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## Academic functioning and peer influences

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## Academic Functioning and Peer Influences: A Short-Term Longitudinal Study of Network–Behavior Dynamics in Middle Adolescence

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In this study, the associations between peer effects and academic functioning in middle adolescence ( $N = 342$ ; 14–15 years old; 48% male) were investigated longitudinally. Similarity in achievement (grade point averages) and unexplained absences (truancy) was explained by both peer selection and peer influence, net of acceptance, and connectedness. Friendships were formed and maintained when adolescents had low levels of achievement or high levels of truancy. Friends influenced one another to increase rather than decrease in achievement and truancy. Moreover, friends' popularity moderated peer influences in truancy in reciprocal friendships but not in unilateral friendships, whereas friends' acceptance moderated peer influences in achievement in both unilateral and reciprocal friendships. The findings illustrate the dynamic interplay between peer effects and academic functioning.

When individuals enter middle adolescence their academic trajectories begin to crystalize (for reviews, see Fredricks, Blumenfeld, & Paris, 2004; Sacerdote, 2011). Some individuals set themselves on a path toward academic success, diligently working on their assignments, earning good grades, and attending school on a regular basis. In contrast, other adolescents' school-related behaviors and attitudes portend failure. These students frequently skip school and expend very little effort on their coursework. A number of factors at different levels shape the direction that adolescents take academically (for school influences, see Eccles & Roeser,

2011; for parental influences, see Pomerantz & Wang, 2009). Increasingly, however, researchers have come to recognize the primary role that adolescents' friends play in fostering their academic beliefs and behaviors (Rodkin & Ryan, 2012).

Indeed, peers play a decisive and critical role in individuals' behaviors and attitudes during adolescence (Dishion, Piehler, & Myers, 2008; Newcomb & Bagwell, 1995), with students forming friendships that support their level of academic functioning. A number of studies have examined how and to what extent the peer environment affects individual behaviors and attitudes (for a review, see Brechwald & Prinstein, 2011), revealing that peers or networks of peers are highly influential on a variety of behaviors and attitudes related to academic functioning or performance. This includes involvement in school (Kindermann, 2007), disruptive behavior in class (Berndt & Keefe, 1995), motivation (Molloy, Gest, & Rulison, 2010), and level of achievement (Blansky et al., 2013). It is likely that both peer selection and

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peer influence play a role in explaining how students' friends affect their academic functioning. Adolescents seek out friends who are similar to them in terms of their academic functioning, and these friends then serve to reinforce their academic functioning over time (see review by McPherson, Smith-Lovin, & Cook, 2001). In this context, *selection* refers to adolescents choosing friends who are similar to them in terms of their academic functioning, whereas *socialization* or *influence* refers to adolescents becoming increasingly more similar to their friends in academic functioning over time.

A full appreciation of the role that both selection and socialization or influence play in the academic functioning or performance of adolescents has been stalled in part by methodological limitations. As Flashman (2012) articulates,

The gap in our understanding stems largely from methodological issues; friends and achievement are endogenous to one another (and) determining the effect of achievement on friend selection depends on both distinguishing the direction of the relationship between friends and achievement and incorporating dynamics into models of friend selection. (p. 63)

Analytic advances in social network analysis (cf. Snijders, van de Bunt, & Steglich, 2010) have allowed for a more nuanced understanding of the relation between adolescent friends and their academic functioning in terms of selection versus socialization effects by adding greater precision to their measurement (see Veenstra, Dijkstra, Steglich, & van Zalk, 2013).

The present study was aimed at gaining more insight into the relation between peer effects and academic functioning and is part of an ongoing series of projects (for more details, see Schwartz, Gorman, Nakamoto, & McKay, 2006). We focused on academic achievement (grade point average [GPA]) and unexplained absences (truancy) as indices of academic functioning, because together they serve as early warning indicators that a student is at risk of dropping out of school. According to a document released by the National High School Center (Heppen & Therriault, 2008), "The most powerful predictors of whether a student will complete high school include course performance and attendance during the first year of high school" (p. 1). In advancing the current state of knowledge, we examined the simultaneous development of friendship and academic functioning and their interplay using longitudinal social network analysis.

### *Peer Effects on Adolescents' Academic Functioning*

Current analytic techniques in social network analysis make it possible to assess peer effects more accurately with stochastic actor-based modeling (for an introduction, see Snijders et al., 2010; for a review, see Veenstra et al., 2013). In particular, this allows researchers to examine the dynamic, reciprocal interplay between selection and socialization in adolescent peer relations. Thus far, the vast majority of studies using these analytic techniques have examined similarity between middle school friends in externalizing problems, such as delinquency (Haynie, Doogan, & Soller, 2014) and bullying (Sentse, Kiuru, Veenstra, & Salmivalli, 2014); internalizing problems, such as depression (Schaefer, Kornienko, & Fox, 2011) and anxiety (van Zalk, van Zalk, Kerr, & Stattin, 2011); health-risk problems, such as alcohol use (Osgood et al., 2013) and obesity (de la Haye, Robins, Mohr, & Wilson, 2013); and also sociocognitive factors, such as social goals (Ojanen, Sijtsema, & Rambaran, 2013) and morality (Caravita, Sijtsema, Rambaran, & Gini, 2014). From the current body of research, it becomes clear that peers are remarkably similar in a wide range of behaviors and attitudes, which can be explained in part by processes of peer selection and peer influence. Yet, far less attention has been devoted to understanding the selection and influence dynamics between friends' academic functioning.

A few studies to date have, however, employed these statistical tools to understand selection and socialization in predicting students' academic functioning in relation to school behaviors and attitudes, including academic achievement and engagement. Using data from the National Longitudinal Study of Adolescent Health (Add Health), Flashman (2012) examined the role of friendship selection and socialization on high school students' academic achievement in eight schools ( $N = 3,251$ ). Selection and socialization explained similarity in GPAs (i.e., GPA rank) between high school friends at the two largest schools analyzed. Building on this study—exploring a wider range of school-related behaviors and attitudes related to academic functioning—Shin and Ryan (2014a, 2014b) found that achievement (GPAs), intrinsic value, effortful behavior, disruptive behavior, and mastery goals were all related to socialization (but not to selection), whereas academic self-efficacy was related to selection (but not to socialization). Finally, Geven, Weesie, and van Tubergen (2013) found that friendship similarity in inattention in class and not doing homework was related to both selection and

socialization. Based on this work, we expected that both selection and socialization play a significant role in predicting friends' academic functioning.

#### *Contributions to Existing Research*

Four key issues are raised by this research, which are also the contributions of the present study. First, previous researchers examined school behaviors and attitudes related to academic functioning as separate outcomes, whereas different school behaviors may affect each other (cf. Fredricks et al., 2004). One explanation for this relates to multicollinearity issues (high correlations between different outcomes), which can be problematic when disentangling different dimensions of school behaviors from each other (Geven et al., 2013). Nonetheless, failing to account for potential confounding effects may raise questions about whether peer effects for one type of behavior is more important than for the other type of behavior. In this study, correlations between our two measures of academic functioning (i.e., GPA and truancy) were moderate (between  $-.46$  and  $-.48$ ); this formed no problem with regard to the analysis as separate analysis showed similar results.

Second, although previous researchers found evidence for both selection and socialization in predicting friends' academic functioning, they did not form any formal analysis to indicate whether selection or socialization contribute more to similarity. However, more insight into the relative contribution of selection and socialization might help in developing better intervention strategies to increase student engagement. For instance, if low-performing students drag each other down primarily because they have a strong preference to form and maintain friendships with each other, this may be a reason to intervene in potential socialization opportunities of these students. Accordingly, one goal of this study was to formally test the contributions of selection and socialization in explaining students' academic functioning in friendship networks. We predicted that similarity in academic functioning (i.e., GPA and truancy) between adolescents and their friends would be better explained by socialization rather than selection effects. The main reason for this is that during middle adolescence peer influences and behavior conformity becomes more prominent.

