Supporting Information to:

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

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List of Appendices:

Table S1. Mathematical representation and interpretation of the effects used in the present study.

Effect used	Mathematical express.	Graphical express.	Interpretation {SIENA shortname}
Network dynamics:			
Structural effects		t1 t1+m	
Outdegree (density)[a]	$\sum_j x_{ij}$		Actor i extending ties to alter j {density}
Truncated outdegree[a]	$\min(x_{i+}, c)$		Actor i with zero ($c = 1$) in/outdegree (isolates) {outTrunc}
Reciprocity	$\sum_j x_{ij}x_{ji}$		Actor i reciprocating ties to alter j {recip}
Transitive triplets (2)[a]	$\sum_{j,h} x_{ij}x_{ih}x_{jh}$		Actor i extending ties to alter j to whom he is indirectly tied (via h) {transTrip2}
Transitive reciprocated triplets	$\sum_{j,h} x_{ij,ji}x_{ih}x_{hj}$		Actor j reciprocating ties to ego i to whom he is directly and indirectly tied (via h) {transRecTrip}
Three-cycles	$\sum_{j,h} x_{ij}x_{jh}x_{hi}$		Actor i extending ties to alter j to whom he is indirectly tied (via h) {cycle3}
Dense triads	$\sum_{j,h} x_{ij,ji}x_{ih,hi}x_{hj,jh} \geq c$		Tendency of actors to reciprocate ties received in a group structure, where c is 6 (completely connected network) {denseTriads}
Transitive ties[a]	$\sum_j x_{ij} \max_h(x_{ih}x_{hj})$		Actor i extending ties to alter j to whom he is directly and indirectly tied (via h) (one indirect tie suffices) {transTies}
Number at distance 2[a]	$\max_h(x_{ih}x_{hj}) > 0$		Tendency of actors to be tied indirectly through at least one intermediary (via h) {nbrDist2}
Number at distance 2 twice	$\max_h(x_{ih}x_{hj}) > 2$		Tendency of actors to be tied indirectly through at two intermediaries (via h and k) {nbrDist2twice}
Geometrically weighted transitive triplets	$\sum x_{ij^a}\{1-(1-e^{-a})^{\sum_{h=1}^{n}x_{ih}x_{hj}}\}$		Tendency of actors to be tied indirectly through at least one intermediary (via h) where the influence of extra intermediaries (k) decreases (GWESPFF)
Indegree-friendship[a]	$\sum_j x_{ij}\sum_h x_{hj}$		Actors with many incoming ties attract more incoming ties {inPop}
Outdegree-friendship	$\sum_j x_{ij}\sum_h x_{jh}$		Actors with many outgoing ties attract more incoming ties {outPop}
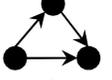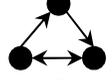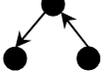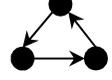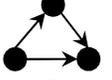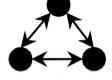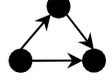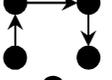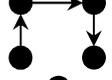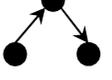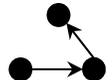
Effect	Formula	Interpretation
Outdegree-activity[a,b]	x_{i+}^2	Actors with many outgoing ties extend more outgoing ties {outAct}
Selection effects[c]:		
Covariate alter	$\sum_j x_{ij} v_j$	Actor i with higher values on a covariate (v) attracts more incoming ties {altX}
Covariate ego	$v_i x_{i+}$	Actor i with higher values on a covariate (v) extends more outgoing ties {egoX}
Same covariate	$\sum_j x_{ij} I\{v_i = v_j\}$	Actor i extends ties to alter j who has exactly the same values on a covariate, where $I = 1$ for same and 0 otherwise {sameX}
Covariate similarity[d]	$\sum_j x_{ij}(\text{sim}_{ij}^v - \widehat{\text{sim}^v})$	Actor i extends ties to alter j who has similar values on a covariate {simX}
Covariate alter X[d] covariate ego	$v_i \sum_j x_{ij} v_j$	Actor i extends ties to alter j who has lower/higher values on a covariate {egoXalterX}
Behavioral dynamics:		
Control effects		
Linear shape	z_i	Tendency of actors to change in academic functioning {linear}
Quadratic shape	z_i^2	Tendency of actors to change in academic functioning {quad}
Covariate ego	$z_i v_i$	Actors with a higher value on a covariate (v) change in academic functioning {effFrom}
Influence effects		
Friends' standing	$z_i \breve{v}_j$	Actor i tend to change in academic functioning (z) when his/her friend (j) has on average higher social standing (v) {avXAlt}
Average similarity[e]	$\sum_j x_{ij}(\text{sim}_{ij}^z - \widehat{\text{sim}^z})$	Actor i tend towards similar values of academic functioning (z) as his/her friend (j) {avSim}
Average similarity X friends' standing	$\sum_j x_{ij} v_j(\text{sim}_{ij}^z - \widehat{\text{sim}^z})$	Actor i tend towards similar values of academic functioning (z) as his/her friend (j) when the friend has on average higher social standing (v) {avSimAltX}

