, the percent of girls reporting any past-year delinquency increased from 24.82% in the fall of sixth grade to 48.26% in the spring of ninth grade. The rate of boys participating in any type of delinquent behavior increased from 45.50% at the start of sixth grade to 54.53% in ninth grade.

Gender variations in drinking and smoking are slightly more complex. In the first two waves, collected during students' sixth grade years, boys reported significantly higher mean levels of drinking, but after seventh grade this pattern reversed and girls drank at higher rates than boys. There was no statistically significant difference in mean levels of smoking for boys and girls in the early waves of the study, but in later waves, girls started smoking at significantly higher rates. Both girls and boys increased their drinking and smoking substantially between sixth and ninth grade. The proportion of girls reporting any past month drinking increased by roughly 30% and the proportion of boys increased by around 25%. With regards to past month

smoking, the proportion of girls increased by roughly 17% and the proportion of boys increased by around 12%. Overall, gender differences in the levels of drinking and smoking were less pronounced that they were for delinquency.

A complete friendship network is plotted at two time points in Figure 1. The friendship network represents a single cohort who attended eighth and ninth grade at a school in Pennsylvania. The shape of nodes represents students' gender: girls are plotted as circles and boys as squares. Furthermore, the nodes are colored with respect to students' current smoking status: students reporting past-month smoking are orange and non-smokers are blue. Friendship homophily by smoking status is visibly clear in both graphs. There is a cluster of smoking boys on the upper left side of the network and a cluster of smoking girls on the upper right side. Apart from these two sections of the friendship network, smoking is relatively uncommon. From comparing the two graphs, it is clear that these adolescents' smoking habits and friendship ties are dynamic; adolescents increase and decrease their smoking while simultaneously adjusting their friendship ties. The network graphs in Figure 1 give convincing evidence for smoking homophily, but cannot explain whether this homophily is the result of friendship selection or peer influence processes.

4.2: Control variables

All SAB models include several network and behavioral parameters as controls. While these parameters are necessary for reducing bias in the selection and influence parameters, they are not directly related to the research questions of this study. Therefore, I will only include a brief overview of these findings. Tables including parameters for all network and behavioral controls are located in the Appendix (see Tables S1, S2, and S3).

All structural network controls were significant and their coefficients estimated as being in the expected direction. In all models, the coefficient for the outdegree (density) parameter was negative and significant, indicating that friendship ties in large networks are rare and that actors send ties to only a small portion of their peers. The positive and significant coefficients for the reciprocity and transitive triplet parameters show a strong tendency for friendship nominations to be reciprocated and for transitive friendships to develop. However, the transitive reciprocated triplets coefficients were all negative and significant, suggesting that transitive friendships have lower odds of being reciprocated. This finding is likely the result of within-group hierarchy; asymmetric friendships can occur within friendship groups because some adolescents are more desirable friends than others (Block 2015). Furthermore, the positive indegree popularity parameters and negative in-in degree assortativity parameters give collective evidence for preferential attachment. The negative outdegree-trunc parameters suggest that actors have a positive tendency towards making no nominations.

Most attribute-based network controls were also significant across models. Girls had greater odds of sending friendship nominations while boys had higher odds of receiving nominations. Non-white students were more likely to receive nominations, but adolescents across all racial groups were equally likely to send nominations. All students had higher probabilities of selecting friends who shared their gender and race. Furthermore, both school transitions and mergers decreased the likelihood that individuals would send nominations.

The majority of the behavioral controls were also statistically significant and in the expected direction. Students with better quality family relationships and greater levels of school bonding had higher odds of decreasing their participation across all three problem behaviors. Those with higher propensities for taking risks were more likely to increase their delinquency,

drinking, and smoking. The effect of race was only significant in the delinquency model; non-white students were expected to report increased levels of delinquency. Living with both biological parents had a protective effect against delinquency and smoking, but no significant effect on drinking.

4.3: Peer influence and friend selection

The SAB simulation results for delinquency, drinking, and smoking are reported in Table 3. The upper section of the table presents coefficients for network evolution parameters, while the coefficients presented in the bottom half estimate behavior change parameters. The first model for each problem behavior tests for the existence of peer influence and friend selection in the general population. The coefficients of the friends' average behavior parameters are positive and significant for delinquency ($b = 0.287$, $p < 0.001$), drinking ($b = 0.827$, $p < 0.001$), and smoking ($b = 0.930$, $p < 0.001$). These findings suggest that all youth in my sample were influenced by the delinquency, drinking, and smoking of their friends, even after controlling for friendship selection processes. For example, if the average drinking level of an adolescent's friends increases by one, the adolescent has roughly 129% greater odds of increasing his or her drinking, all else being equal. The behavior similarity parameter, which measures the tendency for adolescents to select friends who participate in similar problem behaviors as one's own, is also positive and significant for delinquency ($b = 0.216$ $p < 0.001$), drinking ($b = 0.278$, $p < 0.001$), and smoking ($b = 0.405$, $p < 0.001$). This finding suggests that all adolescents, regardless of gender, prefer to select friends who participate in similar problem behaviors as their own, indicating that influence does not account for all of the observed behavior homophily. Odds ratios correspond to ones' odds of choosing a friend with identical problem behavior as one's

own versus a friend whose behavior is on the opposite end of the spectrum. To illustrate this finding with an example, an adolescent with high delinquency has roughly 24% higher odds of befriending a highly delinquent peer than befriending a peer with no reported delinquency.