Third, previous researchers speculate that peers might have a positive or negative influence on their friends' academic functioning (Blansky et al., 2013; Geven et al., 2013), but they did not differentiate

between increases versus decreases in peer influences on academic functioning nor did they differentiate between friendship creation and maintenance. Accordingly, a third goal of this study was to formally test the direction of peer selection and peer influences on students' academic functioning. It stands to reason that (continued) friendships with peers who function academically well might drive adolescents' tendency to increase more than to decrease in achievement, whereas adolescents who (continue to) associate with peers who dysfunction academically might result in the opposite.

A fourth issue raised by Geven et al.'s (2013) study is that some friends might be more influential than others in shaping adolescents' problem behaviors at school. Contrary to the researchers' prediction, friends with a higher indegree (who received more friendship nominations) were not more influential than others in influencing their peers' problematic school behaviors. As the authors speculate, however, the indegree likely reflects the friend's level of social acceptance or how well liked (in terms of friendship affiliation) they are in the peer group rather than their popularity. This is an important distinction because adolescents with greater popularity in the peer group have been found to exert more power and influence over their peers than other students (Sandstrom, 2011). In this study, we explored whether highly popular peers exert a stronger influence in shaping their friends' academic functioning than other peers. In addressing this question, we also considered the moderating effect of social acceptance, another dimension of adolescents' social standing in the peer group. Accordingly, a central goal of this study was to examine if friends' social standing moderates the relation between their academic functioning and that of their peers.

#### *Moderating Effect of Peer Social Standing*

When individuals enter adolescence, the peer landscape becomes more complex and two dimensions of high social standing are distinguishable: social acceptance and popularity among peers (for a review, see Cillessen & Marks, 2011). Social acceptance is generally operationalized as an indicator of likability or positive regard from peers (Coie & Dodge, 1983). In contrast, popularity is a shared recognition among peers or a group's consensus that a particular youth has achieved prestige, visibility, or high social status (Adler, Kless, & Adler, 1992). Popularity is not viewed as an indicator of liking by peers but rather is seen as a reputational

construct involving power and status in the group (Lease, Kennedy, & Axelrod, 2002). As Cillessen and Marks (2011) explain,

[P]opularity is conceptually closer to the traditional sociometric dimension of social impact . . . the sum of “like-most” and “liked-least” nominations received, which is also an indicator of how socially visible someone is in a group, irrespective of the valence of the behavior that attracts others’ attention. (pp. 28–29; see also Cillessen & van den Berg, 2012)

Popular youth are highly visible, admired, and emerge as leaders among their peers (Lease et al., 2002; Parkhurst & Hopmeyer, 1998). It stands to reason that popular students by virtue of both their social standing in the peer group and behavioral attributes would exert a particularly strong influence on their peers’ school attitudes and behaviors.

#### *Popularity and Academic Functioning*

The hypothesis that youth who are popular would exert a strong influence in shaping their peers’ academic functioning is supported by research on adolescent susceptibility to peer influence (for a brief review, see Brechwald & Prinstein, 2011). This work highlights that adolescents publicly conform and alter their beliefs and behavioral intentions so that they are consistent with those of more popular peers. Using an experimental design, Prinstein, Brechwald, and Cohen (2011; see also Cohen & Prinstein, 2006) showed that adolescent boys changed their endorsement of aggressive and health-risk behaviors after being exposed, in a chat room session, to popular peers who advocated antisocial norms (i.e., physical aggression, verbal teasing, vandalism, and substance use). Teunissen et al. (2012) found that adolescents adjusted their willingness to drink to the proalcohol and antialcohol norms endorsed by popular peers with whom they interacted online. In addition, although the effect sizes were small, they found some indication that the participants privately accepted and internalized the antialcohol norms of the popular e-confederates. The authors speculate that adolescents readily conform to the behaviors and attitudes of popular peers in order to both gain the approval of more powerful peers and to avoid the social repercussions of their negative evaluations. Building on this conception—using an actor-based modeling approach—Rambaran, Dijkstra, and Stark (2013) found that influence effects on attitudes toward risk

behaviors (e.g., hitting someone, smoking cigarettes, and drinking alcohol) were stronger in a context where status or perceived popularity in class was more positively correlated with risk attitudes indicating that in this context the high-status adolescents set the norm among peers and influence their beliefs and attitudes. Taken together, this research highlights that popular youth are strong agents of peer influence with regard to antisocial behaviors and attitudes. Yet, it remains unclear whether popular youth also exert influence upon their friends’ academic functioning. So far, there are no studies that provide insight into this relation (cf. Cillessen & van den Berg, 2012). Building on broader work on conformity to antisocial behaviors and attitudes we expect that popular youth exert a similarly negative influence upon their friends’ academic functioning, particularly with regard to truancy which may also be seen as norm-breaking behavior at school.

#### *Acceptance and Academic Functioning*

There is ample research on the associations between individuals’ own acceptance among peers and their academic achievement showing that socially accepted individuals are academically inclined (high achievement, school competence), prosocial, and helpful to peers (see for a review Cillessen & van den Berg, 2012). Although there is clear evidence that individuals with low peer acceptance are at risk for dropout, truancy, and absenteeism (Parker & Asher, 1987), there are no studies that have directly tested the causal effects of these outcomes on peer relationships (see Cillessen & van den Berg, 2012). Thus far, the only evidence comes from Geven et al.’s (2013) study who showed that peers with high acceptance (in terms of friendship nominations) do not affect individuals’ tendency toward problematic school behaviors. Based on broader work on peer acceptance, we expect that accepted youth exert a positive influence upon their friends’ academic functioning, particularly with regard to their academic achievement. Drawing on the work of Geven et al. (2013), we did not anticipate that social acceptance would exert a similar moderating influence on friends’ unexplained absences (truancy).

#### *Present Study*

In the present study, we sought to extend our current understanding of the link between peer relationships during adolescence and academic

functioning (i.e., GPA and truancy). We addressed three main questions: (1) Can similarity in academic functioning among friends be explained by processes of peer selection and peer influence? In addition, (1a) is similarity better explained by peer selection than by peer influence or vice versa? (2) In which direction do peer selection and peer influence processes operate? (3) Do popularity and/or acceptance levels among friends moderate the association between influence and academic functioning? To address our research questions, we used a short-term longitudinal design, with four waves of data collected over two high school years (ninth grade and tenth grade). We focused on middle adolescence because, by this developmental stage, youth are apt to have well-established beliefs about the role of popularity (Juvonen & Murdock, 1995).

We examined our hypotheses using longitudinal social network analysis in Simulation Investigation for Empirical Network Analysis (SIENA) in R (Snijders et al., 2010). The strength of the method lies in that it overcomes several important shortcomings of previous research that did not incorporate the method (see for a detailed explanation Steglich, Snijders, & Pearson, 2010). First, by using information of all students and their friendships to each other (sociocentric networks) this method makes it possible to simultaneously estimate parameters for selection and socialization, describing changes and stability in friendships and academic functioning while controlling for each other. Second, estimates are based on a simulation procedure in which unobserved changes between observations are modeled; a lack of consideration of these changes could result in misinterpretation of selection and socialization effects (see for an illustration Veenstra & Steglich, 2012). Third, alternative friendship processes such as the tendency to reciprocate friendships or being part of a friendship group are controlled for (i.e., friendship patterns in the network); these processes operate in parallel to friendship changes based on academic functioning and need to be accounted for to more accurately estimate the selection and socialization effects. Fourth, this way the method also takes complex endogenous dependence patterns among observation units into account that are characteristic for sociocentric networks.

## Method

### *Sample*

The data were collected from 342 ninth-grade students (174 boys, 168 girls) of a moderately sized public high school (approximately 1,200 total

students) in a semiurban area of southern California. The surrounding neighborhoods were characterized by low to moderate crime rates and a high percentage of single-family homes. The composition of the sample (ascertained from school records) was as follows: 50% European American, 35% Latino, 7% Asian or Pacific Islander, 5% Armenian, 2% African American, and 1% Native American.

English and Spanish language versions of a parental consent letter were sent home for each of the eligible students attending the school. Students who received parental permission were also asked to indicate in writing that they were willing to take part in the project. The consent and assent forms reminded participants that the project was voluntary and that permanent records of names would not be kept. Nineteen parents (4.8%) did not give consent for their children to participate in the project. The student population was relatively stable over the course of the project, reflecting moderate turnover rates in the school district as a whole. Accordingly, sample attrition from Time 1 (T1) to Time 4 (T4) was minimal, with 26 students moving from the school before the completion of data collection. In addition, seven participants opted to withdraw during the project. From the original data pool of 394 students, 342 students participated in the study. Hence, the final sample represented 87% of the recruited population (i.e., the 394 students in ninth grade).