Notes. The figures in column t1 represent the initial state of the configuration. The figures in column t1+m represent the state of the configuration after the estimation procedure has been carried out; [a]Effect was included in the undirected network analysis; [b]The sqrt version was used in the undirected network model; [c]Covariates can be any attribute such as individual or behavioral dispositions and can be constant (e.g., sex and ethnicity) or changing (e.g., academic functioning or social standing); for undirected network analysis incoming nominations (alter effect) are the same as outgoing nominations (ego effect); [d]This effect was substituted with creation and endowment effects in the model in which the direction of peer selection was tested (reported in Table S4); [e]The endowment version of this effect was included in the model in which the direction of peer influence was tested (reported in Table S5), which captured decreases in academic functioning (GPA and truancy).

Appendix S1. Interpretation of selection effects not reported in the manuscript belonging to Table S1.

Selection parameters. Selection parameters are either structural network effects or selection effects related to individual attributes. For the structural part of the model, we included several effects to represent the friendship network structure. These effects represent friendships at the individual level, the dyadic level, and the triadic (group) level. At the individual level, *outdegree* is included to reflect the general tendency of adolescents to nominate friends ($i \rightarrow j$); at the dyadic level, *reciprocity* is included to reflect the general tendency of adolescents to reciprocate nominations received ($i \leftrightarrow j$). Friendship networks are further characterized by subgroup formation according to mechanisms of network closure. We had to include a range of transitivity-related effects to adequately represent subgroup formation and the network structure inside these subgroups in our data: the numbers of transitive triplets (in a linear and a nonlinear, geometrically weighted variant), transitive reciprocated triplets, three-cycles, actor pairs at two degrees of separation (with at least one, and at least two connecting intermediaries), and completely connected cliques of three actors. These effects jointly express the clustering of friendship into groups, but also the selective omission of some ties inside these groups, which reveals local hierarchy differences in the peer system.

In order to account for popularity and nomination activity differences between adolescents, we included three degree-related effects. The *indegree-friendship* effect reflects the tendency of adolescents who receive many nominations to receive more nominations over time (reinforcement of friendship popularity), whereas the *outdegree-activity* effect reflects the tendency of adolescents who give many nominations to give more nominations over time. Finally, the *outdegree-friendship* effect reflects the tendency of adolescents who give many nominations to receive more nominations over time, and thus accounts for the relation between receiving and giving nominations. The inclusion of these effects not only allows to account for observed degree differences in the data, it also offers some protection against omitted variable bias related to ego- and alter effects of individual-level variables not included in our models (Ripley et al., 2015).

Next to these structural selection effects, we included selection effects related to individual attributes, namely, *social standing* (i.e., social acceptance or popularity) and *academic functioning* (i.e., academic achievement or truancy). The academic functioning 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. The social standing variables were only included as effects on nominations received, which is an important mechanism to friendship selection for these variables as it reflects that peers with high social standing in the group are desirable as social partner in friendship networks. Finally, we also controlled for friendship selection based on *same sex* and *same ethnicity*.

Table S2. Network-behavior dynamics for friendship, academic achievement (GPA) and truancy (unexplained absences) ($N = 342$).

