Adolescents' Friendships, Academic Achievement, and Risk Behaviors: Same-Behavior and Cross-Behavior Selection and Influence Processes

Mariola Gremmen, Christian Berger, Alison Ryan, Christian Steglich, René Veenstra and Jan Kornelis Dijkstra

Tweet

LIU LINKÖPING UNIVERSITY

Adolescents' Friendships, Academic Achievement, and Risk Behaviors: Same-Behavior and Cross-Behavior Selection and Influence Processes

Mariola C. Gremmen[a],
Christian Berger[b], Allison M. Ryan[c], Christian E.G. Steglich[a,d]
René Veenstra[a], and Jan K. Dijkstra[a]

[a] *University of Groningen*
[b] *Pontificia Universidad Católica de Chile*
[c] *University of Michigan*
[d] *Linköping University*

Abstract

This study examined to what extent adolescents' and their friends' risk behaviors (i.e., delinquency and alcohol use) hinder or promote their academic achievement (GPA), and vice versa. Longitudinal data were used (N=1219 seventh-ninth grade adolescents; M age =13.69). Results showed that risk behaviors negatively affected adolescents' GPA, whereas GPA protects against engaging in risk behaviors. Moreover, adolescents tend to select friends who have similar behaviors and friends' behaviors become more similar over time (same-behavior selection and influence). Furthermore, although same-behavior effects seemed to dominate, evidence was found for some cross-behavior selection effects and a tendency in seventh grade for cross-behavior influence effects. Concluding, it is important to investigate the interplay between different behaviors with longitudinal social network analysis.

Keywords: academic achievement; alcohol use; delinquency; early adolescence; RSiena

Adolescents' Friendships, Academic Achievement, and Risk Behaviors: Same-Behavior and Cross-Behavior Selection and Influence Processes

It is well-documented that academic motivation and academic achievement tend to decline in adolescence (Crosnoe & Benner, 2015; Eccles, 2004; Shin & Ryan, 2014). Simultaneously, adolescence is a sensitive period for the initiation of risk behaviors, such as delinquency and substance use (Steinberg, 2007). Academic achievement and risk behaviors do not develop independently, and previous studies have found a negative association between these behaviors (Hinshaw, 1992; Maguin & Loeber, 1996; McEvoy & Welker, 2000). Adolescents' educational success is found to be an important buffer for involvement in delinquency (Maguin & Loeber, 1996), and academic remediation trainings have been shown to reduce risk behavior (Patterson, DeBaryshe, & Ramsey, 1990). Risk-behaving students often show academic failure, as they display more off-task behavior in school, have more difficulties completing homework assignments (Jeynes, 2002; Patterson et al., 1990), and both low academic achievement and engagement in risk behaviors can be the result of a low self-control (Tangney, Baumeister, & Luzio Boone, 2004). Adolescents' friendships can be a potential explanation linking their academic achievement and engagement in risk behaviors.

Establishing friendships is important in adolescence and adolescents spend more time with peers in this period than in any other time in the life course (Allen, Weissberg, & Hawkins, 1995; Witkow & Fuligni, 2010). An increasing body of research using social network analyses focuses on the influencing role of friends in adolescents' behaviors, showing that they exert powerful influences on adolescents' social development, by shaping adolescents' behaviors, including academic achievement and risk behaviors (Brechwald & Prinstein, 2011; Veenstra, Dijkstra, & Kreager, 2017). At the same time, selection processes can explain similarity of friends' behaviors, referring to mechanisms by which individuals select peers as friends who are similar to themselves in specific behaviors or attitudes.

Selecting similar others as friends (homophily, Lazarsfeld & Merton, 1954) generally makes relationships more rewarding, stable, and with less conflict as similar peers understand each other better, communicate in an easier way, and find each other more trustworthy and predictable (Hallinan, 1980; McPherson, Smith-Lovin, & Cook, 2001; Veenstra, Dijkstra, Steglich, & Van Zalk, 2013).

With a few notable exceptions, almost all prior research on the role of peers has solely focused on peer selection and influence in one type of behavior (same-behavior processes). Same-behavior selection and influence processes refer to studying one behavior in isolation from other behaviors. Such research examines whether an individual selects friends based on the same behavior and whether an individual's behavior is predicted by the same behavior of friends. However, such a narrow focus might not be sufficient to capture the dynamic and interwoven nature among friends and their attributes. Friendship selection and influence processes may also be guided by cross-behavior processes, in which individuals choose friends based on the combination with another type of behavior and friends' behavior influences another behavior in the individual (Brechwald & Prinstein, 2011; Giletta, Burk, Scholte, Engels, & Prinstein, 2013). Only one study has explicitly tapped into cross-behavior influence processes and showed that friends' depressive symptoms and friends' impulsivity predicted changes in adolescents' nonsuicidal self-injury behaviors (Giletta et al., 2013).

As there is a clear link between the two behaviors (i.e., academic achievement and risk behaviors) which both develop in the peer context, we aim to gain more insights in the causes and consequences of these behaviors, by studying the interplay between adolescents' and their friends' academic achievement and risk behaviors. In this study we contribute to current research by examining both same-behavior and cross-behavior selection and influence processes in adolescence, for academic achievement and risk behaviors (i.e., delinquency and alcohol use). The main research questions related to cross-behavior selection processes are:

To what extent does adolescents' academic achievement affect friendship selection based on peers' risk behaviors? And to what extent do adolescents' risk behaviors affect friendship selection based on peers' academic achievement? The main research questions related to cross-behavior influence processes are: To what extent do risk behaviors of friends hinder or promote adolescents' academic achievement? And to what extent does friends' academic achievement lead to adolescents' risk behaviors?

Theoretical Background

Same-Behavior Selection and Influence. It is not surprising that peers and friends play a role in adolescents' development, as adolescents spend an enormous part of their time in the company of peers (Brown, Eicher, & Petrie, 1986). Especially after the transition from elementary to secondary school, having friends and being with them is an important aspect of school life for most adolescents (Haynie, 2001). Finding a position within larger peer networks is important for adolescents, resulting in susceptibility for peer influence in these transition years (Altermatt & Pomerantz, 2003). Friends can provide social, emotional, as well as academic support, and often act as role models by setting norms for specific behaviors (Eccles et al., 1993; Lynch, Lerner, & Leventhal, 2013; Rodkin & Ryan, 2012). This includes encouraging or discouraging specific behaviors, such as academic achievement (Gremmen, Dijkstra, Steglich, & Veenstra, 2017). Friends can supply an adolescent with the motivation and attitudes to support specific behaviors, such as risk behaviors or promoting pro-school behaviors. This is related to the social learning theory of Bandura (1977), which holds that students both learn specific behaviors through observing and imitating peers and through receiving social rewards or sanctions (reinforcement).

Although academic achievement in adolescence is important for future chances and opportunities, adolescence is often associated with a downward trend in academic achievement, indicated by more academic failure and school dropout than in earlier years

(Crosnoe & Benner, 2015; Eccles et al., 1993; Shin & Ryan, 2014). Friendship selection and influence processes have been found in previous studies to explain students' academic achievement (Flashman, 2012; Gremmen et al., 2017; Rambaran et al., 2017; Shin & Ryan, 2014). These studies have indicated that adolescents' academic achievement functioned as a sorting mechanism for friendships as well as that friends became more similar over time with regard to academic achievement.

Also, friends may pull adolescents toward risk behaviors. Delinquent behaviors and experimentation with alcohol are salient risk factors in early adolescence and considered normative (Franken et al., 2015; Moffitt, 1993). Risk-behaving adolescents get rewarded by their peers in this time period by obtaining a high social status (Franken, Harakeh, Veenstra, Vollebergh, & Dijkstra, 2016). As risk behaviors develop in the peer context, it is important to examine the role of friends in these behaviors (Dodge, Coie, & Lynam, 2008; Osgood, Feinberg, & Ragan, 2015). Indeed, previous studies have found friendship selection and influence effects on adolescents' alcohol use and delinquency (Burk, van der Vorst, Kerr, & Stattin, 2012; Kiuru, Burk, Laursen, Salmela-Aro, & Nurmi, 2010; Osgood et al., 2015; Steglich, Snijders, & West, 2006). These results indicate that students often select friends based on similarity in risk behaviors as well as become more similar to each other over time.

Cross-Behavior Selection and Influence. To understand the negative interplay between adolescents' academic achievement and risk behaviors, we examine whether the negative association between these behaviors can be explained by friendship selection and influence processes. In line with contemporary theories of development, we align with a relational developmental perspective that highlights the interplay between individual characteristics and the context in affecting development over time (Crosnoe & Benner, 2015; Lerner & Schmid Callina, 2013). Although, in principle, all social network studies exemplify this perspective, only considering one behavior is a big limitation and more narrow than the

vision of a relational developmental system perspective, which advocates looking at different behaviors simultaneously. Hence, our study takes a step forward by considering two related behaviors and their interplay in the peer context over time with the examination of cross-behavior effects.

To understand how both behaviors are related to each other, we use the "maturity gap" as theoretical starting point. Adolescents become more vulnerable to engagement in risk behaviors. One explanation is that in Western societies there is often a discrepancy between physical status (i.e., pubertal maturation) and social status (i.e., being acknowledged as mature, for instance by having autonomy in decision making and access to adult privileges), the so-called maturity gap (Dijkstra et al., 2015; Moffitt, 1993). By engaging in risk behaviors, youth try to assert their independence emphasizing their maturity. Risk-behaving adolescents challenge adult rules and parental authority to get a sense of autonomy (Sentse, Dijkstra, Lindenberg, Ormel, & Veenstra, 2010).

Independence can, however, also be asserted by decreasing efforts in school, as low academic achievement also represents a rebellious reaction against the adult norm to achieve well in school. Hence, in adolescence academic achievement represents adult-approved behavior, which is at odds with risk behavior, reflecting more peer-approved behaviors (Hill & Tyson, 2009; Wallace & Fisher, 2007). In support of this, achieving well in school does indeed not go well together with engaging in risk behaviors as a negative association has been found concurrently and over time between individual adolescents' academic achievement and their risk behaviors (Hinshaw, 1992; McEvoy & Welker, 2000). Moreover, academic achievement generally becomes less positively and risk behaviors more positively associated with social status in the peer group (McEvoy & Welker, 2000).