### *Procedure*

Data were collected from September 1997 through June 1999. Data were initially collected when adolescents were in ninth grade (average age of 14 years old) and then again when they were in tenth grade (average age of 15 years old). Four waves of data were obtained, with assessments conducted in the fall and spring of each year. Consecutive time points were separated by 24-week intervals. At all four time points, questionnaires were group administered in English classes, in sessions lasting approximately 50 min. The participants were read aloud standardized instructions and questionnaire items.

### *Measures*

The same measures were collected at all time points. Social acceptance and popularity were assessed with peer ratings. When peer-report rating-scale sociometric and behavioral nomination measures are used in elementary school, each

participant is typically asked to evaluate every student in his or her classroom (Hymel, 1986). This approach is not practical in a high school setting, because students encounter a large number of peers in different classes. Accordingly, an approach similar to that used by Parkhurst and Asher (1992) with a middle school sample was adopted. A random computer-generated list of exactly 50 students was created for each participant to evaluate (approximately 14% of the 10th-grade students participating in the study). The lists of students were generated with two constraints: (a) that each participant's name appeared on exactly 50 lists and (b) that each participant's name did not appear on his or her own list. The same list of classmates appeared on every page of the questionnaire. A random list procedure that relies on multiple informants for peer assessments provides a feasible and reliable method to measure adolescents' status and peer reputations in large peer groups in secondary school settings, and only few students remain unknown by the students who received their names on their lists (Bellmore, Jiang, & Juvonen, 2010).

The school used a cluster system, with the same students taking core classes together. Students had ample opportunity to interact with a wide range of peers outside of their core classes which formed the clusters. Given the large size of the school and the cluster system, and the fact that students had just transitioned to the school from multiple lower levels schools, we did not expect the participants to be familiar with all of the peers in their grade. Accordingly, participants were asked to identify peers they did not know well enough to evaluate by circling 0 on the popularity scales (approximately 40% of responses). With these procedures, each participant evaluated approximately 14% of the sample. The mean number of participants who evaluated each student was 28.6 ( $SD = 6.7$ ). Because of the relatively low turnover rates in the school's population, we expected an increase in familiarity between students after the 1st year of high school. As such the participants rated the same peers at T1 and T2, but new lists were generated at T3, excluding participants who left the school after the 1st year of the study.

#### *Popularity and Acceptance*

The participants were asked to indicate how popular each of the peers on their list (see above) was on a scale ranging from 1 (*not at all*) to 5 (*very popular*). In a similar manner, participants were asked to indicate how much they liked to "hang

out with" each of the peers on their list, using a scale ranging from 1 (*not at all*) to 5 (*very much*). Popularity and acceptance scores were generated on the basis of the mean rating received by each participant. This approach follows procedures used by Asher and Hymel (1986), in which participants were asked to indicate how much they liked to play with, work with, or be in activities with specific peers. We substituted the wording "hang out with" for "play with" to optimize the suitability of the item for adolescents (Graham & Juvonen, 1998).

We opted to assess social standing with ratings (instead of nominations) as these may optimize the reliability and validity of social standing indices in the entire grade (Bellmore et al., 2010). Pragmatically, however, ratings and nominations are likely to provide similar forms of information (Asher & Dodge, 1986). Likewise, the available data suggest that acceptance items that tap liking by peers (e.g., kids you like the most) have similar psychometric properties to items that tap desirability as a social partner (e.g., kids you like to play with) and assess closely related aspects of standing (Jiang & Cillessen, 2005).

Because social acceptance and popularity are moderately correlated (see Cillessen & van den Berg, 2012)—being popular likely means being also socially accepted and vice versa (in our data *correlation coefficients* varied between .61 and .67)—we decided to partial out the effect of popularity from acceptance by performing linear regressions per each time point separately. The unstandardized residuals for social acceptance were used in combination with the "raw" popularity scores in our interaction models. This ensured that our two measures of social standing were uncorrelated per each time point, which allowed us to assess the unique effects of these two outcomes of social standing on academic functioning.

#### *Friendships*

The participants were given an alphabetical list of all consenting students in their grade. They were asked to circle the names of their "closest friends" and were instructed that they could circle as many or as few names as they liked. Participants could provide unlimited same-sex and other-sex nominations. Friendship nominations were coded 1; non-nominations were coded 0. Missing values due to absence during the data collection were coded as 9. Based on these nominations, we constructed an adjacency matrix containing all friendship nominations of the whole grade per each time point. The

median number of friendship nominations was 16 at T1, 18 at T2, 21 at T3, and 19.5 at T4. A relatively large number of friendship dyads were identified, probably because we relied on an unlimited nomination approach. We used this procedure given concerns that restricting adolescents' friendship choices to a fixed number of nominations might lead to an incomplete picture of their friendship networks (cf. Furman, 1996). To enhance the ecological validity of the assessment, we also allowed participants to choose friends from the full grade (instead of restricting potential friendship choices to one specific classroom).

### *Achievement and Truancy*

The mean of the students' five academic course grades for each semester (from official school records) were computed as GPAs. To account for the fact that not all students were enrolled in the same number of courses, GPAs were on a weighted 4.0 scale ensuring comparability across students. Due to the different weighting of different courses, 5.4%–6.9% of students had GPAs that exceeded the 4.0 scale. For analytical purposes, we rounded the scores to the nearest integer, and then truncated the scores left of the scale (the lowest score 0 was coded as 1 because it contained too few cases; 2% across waves). This ensured that the remaining scale had sufficient cases in each category across waves ( $1_{\text{low GPA}} = 11.2\%$ ;  $2 = 31.1\%$ ;  $3 = 38.1\%$ ;  $4_{\text{high GPA}} = 19.5\%$ ).

Unexplained absences (truancy) were computed as a tally of the number of days students were absent from school without a valid explanation (from official school records). A valid explanation was defined by the school as a documented illness, injury, or family emergency. For analytical purposes, we computed the scores using log transformations (keeping the original zeros) and then truncated the scores right of the scale (scores 4 and 5 were coded as 3 because they contained too few cases, approximately 1% across waves), ensuring that the remaining scale had sufficient cases in each category across waves ( $0_{\text{low truancy}} = 37.8\%$ ;  $1 = 27.1\%$ ;  $2 = 24.8\%$ ;  $3_{\text{high truancy}} = 10.3\%$ ).

### *Missing Data Analysis and Treatment*

Missing data could be categorized as missing "academic functioning data" and missing "friendship data". Missing friendship data occurred when students participated in the study (i.e., consented and assented) but were absent during the data

collection day (regular missing). Missing academic functioning data occurred due to record keeping errors at the school. There were no missing data on students' sex, ethnicity, popularity, and acceptance.

Although missing friendship data and academic functioning data were low at T1 (0.3%–1.8%), they were considerably higher at T4 (8.8%–10.2%). Hence, we compared students with missing friendship data with students who had complete data, showing that at the first three measurements students with missing data had lower levels of academic achievement, T1:  $t(334) = -4.28$ ; T2:  $t(335) = -3.64$ ; T3:  $t(316) = -2.11$ ;  $ps < .05$ , and higher levels of truancy, T1:  $t(339) = 4.81$ ; T2:  $t(336) = 4.95$ ; T3:  $t(326) = 3.27$ ;  $ps < .05$ . Moreover, they had lower levels of social acceptance at the last two measurements, T3:  $t(340) = -3.22$ ; T4:  $t(340) = -2.67$ ;  $ps < .05$ , and sent and received fewer nominations at T3 and T4, respectively,  $t(340) = -2.98$ ;  $t(340) = -2.35$ ;  $ps < .05$ . No other significant differences were found. We conclude that missingness is not completely at random but might be at random (MAR) depending on truancy levels, GPA, acceptance, and connectedness.