Network dynamics: Friendship	Model 1: Baseline			Model 2: Popularity			Model 3A: Acceptance			Model 3B: Acceptance		
	Est.	t-Value	OR	Est.	t-Value	OR	Est.	t-Value	OR	Est.	t-Value	OR
Selection effects on structural positions												
Outdegree (density)	-3.53	-84.74*	0.03	-3.49	-87.42*	0.03	-3.48	-82.29*	0.03	-3.49	-76.44*	0.03
Effect of time period 2 (t2-t3)[a]	0.03	1.44	NA	0.04	1.98*	NA	0.04	2.07*	NA	0.04	1.92+	NA
Effect of time period 3 (t3-t4)[a]	-0.14	-7.78*	NA	-0.13	-7.19*	NA	-0.13	-7.29*	NA	-0.13	-6.61*	NA
Reciprocity	1.43	50.35*	4.16	1.43	48.40*	4.17	1.43	50.69*	4.18	1.43	48.53*	4.17
Transitive triplets	0.12	21.25*	1.13	0.12	21.71*	1.13	0.12	22.58*	1.13	0.12	21.27*	1.13
Transitive reciprocated triplets	-0.01	-0.92	0.99	-0.01	-1.02	0.99	-0.01	-1.14	0.99	-0.01	-1.05	0.99
Three-cycles	0.03	6.75*	1.03	0.03	6.56*	1.03	0.03	6.75*	1.03	0.03	7.02*	1.03
Number at distance 2	0.04	21.14*	1.05	0.05	23.68*	1.05	0.04	24.94*	1.05	0.05	21.48*	1.05
Number at distance 2 twice	0.05	14.32*	1.05	0.05	14.86*	1.05	0.05	14.51*	1.06	0.05	14.11*	1.06
Dense triads	-0.02	-1.88+	0.98	-0.02	-1.79+	0.98	-0.02	-1.82+	0.98	-0.02	-1.89+	0.98
Geometrically weighted transitive triplets	1.35	45.53*	NA	1.37	46.37*	NA	1.36	48.55*	NA	1.37	41.45*	NA
Indegree-friendship	0.01	10.00*	1.01	0.003	3.86*	1.003	0.003	3.86*	1.003	0.003	3.86*	1.003
Outdegree-friendship	-0.05	-39.67*	0.95	-0.05	-36.92*	0.95	-0.05	-36.92*	0.95	-0.05	-36.92*	0.95
Outdegree-activity	0.002	10.00*	1.002	0.002	10.00*	1.002	0.002	10.00*	1.002	0.002	10.00*	1.002
Selection effects on individual dispositions												
Ethnicity alter	0.02	1.87+	1.02	0.02	1.61	1.02	0.02	1.67+	1.02	0.02	1.65+	1.02
Ethnicity ego	-0.01	-0.59	0.99	-0.01	-0.48	0.99	-0.01	-0.48	0.99	-0.01	-0.48	0.99
Same ethnicity	0.11	8.60*	1.11	0.11	9.22*	1.11	0.11	9.04*	1.11	0.11	9.07*	1.11
Sex alter	0.04	2.90*	1.04	0.05	3.58*	1.05	0.05	3.58*	1.05	0.05	3.63*	1.05
Sex ego	-0.01	-1.00	0.99	-0.01	-0.90	0.99	-0.01	-0.89	0.99	-0.01	-0.87	0.99
Same sex	0.13	10.59*	1.13	0.13	10.56*	1.14	0.13	10.88*	1.13	0.13	10.74*	1.14
Selection effects on academic functioning												
GPA alter	-0.01	-0.96	0.99	-0.02	-1.34	0.99	-0.01	-1.35	0.99	-0.02	-1.36	0.99
GPA ego	-0.06	-4.98*	0.94	-0.06	-4.96*	0.94	-0.06	-4.98*	0.94	-0.06	-4.86*	0.94
GPA similarity	0.32	5.53*	1.11	0.32	5.74*	1.38	0.32	5.34*	1.38	0.32	5.29*	1.37
GPA alter X ego	0.02	1.12	1.02	0.02	1.06	1.02	0.02	1.02	1.02	0.02	1.03	1.02
Truancy alter	-0.06	-3.79*	0.94	-0.07	-3.97*	0.93	-0.07	-4.45*	0.93	-0.07	-4.08*	0.93
Truancy ego	-0.00	-0.25	1.00	-0.01	-0.41	0.99	-0.01	-0.51	0.99	-0.01	-0.43	0.99
Truancy similarity	-0.50	-3.54*	0.85	-0.56	-3.50*	0.57	-0.56	-4.04*	0.57	-0.56	-3.38*	0.57
Truancy alter X ego	0.15	4.27*	1.16	0.16	4.27*	1.17	0.16	4.74*	1.17	0.16	4.10*	1.17
Selection effects on social standing												