The second model for each behavior contains two interaction terms that directly test my research questions. To test for whether gender significantly moderates the relationship between peer influence and individual problem behavior, I include an interaction between the effect of friends' average behavior parameter and the effect of being male parameter. For delinquency, the interaction is both negative and significant (b = -0.183, $p < 0.001$), indicating that girls are more prone to be influenced by their friends' delinquent behavior. While the delinquent behavior of all adolescents in the sample was affected by the average delinquency of friends, boys are significantly less influenced by their friends' average delinquent behavior, all else being equal. In other words, a one unit increase in friend's average delinquency increases both girls' and boys' odds of escalating their individual delinquency. However, the effect of a one unit increase in friends' average delinquency on a respondent's odds of changing behavior is 16.72% lower for boys than it is for girls. In an extreme case where all of a respondent's friends report the maximum level of delinquency, a female respondent would have 213.93% greater odds of increasing her delinquency while a male would only have 61.61% greater odds. As the average delinquency of a girl's friends increases, her odds of becoming more delinquent increase rapidly. This escalation is not as pronounced for their male peers (see Figure 2).

The interaction parameters between the effect of friends' average behavior parameter and the effect of being male parameter were insignificant in the drinking and smoking models, suggesting that gender did not moderate the relationship between peer influence and individual

drinking or smoking behavior. Girls and boys were similarly influenced by the smoking and drinking behaviors of their friends.

The second set of models presented in Table 3 also tests whether one gender is more apt to select friends who participate in similar behaviors as their own. Specifically, each model includes an interaction term between the behavior similarity and male ego parameters. The coefficients of this interaction can provide evidence as to whether gender moderates the relationship between an individual's problem behavior participation and the friendships that he or she makes. For smoking, the coefficient for the interaction is both negative and significant ($b = -0.080$, $p < 0.05$), indicating that, when compared to girls, boys' preferences for friends with similar smoking behavior as their own are not as strong. As noted previously, girls and boys both prefer friendships with peers who smoke at similar levels as their own. However, a boy's odds of selecting a friend with similar smoking habits as his own are 7.69% lower than a girl's odds of making this same tie. Net of all other controls, a non-smoking boy's odds of forming a friendship tie are 11.52% higher if the peer is a non-smoker compared to a peer who smokes the maximum amount (i.e. smokes more than one cigarette per month). On the other hand, a non-smoking girl's odds of forming a friendship tie are 52.50% higher if the peer is a non-smoker compared to a friend who smokes at the maximum amount (see Figure 3). The same type of interaction between the behavior similarity and male ego parameters was not significant for delinquency or drinking, suggesting that the delinquency and drinking homophily observed within girls' and boys' friendships are similarly shaped by selection processes.

5: DISCUSSION AND CONCLUSION

This study aims to better understand how gender moderates adolescents' experiences with peer influence and friend selection by applying dynamic network models to the study of three different problem behaviors. Findings suggest that gender moderates selection and influence processes for some problem behaviors, but not others. For delinquency, the effect of peer influence was significantly greater on girls' behaviors than it was on boys'. Gender did not moderate the relationship between peer influence and individual drinking or smoking. Additionally, girls and boys both preferred forming friendships with peers who participated in similar levels of delinquency, drinking, and smoking as their own. However, when compared to boys, girls were more likely to prefer friends with similar smoking behaviors.

While previous literature has found evidence for gender differences in selection and influence, few have considered why these differences exist for some behaviors, but not others. The findings of the current study imply that we should further consider why gender variations are not consistent across all problem behaviors. For instance, with regards to gender differences in influence from friends' delinquency, boys consistently reported higher levels of delinquency throughout the duration of the observed period. These gender differences in participation were not as pronounced for drinking or smoking. Because delinquent behaviors participation was more normative for boys than it was for girls, influence from friends may have been particularly necessary for girls to get involved in such activities. Observing their friends participate in these delinquent behaviors may have made delinquency appear to be more normative and thus further influenced girls to increase their participation in such behaviors. While influence from friends was still an important factor in explaining boys' delinquency, it may not have been as important

of a mechanism since delinquent behavior participation was more common for boys than girls in my sample.