However, the extent to which adolescents experience the maturity gap differs depending on their timing of biological maturation and their social mature status (Moffitt,

1993). As a consequence, some adolescents might be more inclined to engage in risk behaviors with low academic achievement, whereas other adolescents comply more with adult-approved behaviors (Allen, Porter, McFarland, Marsh, & McElhaney, 2005). The implication of the idea of the maturity gap is that both behaviors should not only be salient attributes in friendship formation and influences processes, but also be interwoven in these processes, resulting in cross-behavior effects.

With regard to friendship selection, risk behaviors and academic achievement might form a defining feature in the formation of friendship groups by affecting adolescents' attraction to and avoidance of certain peers. That is, whether or not adolescents experience the maturity gap affects with whom adolescents prefer to hang out with. Risk-behaving adolescents might prefer peers as friends who also react against adult norms, and share the same values and frustrations, resulting from the maturity gap. In that sense, it is likely that risk-behaving adolescents are more inclined to select low-achieving peers as friends, whereas adolescents who do not engage in risk behaviors might be more likely to befriend high-achieving adolescents. Friendship selection may also function the other way around, with low-achieving adolescents being more inclined to befriend risk-behaving peers, whereas high-achieving adolescents might be more likely to choose peers as friends who do not engage in risk behaviors.

With regard to influence processes, susceptibility to peer behaviors across behaviors might also be driven by experiencing the maturity gap. That is, adolescents who feel trapped in the maturity gap might be more susceptible to peer behaviors that reflect opposing against adult norms; favoring risk behaviors and rejecting academic achievement. As such, different behaviors might constitute a subculture with clear norms either approving or disapproving behaviors. As adolescents generally have a need for social approval (and the avoidance of social rejection) by peers, they adjust their behaviors to that of their friends to be appreciated

by those peers they value and feel most positively about (Brechwald & Prinstein, 2011; Hallinan, 1980). This search for approval by means of meeting peers' approved behaviors might affect different, sometimes incompatible, behaviors. Adolescents might be influenced by the norms for engaging in adult-approved behaviors (i.e., high academic achievement and no engagement in risk behaviors) or peer-approved behaviors (i.e., low academic achievement and engagement in risk-behaviors).

Moreover, friends also provide opportunities for risk behaviors (Osgood et al., 2015). Spending time with peers and engagement in these behaviors might allocate time away from academic-oriented behaviors, such as doing homework. In reverse, having friends who are focused on academic achievement might protect against risk behaviors as their time spending pattern leaves less room for risk behaviors. Thus, risk behaviors of friends might negatively affect adolescents' academic achievement, whereas, in reverse, academic achievement of peers might protect against involvement in risk behaviors.

The Present Study

We examine the interplay between adolescents' and their friends' alcohol use, delinquency, and academic achievement, by focusing on both same-behavior and cross-behavior selection and influence processes using a social network approach. We expect that friends influence adolescents' academic achievement and risk behaviors both directly (same-behavior processes) and indirectly (cross-behavior processes). As the generative processes responsible for this association can come about in two ways, we are interested in the role of adolescents' and their friends' risk behaviors in their academic achievement as well as the role of adolescents' and their friends' academic achievement in their engagement in risk behaviors.

We hypothesize that adolescents select similar-achieving peers as friends (*same-behavior academic selection hypothesis*) and select friends based on similarity in risk behaviors (*same-behavior risk selection hypothesis*). Moreover, we expect that low-achieving

adolescents are more likely to select friends who engage in risk behaviors whereas high-achieving adolescents are more likely to select friends who do not engage in risk behaviors *(cross-behavior academic ego by risk alter selection hypothesis).* Furthermore, we hypothesize that adolescents with no engagement in risk behaviors are more inclined to select high-achieving peers as friends, whereas adolescents who engage in risk behaviors are more likely to select low-achieving peers as friends (*cross-behavior risk ego by academic alter selection hypothesis*).

With regard to influence, we hypothesize that adolescents become more similar with regard to academic achievement to their friends (*same-behavior academic influence hypothesis*) and more similar in risk behaviors to their friends (*same-behavior risk influence hypothesis*). Additionally, we expect cross-behavior socialization effects, in such a way that friends' risk behaviors predict adolescents' academic achievement over time, with friends having high scores on risk behaviors discouraging academic achievement (decreases over time) and those having low scores on risk behaviors promoting academic achievement (increases over time) (*cross-behavior risk influence hypothesis*). Similarly, we hypothesize that friends' academic achievement predicts adolescents' risk behaviors over time, with high-achieving friends discouraging risk behaviors and low-achieving friends promoting risk behaviors (*cross-behavior academic influence hypothesis*).

We test our hypotheses with SNARE data for seventh, eighth, and ninth graders' academic achievement, alcohol use, and delinquency, allowing to assess potential differences between school years. This is particularly relevant in view of the increase of risk behaviors in early adolescence. Partially the same data (the same eighth grade students) has been used to test developmental differences between school years in selection and influence processes with regard to average and cluster-specific academic achievement (Gremmen et al., 2017). Other studies with SNARE data used different subsamples to study the role of parents (Dijkstra et

al., 2015), status (Franken, Harakeh, Veenstra, Vollebergh, & Dijkstra, 2016), self-control (Franken, Moffitt, et al., 2016), and biological maturation (Franken, Prinstein, et al., 2016) in friendship and externalizing behavior dynamics.

We apply stochastic actor-based modelling (RSiena) to unravel same-behavior and cross-behavior selection and influence processes for academic achievement and risk behaviors (i.e., alcohol use and delinquency). RSiena makes it possible to disentangle selection from influence processes by examining changes in relationships and behaviors simultaneously as well as cross-selection and cross-influences of different behaviors (Giletta et al., 2013; Ripley, Snijders, Boda, Vörös, & Preciado, 2016; Snijders, Van de Bunt, & Steglich, 2010; Steglich, Snijders, & Pearson, 2010).

Method

Participants and Procedure

Data stem from the SNARE (Social Network Analysis of Risk behavior in Early adolescence) study, which is a longitudinal project on the social development of early adolescents with a specific focus on adolescents' involvement in risk behaviors (Dijkstra et al., 2015; Franken et al., 2016). Two secondary schools in rural areas were asked and willing to participate: one in the middle (one location) and one in the north of the Netherlands (with four distinct locations), covering the full range of academic tracks. Subsequently, all first- and second-year secondary school students from these schools were approached for enrollment in SNARE (2011-2012). One year later (2012-2013) all new first year students were again approached for participation in the study.

All students received an information letter for themselves and their parents, in which they were asked to participate. If students wished to refrain from participation, or if their parents disagreed with their children's participation, they were requested to send a reply card or email within ten days. This procedure is in accordance with the Dutch law, and has been

used in previous social network studies among children and adolescents (Osgood et al., 2013; Shin & Ryan, 2014). During every assessment, it was emphasized that participation was confidential and could be terminated at any point in time. The study was approved by the Institutional Review Board (IRB) of one of the participating universities.

In total, 1826 students were approached for this study, of which 40 students (2.2%) refused to participate for several reasons, for example, the parent and/or adolescent had no interest, the adolescent was dyslectic, or it was too time consuming. A total of 1786 students participated in SNARE (*M* age Time 1 = 12.91 years, *SD* = 0.70, 50.1% boys, 83.9% Dutch). There were three measurement waves per school year, in October, December, and April.

During the assessments a teacher and research assistants were present. The research assistants gave a brief introduction followed by the students filling in a questionnaire on an individual computer during class, containing both self-reports and peer nominations. Data were collected via questionnaires using 'Cloud Solutions Socio Software' (www.sociometric-study.com). This software was developed for SNARE and allowed students to answer peer nomination questions easily by looking up and selecting their class- or grademates' names from a database. The assessment of the questionnaires took place during regular lessons within approximately 45 minutes. The students that were absent that day were, if possible, assessed within a month.

The present study includes all seventh graders (first year students in secondary education), eighth graders (second year students), and ninth graders (third year students) in the four northern locations in 2012-2013, with three waves per school year. In the seventh grade, there were 19 classrooms (Time 1; *N*=390, *M* age = 12.64, 48.2% boys, 97.7% of the participants was born in the Netherlands, 95.9% of their fathers, and 96.2% of their mothers). In the eighth grade, there were as well 19 classrooms (Time 1; *N*=418, *M* age = 13.64, 50.0% boys, 98.7% of the participants was born in the Netherlands, 96.8% of their fathers, and

96.5% of their mothers). In the ninth grade, there were 21 classrooms (Time 1; *N*=411, *M* age = 14.75, 49.6% boys; 98.6% of the participants was born in the Netherlands, 96.1% of their fathers, and 97.2% of their mothers). Grade level networks were created per wave per school year. See Appendix A for more specific information on the number of students per wave and the missing data due to attrition and dropout. Based on the available information, students had on average less than two classmates in secondary school who attended the same elementary school. Hence, the vast majority of students enter a new peer context when they make the transition to secondary education. Note that students in their first years of secondary school in the Netherlands follow the same courses with the same classmates every school day.

Tracked system

In the Netherlands, secondary schools are organized by a tracked system. At the end of elementary school, where no track differentiation was yet made (in sixth grade; at age 12), students select a secondary school, and the track plays a crucial role in this selection. Students' track is based on a combination of recommendations from their elementary school (which holds records of students' academic development over time), a national test known as 'Citotoets', and their own preferences. The tracks are: pre-university education (with a duration of six years, called 'VWO'), general secondary education (five years, called 'HAVO'; preparation for applied universities), and pre-vocational education (four years, called 'VMBO'). Pre-vocational education covers four sectors (i.e., technology, health and personal care and welfare, economics, and agriculture) and four learning tracks. Three of these tracks have a practical orientation and one has a theoretical orientation.

Some exceptions notwithstanding (as there are combined HAVO/VWO classes), teaching takes places in track-homogeneous classes of 20-25 students who are educated together. Due to academic level differences in academic tests, the grades obtained in this tracked system indicate students' performance with regard to their own educational level.