Acceptance alter				0.10	4.80*	1.11	0.10	5.03*	1.11	0.10	4.95*	1.11
Popularity alter				0.07	4.76*	1.07	0.07	4.75*	1.07	0.07	4.78*	1.07
Behavioral dynamics: GPA												
Control effects on truancy												
Linear shape	-0.16	-2.16*	0.86	-0.20	-1.65+	0.81	-0.23	-1.71+	0.80	-0.23	-1.75+	0.80
Quadratic shape	0.13	0.98	NA	0.13	0.94	NA	0.14	1.03	NA	0.14	0.99	NA
Own sex	-0.15	-1.11	0.86	-0.15	-1.06	0.86	-0.15	-1.15	0.86	-0.15	-1.11	0.86
Own truancy	-0.38	-2.88*	0.68	-0.39	-3.04*	0.68	-0.39	-2.86*	0.68	-0.39	-2.91*	0.68
Influence effects on GPA												
Average similarity	4.91	3.59*	5.14	4.51	2.97*	4.49	5.00	3.55*	5.29	4.99	3.43*	5.27
Friends' acceptance				-0.01	-0.01	0.99	0.00	0.00	1.00	-0.01	0.00	0.99
Friends' popularity				0.24	0.71	1.28	0.30	0.85	1.34	0.30	0.86	1.35
Average similarity X friends' popularity				1.72	0.59	1.78						
Average similarity X friends' acceptance[b]							2.22	4.94*	NA			
Behavioral dynamics: Truancy												
Control effects on truancy												
Linear shape	-0.02	-0.39	0.98	-0.13	-1.06	0.88	-0.05	-0.52	0.96	-0.04	-0.52	0.96
Quadratic shape	0.25	3.59*	NA	0.22	3.07*	NA	0.23	3.23*	1.26	0.23	3.22*	NA
Own sex	-0.06	-0.88	0.94	-0.06	-0.74	0.94	-0.05	-0.61	0.95	-0.05	-0.61	0.95
Own GPA	-0.29	-4.64*	0.75	-0.28	-4.28*	0.75	-0.27	-4.11*	0.76	-0.27	-4.13*	0.76
Influence effects on truancy												
Average similarity	3.48	4.04*	3.19	2.52	2.35*	2.31	3.33	4.15*	3.04	3.33	3.84*	3.04
Friends' acceptance				-1.18	-1.23	0.31	-1.15	-1.35	0.32	-1.18	-1.38	0.31
Friends' popularity				0.43	1.65+	1.54	0.27	1.40	1.31	0.27	1.39	1.31
Average similarity X friends' popularity				2.73	1.22	2.49						
Average similarity X friends' acceptance[b]							1.12	1.24	NA			

Notes. Rate of change effects were also included but omitted from the table; 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); [a]Time effects included for Outdegree (density) to account for heterogeneity across time; [b]Interaction terms showed high parameter estimates and high standard deviations (i.e., non-convergence). Accordingly, we score-tested them separately in separate models and report the one-sided (normal variate) estimates with c-statistics that follow a chi-square distribution with 1 degrees of freedom; +$p < .10$, *$p < .05$ (two-tailed test).

Appendix S2. Description of the results related to network dynamics not reported in the text belonging to Table S2.