Furthermore, the models used in this study assume that peer influence has an equal effect on adolescents' decisions to increase or decrease their participation in problem behaviors. However, recent work has suggested that this assumption may not be valid. Haas and Schaefer (2014) find that adolescents are more likely to be influenced by their friends to initiate smoking than to terminate their smoking behavior. In a study conducted by Haynie et al. (2014) that specifically considers how gender moderates the relationship between peer influence and violence participation, they find that compared to boys, girls are more influenced by their friends' participation in violence. They argue that this gender difference occurs because girls are more likely to be influenced by friends to both increase and decrease their participation in violence. Boys, on the other hand, can only be influenced by friends to increase their violent behaviors. Differences in positive and negative influence could help explain why gender variations are not consistent across the three different problem behaviors considered in this study and should be considered in future work. Relatedly, adolescents may have different preferences to select friends as a result of their problem behavior participation. For instance, drinkers may specifically seek out friends who also drink alcohol, while non-drinkers may have little preference as to whether their friends' drinking behaviors to align with their own. Again, these differences in selection by individual behavior could further vary by gender and this should be considered in future research

There are several limitations to my study that should be addressed. First, the PROSPER survey only allowed for students to nominate friends who were in their same grade and attended their same school. However, a number of respondents in the study had friends outside of their

grade or who attended different schools. The study did not collect behavioral data on out-of-school and out-of-grade friends, making it impossible to measure how these friendship ties relate to selection and influence processes. This limitation is particularly relevant to studying gender differences in problem behavior because adolescent girls tend to report higher numbers of older and out-of-school friends than their male peers (Poulin and Pedersen 2007). These friendships can increase female adolescents' exposure to problem behaviors (Poulin, Denault, and Pedersen 2011), which would likely underestimate the effects of peer influence on girls' participation in delinquency, drinking, and smoking in the current study.

Second, students were only given the opportunity to nominate seven friends. Roughly 14% of female students sent all seven nominations, while 8% of boys made all possible nominations. Some of the students in this already small minority may not have been able to nominate all of their peers who they considered to be friends. Since girls were more likely to send out the maximum number of nominations, it is again possible that the current study underestimates how much girls were affected by peer influence and how likely they are to nominate friends with similar problem behavior as their own. However, since the proportion of students who were unable to nominate all of their friends is relatively small, possible biases are apt to be limited.

Finally, due to limitations of the methods used in the current study, it was not possible to differentiate between same-gender and cross-gender friends. When SIENA analyzes SAB models, it does not account for the gender of friends who are either influencing the respondent or being chosen by the respondent. Since previous literature has suggested that cross-gender friends may be more influential, especially on girls' behaviors (Rose and Rudolph 2006), future research

should consider whether peer influence and friend selection processes vary for same- and cross-gender friendship ties.

Despite these limitations, the current study provides convincing evidence that gender moderates the relationship between influence and selection and friendship homophily for some problem behaviors, but not others. By aggregating the separate analyses of over fifty adolescent friendship networks, these findings on gender differences in influence and selection are relatively robust. Furthermore, by applying SAB models to three unique problem behaviors, this study suggests that gender differences in selection and influence processes may be more complicated than has been previously assumed. Differences in influence and selection are not similarly gendered across all problem behaviors; instead, they vary based on the problem behavior of interest.

It is important to note that even when gender differences in influence and selection were statistically significant, these differences were a matter of degree, not direction. For instance, even though girls were significantly more likely to be influenced by the delinquent behavior of their friends, this does not imply that boys' delinquency was immune to the effects of friend influence. Like girls, boys also had significantly higher odds of increasing delinquency participation as the average delinquent behavior of their friends increased; the effect of average friends' delinquency was simply not quite as influential in increasing boys' odds as it was for girls'. The significant gender differences in smoking-based friend selection tell a similar story. Both girls and boys had statistically significant preferences for friends who smoked at similar rates as their own; however, girls had somewhat higher odds for sending out friendship ties to peers with similar smoking behavior. The current study's findings compliment recent research that argues that differences in male and female friendships tend to be exaggerated (e.g. Felmlee,

Sweet, and Sinclair 2012; Giordano 2003). Gender and friendship scholars should be cautious when discussing the variation in girls' and boys' experiences with friendship. While the strength of influence and selection processes can significantly differ for girls and boys, adolescents' experiences with these processes tend to be more alike than they are different.

The results of the current study can also further inform prevention and intervention campaigns related to adolescent problem behaviors. For instance, since girls are more influenced by their friends' participation in delinquency, such campaigns should make an effort to utilize examples of girls resisting peer pressure to participate in delinquent acts. However, as mentioned previously, prevention and intervention specialists should be wary not to overemphasize gender differences in influence and selection since the behavior homophily observed in both girls' and boys' friendship groups tends to be similarly shaped by both of these processes. By better understanding girls' and boys' experiences with peer influence and friend selection, prevention and intervention campaigns can be improved to help further reduce the short- and long-term mortality consequences associated with adolescent problem behavior.