Some secondary schools offer classes at all academic tracks, whereas others only offer classes at specific tracks. Students rarely change tracks, and when they do, this means they need to change the class of schoolmates they meet on a daily basis. When they have insufficient grades and cannot pass the year, they will repeat a year. Alternatively, they can go to a lower track and not repeat the year. Changes to a higher track are only possible when students have outstanding grades.

For the analyses, we made three categories based on the type of tracks. The lowest track included the pre-vocational track with a practical orientation (30.0%) and the middle track included the pre-vocational track with a theoretical orientation (24.5%). The highest track included both the pre-university and general education tracks (45.4%), as these are both high tracks and often combined within a classroom. In the models, we control for being in the same track (track ego * track alter).

Measures

Friendships within grades were assessed using a peer nomination procedure. Participants were presented the names of their classmates on a computer screen in alphabetical order, starting at a random name. They were asked to nominate their friends ('Who are your best friends?'), followed by the same question concerning friends from the same grade across all locations. Participants were allowed to nominate an unlimited number of same- and cross-gender peers. Based on both the within-class and within-grade nominations, we constructed an overall adjacency matrix for the entire grade at all waves within the school year containing all friendship nominations, with 0 and 1 representing absence and presence of a nomination between actors i and j.

Academic Achievement (GPA; Grade Point Average) was derived from administrative data; adolescents' school report cards. On these school report cards, which are issued four times per school year, adolescents' average grades on all school subjects are

displayed, according to the Dutch grading system (i.e., ranging between 1 and 10, with grades of 5.5 or higher corresponding to a pass). Grades from the first three school report cards match with the data collection waves (i.e., October, December, and April), so we could match the grades obtained for the period preceding data collection with the data collected in the questionnaire.

We calculated the average grades over six school subjects per adolescent if data was at least available for three out of the six subjects: Dutch, English, mathematics, biology, history, and geography. Because RSiena requires dependent variables to be measured on a discrete, ordinal scale, adolescents' grades were categorized into eight subcategories that optimally differentiate the students (see Table 1; Gremmen et al., 2017).

Alcohol use was measured by asking participants to report on how many occasions they consumed alcohol during the last three months (T1) or since the previous questionnaire (T2 and T3), using a 13-point scale ranging from 0 to over 40 times (Wallace et al., 2002). As the prevalence of alcohol use is relatively low in the examined age period, we decided to recode this variable as binary, indicating no use at all (0) or any use (1). This recoding allowed for an examination of whether students drank alcohol in the last three months, instead of the amount of alcohol use.

Delinquency was measured by asking participants how often (using a five-point scale, ranging between 0 and 12 or more times) they had been involved in 18 types of antisocial behavior during the last three months (T1) or since the previous questionnaire (T2 and T3); including stealing, vandalism, burglary, violence, weapon carrying, threatening to use a weapon, truancy, contact with the police, and fare evasion in public transport. The scale was based on the 12 questions frequently used in Dutch research (Nijhof, Scholte, Overbeek, & Engels, 2010), and six additional items which reflect other important delinquent behaviors (e.g., Van Der Laan, Veenstra, Bogaerts, Verhulst, & Ormel, 2010). As the engagement in

14

delinquent behaviors is relatively low in the examined age period, we decided to recode this variable as binary, indicating no engagement at all (0) or any engagement (1).

Gender was coded 0 for girls and 1 for boys.

Analytical Strategy

Social Network Analysis

Adolescents' development of academic achievement and risk behaviors were examined using the Simulation Investigation for Empirical Network Analysis (Siena) software package in R (Ripley et al., 2016; Snijders et al., 2010), package version 1.1.304. The co-evolution of adolescents' friendship networks and behaviors are estimated by stochastic actor-based simulation models. In this way, we are able to assess the contributions of same-behavior and cross-behavior selection and influence processes to friends' similarity in academic achievement and risk behaviors (Steglich et al., 2010). Similarity needs to be understood here in a correlational sense: two adolescents are similar to the degree that their behavior scores differ in the same direction from the average adolescent's scores in the grade.

Both adolescents'friendships and behaviors are assumed to change continuously between observation moments, based on individual preferencesEnough stability as well as change is needed between time points to reach model convergence. Adolescents' friendships (i.e., creating a new friendship or dropping an existing one) as well as their behaviors (i.e., by going one or more steps up or down in behavior) may change in response to the current friendship structure and the behaviors of other adolescents in the network. Overall, it is thus a dynamic process in which the model controls for changes in both adolescents' friendships and behaviors as well as structural and individual effects on these changes in friendships and academic and risk behaviors. These changes in adolescents' friendships and behaviors are modeled as the result of their decisions, revealing an underlying preference measure

('objective function') indicating how 'satisfied' adolescents are with their local network neighborhood configuration.

In this study, we estimated friendship dynamics (including same-behavior and cross-behavior selection parameters) and behavior dynamics (including same-behavior and cross-behavior influence parameters) for academic achievement, alcohol use, and delinquency. In the model specification, in the following subparagraph, the parameters are explained and tested using *t*-ratios (parameter estimate divided by its standard error), similar to other generalized linear models.

Model Specification

Analyses in RSiena include parameter estimates related to both network dynamics (structural network and behavior-dependent selection dynamics) and behavior dynamics (behavior tendencies and influence effects). Using the Robbins-Monro stochastic approximation algorithm (see Ripley et al., 2016), parameter estimates are derived from iterative simulations. Table 2 provides an overview and textual and visual explanation of the main effects in the model. Most of the included effects function as control measures in order to more accurately assess selection and influence effects with regard to adolescents' behaviors (academic achievement, alcohol use, and delinquency). Friendship networks were analyzed on a grade level (seventh, eighth, and ninth grade) and separate models were analyzed for the interplay between alcohol use and GPA, and delinquency and GPA. Moreover, time-heterogeneity was tested running models separately per period within each school year and no differences were found in parameter estimates..

The network dynamics part of the model consists of the following effects. *Rate parameters* reflect the rate of change in adolescents' friendships between time points, indicating whether there is enough change in the friendship network. We also included the most common *structural network effects* in our model (Veenstra et al., 2013). *Density*

(outdegree) refers to adolescents' tendency to nominate others. *Reciprocity* reflects adolescents' tendency to reciprocate received nominations by peers. *Transitive triplets* and *reciprocated transitive triplets* concern the transitive closure of adolescents ('friends of friends become friends') and its interaction with reciprocity, respectively (Block, 2015). *Three cycles* represent nonhierarchical cycles of generalized reciprocity (i.e., adolescent A nominates adolescent B, adolescent B nominates adolescent C, and adolescent C nominates adolescent A). Moreover, *ego)* effects (sender; given nominations) and *alter* effects (receiver; received nominations) were included for adolescents' gender, track, alcohol use, delinquency, and GPA. For example, *gender ego* and *gender alter* show to what extent gender affects the number of nominations given and received, respectively.

Furthermore, we estimated the *ego * alter* effect (selection effect) for track, GPA, alcohol, and delinquency, which measures whether adolescents with high (low) scores selected others who also scored high (low), showing whether similarity between ego and alter increases the probability of a friendship between them. For gender, class, and location, we tested the effect for having the same gender, being in the same class or at the same location. For example, the *same gender* effect indicates whether girls nominate more girls and boys nominate more boys as friends. Finally, we included the cross-behavior selection effects between GPA and both risk behaviors in the network dynamics part, for example the *alcohol ego * GPA alter* effect, which indicates whether adolescents with high (low) scores on alcohol use selected others who had high (low) GPA scores.

The behavior dynamics part of the model consists of the following effects. *Rate parameters* refer to the rate of change in GPA, delinquency, and alcohol use between time points, indicating whether there is enough change in these behaviors. The *average alter effect* (same-behavior influence effect) estimates whether adolescents' academic achievement, alcohol use or delinquency were higher for adolescents whose friends also had higher scores

on the same behavior, showing whether adolescents tend to behave similarly to their friends over time. Moreover, we estimated the *alter's (friendship) average alter* (cross-behavior influence effect), indicating whether a friends' GPA, alcohol use, or delinquency influenced adolescents' behavior in a different domain. Hence, it indicates, for example, whether adolescents changed their risk behaviors in response to their friends' GPA.

We also included the *linear shape* effect (overall tendency) and the *quadratic shape* effect to control for the overall mean and variance of adolescents' behaviors This latter effect can only be included for variables with more than two categories, here GPA. A negative parameter indicates pulling towards the mean, whereas a positive parameter indicates pushing away from the mean. Also, the effect of indegree on the behaviors was estimated (e.g., do received friendship nominations make an adolescent drink/being delinquent/having high grades?) as well as the outdegree (e.g., do given friendship nominations make an adolescent drink/being delinquent/having high grades?). Finally, we controlled for adolescents' gender, track, and GPA, alcohol use, or delinquency (depending on the outcome variable).

Results

Descriptive Statistics

Risk behaviors. In Table 3, the percentages of adolescents that recently engaged in some levels of alcohol use or engaged in delinquent behaviors are displayed per wave per school year. It can be seen that the prevalence of alcohol use increased in higher grades, whereas a less clear pattern was found for delinquency. Delinquency was more prevalent than alcohol use in seventh grade, whereas alcohol use was more prevalent in ninth grade compared to delinquency. Moreover, the percentage of adolescents is shown that both used alcohol and engaged in delinquent behaviors. This percentage can be used to calculate the net overlap, which varied between 43.7% (referring to the percentage of delinquent adolescents at T2 in eighth grade (9.3 / 21.3) who also drank alcohol) and 81.9% (referring to the percentage

of delinquent adolescents at T3 in ninth grade (25.8 / 31.5) who also drank alcohol). It can thus be concluded that there were adolescents that showed both behaviors.

Correlations. Table 4 shows the correlations between GPA and alcohol use and delinquency for all waves in all three school years. At all waves there was a significant negative correlation between adolescents' academic achievement and both risk behaviors, indicating that high-achieving adolescents were less likely to drink alcohol or engage in delinquent behaviors. Also, a significant positive correlation was found in all three school years between alcohol use and delinquency, indicating that adolescents who drank alcohol were also more inclined to engage in delinquent behaviors (range = .24-.45). Moreover, correlations were positively significant across all waves within GPA (range = .71-.86), alcohol use (range = .44-.54), and delinquency (range = .40-.57). This indicates that adolescents with higher scores on these behaviors were more inclined to have higher scores on the same behavior over time.