Effects of the network structure. The results of the SIENA-analyses with regard to network dynamics for friendship will be discussed on the basis of Model 1 (reported in Appendix S2). The negative outdegree parameter estimate indicates the low density of the grade network and indicates that the probability of a friendship tie is less than .5 ($OR = 0.12$, $p < .001$). The positive reciprocity effect estimate indicates that students reciprocated a friendship tie that they received from a grade mate ($OR = 4.14$, $p < .001$); specifically, students were approximately 4 times more likely to reciprocate a tie from a peer than to not reciprocate the tie, all else being equal.

Because the transitive-related effects are statistically depended on each other, they cannot be interpreted separately, and therefore, we summarized them with multi-effect Wald-type tests (for sets of effects) (cf. Ripley et al., 2015). For ease of interpretation, we did the same for our included degree-related effects. The joint contribution of the transitivity-related effects and the degree-related effects to friendship selection was considerable ($\chi2$ (7) = 4571.6 and $\chi2$ (3) = 1512.6, ps < .001, respectively). Together, these findings indicate that students kept the friendship networks closed ('transitive closure') and that students vary in number of nominations sent and received.

Effects of sex and ethnicity. The joint contribution of selection effects (i.e., the alter effect, the ego effect, and the same effect) related to sex ($\chi2$ (3) = 79.0) and ethnicity ($\chi2$ (3) = 117.9) was a significant predictor (ps < .001) of explaining friendships between adolescents and peers. Importantly, adolescents had a significant preference for same-sex ($OR = 1.13$) and same-ethnicity friends ($OR = 1.11$).

Table S3. Models for relative contribution of selection and socialization (influence) in academic functioning (GPA and truancy) (*N*=342).

Network dynamics: Friendship	Full Model Est.	t-Value	No Selection Model Est.	t-Value	No Influence Model Est.	t-Value	Control Model Est.	t-Value	Trend Model Est.	t-Value
Selection effects on structural positions										
Outdegree (density)	-3.53	-84.74*	-3.52	-86.44*	-3.55	-90.03*	-3.53	-91.16*	-1.24	-188.47*
Effect of time period 2 (t2-t3)[a]	0.03	1.44	0.03	2.08*	0.03	1.57	0.03	2.21*	0.13	8.32*
Effect of time period 3 (t3-t4)[a]	-0.14	-7.78*	-0.13	-8.45*	-0.14	-8.10*	-0.13	-8.46*	-0.03	-1.94+
Reciprocity	1.43	50.35*	1.43	49.91*	1.43	51.70*	1.43	48.74*		
Transitive triplets	0.12	21.25*	0.12	23.41*	0.12	21.64*	0.12	21.02*		
Transitive reciprocated triplets	-0.01	-0.92	-0.01	-1.14	-0.02	-1.49	-0.01	-1.28		
Three-cycles	0.03	6.75*	0.03	7.25*	0.03	7.52*	0.03	7.24*		
Number at distance 2	0.04	21.14*	0.05	23.95*	0.05	23.74*	0.05	24.11*		
Number at distance 2 twice	0.05	14.32*	0.05	14.18*	0.05	15.23*	0.05	14.16*		
Dense triads	-0.02	-1.88+	-0.02	-1.88+	-0.02	-1.48	-0.02	-1.54		
Geometrically weighted transitive triplets	1.35	45.53*	1.37	47.26*	1.37	47.92*	1.37	45.60*		
Indegree-popularity	0.01	10.00*	0.01	10.00*	0.01	10.00*	0.005	9.80*		
Outdegree-popularity	-0.05	-39.67*	-0.05	-40.50*	-0.05	-40.08*	-0.05	-40.58*		
Outdegree-activity	0.002	10.00*	0.002	10.00*	0.002	9.50*	0.002	10.00*		
Selection effects on individual dispositions										
Ethnicity alter	0.02	1.87+	0.02	2.04*	0.02	1.98*	0.02	2.10*		
Ethnicity ego	-0.01	-0.59	0.01	0.78	-0.01	-0.50	0.01	0.79		
Same ethnicity	0.11	8.60*	0.11	9.78*	0.11	9.22*	0.11	9.47*		
Sex alter	0.04	2.90*	0.04	3.30*	0.04	2.97*	0.04	3.36*		
Sex ego	-0.01	-1.00	-0.01	-0.84	-0.01	-1.02	-0.01	-0.84		
Same sex	0.13	10.59*	0.12	10.36*	0.12	11.00*	0.12	10.29*		
Selection effects on academic functioning										
GPA alter	-0.01	-0.96			-0.01	-1.06				
GPA ego	-0.06	-4.98*			-0.06	-5.29*				
GPA similarity	0.32	5.53*			0.32	5.55*				
GPA alter X ego	0.02	1.12			0.02	1.12				
Truancy alter	-0.06	-3.79*			-0.06	-3.88*				
Truancy ego	-0.00	-0.25			-0.01	-0.38				
Truancy similarity	-0.50	-3.54*			-0.53	-3.88*				
Truancy alter X ego	0.15	4.27*			0.15	4.69*				
Behavioral dynamics: GPA										