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APPENDIX

Table 1: Descriptive Statistics

	Mean	S.D.	Min.	Max.
Delinquency	1.830	1.091	1	4
Drinking Alcohol	0.302	0.639	0	2
Smoking	0.166	0.523	0	2
Gender	0.486	-	0	1
Race	0.813	-	0	1
Lives with Both Bio. Parents	0.609	-	0	1
Family Relations	-0.009	0.502	-2.997	1.188
School Adjustment & Bonding	3.788	0.766	1	5
Sensation & Risk Taking	2.138	1.002	1	5

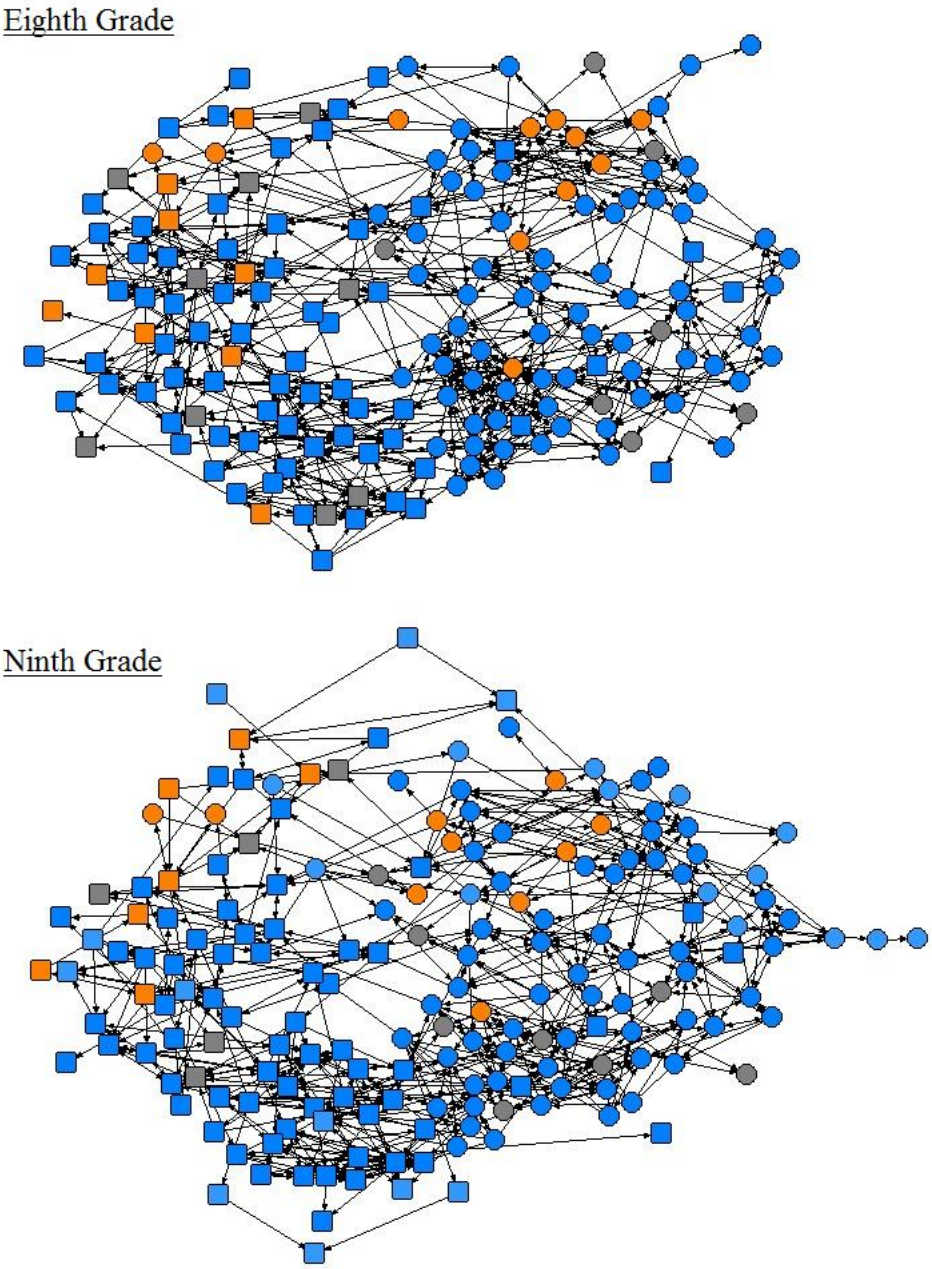
Note: for each wave, average n = 9,135.