Network variables. Descriptions of the networks and changes in behaviors are presented in Table 5. The average number of friendship nominations given varied between 5.25 and 8.63 across the school years. The friendship networks were characterized by a moderate reciprocity index in all years, with participants reciprocating about 52% of the friendship nominations. There was also a tendency for friendships to occur in cohesive subgroups, indicated by a transitivity index in the network of on average 45%. Further, most friendship nominations occurred between adolescents of the same gender (about 84%). The amount of changing nominations per student ranges between 4.71 and 6.09 and indicates sufficient power; its sum over all actors (the so-called Hamming Distance) is the main determinant of statistical power of the study and roughly corresponds to the role played by sample size in regression models. The Jaccard index indicates the amount of stability in friendship nominations. In order to be able to detect structural network effects (and hence

control for network interdependence), this index should be higher than 30% (see Veenstra et al., 2013), which is the case for every wave.

RSiena analyses

Alcohol use and GPA. Table 6 shows the results of the RSiena analysis with regard to adolescents' alcohol use and GPA for the seventh, eighth and ninth grade. The table includes the estimate and the standard error for each effect. Estimates can be interpreted as log odds for a relationship to exist (friendship part of the model) or for a behavior to change (alcohol use or GPA; Ripley et al., 2016).

A negative significant effect for outdegree was found, indicating that participants on average selected few peers (less than half of their grade) as friends. Moreover, adolescents tended to reciprocate friendships, were likely to become friends with friends' friends, but not necessarily reciprocated, and there was a tendency to have a hierarchical ordering as there were relatively few three cycles. Also, adolescents selected same-gender peers as friends and there were more friendships between adolescents in the same classroom and same location. No significant alcohol ego and alter effects were found, indicating that students' alcohol use did not affect the amount of given or received friendship nominations. GPA did not influence the amount of given nominations as well, but in the eighth grade high-achieving adolescents received more nominations (GPA alter) whereas in the ninth grade they received less nominations.

In line with the same-behavior academic achievement and risk behavior selection hypotheses, we found significant positive selection effects for GPA and alcohol use in all school years. This indicates that adolescents selected peers with similar behaviors as friends. With regard to the cross-behavior selection hypotheses, it turned out that seventh graders who used alcohol avoided selecting high-achieving peers as friends (and, correspondingly, seventh graders who did not use alcohol to avoid selecting low-achieving peers as friends; alcohol ego

x grade alter). This is in line with the expectations. We can also see weaker cross-behavior selection effects over school years. Moreover, high-achieving adolescents in the ninth grade were more likely to select peers as friends who used alcohol whereas low-achieving adolescents more likely selected friends who did not use alcohol. No other significant cross-behavior selection effects were found.

Concerning behavior dynamics, no significant effects were found for gender and GPA on students' alcohol use, and there were also no significant effect from gender on adolescents' GPA. Adolescents in seventh and eighth grade from lower tracks, however, were more likely to drink alcohol, and alcohol use was associated with lower grades in seventh and ninth grade. Adolescents' track also had a small effect on their grades, negatively in seventh grade and positively in the ninth grade. Same-behavior influence effects were found across all school years for both alcohol use and GPA. This is in line with the same-behavior academic and risk influence hypotheses, revealing that adolescents' behaviors (alcohol use and GPA) were affected by the same behaviors of their friends. With regard to the cross-behavior influence hypotheses, only in the seventh grade a trend (marginally significant) was found for a negative influence effect of friends' GPA on an individual adolescent's alcohol use. This result suggests that having high-achieving friends leads to a lower chance of drinking alcohol, whereas having low-achieving friends leads to a higher chance of drinking alcohol. No significant effects of friends' alcohol use on individuals' GPA have been found.

In sum, same-behavior selection and influence processes were found for both alcohol use and GPA. There were also some cross-behavior selection processes, with seventh graders who used alcohol avoiding high-achieving peers as friends and high-achieving ninth graders selecting peers as friends who used alcohol. Furthermore, in seventh grade there was a trend towards cross-behavior influence from friends' GPA on individual adolescents' alcohol use.

Delinquency and GPA. Table 7 shows the results of the RSiena analysis with regard to adolescents' delinquent behaviors and GPA for the seventh, eighth, and ninth grade. The network structure effects were similar to the ones in Table 4. Further, we found in the seventh grade that adolescents who engaged in delinquent behaviors received more nominations (delinquency alter) and that they gave more nominations (delinquency ego), which happens in the ninth grade as well. Also, related to the same-behavior academic selection hypothesis, we found significant positive selection effects for GPA in all school years. This indicates that adolescents selected peers as friends based on similarities in GPA. Selection effects for delinquency were only found in the ninth grade (same-behavior risk selection hypothesis). With regard to the cross-behavior selection hypothesis, it was shown that seventh and eighth graders who were delinquent avoided high-achieving peers (delinquency ego x GPA alter), which is in line with the expectations. In the ninth grade, high-achieving adolescents were more likely to select delinquent peers as friends. No other cross-behavior selection effects were found.

Results for behavior dynamics showed a positive effect for gender on adolescents' delinquency in seventh grade, indicating that boys engaged more in delinquent behaviors than girls. No gender effects were found in the other grades, and there were no effects from adolescents' track on delinquency in all school years. GPA negatively influenced students' delinquency in seventh and ninth grade, indicating that high-achieving adolescents were less likely to engage in delinquent behavior. Adolescents' GPA was not significantly affected by their gender, and delinquency only affected their GPA negatively in seventh grade. There was also a negative effect of track in seventh grade, indicating that adolescents in lower tracks had higher grades, whereas in ninth grade a positive effect was found.

Same-behavior influence effects of friends were found in eighth and ninth grade, for both GPA and delinquency. This means that these adolescents, in line with the same-behavior

22

academic and risk influence hypotheses, were affected by their friends' delinquent behaviors and GPA. Moreover, there was a negative marginally significant effect in the seventh grade of friends' GPA on individual adolescents' delinquent behaviors (cross-behavior influence hypothesis). This means that there was a trend that having low-achieving friends increased the likelihood of engaging in delinquent behaviors, whereas having high-achieving friends decreased the chance of engaging in delinquent behaviors.

In sum, same-behavior selection effects were found for GPA in all school years and for delinquency in the ninth grade. Same-behavior influence processes were found for both delinquency and GPA in eighth and ninth grade. Cross-behavior selection and influence processes were similar to the model with alcohol use, with delinquent seventh graders avoiding high-achieving peers as friends and high-achieving ninth graders selecting peers as friends who engaged in some delinquent behaviors. Furthermore, in seventh grade there was a tendency for cross-behavior influence, from friends' GPA on individual adolescents' delinquency.

Discussion

This study examined the role of friendship selection and influence processes in adolescents' academic achievement, alcohol use, and delinquent behaviors in the first three years of secondary education. We investigated not only same-behavior but also cross-behavior selection and influence processes, by tapping into the interplay between different behaviors.

Same-Behavior Selection and Influence Processes

We generally found support for same-behavior selection and influence processes, which is in line with our hypotheses and also matches with findings of previous studies with regard to delinquency (e.g., Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010), alcohol use (e.g., Osgood et al., 2013; Osgood, Feinberg, & Ragan, 2015), and academic achievement (e.g., Flashman, 2012; Fortuin, van Geel, & Vedder, 2015). Our results indicate that adolescents

select peers as friends who have similar behaviors, as well as that friends' behaviors become more similar over time. However, these effects were most pronounced and consistent for academic achievement and alcohol use. For delinquency selection effects were only found in the ninth grade and influence effects in the eighth and ninth grade. These inconsistent effects for delinquency are in accordance with findings by Osgood et al. (2015) and may be related to the following arguments.

First, the prevalence rates over school years followed different patterns for alcohol use and delinquency. Whereas alcohol use steadily increases with age and becomes more normative and social (Crosnoe, 2006), delinquency seems to fluctuate more, with lower prevalence rates in the eighth grade compared to the seventh and ninth grade. Reflecting these fluctuations, selection and influence processes might also be less consistent.

Second, especially in the seventh grade adolescents who engaged in delinquent behaviors received and gave more nominations, indicating that they were attractive, socially central and had many friends (Franken et al., 2016). The seventh grade is the first year of secondary education and thus provides a context in which adolescents do not know each other yet, which might lead to a focus on visible (rebellious) peers. When entering a new peer ecology, adolescents may be more competing to be visible within the classroom and grade, whereas over time friendships may be strongly based on shared behaviors and being similar, in the context of a more settled social hierarchy. As a result, delinquency may be more rewarded at the start of secondary education, whereas selection and influence processes took place in higher grades.

Third, the inconsistency in results for delinquency might be explained by the way of measuring this global construct using the combination of various types of delinquent behaviors. These wide range of behaviors differ in severity (e.g., weapon carrying versus fare evasion in public transport) and consequently some less severe delinquent behaviors might for

instance be rewarded more positively by peers than some more severe delinquent acts (Moffitt, 1993). Moreover, these various delinquent behaviors differ regarding their nature, that is, the difference between overt (e.g., violence) and covert (e.g., stealing) behaviors (Loeber & Farrington, 2000). Consequently, the causes of these behaviors differ, including the role of peers and friends.

Cross-Behavior Selection and Influence Processes

We took a relational developmental systems perspective and focused on cross-behavior selection and influence processes by investigating the interplay between academic achievement and risk behaviors. We argued that adolescents behave mostly according to adult- or peer-approved norms, expecting that adolescents' friendships could explain the negative relation between their academic achievement and risk behaviors. Moreover, we used the maturity gap theory, a discrepancy between adolescents' physical and social status, as an explanation for engaging in risk behaviors as well as low academic achievement in school (Dijkstra et al., 2015; Moffitt, 1993). Overall, we found some support for this idea.