Control effects for GPA										
Linear shape	-0.16	-2.16*	-0.15	-2.09*	-0.11	-1.69+	-0.11	-1.69+	-0.09	-1.47
Quadratic shape	0.13	0.98	0.18	1.19	-0.31	-4.16*	-0.31	-4.05*	-0.17	-3.20*
Own sex	-0.15	-1.11	-0.15	-1.12	-0.18	-1.42	-0.18	-1.41		
Own truancy	-0.38	-2.88*	-0.40	-2.83*	-0.43	-3.53*	-0.43	-3.30*		
Influence effects for GPA										
Average similarity	4.91	3.59*	5.15	3.34*						
Behavioral dynamics: Truancy										
Control effects for truancy										
Linear shape	-0.02	-0.39	-0.05	-0.97	-0.12	-2.92*	-0.12	-2.94*	-0.12	-2.86*
Quadratic shape	0.25	3.59*	0.27	3.79*	-0.02	-0.53	-0.02	-0.51	0.08	2.35*
Own sex	-0.06	-0.88	-0.07	-0.87	-0.09	-1.34	-0.10	-1.41		
Own GPA	-0.29	-4.64*	-0.33	-5.05*	-0.38	-6.54*	-0.38	-6.52*		
Influence effects for truancy										
Average similarity	3.48	4.04*	3.55	4.52*						

Notes. Rate of change effects were also included but omitted from the table; 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); [a]Time effects included for Outdegree (density) to account for heterogeneity across time; +$p < .10$, *$p < .05$ (two-tailed test).

Relative contribution results of selection and influence belonging to Table S3.
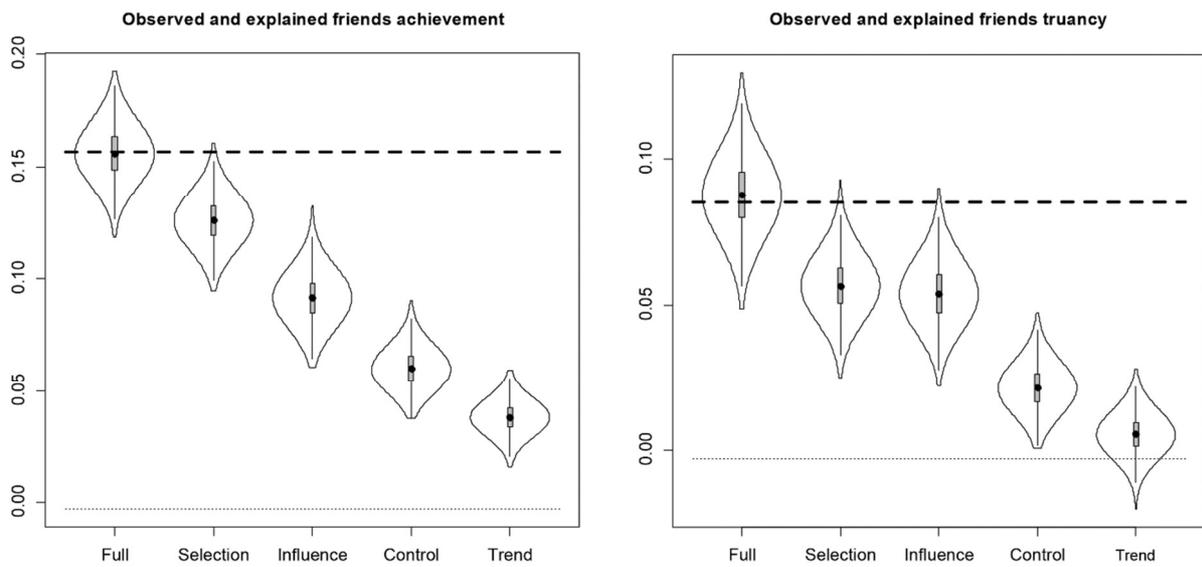
**Figure S1.** Relative contribution of selection and influence to similarity between friends in academic achievement (left) and truancy (right). Dashed lines on top represent observed autocorrelation in the data, dotted lines on the bottom represent random-expected autocorrelation given the marginal distributions. Violins represent the distribution of autocorrelations that five different, partially nested model specifications imply.