Table 2. Descriptive Statistics by Wave and Gender

	Delinquency			Drinking Alcohol			Smoking Tobacco		
	Girls	Boys		Girls	Boys		Girls	Boys	
6th Grade	1.394	1.781	***	0.089	0.124	***	0.045	0.051	
(Fall)	(0.012)	(0.016)		(0.005)	(0.007)		(0.004)	(0.005)	
6th Grade	1.463	1.863	***	0.131	0.172	***	0.070	0.078	
(Spring)	(0.013)	(0.016)		(0.006)	(0.007)		(0.005)	(0.005)	
7th Grade	1.650	1.985	***	0.240	0.254		0.155	0.007	*
	(0.014)	(0.017)		(0.008)	(0.009)		(0.131)	(0.007)	
8th Grade	1.848	2.128	***	0.406	0.376	*	0.251	0.183	***
	(0.016)	(0.017)		(0.010)	(0.010)		(0.009)	(0.008)	
9th Grade	1.959	2.156	***	0.583	0.550	*	0.355	0.279	***
	(0.016)	(0.018)		(0.012)	(0.012)		(0.010)	(0.010)	
All Waves	1.676	1.992	***	0.300	0.304		0.182	0.149	***
	(0.007)	(0.008)		(0.004)	(0.004)		(0.004)	(0.003)	

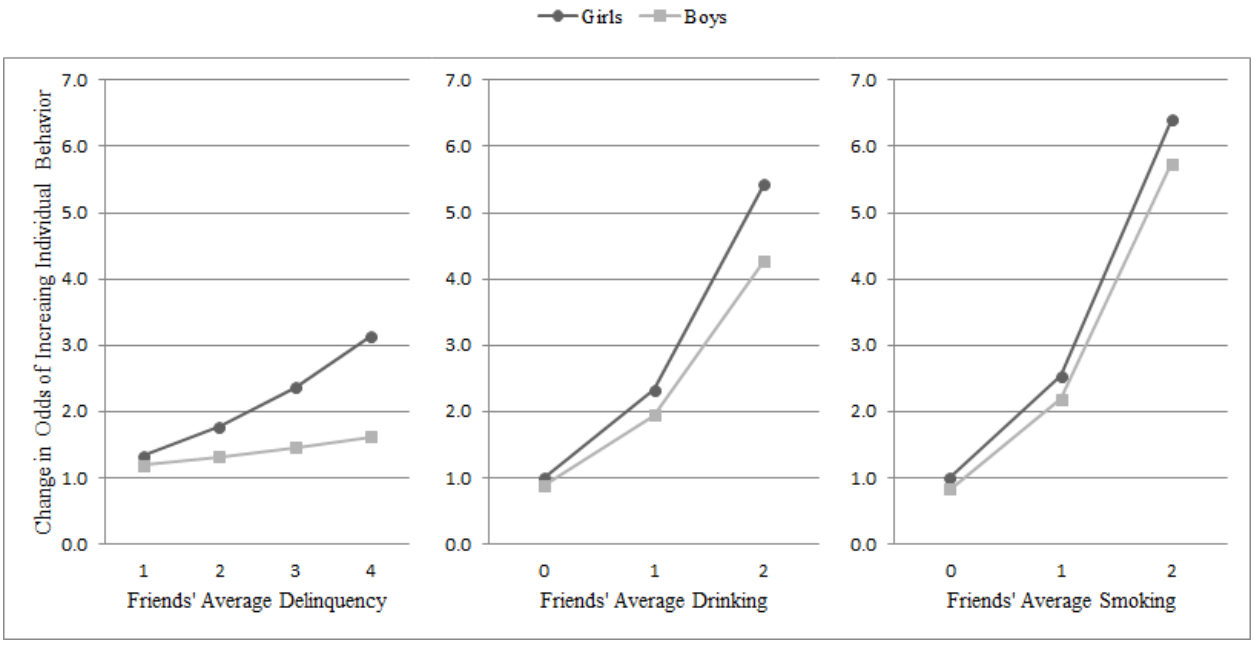
Notes: * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$, for paired t-test of difference in means. Standard errors are in parentheticals.

Figure 1: Friendship Networks of a School in Pennsylvania during Eighth and Ninth Grade