With regard to cross-behavior selection processes for alcohol use, results showed that in seventh grade, adolescents who drank alcohol were more likely to select low-achieving peers as friends, whereas adolescents who did not drink alcohol were more likely to select high-achieving peers as friends. This is in line with the idea that whether or not adolescents experience the maturity gap affects their friendship preferences, by attraction and avoidance of certain peers. However, in the ninth grade high-achievers selected peers as friends who drank alcohol. One explanation is that alcohol use is less prevalent in lower grades compared to higher grades as it becomes more normative over time. Consequently, alcohol use might be more sanctioned as deviant in seventh grade compared to ninth grade. In seventh grade, adolescents who drank alcohol did not behave according to the adult-approved norms and therefore also did not prefer to befriend peers who performed well in school. Rebellious peers,

however, become more salient and socially prominent during middle adolescence (Allen et al., 2005). Hence, this clear-cut distinction between being a good student and behaving risky (i.e., drinking alcohol and performing delinquent acts) might fade during adolescence (Crosnoe, 2006). Overall increases in the prevalence of alcohol use and the popularity associated with this behavior, allowed early drinkers to befriend high-achieving adolescents as well (Rodkin, Farmer, Pearl, & Van Acker, 2006).

For delinquency, similar cross-behavior selection effects were found as for alcohol use, but the processes might differ. In the seventh grade, adolescents who engaged in delinquent behaviors not only received and gave more nominations, but they were also more likely to select low-achieving peers as friends. Also in the eighth grade there was a cross-selection effect, with adolescents who engaged in delinquent behaviors selecting low-achieving peers as friends. However, in the ninth grade delinquent adolescents received more nominations and high-achieving adolescents were more likely to select peers as friends who showed some delinquent behaviors. This could be explained by the idea that in earlier ages peer perception on their behaviors is more dichotomous, that is, either being delinquent or not, a good student or not, whereas overtime adolescents might develop a more nuanced view on behavior of peers. Hence, affiliation of 'good' adolescents with delinquent peers is more likely.

Regarding cross-behavior influence effects, we only found a marginally negative effect of friends' GPA on both adolescents' alcohol use and delinquent behavior in seventh grade. This finding is in line with the idea that adolescents have a need for social approval (Brechwald & Prinstein, 2011) and susceptibility to peer influence across behaviors, reflected by adult- or peer-approved norms. These cross-behavior influence effects can be interpreted in two ways. On the one hand, it can mean that adolescents who had low-achieving friends were more likely to engage in risk behaviors over time. This would indicate that friends' low GPA

is a risk factor for engaging in risk behaviors. On the other hand, it can mean that adolescents who had high-achieving friends were less likely to engage in risk behaviors. This would indicate that friends' high GPA is a protective factor against involvement in risk behaviors. This effect, however, was not found in higher grades. Unfortunately, current models do not allow to untangle the direction and strength of these cross-behavior effects. Future research might profit from further extensions of longitudinal social network models.

Although friends' behaviors seem to affect similar behaviors in adolescents and negative correlations have been found between risk behaviors and academic achievement, only significant cross-behavior effects were found from friends' GPA affecting risk behaviors but not from friends' risk behaviors to adolescents' GPA. No cross-behavior influence effects have been found from friends' risk behaviors on an individual's academic achievement, indicating that an individual student's academic achievement does not change in response to friends' risk behaviors. This means that potential spill-over effects from friends' behaviors to different individual behaviors start from friends' GPA and not from their risk behaviors.

An explanation for only finding cross-behavior influence effects from friends' GPA to individual's risk behaviors may be that positive attitudes towards academics and high grades act as protective factors against risk behaviors (Bryant, Schulenberg, Malley, Bachman, & Johnston, 2003). Moreover, academic achievement is highly indicative of cognitive functions and skills and is harder to modify as compared to alcohol use and delinquent behaviors. Actually, academic achievement requests adolescents to put more efforts in their school work, whereas behaviors such as alcohol use or delinquent behavior depend on specific contexts or situations. However, both academic achievement and risk behaviors are influenced by friends and adolescents apparently seem to balance between these behaviors, where one behavior does not exclude the other behavior. With regards to the maturity gap explanation, and especially adolescent-limited antisocial youth, these results indicate that academic

achievement and risk behaviors are not two ends of one continuum from adult-approved positive academic behaviors to adult-disapproved risk behaviors (Moffitt, 1993). These behaviors seem to be largely separate behaviors in the peer context, probably with distinct underlying motivations.

Limitations and Future Directions

This study has a number of strengths. We were able to examine different behaviors within longitudinal social network analyses and studied cross-behavior friendship selection and influence processes. However, it is also important to acknowledge that some limitations apply to the study.

A first limitation is that we studied academic achievement (GPA), which does not always reflect adolescents' academic abilities as other factors such as attitudes, strategies, behaviors, and non-cognitive skills play a role in their performance as well (for a review see Farrington et al., 2012). Nevertheless, an adolescents' GPA concerns actual grades which are important, as it determines future educational opportunities (Witkow & Fuligni, 2010). Nonetheless, it would be interesting for future studies to additionally focus on other school-related factors, such as school interest, effort, engagement, truancy, and school bonding.

A second limitation is that we had to recode adolescents' alcohol use and delinquency into dummy variables, as well as combining different types of delinquent behaviors in our measure. This is due to the relatively low prevalence of alcohol use and delinquency among the participants. The prevalence, however, is normal in this age period and similar to the percentages found in previous studies (Osgood et al., 2013, 2015). For future studies it would be interesting to replicate this study among older students, for example college students, among whom risk behaviors, such as smoking behaviors and drugs use, are more common (Jeynes, 2002). This also allows to differentiate between various types of delinquent behaviors, which may be important, as neurocognitive abilities relate differently to diverse

types of the related construct of aggression, suggesting distinct underlying causes for various forms of delinquent behaviors (Barker et al., 2011).

Relatedly, although selection and influence processes are ongoing processes throughout school years, there were differences between the school years in our subsample. Whereas seventh grade adolescents did not know each other yet at the beginning of the school year, the adolescents in the eighth and ninth grade already knew each other. Due to these differences in familiarity between adolescents, differences between school years should also be treated with caution. Future studies can benefit from following the same respondents over different school years.

What must also not be forgotten is the possibility of unobserved confounding. In the present context, this means that the presence of joint determinants of achievement and risk behaviors (as well as joint determinants of friendship and one, or both, of the risk behaviors) are assumed to be controlled for. Future studies should control for likely common causes. Such common causes could be individual maturity indicators like self-command and internalization of societal norms (for achievement and risk behaviors), or social interaction contexts outside school classes, such as doing homework together (for achievement and friendship) and jointly participating in sports and other structured or unstructured, non-academic activities (for risk behaviors and friendship). Moreover, individual factors, regardless of the peer context, can influence the interplay between behaviors as well. For example, a low self-control can result in a low academic achievement but also lead to engagement in risk behaviors (Tangney, Baumeister, & Luzio Boone, 2004).

Practical Implications

Our findings have several practical implications. Adolescents need to be understood within their social contexts and specific behaviors seem to depend on each other as well as on different behaviors by friends. The effectiveness of prevention and intervention programs

(e.g., in schools) for risk behaviors might be enhanced by emphasizing the role of friends and academic outcomes in these behaviors. Moreover, it is important that teachers and parents are aware of the complex interaction between behaviors. Teachers can try to facilitate contact between low- and high-achieving adolescents and enhance pro-school behaviors (Gest, Madill, Zadzora, Miller, & Rodkin, 2014), keeping in mind that adolescents' and their friends' academic achievement might affect their risk behaviors in some situations.

Conclusion

Overall, it can be concluded that not only same-behavior but to some extent also cross-behavior selection and influence processes are relevant for (the interplay between) adolescents' and their friends' academic achievement and risk behaviors. Same-behavior processes were more prevalent than cross-behavior processes, but subtle cross-behavior processes occurred as well. In general, future studies should expand knowledge about indirect forms of selection and influence processes in different behaviors, as this study is one of the first studies to examine and to show some evidence that both same-behavior and cross-behavior friendship processes can play a role in adolescents' development. By only focusing on selection and influence processes in one domain, the more complex socializing role of friends across different behaviors remains unclear. Future studies can for example focus on other types of risk behaviors or on prosocial behaviors. Additionally, more insights need to be gained concerning the underlying mechanisms, that is, the reasons for adolescents to engage in a behavior that is different from the behavior endorsed by friends.

Thus, in the absence of many cross-behavior effects between academic achievement and risk behaviors in our study, research should continue to explore cross-behavior selection and influence processes as focusing on only one type of behavior ignores the complexity of adolescents' behaviors in the peer context.

References

Allen, J. P., Porter, M. R., McFarland, F. C., Marsh, P., & McElhaney, K. B. (2005). The two faces of adolescents' success with peers: adolescent popularity, social adaptation, and deviant behavior. *Child Development*, *76*, 747–760. https://doi.org/10.1038/jid.2014.371

Allen, J. P., Weissberg, R. P., & Hawkins, J. A. (1995). The relation between values and social competence in early adolescence. *Developmental Psychology*, *25*, 459–464.

Altermatt, E. R., & Pomerantz, E. M. (2003). The development of competence-related and motivational beliefs: An investigation of similarity and influence among friends. *Journal of Educational Psychology*, *95*, 111–123. https://doi.org/10.1037/0022-0663.95.1.111

Bandura, A. (1977). *Social learning theory*. Englewood Cliffs: NJ: Prentice Hall.

Barker, E. D., Tremblay, R. E., van Lier, P. A., Vitaro, F., Nagin, D. S., Assaad, J. M., & Séguin, J. R. (2011). The neurocognition of conduct disorder behaviors: Specificity to physical aggression and theft after controlling for ADHD symptoms. *Aggressive Behavior, 37*, 63-72. https://doi.org/10.1002/ab.20373

Brechwald, W. A., & Prinstein, M. J. (2011). Beyond homophily: A decade of advances in understanding peer influence processes. *Journal of Research on Adolescence, 21*, 166–179. https://doi.org/10.1111/j.1532-7795.2010.00721.x

Brown, B. B., Eicher, S. A., & Petrie, S. (1986). The importance of peer group ("crowd") affiliation in adolescence. *Journal of Adolescence*, *9*, 73–96.