In a simulation study, the missing data handling procedure implemented in the SIENA R program was shown to handle up to 20% of missing network data without estimation problems and without producing biased results in the MAR case (Huisman & Steglich, 2008). Missing data are imputed efficiently during the estimation run with "last observation carry forward" (LOCF, cf. Ripley, Snijders, Boda, Vörös, & Preciado, 2015). This means that for each tie variable the last previous nonmissing value (if it exists) is imputed; if there is no previous nonmissing value, the value 0 (no friendship tie) is imputed. Also for the academic functioning data, LOCF is applied, and the missing values are imputed by the mode per observation when no previous nonmissing value exists. Whenever imputed values are used, parameter estimate updates are based on the nonimputed parts of the data, which minimizes the impact of imputations on the results.

### *Analytic Strategy*

The role of peers on the development of academic functioning (GPA and truancy) was investigated with longitudinal social network analysis (SIENA; Snijders et al., 2010). SIENA has been successfully used to explain the association between network connectedness (mainly friendships) and behavior in a wide range of such behaviors (see Veenstra et al., 2013), including attitudes and behaviors related to academic functioning



(Flashman, 2012; Geven et al., 2013; Shin & Ryan, 2014a, 2014b).

SIENA instantiates an actor-based simulation model, which allows us to examine whether similarity between friends (or any other association between friendship and the friends' behavior) is the result of selection or socialization processes (Steglich et al., 2010). Students are assumed to change their friendship ties and behaviors in continuous time between observation moments, based on individual preferences. At a given moment, students may change a friendship tie (i.e., create a new tie, drop one existing tie, or keep the relationship unchanged) or their behavior (by going one step up or down or keep their behavior the same; "microsteps") in response to the current state of the network structure and the "behavior" of other students in the network when they make the change. In this way, the dynamic feedback between behavior change and friendship change can be controlled for, as well as structural and individual effects on changes in friendships and academic functioning. One key assumption of the model is that students have full information about the relationships and behaviors in the network, which may not be realistic given the large network size. Changes in friendships and academic functioning are modeled as outcomes of students' decisions, revealing an underlying preference measure ("objective function") indicating how "satisfied" the students are with their local network neighborhood configuration. Parameter estimates are derived from iterative simulations using the Robbins–Monro stochastic approximation algorithm (see Ripley et al., 2015).

#### *Model Specification and Effect Interpretation*

Analysis in SIENA yields parameter estimates related to network dynamics (structural and attribute-dependent selection dynamics), and parameter estimates related to behavior dynamics (influence effects and behavioral tendencies). Most of these effects are control effects to more accurately assess and interpret selection and influence effects on academic functioning. Below, we briefly discuss the effects that are of main interest. For a complete description of all included effects in our models, we refer to Table S1.

We estimated several models to answer our research questions. In all models, selection effects based on students' traits (i.e., sex and ethnicity) and behaviors (i.e., GPA and truancy) were estimated

while controlling for effects of the friendship network structure (see Appendix S1). Additionally, academic achievement (GPA) and truancy were added as separate behaviors in the same model. This model tested the hypothesis regarding selection and socialization on academic achievement and truancy (RQ1), and served as a baseline model for the models in which we assessed the relative contribution of selection and socialization (RQ1a), the direction of selection and socialization (RQ2), and the hypotheses regarding moderation by friends' social standing among peers (RQ3).

#### *Selection and Socialization Parameters for RQ1(a)*

To assess whether similarity in academic functioning among friends is explained by peer selection and/or peer influence, we included general (i.e., evaluation) selection and socialization effects related to individual academic achievement and truancy. For selection, these variables were included as effects on nominations received (*alter* effects) and on nominations given (*ego* effects). To account for homophily on these variables, we also included *similarity* effects. Selection processes were estimated while controlling for potential selection effects based on students' *sex* and *ethnicity* (Veenstra et al., 2013). Because our two included similarity terms (i.e., *similarity* effect and *alterXego* effect) for academic achievement or truancy are mutually depended on each other they cannot be interpreted separately. Therefore, we calculated ego-alter selection tables (cf. Ripley et al., 2015), which contain the combined contribution (odds) of selection effects to friendship formation and development.

Socialization was included as the tendency of students to change their own academic achievement or truancy to more closely resemble their friends' average academic achievement or truancy (*average similarity* effects). This tendency could thus work in the upward or in the downward direction, depending on whether friends display higher or lower levels of academic achievement or truancy than the adolescent does. Socialization processes were estimated while controlling for the overall distributional shape of academic achievement and truancy (linear and quadratic shape parameters), a main effect of sex, and the main effect of academic achievement and truancy on each other to account for to-be-expected correlations between these two academic outcomes (Fredricks et al., 2004).

### *Selection and Socialization Parameters for RQ2*

To assess the direction of peer selection and socialization, we included specific effects. For selection, we differentiated processes of friendship formation from friendship maintenance by substituting both the “creation” (i.e., formation) and “endowment” (i.e., maintenance) effects for the general “evaluation” effect. A similar procedure was carried out in other SIENA studies (Sijtsema, Rambaran, & Ojanen, 2013). Again, because we cannot interpret the two similarity terms separately (see above), we calculated ego-alter selection tables to understand the selection processes separately for friendship formation and maintenance.

For socialization, we tested the differential effect of peer influence on increases versus decreases on academic functioning by including two socialization effects in our model (as per Haas & Schaefer, 2014). This enables us to differentiate between tendencies to increase behavior (captured via the “evaluation” effect) and reluctance to decrease behavior (captured via the “endowment” effect). A positive evaluation effect estimate indicates that adolescents tend to *conform* to their friends—adjusting in such a way that they *more* closely resemble their friends; in contrast, a positive endowment effect estimate indicates that adolescents tend to conform to their friends more in downward than in upward moves on the behavior scale. If friends are more important for increases than for decreases this would be indicated by a positive evaluation effect and a negative endowment effect.

### *Selection and Socialization Parameters for RQ3*

To test the hypotheses that socialization is moderated by friends’ social standing among peers (i.e., their social acceptance and popularity), we included two evaluation interaction terms between the *average similarity* effect and *friends’ popularity* or *friends’ acceptance*, respectively. In order not to misinterpret the results, we controlled for the main effects of *friends’ social acceptance* and *friends’ popularity* on academic achievement and truancy to account for the unique effects of these outcomes of social standing to change in academic functioning (Cillessen & Marks, 2011). In addition, we controlled for the tendency of adolescents to nominate highly popular and highly accepted peers as their friends; an important selection mechanism for these variables reflecting that peers with high social standing in the group are desirable as social partner in friendship networks.

## Results

### *Descriptive Statistics*

Description of the network and individual variables are presented in Table 1. The amount of friendship nominations made in this study varied between 16 and 21 across the four time points. This is higher than typically found in network studies across adolescent samples in the United States, which may be explained by the low barrier to choosing friends as we relied on an unlimited nomination procedure with no restrictions to same- and other-sex peers (see also Rambaran, Dijkstra, Munniksma, & Cillessen, 2015). Accordingly, important characteristics of the network deviated a bit from previous studies (cf. Veenstra et al., 2013). First, the friendship grade network was characterized by moderate reciprocity with participants reciprocating about 40% of the friendship ties. This is less than the 60%–70% reciprocated ties that are commonly found in studies with limited nominations and reflects the elicitation of more weak friendship ties in the data. This is also reflected in the moderate transitivity index: The ratio of the numbers of transitive triplets divided by the number of two paths (potentially transitive triplets), reflecting the tendency of participants to form cohesive peer groups, was 30%. This again is low compared to studies with limited nominations, where this index typically takes values of 40%–50%. As commonly observed, density was low, with 7%–9% of friendship ties being present in relation to the total amount of ties possible. Over 60% of friendship nominations were of the same sex, and around 50% of nominations were of the same ethnicity.

Moran’s *I* network autocorrelation coefficient indicates the degree to which friends display similarity in academic functioning (see Steglich et al., 2010). Values close to 0 are expected under random pairing (i.e., perfect independence), whereas values close to 1 indicate perfect similarity. Typically, values of .2 to .3 show good indication of behavioral similarity. In the present study, Moran’s *I* was low to moderate for academic achievement (values between .11 and .15) but low for truancy (values between .04 and .08). However, all correlations departed significantly from zero (all  $ps \leq .001$ ), indicating that adolescent friends were similar in both achievement and truancy. Moreover, Moran’s *I* was slightly higher in reciprocal friendships (achievement: values between .17 and .22; truancy: values between .06 and .13); again, suggesting elicitation of more weak friendship ties in the data.