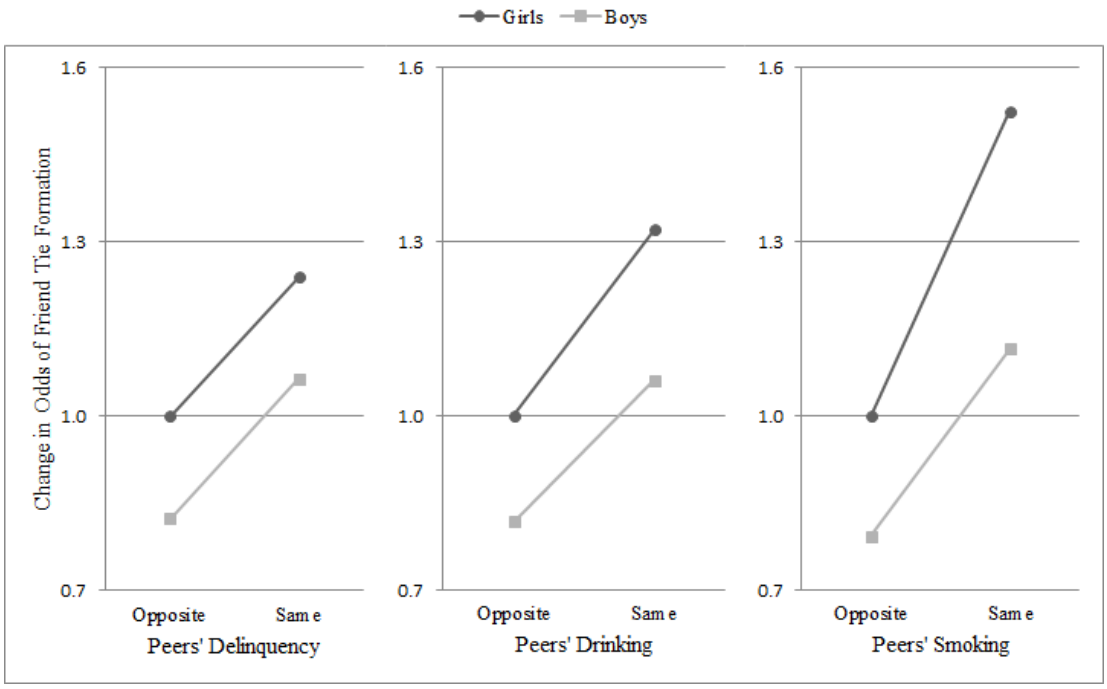
Notes: Orange nodes represent current smoker, blue nodes represent non-smokers, and gray nodes represent nodes with missing data on smoking. Circular nodes are female students and square nodes are male students. Graphs are for eighth and ninth graders from a single cohort who attended the same school (community #215). All nodes have been locked in place so students are located at the same coordinates for both graphs. Isolates have been removed.

Figure 2: Differences in Influence for Girls and Boys on Delinquency, Drinking, and Smoking



Notes: The y-axis reports how the average behavior participation of friends relates to a respondent's decision to change his or her own behavior. All coefficients have been exponentiated. A y-value that is greater than 1 indicates that the respondent is expected to increase his/her behavior, while a y-value less than 1 indicates that a respondent is expected to decrease his/her behavior. A y-value equal to one indicates that the respondents' odds of changing his/her behavior remain unchanged.

Figure 3: Differences in Selection for Girls and Boys on Delinquency, Drinking, and Smoking



Notes: The y-axis reports how a peer's behavior similarity relates to a respondent's odds of forming a friendship tie. All coefficients have been exponentiated. A y-value that is greater than 1 indicates that the respondent has increased odds of sending a tie, while a y-value less than 1 indicates that the respondent has decreased odds of sending a tie. A y-value equal to one indicates that the respondents' odds of tie formation remain unchanged.

Table 3: SAB Models for Gender Variations in Selection and Influence for Delinquency, Drinking, and Smoking

	Delinquency				**Drinking Alcohol**				**Smoking Tobacco**			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
Network Evolution Parameters:												
Male alter	0.093	***	0.094	***	0.102	***	0.105	***	0.111	***	0.109	***
	(0.010)		(0.010)		(0.010)		(0.010)		(0.011)		(0.011)	
Male ego	-0.195	***	-0.194	***	-0.198	***	-0.202	***	-0.223	***	-0.233	***
	(0.013)		(0.014)		(0.014)		(0.014)		(0.015)		(0.015)	
Same gender	0.657	***	0.661	***	0.661	***	0.664	***	0.657	***	0.662	***
	(0.025)		(0.025)		(0.025)		(0.025)		(0.028)		(0.026)	
Behavior alter	0.059	***	0.058	***	0.136	***	0.138	***	0.164	***	0.174	***
	(0.006)		(0.006)		(0.010)		(0.010)		(0.020)		(0.021)	
Behavior ego	-0.010		-0.008		0.028		0.034	*	0.027		0.023	
	(0.008)		(0.007)		(0.015)		(0.016)		(0.025)		(0.022)	
Behavior similarity (selection)	0.216	***	0.215	***	0.278	***	0.278	***	0.405	***	0.422	***
	(0.028)		(0.028)		(0.022)		(0.025)		(0.046)		(0.030)	
Behavior similarity x male ego			0.042				-0.017				-0.080	*
			(0.046)				(0.055)				(0.030)	
Behavior Change Parameters:												
Friends' average behavior (influence)	0.287	***	0.286	***	0.827	***	0.846	***	0.930	***	0.928	***
	(0.017)		(0.019)		(0.047)		(0.047)		(0.079)		(0.073)	
Effect from male	0.042	**	0.068	***	-0.140	***	-0.122	***	-0.170	***	-0.180	***
	(0.010)		(0.011)		(0.013)		(0.027)		(0.024)		(0.033)	
Friends' behavior x effect from male			-0.183	***			-0.058				0.035	
			(0.041)				(0.066)				(0.179)	
Effect from race	-0.076	***	-0.077	***	-0.004		-0.006		-0.031		-0.039	
	(0.022)		(0.022)		(0.027)		(0.027)		(0.019)		(0.020)	
Effect from living with both parents	-0.127	***	-0.128	***	-0.030		-0.030		-0.221	***	-0.216	***
	(0.016)		(0.016)		(0.020)		(0.019)		(0.032)		(0.031)	
Effect from family relations	-0.202	***	-0.202	***	-0.144	***	-0.151	***	-0.156	***	-0.174	***
	(0.016)		(0.022)		(0.020)		(0.021)		(0.029)		(0.029)	
Effect from school bonding	-0.132	***	-0.130	***	-0.183	***	-0.187	***	-0.233	***	-0.245	***
	(0.012)		(0.010)		(0.012)		(0.013)		(0.016)		(0.017)	
Effect from sensation/risk seeking	0.097	***	0.097	***	0.150	***	0.156	***	0.136	***	0.148	***
	(0.007)		(0.007)		(0.010)		(0.011)		(0.013)		(0.011)	