Bryant, A. L., Schulenberg, J. E., Malley, P. M. O., Bachman, J. G., & Johnston, L. D. (2003). How academic achievement, attitudes , and behaviors relate to the course of substance use during adolescence: A 6-year, multiwave national longitudinal study. *Journal of Research on Adolescence, 13*, 361–397. https://doi.org/10.1111/1532-7795.1303005

Burk, W. J., van der Vorst, H., Kerr, M., & Stattin, H. (2012). Alcohol use and friendship dynamics: selection and socialization in early-, middle-, and late-adolescent peer

networks. *Journal of Studies on Alcohol and Drugs*, *73*, 89–98.

https://doi.org/10.15288/jsad.2012.73.89

Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: compliance and conformity.

Annual Review of Psychology, *55*, 591–621.

https://doi.org/10.1146/annurev.psych.55.090902.142015

Crosnoe, R. (2006). The connection between academic failure and adolescent drinking in

secondary school. *Sociology of Education*, *79*, 44–60.

Crosnoe, R., & Benner, A. D. (2015). Children at school. In R. M. Lerner (Ed.), *Handbook of*

Child Psychology and Developmental Science (7th ed., Vol. 4:7, pp. 1–37). John Wiley

& Sons, Inc. https://doi.org/10.1002/9781118963418.childpsy407

Crosnoe, R., Benner, A. D., & Schneider, B. (2012). Drinking, socioemotional functioning,

and academic progress in secondary school. *Journal of Health and Social Behavior*, *53*,

150–164. https://doi.org/1 0.1 177/002214651 1433507

Dijkstra, J. K., Kretschmer, T., Pattiselanno, K., Franken, A., Harakeh, Z., Vollebergh, W., &

Veenstra, R. (2015). Explaining adolescents' delinquency and substance use: A test of

the maturity gap: The SNARE study. *Journal of Research in Crime and Delinquency*, *52*,

747–767. https://doi.org/10.1177/0022427815582249

Dodge, K. A., Coie, J. D., & Lynam, D. (2008). Aggression and antisocial behavior in youth.

In W. Damon & R. M. Lerner (Eds.), *Child and Adolsecent Development: An advanced*

course (pp. 437–473). Hoboken, New Jersey: John Wiley & Sons, Inc.

Eccles, J. S. (2004). Schools, academic motivation, and stage-environment fit. In R. M.

Lerner & L. Steinberg (Eds.), *Handbook of Adolescent Psychology* (pp. 125–153).

Hoboken, NJ: Wiley. 2nd ed.

Eccles, J. S., Midgley, C., Wigfield, A., C.M., B., Reuman, D., Flanagan, C., & Mac Iver, D.

(1993). Development during adolescence: The impact of stage-environment fit on young

adolescents' experience in schools and families. *American Psychologist*, *48*, 90–101.

Farrington, C. A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T. S., Johnson, D. W., & Beechum, N. O. (2012). *Teaching Adolescents to Become Learners: The Role of Noncognitive Factors in Shaping School Performance--A Critical Literature Review*. Chicago, IL: Consortium on Chicago School Research.

Flashman, J. (2012). Academic achievement and its impact on friend dynamics. *Sociology of Education*, *85*, 61–80. https://doi.org/10.1177/0038040711417014

Fortuin, J., van Geel, M., & Vedder, P. (2015). Peers and academic achievement: A longitudinal study on selection and socialization effects of in-class friends. *The Journal of Educational Research*, 1–6. https://doi.org/10.1080/00220671.2014.917257

Franken, A., Harakeh, Z., Veenstra, R., Vollebergh, W., & Dijkstra, J. K. (2016). Social status of adolescents with an early onset of externalizing behavior: The SNARE study. *The Journal of Early Adolescence*, 1–17. https://doi.org/10.1177/0272431616636478

Franken, A., Moffitt, T. E., Steglich, C. E. G., Dijkstra, J. K., Harakeh, Z., & Vollebergh, W. A. M. (2015). The role of self-control and early adolescents' friendships in the development of externalizing behavior: The SNARE study. *Journal of Youth and Adolescence*, *45*, 1–12. https://doi.org/10.1007/s10964-015-0287-z

Franken, A., Moffitt, T. E., Steglich, C. E. G., Dijkstra, J. K., Harakeh, Z., & Vollebergh, W. A. M. (2016). The role of self-control and early adolescents' friendships in the development of externalizing behavior: The SNARE study. *Journal of Youth and Adolescence*, *45*, 1800–1811. https://doi.org/10.1007/s10964-015-0287-z

Franken, A., Prinstein, M. J., Dijkstra, J. K., Steglich, C. E. G., Harakeh, Z., & Vollebergh, W. A. M. (2016). Early adolescent friendship selection based on externalizing behavior: The moderating role of pubertal development. The SNARE study. *Journal of Abnormal Child Psychology*, *44*, 1647–1657. https://doi.org/10.1007/s10802-016-0134-z

Gest, S. D., Madill, R. A., Zadzora, K. M., Miller, A. M., & Rodkin, P. C. (2014). Teacher management of elementary classroom social dynamics: Associations with changes in student adjustment. *Journal of Emotional and Behavioral Disorders*, *22*, 107–118. https://doi.org/http://dx.doi.org/10.1177/1063426613512677

Giletta, M., Burk, W. J., Scholte, R. H. J., Engels, R. C. M. E., & Prinstein, M. J. (2013). Direct and indirect peer socialization of adolescent nonsuicidal self-injury. *Journal of Research on Adolescence*, *23*, 450–463. https://doi.org/10.1111/jora.12036

Gremmen, M. C., Dijkstra, J. K., Steglich, C. E. G., & Veenstra, R. (2017). First selection, then influence: Developmental differences in friendship dynamics regarding academic achievement. *Developmental Psychology, 53*, 1356-1370. Retrieved from http://dx.doi.org/10.1037/dev0000314

Hallinan, M. T. (1980). Patterns of cliquing among youth. In H. C. Foot, A. J. Chapman, & J. R. Smith (Eds.), *Friendship and social relations in children* (pp. 321–342). Chicester, UK: Wiley.

Haynie, D. L. (2001). Delinquent peers revisited: does network structure matter? *American Journal of Sociology*, *106*, 1013–1057. https://doi.org/10.1086/320298

Hinshaw, S. P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. *Psychological Bulletin*, *111*, 127–155. https://doi.org/10.1037/0033-2909.111.1.127

Jeynes, W. H. (2002). The relationship between the consumption of various drugs by adolescents and their academic achievement. *The American Journal of Drug and Alcohol Abuse*, *28*, 15–35.

Kiuru, N., Burk, W. J., Laursen, B., Salmela-Aro, K., & Nurmi, J. E. (2010). Pressure to drink but not to smoke: Disentangling selection and socialization in adolescent peer networks and peer groups. *Journal of Adolescence*, *33*, 801–812.

https://doi.org/10.1016/j.adolescence.2010.07.006

Knecht, A., Snijders, T. A. B., Baerveldt, C., Steglich, C. E. G., & Raub, W. (2010). Friendship and delinquency: Selection and influence processes in early adolescence. *Social Development*, *19*, 494–514. https://doi.org/10.1111/j.1467-9507.2009.00564.x

Lazarsfeld, P. F., & Merton, R. K. (1954). Friendship as a social process: A substantive and methodological analysis. In M. Berger, T. Abel, & C. H. Page (Eds.), *Freedom and control in modern society* (pp. 18–66). New York: Van Nostrand.

Lerner, R. M., & Schmid Callina, K. (2013). Relational developmental systems theories and the ecological validity of experimental designs: Commentary on freund and isaacowitz. *Human Development*, *56*, 372–380. https://doi.org/10.1159/000357179

Lindenberg, S. (2013). Social rationality, self-regulation, and well-being: The regulatory significance of needs, goals, and the self. In R. Wittek, T. A. B. Snijders, & V. Nee (Eds.), *Handbook of Rational Choice Social Research* (pp. 72–112). Stanford: Stanford University Press.

Loeber, R., & Farrington, D. P. (2000). Young children who commit crime: epidemiology, developmental origins, risk factors, early interventions, and policy implications. *Development and Psychopathology*, *12*, 737–762. https://doi.org/10.1017/S0954579400004107

Lynch, A. D., Lerner, R. M., & Leventhal, T. (2013). Adolescent academic achievement and school engagement: An examination of the role of school-wide peer culture. *Journal of Youth and Adolescence*, *42*, 6–19. https://doi.org/10.1007/s10964-012-9833-0

Maguin, E., & Loeber, R. (1996). Academic performance and delinquency. *Crime and Justice*, *20*, 145–264.

McEvoy, A., & Welker, R. (2000). Antisocial behavior, academic failure, and school climate. *Journal of Emotional and Behavioral Disorders*, *8*, 130–140.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in
social networks. *Annual Review of Sociology*, *27*, 415–444.

Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A
developmental taxonomy. *Psychological Review*, *100*, 674–701.
https://doi.org/10.1037//0033-295X.100.4.674

Nijhof, K. S., Scholte, R. H. J., Overbeek, G., & Engels, R. C. M. E. (2010). Friends' and
adolescents' delinquency: The moderating role of social status and reciprocity of
friendships. *Criminal Justice and Behavior*, *37*, 289–305.
https://doi.org/10.1177/0093854809355776

Osgood, D. W., Feinberg, M. E., & Ragan, D. T. (2015). Social networks and the diffusion of
adolescent problem behavior: Reliable estimates of selection and influence from sixth
through ninth grades. *Prevention Science*, *16*, 832–843. https://doi.org/10.1007/s11121-
015-0558-7

Osgood, D. W., Ragan, D. T., Wallace, L., Gest, S. D., Feinberg, M. E., & Moody, J. (2013).
Peers and the emergence of alcohol use: Influence and selection processes in adolescent
friendship networks. *Journal of Research on Adolescence*, *23*, 500–512.

Patterson, G. R., DeBaryshe, B., & Ramsey, E. (1990). A developmental perspective on
antisocial behavior. *American Psychologist*, *44*, 329–335.

Rambaran, J. A., Hopmeyer, A., Schwartz, D., Steglich, C., Badaly, D., & Veenstra, R.
(2017). Academic functioning and peer influences: A short-term longitudinal study of
network-behavior dynamics in middle adolescence. *Child Development, 88*, 523-543.
https://doi.org/10.1017/CBO9781107415324.004

Ripley, R. M., Snijders, T. A. B., Boda, Z., Vörös, A., & Preciado, P. (2016). Manual for
RSiena. *University of Oxford; Department of Statistics; Nuffield College.*, Retrieved
online 05-05-2015. Retrieved from

http://www.stats.ox.ac.uk/~snijders/siena/RSiena_Manual.pdf

Rodkin, P. C., Farmer, T. W., Pearl, R., & Van Acker, R. (2006). They're cool: Social status and peer group supports for aggressive boys and girls. *Social Development*, *15*, 175–204.