The Jaccard index showed satisfactory stability in friendship ties (around 35–45%), which is necessary

Table 1  
Description of the Variables Per Time Point and Longitudinal Transitions Between Time Points

Sample	T1	T2	T3	T4	T1-T2	T2-T3	T3-T4	T1-T4
Network density indicators								
Density	6.8%	7.6%	8.9%	9.1%	6950	8003	6817	10293
Median out/indegree	16/21	18/23	21/25	19.5/26	40.2%	36.5%	45.9%	24.9%
Number of ties	7891	8638	9508	9677	4.1%	10.1%	11.1%	9.0%
Missing fraction	1.2%	2.6%	8.2%	8.8%				
Other network indicators								
Reciprocity	36.6%	38.8%	42.5%	41.0%	.79***	.77***	.82***	.49***
No. of reciprocal ties	2870	3260	3752	3700	.93***	.91***	.94***	.82***
No. of asymmetric ties	9960	10264	10160	10670	.65***	.49***	.62***	.43***
Transitivity	28.2%	28.2%	29.0%	30.7%	.92***	.89***	.94***	.83***
Same sex	65.7%	63.7%	61.9%	60.6%	.60***	.43***	.73***	.41***
Same ethnicity	48.7%	46.9%	48.2%	48.4%	.80***	.76***	.78***	.64***
Standing distribution (min.-max., SD)								
Popularity	1.00 to 4.45 (0.66)	1.13 to 4.19 (0.65)	1.09 to 4.43 (0.68)	1.16 to 4.51 (0.68)				
Acceptance <sup>a</sup>	-0.77 to 1.03 (0.33)	-1.03 to 0.98 (0.33)	-0.97 to 0.76 (0.31)	-1.16 to 0.71 (0.30)	.61***	.59***	.53***	.42***
Functioning distribution (M, SD)								
GPA	2.75 (0.88)	2.50 (0.97)	2.72 (0.91)	2.67 (0.88)	128	124	101	141
Truancy	0.80 (0.93)	1.20 (0.99)	1.01 (1.06)	1.32 (1.02)	62.3%	62.6%	67.1%	58.3%
Network autocorrelation <sup>b</sup>								
Moran's I GPA	.13***	.15***	.13***	.10***	230	211	225	270
Moran's I truancy	.04***	.08***	.05***	.06***	44.1%	46.8%	43.6%	36.9%

Note. Density was calculated as  $N$  of ties divided by the total amount of potential ties ( $N^*(N - 1)$ ); reciprocity was calculated as  $2M/(2M + A)$ , where  $M$  = mutual ties and  $A$  = asymmetric ties; transitivity was calculated as  $N$  of transitive triplets divided by  $N$  of 2-paths (potentially transitive triplets); Hamming distance is the amount of tie changes from one time point to the next. For more information on the calculation of the different network indices, see Veenstra and Steglich (2012). GPA = grade point average. <sup>a</sup>Unstandardized residuals of acceptance with popularity partialled. <sup>b</sup>Significance tests ( $***p \leq .001$ ) performed using permutation tests (10,000 permutations were used) in Ucinet 6.

for longitudinal social network analysis (Veenstra & Steglich, 2012). The greatest turnover in friendship ties occurred between Time 2 and Time 3, which corresponded with a summer break and the beginning of a new school year. There was also sufficient change (distance) and stability (fraction stable actors) in our two measures of academic functioning and also relative stability between the first and last measurement for sending and receiving nominations for friendship (correlations of .49 and .82, respectively) and peer ratings for social acceptance and popularity (correlations of .41 and .83, respectively).

#### *Peer Effects on Adolescents' Academic Functioning*

Table 2 (Model 1) presents the results of the SIENA analyses (performed with RSiena version 1.1-284) of network and behavior dynamics for academic functioning. Only effects related to our hypothesis are reported; the full models are presented in Table S2. The results of the goodness-of-fit tests and sensitivity analysis are also reported in the Supporting Information (Appendix S3 and Figure S2). To facilitate the interpretation of the findings, we calculated odds by taking the exponential function of the parameter estimates ( $= \exp(\beta k)$ ; Ripley et al., 2015). For the similarity parameters for academic achievement and truancy, we first divided the estimates by the number of answer categories  $-1$  to reflect the effect of a one-unit increase or decrease on the scales. Odds were not calculated for the effects that were not linear (e.g., quadratic shape terms). Odds that depart significantly from 1 in upward (downward) direction can be seen as a tendency to have (avoid) friendships (for the selection parameters) or a tendency to obtain a higher (lower) score on an academic functioning variable (for the behavior parameters).

#### *Selection Effects on Academic Functioning*

The joint contribution of selection effects (i.e., the *alter* effect, the *ego* effect, the *similarity* effect, and the *egoXalter* effect)—summarized with multieffect Wald-type tests (for sets of effects; cf. Ripley et al., 2015)—related to academic achievement,  $\chi^2(4) = 127.8$ , and truancy,  $\chi^2(4) = 30.1$ , was a significant predictor ( $p < .001$ ) of explaining friendships between adolescents and their peers, and was as expected. In terms of inferential analysis, Table 3A–B summarizes the SIENA estimates for these selection effects. Subtracting the values for those with the highest scores from those with the lowest scores shows that chances were higher of friendship

selection to occur when adolescents scored lowest on academic achievement, Table 3A, OR ( $\exp(.28 - .05)$ ) = 1.28, and highest on truancy, Table 3B, OR ( $\exp(.23 - .06)$ ) = 1.19. This means that friendship selection was more likely when adolescents and friends functioned poorly academically.

#### *Influence Effects on Academic Functioning*

Table 2 (Model 1) also presents the results of the SIENA analyses of behavior dynamics for academic achievement and truancy. We discuss only the effects that reached statistical levels of significance. The negative *GPA linear shape* effect indicated that on average students tended toward lower levels of achievement over time. The negative *effect of own truancy* indicates that students with higher levels of truancy tended toward lower levels of achievement over time (OR = 0.68,  $p < .01$ ). As expected, the positive *average similarity* effect indicates that students tended to become more similar to friends in achievement over time (OR = 5.14,  $p < .001$ ).

For truancy, the positive *quadratic shape* effect indicates that those with initially high values on truancy tended toward higher values, whereas those with initially low values tended toward lower values over time (Est. = 0.25,  $p < .001$ ). Moreover, the negative *effect of GPA* indicates that students with higher levels of academic achievement tended toward lower levels of truancy over time (OR = 0.75,  $p < .001$ ). As expected, the *average similarity* effect indicates that students tended to become more similar to friends in truancy over time (OR = 3.19,  $p < .001$ ).

#### *Relative Contribution of Selection and Influence*

As expected, our results show that both selection and influence predict similarity in friends' academic functioning (RQ1). Therefore, we assessed the relative contributions of both processes to friend similarity (RQ1a) by estimating four additional, partial models with only a subset of parameters, besides our baseline model (see for details on the calculation method Steglich et al., 2010). The results of these models are reported in Table S3 and Figure S1. It appeared that selection contributed relatively more to similarity among friends than socialization for academic achievement (GPA). However, for truancy selection and socialization contributed equally to explaining similarity between friends. The findings from this analysis also show that a fair amount of network autocorrelation is already captured by our included controls (i.e., selection based on network positions and individual dispositions),

Table 2

Network-Behavioral Dynamics for Friendship, Academic Achievement (GPA), and Truancy (Unexplained Absences; N = 342)