Table S4. Direction of peer selection on academic functioning (GPA and truancy) (*N*=342).

Network dynamics: Friendship	Est.	t-Value	OR
Outdegree (density)	-3.32	-89.47*	0.04
Effect of time period 2 (t2-t3)[a]	0.04	2.12*	NA
Effect of time period 3 (t3-t4)[a]	-0.13	-7.15*	NA
Reciprocity	1.43	49.90*	4.19
Transitive triplets	0.12	20.79*	1.13
Transitivity reciprocated triplets	-0.01	-0.64*	0.99
Three-cycles	0.03	6.09*	1.03
Number at distance 2	0.04	21.26*	1.04
Number at distance 2 twice	0.05	14.14*	1.05
Dense Triads	-0.03	-2.25*	0.97
GWESPFF	1.26	46.66*	NA
Indegree-popularity	0.003	4.43*	1.003
Outdegree-popularity	-0.05	-39.08*	0.95
Outdegree-activity	0.002	9.00*	1.002
Ethnicity alter	0.02	1.84+	1.02
Ethnicity ego	-0.01	-0.37	0.99
Same ethnicity	0.10	8.59*	1.11
Sex alter	0.04	3.30*	1.04
Sex ego	-0.01	-0.87	0.99
Same sex	0.12	10.31*	1.13
GPA alter	-0.01	-1.17	0.99
GPA ego	-0.06	-4.85*	0.94
GPA similarity maintenance	-0.05	-0.28	0.98
GPA similarity formation	0.56	3.61*	1.21
GPA alter X ego maintenance	0.09	1.97*	1.03
GPA alter X ego formation	-0.04	-0.85	0.99
Truancy alter	-0.07	-3.94*	0.93
Truancy ego	-0.01	-0.29	1.00
Truancy similarity maintenance	-0.12	-0.43	0.96
Truancy similarity formation	-0.83	-2.72*	0.76
Truancy alter X ego maintenance	0.13	1.52	1.04
Truancy alter X ego formation	0.17	2.25*	1.06
Acceptance alter	0.07	4.85*	1.07
Popularity alter	0.10	4.98*	1.11
Behavioral dynamics: GPA			
Linear shape	-0.16	-2.19*	0.86
Quadratic shape	0.14	0.92	NA
Own sex	-0.15	-1.04	0.86
Own truancy	-0.38	-2.84*	0.69
Average similarity	4.89	3.28*	5.10
Behavioral dynamics: Truancy			
Linear shape	-0.02	-0.38	0.98
Quadratic shape	0.26	3.65*	NA
Own sex	-0.06	-0.86	0.94
Own GPA	-0.30	-4.88*	0.74
Average similarity	3.51	4.41*	3.22

Notes. Rate of change effects were also included but omitted from the table; 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); [a]Time effects included for Outdegree (density) to account for heterogeneity across time; +*p* < .10, **p* < .05 (two-tailed test).

Table S5. Direction of peer influence on academic functioning (GPA and truancy) (*N*=342).