Notes: Estimates are presented as *b*-coefficients. Standard errors are in parentheticals. Models also include rate, shape, structural, and attribute-based selection parameters that are not shown. Delinquency models include 50 networks, drinking include 48, and smoking include 36. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S1: SAB Models for Delinquency

	Model 1			**Model 2**		
	b coef.	s.e.		*b* coef.	s.e.	
Network Evolution Parameters:						
Constant friends rate (time 1)	11.349	0.425	***	11.324	0.421	***
Constant friends rate (time 2)	21.257	0.788	***	21.059	0.935	***
Constant friends rate (time 3)	18.195	0.748	***	18.050	0.718	***
Constant friends rate (time 4)	15.764	0.682	***	15.767	0.683	***
Outdegree (density)	-3.072	0.061	***	-3.080	0.060	***
Reciprocity	2.377	0.046	***	2.375	0.046	***
Transitive triplets	0.750	0.019	***	0.751	0.019	***
Transitive reciprocated triplets	-0.514	0.024	***	-0.513	0.024	***
Indegree-popularity (sqrt)	0.487	0.026	***	0.490	0.024	***
Outdegree-trunc	-2.522	0.125	***	-2.519	0.125	***
In-in degree assortativity	-0.243	0.011	***	-0.244	0.011	***
Male alter	0.093	0.010	***	0.094	0.010	***
Male ego	-0.195	0.013	***	-0.194	0.014	***
Same gender	0.657	0.025	***	0.661	0.025	***
White alter	-0.123	0.016	***	-0.123	0.016	***
White ego	-0.025	0.015		-0.026	0.015	
Same race	0.180	0.024	***	0.180	0.024	***
Delinquency alter	0.059	0.006	***	0.058	0.006	***
Delinquency ego	-0.010	0.008		-0.008	0.007	
Delinquency similarity	0.216	0.028	***	0.215	0.028	***
Transition ego	-0.192	0.022	***	-0.194	0.023	***
Merger ego	-0.557	0.053	***	-0.557	0.054	***
Delinquency similarity x male ego				0.042	0.046	
Behavior Change Parameters:						
Rate of delinquency change (time 1)	2.466	0.089	***	2.443	0.091	***
Rate of delinquency change (time 2)	3.717	0.214	***	3.821	0.220	***
Rate of delinquency change (time 3)	3.916	0.178	***	3.938	0.189	***
Rate of delinquency change (time 4)	3.956	0.254	***	3.961	0.259	***
Behavior delinquency linear shape	-0.835	0.039	***	-0.823	0.038	***
Behavior delinquency quadratic shape	0.377	0.012	***	0.373	0.012	***
Friends' average delinquency	0.287	0.017	***	0.286	0.019	***
Effect from gender	0.042	0.010	***	0.068	0.011	***
Effect from white	-0.076	0.022	**	-0.077	0.022	***
Effect from living with both bio. parents	-0.127	0.016	***	-0.128	0.016	***
Effect from family relations	-0.202	0.022	***	-0.202	0.022	***
Effect from school bonding	-0.132	0.012	***	-0.130	0.010	***
Effect from sensation seeking	0.097	0.007	***	0.097	0.007	***
Friends' delinquency x effect from male				-0.183	0.041	***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S2: Complete SAB Models for Drinking