	Model 1: Baseline			Model 2: Standing		
	Est.	<i>t</i> value	OR	Est.	<i>t</i> value	OR
Network dynamics: Friendship						
Selection effects on academic functioning						
GPA alter	-0.01	-0.96	0.99	-0.02	-1.34	0.99
GPA ego	-0.06	-4.98***	0.94	-0.06	-4.96***	0.94
GPA similarity	0.32	5.53***	1.11	0.32	5.74***	1.38
GPA Alter × Ego	0.02	1.12	1.02	0.02	1.06	1.02
Truancy alter	-0.06	-3.79***	0.94	-0.07	-3.97***	0.93
Truancy ego	-0.00	-0.25	1.00	-0.01	-0.41	0.99
Truancy similarity	-0.50	-3.54***	0.85	-0.56	-3.50***	0.57
Truancy Alter × Ego	0.15	4.27***	1.16	0.16	4.27***	1.17
Selection effects on social standing						
Popularity alter				0.07	4.76***	1.07
Acceptance alter				0.10	4.80***	1.11
Behavioral dynamics: GPA						
Control effects for GPA						
Linear shape	-0.16	-2.16*	0.86	-0.20	-1.65 <sup>†</sup>	0.81
Quadratic shape	0.13	0.98	NA	0.13	0.94	NA
Own sex	-0.15	-1.11	0.86	-0.15	-1.06	0.86
Own truancy	-0.38	-2.88**	0.68	-0.39	-3.04**	0.68
Friends' influence on GPA						
Average similarity	4.91	3.59***	5.14	4.51	2.97**	4.49
Influence of friends' standing on GPA						
Friends' popularity				0.24	0.71	1.28
Friends' acceptance				-0.01	-0.01	0.99
Average Similarity × Friends' Popularity				1.72	0.59	1.78
Average Similarity × Friends' Acceptance				2.22 <sup>a</sup>	4.94 <sup>*a</sup>	NA
Behavioral dynamics: Truancy						
Control effects for truancy						
Linear shape	-0.02	-0.39	0.98	-0.13	-1.06	0.88
Quadratic shape	0.25	3.59***	NA	0.22	3.07**	NA
Own sex	-0.06	-0.88	0.94	-0.06	-0.74	0.94
Own GPA	-0.29	-4.64***	0.75	-0.28	-4.28***	0.75
Friends' influence on truancy						
Average similarity	3.48	4.04***	3.19	2.52	2.35*	2.31
Influence of friends' standing on truancy						
Friends' popularity				0.43	1.65 <sup>†</sup>	1.54
Friends' acceptance				-1.18	-1.23	0.31
Average Similarity × Friends' Popularity				2.73	1.22	2.49
Average Similarity × Friends' Acceptance <sup>a</sup>				1.12 <sup>a</sup>	1.24 <sup>a</sup>	NA

Note. Significance tests performed by dividing the estimates with its standard error resulting in *t* values which under the null hypothesis are approximately normally distributed (Ripley et al., 2015). GPA = grade point average. <sup>a</sup>Interaction terms showed high parameter estimates and high standard deviations (i.e., the so-called Donner-Hauck phenomenon). As a possible solution (cf. Ripley et al., 2015), we score tested them in separate models and report one-sided (normal variate) estimates with test statistic *c* that follows a chi-square distribution with 1 *df* (the full models are reported in Models 3A and 3B in Table S2).

<sup>†</sup>*p* < .10. \**p* < .05. \*\**p* < .01. \*\*\**p* < .001 (two-tailed test).

indicating that, for a large part, friend similarity in academic functioning can be explained by processes other than selection and socialization or by what happened before the period under investigation in this study.

#### Direction of Peer Selection and Peer Influence

To gain more insight into the direction of peer selection and socialization processes (RQ2), we performed two additional separate analyses. For the direction of

Table 3  
Likelihood of Peer Selection Based on GPA (Left) and Truancy (Right)

Individual/peer	1	2	3	4	0	1	2	3	
A: GPA creation and maintenance <sup>a</sup>					B: Truancy creation and maintenance <sup>a</sup>				
1	<b>.28</b>	.13	-.02	-.17	0	<b>.06</b>	.01	-.04	-.09
2	.08	.16	.03	-.10	1	.07	-.17	-.08	.01
3	-.12	-.02	.08	-.03	2	.08	-.02	-.12	.12
4	-.32	-.20	-.07	<b>.05</b>	3	.08	.13	.18	<b>.23</b>
C: GPA creation only <sup>b</sup>					D: Truancy creation only <sup>b</sup>				
1	<b>.21</b>	.07	-.07	-.21	0	<b>-.02</b>	.01	.03	.05
2	.03	.22	.04	-.13	1	.07	-.30	-.10	.11
3	-.16	.00	.16	-.06	2	.16	-.03	-.22	.16
4	-.34	-.22	-.10	<b>.02</b>	3	<b>.25</b>	.24	.22	<b>.21</b>
E: GPA maintenance only <sup>b</sup>					F: Truancy maintenance only <sup>b</sup>				
1	<b>.36</b>	.21	.05	-.10	0	<b>.19</b>	.02	-.15	<b>-.32</b>
2	.16	.08	.01	-.05	1	.08	-.04	-.08	-.11
3	-.03	-.03	-.03	.00	2	-.02	-.01	.00	.09
4	-.23	-.14	-.04	<b>.05</b>	3	-.12	.02	.15	<b>.29</b>

Note. The values in the diagonal indicate the likelihood of friendship selection (creation and/or maintenance) to occur when the individual and peer have exactly the same score on GPA and truancy; The values in the cells in these tables can be transformed to odds by taking the exponential function (exp.(βk)). The values in bold in the tables are mentioned in the text. GPA = grade point average.  
<sup>a</sup>Calculation based on the estimates in Model 1 in Table 2. <sup>b</sup>Calculation based on the estimates reported in Table S4 (for an explanation, see Ripley et al., 2015).

peer selection effects, we turn to Table 3C–F (based on the estimates reported in Table S4). It appeared that compared to students with the highest GPA score (4), students with the lowest GPA score (1) have a higher likelihood to become friends, Table 3C, OR (exp.(.21 – .02)) = 1.21, and to remain friends, Table 3E, OR (exp.(.36 – .05)) = 1.36. Similarly, for truancy it appeared that compared to students with the lowest truancy score (0), students with the highest truancy score (3) have a higher likelihood to become friends, Table 3D, OR (exp.(.21 – .02)) = 1.26, and to remain friends, Table 3F, OR (exp.(.29 – .19)) = 1.11. Furthermore, students who were high in achievement were less likely to maintain friendships with peers who were low in achievement, Table 3E, OR in cell 4,1 = (exp.(–.23)) = 0.79, and students who were low in truancy were less likely to maintain friendships with peers who were high in truancy, Table 3F, OR in cell 1,4 = (exp.(–.32)) = 0.73. These findings indicate that individuals who function academically poorly rely on each other for continued friendship. In addition, students who were high in truancy were more likely to extend friendship nominations to students who were low in truancy, Table 3D, OR in cell 4,1 = (–exp.(.25)) = 1.28.

With regard to the direction of socialization processes (reported in Table S5), the positive *average similarity increase* (evaluation) effects estimates indicate that adolescents tend toward similar levels of academic functioning as friends (achievement: Est. = 8.82; truancy: Est. = 10.36; *ps* < .001). In addition, the negative *average similarity decrease* (endowment) effects estimates (achievement: Est. = –6.83; truancy: Est. = –13.74; *ps* < .001) indicate that peers have less of an influence on decreases in achievement or truancy than they do on increases. In our two measures of academic functioning increases appear to be more important than decreases.

By summing the obtained estimates, we calculated the relative impact of increases versus decreases. It shows that friends do not influence one another to decrease their truancy to the same extent that they influence one another to increase in truancy (–3.38 = 10.36 – 13.74) and that friends influence one another to increase in achievement more than they influence one another to decrease in achievement (2.01 = 8.84 – 6.83). This indicates that friends had a relatively negative impact on each other’s truancy, whereas they had a relatively positive impact on each other’s achievement. These findings illustrate the differential role of peer influences on academic functioning and hint at potential differential susceptibility to socioenvironmental influences (Belsky & Pluess, 2009).

*Moderating Effect of Peer Social Standing on Academic Functioning*

Finally, to test the hypothesis that socialization on academic functioning was moderated by friends’

popularity (RQ3), we look at the estimates for the *average similarity*  $\times$  *friends' popularity* effects for academic achievement and truancy (Model 2 in Table 2), which were nonsignificant. This indicates that over time, on average, students did not become significantly more similar to popular friends in academic achievement and truancy than to nonpopular friends (OR = 1.78 and OR = 2.49,  $p = .56$  and  $.22$ , respectively). Also on average, no main effects were found: Adolescents with popular friends did not tend toward higher or lower levels of truancy, after controlling for friends' acceptance. This indicates that popular friends had no significant influence on adolescents' academic functioning in unilateral friendships.