Rodkin, P. C., & Ryan, A. M. (2012). Child and adolescent peer relations in educational context. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA Educational Psychology Handbook: Vol. 2. Individual Differences and Cultural and Contextual Factors* (pp. 363–389). Washington, DC, US: American Psychological Association. https://doi.org/10.1037/13274-015

Sentse, M., Dijkstra, J. K., Lindenberg, S., Ormel, J., & Veenstra, R. (2010). The delicate balance between parental protection, unsupervised wandering, and adolescents' autonomy and its relation with antisocial behavior: The TRAILS study. *International Journal of Behavioral Development*, *34*, 159–167. https://doi.org/10.1177/0165025409350949

Shin, H., & Ryan, A. M. (2014). Early adolescent friendships and academic adjustment: Examining selection and influence processes with longitudinal social network analysis. *Developmental Psychology*, *50*, 2462–2472.

Snijders, T. A. B., Van de Bunt, G. G., & Steglich, C. E. G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, *32*, 44–60. https://doi.org/10.1016/j.socnet.2009.02.004

Steglich, C., Snijders, T. A. B., & Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*, *40*, 329–393. https://doi.org/10.1111/j.1467-9531.2010.01225.x

Steglich, C., Snijders, T. A. B., & West, P. (2006). Applying SIENA: An illustrative analysis of the coevolution of adolescents' friendship networks, taste in music, and alcohol consumption. *Methodology*, *2*, 48–56. https://doi.org/10.1027/1614-2241.2.1.48

Steinberg, L. (2007). Risk taking in adolescence: New perspectives from brain and behavioral science. *Current directions in psychological science, 16*, 55-59.

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of personality, 72*, 271-324.

Van Der Laan, A. M., Veenstra, R., Bogaerts, S., Verhulst, F. C., & Ormel, J. (2010). Serious, minor, and non-delinquents in early adolescence: The impact of cumulative risk and promotive factors. The TRAILS study. *Journal of Abnormal Child Psychology*, *38*, 339–351. https://doi.org/10.1007/s10802-009-9368-3

Veenstra, R., Dijkstra, J. K., & Kreager, D. A. (2017). Pathways, networks, and norms. A sociological perspective on peer research. In W. M. Bukowski, B. Laursen, & K. H. Rubin (Eds.), *Handbook of peer interactions, relationships, and groups*. New York, NY: Guilford.

Veenstra, R., Dijkstra, J. K., Steglich, C., & Van Zalk, M. H. W. (2013). Network-behavior dynamics. *Journal of Research on Adolescence*, *23*, 399–412. https://doi.org/10.1111/jora.12070

Wallace, J. M., Bachman, J. G., O'Malley, P. M., Johnston, L. D., Schulenberg, J. E., & Cooper, S. M. (2002). Tobacco, alcohol, and illicit drug use: Racial and ethnic differences among U.S. high school seniors, 1976-2000. *Public Health Reports*, *117*, 67–75. https://doi.org/PMCID: PMC1913705

Witkow, M. R., & Fuligni, A. J. (2010). In-school versus out-of-school friendships and academic achievement among an ethnically diverse sample of adolescents. *Journal of Research on Adolescence, 20*, 631–650. https://doi.org/10.1111/j.1532-7795.2010.00653.x

Appendix A

Number of adolescents **within the seventh grade (first year).** Grade level networks were created at T1, T2 and T3 for all 390 adolescents in the seventh grade, with per wave missing codes for the adolescents who left, refused or were absent. Between T1 and T2 as well as between T2 and T3 one adolescent left the school. Also, at T1 one adolescent refused to participate in the study. In addition, nine adolescents did not fill out the questionnaire at T1, fifteen adolescents at T2, and twelve adolescents at T3. This leaves us with 380, 374, and 376 participants at T1, T2, and T3 respectively.

Number of adolescents **within the eighth grade (second year).** Grade level networks were created at T1, T2 and T3 for all 424 adolescents in the eighth grade, with per wave missing codes for the adolescents who entered, left, refused or were absent. Between T1 and T2 two adolescents entered the school and between T2 and T3 three adolescents left the school. Also, at all three waves four adolescents refused to participate in the study. In addition, seven adolescents did not fill out the questionnaire at T1, ten students at T2, and twelve adolescents at T3. This leaves us with 413, 412, and 407 participants at T1, T2, and T3 respectively.

Number of adolescents **within the ninth grade (third year).** Grade level networks were created at T1, T2 and T3 for all 424 adolescents in the eighth grade, with missing codes for the adolescents who entered, left, refused or were absent. Between T1 and T2 four adolescents entered the school and between T2 and T3 four students left the school. Also, at all three waves seven adolescents refused to participate in the study. In addition, eleven adolescents did not fill out the questionnaire at T1, twenty-nine adolescents at T2, and eleven adolescents at T3. This leaves us with 406, 386, and 400 participants at T1, T2, and T3 respectively.

Tables

Table 1

Categories for school grades: per school year per wave the number of adolescents *that have average grades falling into a specific category.*

Category	Grades	Seventh grade			Eighth grade			Ninth grade		
		T1	T2	T3	T1	T2	T3	T1	T2	T3
1	< 5.0	2	6	12	1	3	7	2	4	15
2	5.0 – 5.49	4	11	10	26	6	9	14	16	20
3	5.5 – 5.99	9	21	27	51	50	47	55	68	70
4	6.0 – 6.49	40	51	54	75	79	82	96	119	118
5	6.5 – 6.99	71	100	57	116	117	108	118	99	92
6	7.0 – 7.49	114	87	102	82	89	90	72	57	54
7	7.5 – 7.99	91	68	65	32	48	44	28	35	23
8	≥ 8.0	47	37	39	15	14	19	9	11	14

Note. School grades below 5.5 (categories 1 and 2) are considered unsatisfactory. Adolescents get grades for about 13 subjects. For transition to the next year/grade, an overall maximum of three unsatisfactory grade points on these 13 subjects is allowed.

Table 2

Explanation of some basic parameters in the RSiena model.

Effect	RSiena effect name	Explanation	Graphical representation
Outdegree	density	The basis tendency to form relationships	
Reciprocity	recip	The tendency toward reciprocation	
Transitive triplets	transTrip	Transitive closure $(i \rightarrow h \rightarrow j; i \rightarrow j)$: Friends of friends become friends)	
3-cycles	cycle3	Nonhierarchical cycles of generalized reciprocity	
Same X	sameX	Relations occur more often between actors with this same characteristic	
Alter effect	altX	Actors with higher scores on this characteristic/behavior receive more nominations	
Ego effect	egoX	Actors with higher scores on this characteristic/behavior give more nominations	
Ego * Alter (similarity effect)	egoX * altX and egoX * altY	Relations occur more often between adolescents with these similar characteristics/behaviors	
Average alter	avAlt	The tendency of adolescents to become similar to their friends on a specific behavior	
Alter's (friendship) behavior Y on ego's behavior X	avXAlt	Cross-behavior influence: the tendency of adolescents to change behavior X in response to friends' behavior Y	

Table 3

Per school year per wave the percentage of adolescents that consumed alcohol, engaged in delinquent behaviors, and the percentage of adolescents that showed both risk behaviors.

		Alcohol use	**Delinquency**	**Both risk behaviors**
Seventh grade	T1	21.5%	49.6%	15.9%
	T2	20.0%	39.3%	12.7%
	T3	22.6%	42.6%	16.0%
Eighth grade	T1	33.3%	32.0%	19.5%
	T2	25.4%	21.3%	9.3%
	T3	31.5%	27.7%	14.9%
Ninth grade	T1	55.1%	46.1%	35.8%
	T2	55.1%	35.5%	26.4%
	T3	55.8%	31.5%	25.8%

Table 4

Correlations between academic achievement (GPA), alcohol use and delinquency across the seventh grade (N =390), eighth Grade (N = 418), and ninth Grade (N = 411).

			Alcohol			Delinquency		
			T1	T2	T3	T1	T2	T3
Seventh grade	**GPA**	T1	-.11*	-.15**	-.14**	-.16**	-.17**	-.20**
		T2	-.13**	-.19**	-.20**	-.23**	-.17**	-.19**
		T3	-.13**	-.18**	-.19**	-.21**	-.17**	-.24**
Eighth grade	**GPA**	T1	-.25**	-.18**	-.19**	-.26**	-.21**	-.15**
		T2	-.18**	-.22**	-.21**	-.24**	-.21**	-.14**
		T3	-.19**	-.15**	-.18**	-.21**	-.17**	-.12*
Ninth grade	**GPA**	T1	-.19**	-.17**	-.20**	-.15**	-.14**	-.14**
		T2	-.20**	-.18**	-.16**	-.10	-.11*	-.15**
		T3	-.22**	-.23**	-.22**	-.16**	-.17**	-.18**

Note. GPA = Grade Point Average. $**p < .01$; $*p < .05$.

Table 5

Sample and change descriptives for the seventh grade (N=390), eighth grade (N=418), and ninth grade (N=411).