	Model 1			**Model 2**		
	b coef.	s.e.		*b* coef.	s.e.	
Network Evolution Parameters:						
Constant friends rate (time 1)	11.321	0.442	***	11.352	0.425	***
Constant friends rate (time 2)	21.148	0.943	***	20.926	0.924	***
Constant friends rate (time 3)	18.020	0.758	***	18.069	0.722	***
Constant friends rate (time 4)	15.566	0.675	***	15.701	0.668	***
Outdegree (density)	-3.067	0.060	***	-3.076	0.063	***
Reciprocity	2.383	0.045	***	2.390	0.047	***
Transitive triplets	0.750	0.019	***	0.758	0.015	***
Transitive reciprocated triplets	-0.511	0.023	***	-0.519	0.023	***
Indegree-popularity (sqrt)	0.484	0.025	***	0.492	0.025	***
Outdegree-trunc	-2.500	0.131	***	-2.560	0.118	***
In-in degree assortativity	-0.242	0.010	***	-0.247	0.011	***
Male alter	0.102	0.010	***	0.105	0.010	***
Male ego	-0.198	0.014	***	-0.202	0.014	***
Same gender	0.661	0.025	***	0.664	0.025	***
White alter	-0.128	0.016	***	-0.124	0.015	***
White ego	-0.024	0.016		-0.018	0.015	
Same race	0.183	0.024	***	0.184	0.025	***
Drinking alter	0.136	0.010	***	0.138	0.010	***
Drinking ego	0.028	0.015		0.034	0.016	
Drinking similarity	0.278	0.022	***	0.278	0.025	***
Transition ego	-0.198	0.024	***	-0.195	0.023	***
Merger ego	-0.572	0.057	***	-0.564	0.057	***
Drinking similarity x male ego				-0.017	0.055	
Behavior Change Parameters:						
Rate of drinking change (time 1)	1.642	0.082	***	1.593	0.079	***
Rate of drinking change (time 2)	2.356	0.168	***	2.310	0.161	***
Rate of drinking change (time 3)	3.582	0.209	***	3.489	0.166	***
Rate of drinking change (time 4)	4.091	0.212	***	4.059	0.209	***
Behavior drinking linear shape	-2.633	0.075	***	-2.617	0.076	***
Behavior drinking quadratic shape	1.475	0.030	***	1.459	0.029	***
Friends' average drinking	0.827	0.047	***	0.846	0.047	***
Effect from gender	-0.140	0.013	***	-0.122	0.016	***
Effect from white	-0.004	0.027		-0.006	0.027	
Effect from living with both bio. parents	-0.030	0.020		-0.030	0.019	
Effect from family relations	-0.144	0.020	***	-0.151	0.021	***
Effect from school bonding	-0.183	0.012	***	-0.187	0.013	***
Effect from sensation seeking	0.150	0.010	***	0.156	0.011	***
Friends' drinking x effect from male				-0.058	0.066	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S3: Complete SAB Models for Smoking Tobacco

	Model 1			**Model 2**		
	b coef.	s.e.		*b* coef.	s.e.	
Network Evolution Parameters:						
Constant friends rate (time 1)	11.406	0.501	***	11.423	0.499	***
Constant friends rate (time 2)	20.629	0.861	***	21.199	1.005	***
Constant friends rate (time 3)	17.884	0.622	***	18.301	0.718	***
Constant friends rate (time 4)	15.562	0.731	***	15.761	0.714	***
Outdegree (density)	-3.064	0.073	***	-3.095	0.068	***
Reciprocity	2.343	0.049	***	2.367	0.052	***
Transitive triplets	0.742	0.019	***	0.753	0.021	***
Transitive reciprocated triplets	-0.502	0.022	***	-0.513	0.025	***
Indegree-popularity (sqrt)	0.505	0.029	***	0.510	0.028	***
Outdegree-trunc	-2.518	0.104	***	-2.603	0.126	***
In-in degree assortativity	-0.249	0.012	***	-0.249	0.012	***
Male alter	0.111	0.011	***	0.109	0.011	***
Male ego	-0.223	0.015	***	-0.223	0.015	***
Same gender	0.657	0.028	***	0.662	0.026	***
White alter	-0.125	0.017	***	-0.124	0.017	***
White ego	-0.022	0.017		-0.021	0.014	
Same race	0.183	0.027	***	0.203	0.026	***
Smoking alter	0.164	0.020	***	0.174	0.021	***
Smoking ego	0.027	0.025		0.023	0.022	
Smoking similarity	0.405	0.046	***	0.422	0.051	***
Transition ego	-0.196	0.022	***	-0.180	0.026	***
Merger ego	-0.556	0.048	***	-0.556	0.049	***
Smoking similarity x male ego				-0.080	0.030	*
Behavior Change Parameters:						
Rate of smoking change (time 1)	1.890	0.274	***	2.020	0.302	***
Rate of smoking change (time 2)	5.149	0.717	***	5.252	0.743	***
Rate of smoking change (time 3)	14.034	4.585	**	6.596	0.610	***
Rate of smoking change (time 4)	7.429	0.926	***	7.156	0.783	***
Behavior smoking linear shape	-5.136	0.131	***	-5.176	0.144	***
Behavior smoking quadratic shape	2.662	0.038	***	2.636	0.037	***
Friends' average smoking	0.930	0.079	***	0.928	0.073	***
Effect from gender	-0.170	0.024	***	-0.180	0.033	***
Effect from white	-0.031	0.019		-0.039	0.020	
Effect from living with both bio. parents	-0.221	0.032	***	-0.216	0.034	***
Effect from family relations	-0.156	0.029	***	-0.174	0.029	***
Effect from school bonding	-0.233	0.016	***	-0.245	0.017	***
Effect from sensation seeking	0.136	0.013	***	0.148	0.011	***
Friends' smoking x effect from male				0.035	0.179	

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$