We also tested whether socialization on academic functioning was moderated by friends' social acceptance (Model 2 in Table 2). Only the effect of friends' acceptance on academic achievement was statistically significant (positive *average similarity*  $\times$  *friends' acceptance* score-type effect;  $c = 4.94$ ,  $df = 1$ ,  $p < .05$ ) and in combination with a positive one-sided (normal variate) test statistic this indicates that over time on average students become significantly more similar to highly accepted friends in academic achievement than to friends who were not as highly accepted.

#### *Moderating Effect of Peers' Social Standing in Reciprocal Relationships*

Additionally, we tested whether the moderating effect of friends' social standing operated in undirected (i.e., reciprocal) friendships rather than in directed (i.e., unilateral) friendships (results available upon request). To achieve this, we considered all unilateral ties as nonexistent (i.e., coded 0) and altered the model specification to fit undirected network analysis estimating the effects (reported in Table S1) with only the reciprocal friendships (approximately 40% of ties were reciprocal). Findings with regard to social acceptance were similar in both types of analysis, indicating that socially accepted peers do not exert more influence upon their friends' academic achievement in reciprocal friendships than in unilateral ones. Findings with regard to popularity, however, showed that adolescents were more likely to become similar to friends in terms of truancy (but not achievement) when friends were high in popularity than to friends who were low in popularity when they were involved in reciprocal friendships with them (OR = 2.18,  $p < .05$ , one sided). In addition, a positive main effect of friends' popularity on truancy was found

(OR = 1.43,  $p < .05$ ), indicating that adolescents with popular peers as friends tended toward higher levels of truancy over time. Taken together, these findings indicate that adolescents were more likely to conform to the higher truancy levels of popular youth in mutual friendships with them.

## Discussion

The importance of friends has largely been attributed to mechanisms of homophily or similarity in adolescent friendship networks; a well-established and important social phenomenon that oftentimes is related to selection and socialization or influence (Kandel, 1978). Although both factors are crucial to our understanding of peer effects in the academic domain (Brechwald & Prinstein, 2011), conclusions about the link between academic functioning and peer effects have been largely underdeveloped. Therefore, we aimed to gain more insight into this matter by incorporating advanced statistical methods that allowed us to examine the role of peer effects with greater precision with longitudinal social network analysis (Veenstra et al., 2013).

### *The Importance of Selection to Understanding Socialization*

First, our results showed that peer selection plays a crucial role in explaining similarity between friends' academic functioning. In fact, selection predicted more of the similarity between friends in terms of their shared levels of achievement, whereas selection and influence were equally strong predictors of similarity between friends in terms of their shared levels of truancy. This is a crucial step in understanding the socialization processes in adolescent friendship networks (see McPherson et al., 2001). Namely, conformity to and reinforcement of friends' academic functioning were preceded by association based on similar levels of academic functioning. This indicates that when individuals associate with high-achieving peers they may increase their own GPAs, whereas when they associate with low-achieving peers they may decrease their GPAs as a result of low attendance rates.

Which peers individuals eventually select as their friends and consequently whether these friends influence their academic functioning is not only based on similarity but depends also on their availability and preferences. Consistent with these thoughts, we found that individuals who had high levels of truancy were relatively speaking more

negatively assessed by peers through receiving fewer friendship nominations from peers who had low levels of truancy. Considering that truant adolescents extended more friendship nominations to these peers themselves, this can be seen as a form of peer rejection, which puts them in a bad position because they are singled out. The consequences are that they are stuck with peers who do not function academically (i.e., the concept of default selection; see Deptula & Cohen, 2004; Sijtsema, Lindenberg, & Veenstra, 2010); consequently, they are unable to maneuver into a better position academically.

#### *Positive and Negative Peer Influences*

Despite the fact that selection played a prominent role, similarity in academic functioning was explained by peer influence, net of peer selection, acceptance, and connectedness. In addition, estimation of the direction of peer influence showed that friends influenced one another to increase rather than decrease in achievement and truancy over time. Together, these findings indicate different academic trajectories for students in middle adolescence and illustrate that academic success and academic failure depends in part on peer influences in friendship networks. Although we did not include measures that tap academic motivation, goals, or self-efficacy, our findings are consistent with research that argue crucial differences between students who are “at risk” or “unmotivated” and students who are resilient, resourceful, and successful (i.e., the concept of positive psychology; see Furlong, Gilman, & Huebner, 2009). From this body of research (Ryan, 2001), it becomes clear that students select their friends and peer groups on the basis of similarity, which enhances the potential influence of modeling, and promote/demote motivational socialization. Peer group socialization may influence (positively or negatively) the group’s academic self-efficacy and motivation (Schunk & Pajares, 2002), which in terms of academic functioning may be beneficial to students who perform academically well, but may prove to be detrimental for students who perform academically poorly.

#### *The Moderating Role of Friends’ Popularity*

We considered the role of peers with a high social standing in the group in determining adolescents’ academic functioning. These individuals occupy central positions in networks and are thus in a better position to exert more influence than other peers (Sandstrom, 2011). Although we found

no support for our hypothesis that popular peers exert a stronger influence in shaping their friends’ academic functioning than other peers in unilateral friendships, findings from our additional analysis showed that in mutual friendships—where there is probably more close interaction and mutual exchange of shared thoughts and beliefs—popular peers influenced their friends in terms of conformity to their levels of truancy. This may be explained by the fact that popular youth are highly attractive for peer affiliation and members of popular groups are often described in negative terms such as being dominant and exclusionary (Brown, 2011). If norm-breaking behavior related to poor academic functioning such as truancy is valued by popular youth, individuals who are more closely involved with them may be more motivated to conform to their behavior and attitudes to remain part of the popular group than individuals who are not involved in mutual friendships with them. Although popular youth have been described by their peers as more academically able and intelligent than unpopular peers (LaFontana & Cillessen, 2002), their influence appears to be negative in terms of shaping their friends’ academic functioning.

#### *The Moderating Role of Friends’ Acceptance*

In contrast to friends’ popularity, social acceptance of friends seemed to have a moderating effect on peer influences on academic achievement in unilateral friendships. This is not surprising considering that we asked the students to indicate how much they would like to “hang out with” their peers, which may also be seen as an indication of how much time they were willing to spend with them, which essentially means that socially accepted youth have more time to influence their peers. When we take into consideration that the estimate for the main effect of friends’ acceptance was close to zero, this indicates that the influence of socially accepted peers was relatively similar across the range of achievement levels. Depending on where the average achievement levels of socially accepted youth is to be found on the 4-point scale for achievement the achievement levels of their friends was influenced in either positive or negative direction (or remain status quo when their level was already similar). Although previous research mainly observed that socially accepted youth are academically inclined or proficient, prosocial, and generally helpful to their peers (Lease et al., 2002), and thus may positively impact their friends’



academic achievement, our findings suggest that this may not always be the case if they have low achievement levels themselves.

There is clear evidence that low acceptance in the peer group (i.e., peer rejection) positively relates to dropout, truancy, and absenteeism (cf. Cillessen & van den Berg, 2012). If this is true, then we would expect to see that having highly accepted friends would result in decreased levels of truancy via peer influence processes. The fact that we did not find such an association, however, is consistent with Geven et al.'s (2013) study who examined this in relation to problematic school behaviors (inattention to school and homework inactivity). Longitudinal studies across multiple school years (Parker & Asher, 1987) show that low acceptance is a significant antecedent of later school adjustment problems, particularly dropping out of high school. Collectively, research suggests that the association between friends' acceptance and adolescents' truancy might be stronger only for adolescents who obtained low acceptance already before entering high school. Because for these individuals the urge to gain acceptance and social approval from peers is probably high, they might also be more willing to conform to their peers' (problematic) behaviors and attitudes (cf. Brechwald & Prinstein, 2011).