	Seventh grade			Eighth grade			Ninth grade		
Sample	T1	T2	T3	T1	T2	T3	T1	T2	T3
Network density indicators									
Average degree	7.49	8.63	7.85	7.39	7.18	6.14	6.30	5.72	5.25
Other network indicators									
Reciprocity	56%	54%	57%	52%	52%	54%	50%	47%	49%
Transitivity	40%	40%	43%	43%	47%	45%	42%	45%	47%
Same gender	83%	85%	87%	81%	81%	81%	84%	81%	84%
Change	T1-T2	T2-T3		T1-T2	T2-T3		T1-T2	T2-T3	
Friendship indicators									
Jaccard index (stability)	45%	46%		49%	46%		42%	40%	
Hamming distance (change per student)	6.09	6.00		4.77	4.71		4.93	4.82	
No. of friendships dissolved	971	1340		1106	1259		1154	1102	
No. of friendships emerged	1413	1036		1016	819		911	918	
No. of friendships maintained	1951	2024		2029	1786		1515	1324	
Changes in achievement									
No. of steps down	242	120		102	140		174	198	
No. of steps up	63	95		185	121		114	117	
Actors that remain stable	35.4%	51.8%		39.7%	45.2%		38.4%	41.8%	
Changes in alcohol use									
No. of steps down	34	32		65	34		44	47	
No. of steps up	28	42		31	59		43	50	
Actors that remain stable	83.8%	80.5%		76.6%	77.8%		78.8%	78.1%	
Changes in delinquency									
No. of steps down	62	50		70	39		47	64	
No. of steps up	28	58		30	64		50	38	
Actors that remain stable	76.7%	71.8%		75.6%	75.4%		78.1%	76.9%	

Note. Reciprocity was calculated as $2M/(2M+A)$, where M = mutual friendship and A = asymmetric friendship; Transitivity was calculated as N of transitive triplets divided by N of 2-paths (potentially transitive triplets); See for more information on the calculation of the different network indices Veenstra and Steglich (2012).

Table 6

RSiena results on friendships, academic achievement, and alcohol use in the seventh grade (N=390), eighth grade (N=418), and ninth grade (N=411)

	Seventh grade		Eighth grade		Ninth grade	
	Est.	*SE*	**Est.**	*SE*	**Est.**	*SE*
Network dynamics: Friendship						
Constant friendship rate (period 1)	22.13	1.03	14.34	0.59	15.55	0.63
Constant friendship rate (period 2)	17.29	0.69	15.34	0.62	16.73	0.64
Outdegree (density)	-3.89***	0.05	-4.10***	0,05	-4.25***	0.06
Reciprocity	1.95***	0.06	1.88***	0.06	1.67***	0.07
Transitive triplets	0.41***	0.01	0.37***	0.01	0.42***	0.02
Transitive reciprocated triplets	-0.25***	0.02	-0.14***	0.02	-0.18***	0.03
3-cycles	-0.21***	0.02	-0.31***	0.02	-0.30***	0.02
Gender (1=boy) alter	-0.03	0.04	0.02	0.04	-0.15***	0.04
Gender (1=boy) ego	0.08*	0.04	-0.17***	0.04	0.14***	0.04
Same gender	0.85***	0.04	0.77***	0.04	0.73***	0.04
Same class	0.98***	0.04	0.94***	0.04	0.95***	0.04
Same location	0.42***	0.05	0.63***	0.06	0.85***	0.06
Track alter	-0.02	0.02	-0.04	0.02	-0.02	0.03
Track ego	-0.10***	0.02	-0.03	0.03	-0.05†	0.03
Track ego * track alter	-0.03	0.03	0.04	0.03	0.05	0.03
Alcohol alter	0.04	0.06	0.09	0.06	0.04	0.06
Alcohol ego	0.09	0.07	0.10†	0.06	0.00	0.05
GPA alter	0.01	0.01	0.03*	0.01	-0.05***	0.01
GPA ego	0.02	0.01	-0.01	0.01	0.02	0.02
Same-behavior selection effects						
Alcohol ego * alcohol alter	0.51**	0.19	0.74***	0.22	0.71***	0.14
GPA ego * GPA alter	0.03***	0.01	0.03**	0.01	0.03**	0.01
Cross-behavior selection effects						
Alcohol ego * GPA alter	-0.16***	0.04	-0.08	0.06	0.03	0.04
GPA ego * alcohol alter	-0.02	0.04	0.02	0.05	0.08†	0.04
Behavior dynamics: Alcohol and GPA						
Rate alcohol (period 1)	0.86	0.15	0.94	0.12	0.72	0.13
Rate alcohol (period 2)	1.08	0.19	1.05	0.18	0.78	0.12
Alcohol linear shape	-2.04***	0.53	-2.34***	0.45	-0.32	0.39
Alcohol indegree	-0.02	0.07	0.13*.	0.06	0.07	0.07
Alcohol outdegree	0.05	0.05	0.02	0.03	0.02	0.04
Alcohol: effect from gender	-0.26	0.40	0.37	0.30	0.04	0.26
Alcohol: effect from track	-0.42†	0.25	-0.33*	0.16	-0.14	0.20
Alcohol: effect from GPA	-0.15	0.15	-0.28†	0.17	-0.24	0.15
Rate GPA (period 1)	2.08	0.18	1.87	0.15	1.86	0.18
Rate GPA (period 2)	1.19	0.11	1.58	0.15	2.05	0.19
GPA linear shape	-0.18	0.12	-0.02	0.11	0.03	0.11
GPA quadratic shape	-0.05**	0.02	-0.12**	0.02	-0.16***	0.02
GPA indegree	0.01	0.02	0.01	0.02	-0.03†	0.02
GPA outdegree	-0.02	0.01	0.00	0.01	0.00	0.01
GPA: effect from gender	-0.16	0.10	0.07	0.08	-0.13	0.08
GPA: effect from track	-0.12*	0.06	-0.01	0.05	0.17**	0.06
GPA: effect from alcohol	-0.35†	0.20	0.10	0.16	-0.29†	0.15
Same-behavior influence effects						
Alcohol average alter	4.51**	1.70	3.03**	1.16	2.31*	1.08
GPA average alter	0.23*	0.10	0.20*	0.10	0.42***	0.10
Cross-behavior influence effects						
Alcohol: effect from friends' GPA	-0.86†	0.50	0.65	0.46	0.03	0.36
GPA: effects from friends' alcohol use	0.69	0.62	0.22	0.35	0.33	0.36

Note. † p-value ≈.05 * p-value <.05. ** p-value <.01. *** p-value < .001 (two-tailed tests).

Table 7

RSiena results on friendships, academic achievement, and delinquency in the seventh grade (N=390), eighth grade (N=418), and ninth grade (N=411)

	Seventh grade		Eighth grade		Ninth grade	
	Est.	*SE*	Est.	*SE*	Est.	*SE*
Network dynamics: Friendship						
Constant friendship rate (period 1)	21.92	1.04	14.44	0.68	15.11	0.69
Constant friendship rate (period 2)	17.31	0.67	15.51	0.75	16.27	0.75
Outdegree (density)	-3.90***	0.05	-4.06***	0.05	-4.29***	0.06
Reciprocity	1.96***	0.05	1.89***	0.06	1.70***	0.06
Transitive triplets	0.41***	0.01	0.38***	0.01	0.42***	0.02
Transitive reciprocated triplets	-0.25***	0.02	-0.15***	0.02	-0.18***	0.03
3-cycles	-0.22***	0.02	-0.31***	0.02	-0.31***	0.02
Gender (1=boy) alter	-0.06	0.04	0.02	0.04	-0.18***	0.04
Gender (1=boy) ego	0.04	0.04	-0.18***	0.04	0.10*	0.04
Same gender	0.85***	0.04	0.76***	0.04	0.74***	0.04
Same class	0.99***	0.04	0.93***	0.04	0.97***	0.04
Same location	0.42***	0.05	0.61***	0.06	0.86***	0.06
Track alter	-0.02	0.02	-0.04	0.03	-0.02	0.03
Track ego	-0.10***	0.02	-0.03	0.03	-0.02	0.03
Track ego * track alter	-0.03	0.03	0.05	0.03	0.05	0.03
Delinquency alter	0.14**	0.05	-0.06	0.06	0.04	0.05
Delinquency ego	0.18***	0.05	0.01	0.07	0.40***	0.06
GPA alter	0.02	0.01	0.01	0.01	-0.05**	0.02
GPA ego	0.02	0.01	-0.02	0.02	0.04**	0.02
Same-behavior selection effects						
Delinquency ego * delinquency alter	0.18	0.12	0.05	0.22	0.56***	0.13
GPA ego * GPA alter	0.03***	0.01	0.02†	0.01	0.03**	0.01
Cross-behavior selection effects						
Delinquency ego * GPA alter	-0.16***	0.04	-0.15*	0.06	-0.03	0.04
GPA ego * delinquency alter	-0.02	0.03	-0.10	0.06	0.09*	0.04
Behavior dynamics: Delinquency and GPA						
Rate delinquency (period 1)	0.78	0.10	0.97	0.16	1.13	0.18
Rate delinquency (period 2)	1.13	0.18	1.27	0.23	0.91	0.12
Delinquency linear shape	-1.13**	0.38	-0.78†	0.41	-0.88*	0.40
Delinquency indegree	-0.04	0.06	-0.04	0.06	-0.01	0.07
Delinquency outdegree	0.11**	0.04	0.00	0.03	0.02	0.04
Delinquency: effect from gender	0.68*	0.32	0.05	0.28	0.16	0.28
Delinquency: effect from track	-0.28	0.18	-0.07	0.17	-0.19	0.17
Delinquency: effect from GPA	-0.20†	0.12	-0.14	0.11	-0.33†	0.17
Rate GPA (period 1)	2.02	0.19	1.87	0.20	1.86	0.16
Rate GPA (period 2)	1.21	0.11	1.59	0.15	2.04	0.21
GPA linear shape	-0.23†	0.12	-0.03	0.12	0.06	0.11
GPA quadratic shape	-0.06**	0.02	-0.13***	0.02	-0.16***	0.02
GPA indegree	0.02	0.02	0.02	0.02	-0.04†	0.02
GPA outdegree	-0.02	0.01	0.00	0.01	0.01	0.01
GPA: effect from gender	0.04	0.11	0.05	0.08	-0.13	0.09
GPA: effect from track	-0.19**	0.07	-0.01	0.05	0.17**	0.06
GPA: effect from delinquency	-0.35*	0.16	-0.11	0.17	-0.22	0.15
Same-behavior influence effects						
Delinquency average alter	1.59	1.05	2.75*	1.08	3.71***	1.05
GPA average alter	0.13	0.12	0.21*	0.09	0.41***	0.09
Cross-behavior influence effects						
Delinquency: effect from friends' GPA	-0.66†	0.37	-0.01	0.38	-0.05	0.44
GPA: effect from friends' delinquency	-0.54	0.53	0.48	0.40	0.26	0.37

Note. † p-value ≈.05 * p-value <.05. ** p-value <.01. *** p-value < .001 (two-tailed tests).