#### *Social Positions in Networks as a Means to Interventions*

In a review by Valente (2012) on network interventions, it was suggested that social positions in networks are crucial to network influences on behaviors. Specifically, the spread or diffusion of network information (such as academic beliefs) may be strengthened or obstructed by one's social positions in networks. Specifically, those at the periphery may be too isolated from the influences from others in school. If this pertains to those high in truancy, this may indicate that they are operating in friendship groups in which their negative academic beliefs and behaviors are approved of and shared and reinforced by the majority of its group members (i.e., the concept of deviancy training; see Dishion, Spracklen, Andrews, & Patterson, 1996), and, in time, this may cause a vicious cycle leading to dropout. Future research may want to map the individuals that make up these subgroups. It may provide valuable insights about how exactly academic beliefs and behaviors flow in networks and why some youth are positively influenced by peers, whereas others are negatively influenced.

Taken together, the findings from our study indicate that youth with high social standing in the peer group—particularly those with high popularity—who are often considered to be social leaders are not always the best agents to behavior change (Valente, 2012), and, without intervening, they might have a quite negative impact on their friends' academic functioning. Particularly individuals who engage with popular peers in mutual friendships and who conform to their poor academic functioning are at risk of dropping out. Policymakers may want to consider the importance of such significant others and considering that popular peers are powerful influencers (Sandstrom, 2011), it may be better to change their negative influence and engage them as positive influencers. In this way, they may spread positive academic beliefs and behaviors and consequently turn the tables around.

This idea is consistent with evolutionary models of risky adolescent behaviors, in which successful intervention are suggested to depend on working with, instead of against, adolescent goals and motivations (see Ellis et al., 2012). If status in the peer group can be achieved through display of positive behaviors instead of negative behaviors, this changes the way status is perceived by adolescents. Subsequently, it may prove to be a useful tool to change the existing norms of the social context of these adolescents regarding academic functioning. In a recent study by Teunissen et al. (2014), it was shown that participants who were exposed to antialcohol norms were more negative about, and perceived themselves as less heavy drinker prototypes, than participants who were exposed to proalcohol norms. If perceptions about popularity are positively associated with school performance and attendance (Ainsworth & Downey, 1998), the students who look up to these peers and who are exposed to their proschool behaviors and attitudes might be more inclined to stay in school and attend school more regularly (Heart Research Report, 2012), and consequently increase their achievement.

#### *Limitations, Strengths, and Implications*

Our findings should be interpreted in light of its limitations. In this study, we argued that adolescents seek out friends who are similar to them in terms of academic functioning and these friends then serve to reinforce their academic functioning over time. Although our findings are consistent with this argument, we can only guess what has happened because we did not incorporate measures that tap more fully into the mechanisms leading to

socialization. This investigation could benefit from inclusion of social cognitions or motivations that may explain the link between friends' behavior and individual behavior (Sijtsema, Rambaran, Caravita, & Gini, 2014).

Incorporation of behavioral and attitudinal norms would provide additional information into the black box of change (Prinstein et al., 2011; Rambaran et al., 2013). Norm effects could alternatively explain why the change in academic functioning among our high school students depended on the level of friends' social standing (see for a discussion Cillessen & van den Berg, 2012). In addition, popular peers have influence beyond friendship boundaries. As previous studies showed, this investigation benefits from taking into consideration the social contexts (e.g., characteristics at the classroom-level or school-level) in which the influence of popular youth flourishes more noticeably.

With regard to self-selection, high schools often track students together of similar achievement levels; as such, high achievement students are generally in the same classes. The school recruited for our study used a cluster system so that students participated in the same core classes together. It may be possible that the effect of friendship choice based on similarity in academic achievement could be based on opportunity based on tracking (Frank, Muller, & Mueller, 2013). Allowing students to nominate friends outside their own classroom likely reduced this effect because participants could nominate friends across cluster groups. Even when there is not a formal structure in place, segregation by ability happens quite naturally. Accordingly, the results in this study may be conditionally true only, assuming there are no systematic effects of factors resulting from structured and unstructured social settings, a quite common limitation of peer influence studies, not excluding SIENA studies.

Relying on an unlimited nomination approach enhanced the ecological validity of assessment of friendship and provided a more complete picture of students' friendship networks (Cillessen & Marks, 2011; Furman, 1996). Yet, the high number of friendship nominations raises questions whether we captured the influence of "close friends" (Newcomb & Bagwell, 1995). More insight into this matter would require information on the strength or quality of the relationship, which, unfortunately was not available in the present data.

Although missing data were low in the present study, students with missing data had lower levels of academic achievement, were more likely to be

truant, and had lower social prominence, which provides another selection problem that could potentially produce bias in the estimates of effects. Finally, although our findings provide support for the important role of friends on adolescents' academic functioning, our conclusions are based on the one high school analyzed. Thus, validation is needed, preferable over a longer period.

Strengths of our study were the examination of peer effects (i.e., selection and socialization) at the grade level to capture a large proportion of adolescents' peer networks. Adding to previous studies on the effects of peers on academic achievement and unexplained absences, this study examined processes of selection and socialization adequately with stochastic actor-based modeling. In advancing the current state of knowledge, we examined the relative contribution of both processes, examined the direction of peer selection and peer influence, and assessed whether peer influence was moderated by friends' social standing. The robustness of our findings is supported by the observation that the results regarding our hypotheses did not differ much depending on our control variables.

### *Conclusion*

In the past decade, a great deal of effort and expenditure has been put into improving student achievement, by increasing standards, strengthening curriculum, and improving teaching and learning in the classroom (Heart Research Report, 2012). Yet, although these reform efforts are necessary, they are not sufficient. As shown by recent figures from the Get Schooled Project, by the time students are in ninth grade, nearly half (46%) of students who skip school do so on a regular basis (once a week). Mistakenly, students largely believe that there are no real-life consequences for skipping school. However, skipping a class or full day at school can really add up over time (Balfanz & Byrnes, 2012). Missing 3 school days in ninth grade—the mean number of days students were absent in our analyzed high school—decreases one's chances of high school graduation by 15%.

When asked what students do when they are not in school, 65% reported "hanging out with friends," and almost half of them (47%) reported that they would attend school more regularly if they had more friends at school and people they enjoy being around with. This indicates that peers play a primary role in fostering adolescents' academic beliefs and behaviors (Rodkin & Ryan, 2012). This

investigation seems important considering that students' attendance rates tend to decline rapidly over the course of high school and subsequently also their levels of academic performance (Balfanz & Byrnes, 2012).

This study shows that similarity in academic achievement (GPAs) and unexplained absences (truancy) was explained by peer selection and peer influence, net of acceptance, and connectedness (i.e., direct and indirect friendships). Friendships were formed and maintained when adolescents had low levels of achievement or high levels of truancy. Friends influenced one another to increase rather than decrease in achievement and truancy over time. Moreover, friends' popularity moderated peer influences on truancy in reciprocal friendships but not in unilateral friendships, whereas friends' acceptance moderated peer influences on achievement in both unilateral and reciprocal friendships. Our findings illustrate the dynamic interplay between academic functioning and peer effects and how they shape academic trajectories in middle adolescence. It suggests that in order to improve students' academic functioning in middle adolescence the role of peers, particularly those with high popularity, should be changed from potentially negative influencers to positive influencers.

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### Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

**Figure S1.** Relative Contribution Results of Selection and Influence Belonging to Table S3

**Figure S2.** Goodness-of-Fit Results for Directed Friendship Networks Belonging to Appendix S3

**Table S1.** Mathematical Representation and Interpretation of the Effects Used in the Present Study

**Table S2.** Network–Behavior Dynamics for Friendship, Academic Achievement (Grade Point

Average [GPA]), and Truancy (Unexplained Absences;  $N = 342$ )

**Table S3.** Models for Relative Contribution of Selection and Socialization (Influence) in Academic Functioning (Grade Point Average [GPA] and Truancy;  $N = 342$ )

**Table S4.** Direction of Peer Selection on Academic Functioning (Grade Point Average [GPA] and Truancy;  $N = 342$ )

**Table S5.** Direction of Peer Influence on Academic Functioning (Grade Point Average [GPA] and Truancy;  $N = 342$ )

**Appendix S1.** Interpretation of Selection Effects Not Reported in the Manuscript Belonging to Table S1

**Appendix S2.** Description of the Results Related to Network Dynamics Not Reported in the Text Belonging to Table S2

**Appendix S3.** Sensitivity Analysis and Goodness-of-Fit Results of Auxiliary Statistics