Network dynamics: Friendship	Est.	t-Value	OR
Outdegree (density)	-3.52	-91.94*	0.03
Effect of time period 2 (t2-t3)[a]	0.03	1.74+	NA
Effect of time period 3 (t3-t4)[a]	-0.14	-7.56*	NA
Reciprocity	1.43	51.70*	4.17
Transitive triplets	0.12	19.95*	1.13
Transitivity reciprocated triplets	-0.01	-1.01	0.99
Three-cycles	0.03	6.62*	1.03
Number at distance 2	0.04	22.00*	1.04
Number at distance 2 twice	0.05	13.59*	1.05
Dense Triads	-0.02	-1.70+	0.98
GWESPFF	1.35	47.95*	NA
Indegree-popularity	0.01	8.33*	1.01
Outdegree-popularity	-0.05	-34.00*	0.95
Outdegree-activity	0.002	10.00*	1.002
Ethnicity alter	0.03	1.98*	1.03
Ethnicity ego	-0.01	-0.46	0.99
Same ethnicity	0.11	9.12*	1.11
Sex alter	0.04	2.87*	1.04
Sex ego	-0.01	-1.03	0.99
Same sex	0.12	10.70*	1.13
GPA alter	-0.01	-1.13	0.99
GPA ego	-0.06	-4.86*	0.94
GPA similarity	0.31	5.37*	1.11
GPA alter X ego	0.02	1.08	1.02
Truancy alter	-0.08	-3.66*	0.93
Truancy ego	-0.01	-0.71	0.99
Truancy similarity	-0.53	-3.32*	0.84
Truancy alter X ego	0.15	4.12*	1.16
Behavioral dynamics: GPA			
Linear shape	0.03	0.26	1.03
Quadratic shape	0.12	0.90	NA
Own sex	-0.18	-1.26	0.83
Own truancy	-0.45	-3.06*	0.63
Average similarity increase	8.84	3.62*	19.05
Average similarity decrease	-6.83	-2.18*	0.01
Behavioral dynamics: Truancy			
Linear shape	0.19	2.64*	1.21
Quadratic shape	0.24	3.17*	NA
Own sex	-0.07	-0.83	0.94
Own GPA	-0.32	-4.13*	0.73
Average similarity increase	10.36	5.35*	31.65
Average similarity decrease	-13.74	-4.17*	0.0002

Notes. Rate of change effects were also included but omitted from the table; 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); [a]Time effects included for Outdegree (density) to account for heterogeneity across time; +*p* < .10, *p* < .05 (two-tailed test).

Appendix S6. Sensitivity analysis and goodness of fit results of auxiliary statistics.

Goodness of fit. We assessed the Goodness of fit (GoF) with auxiliary statistics. The GoF was assessed for the model in which the main hypothesis regarding selection and socialization was tested (Model 1 in Table S2). Four auxiliary network statistics were computed: outdegree distribution, indegree distribution, geodesic distance, and triad census. Two auxiliary behavior statistics were computed: behavior distribution for GPA and truancy. The auxiliary network statistics are important indices for how well friendship patterns in the network are represented with the included model effects or whether additional effects are needed. For each auxiliary statistic, the differences between the values in the observed network (summed across the four waves of data) and the simulated values in the model (summed across 2,000 random networks) are assessed with the Mahalonobis distance (cf. Ripley et al., 2015). The results are illustrated figuratively below.

Violin plots can be used to inspect whether, for a specific statistic, there are too 'many' (or too 'few' or a 'sufficient' number of) values being simulated in comparison to the observed values with a five percent margin of error. The red solid lines shows the observed values; the boxplots and violins show the distribution of the simulated values. Out/indegree were underrepresented in the lower and higher range of the distribution and overrepresented in the middle range. The number of direct connections (geodesic distance 1) and indirect connections close by in the network (geodesic distance 2) were better represented than indirect connections further away (geodesic distance 3-5). Fit on academic achievement was good; for truancy fit was acceptable but score 2 and 3 were slightly under/overrepresented, probably because the distribution was skewed.

In summary, fit on all auxiliary statistics was acceptable as the simulated values do not depart too far from the observed values. Inclusion of additional network-related parameters (i.e., Model 1 in Table S2) improved the modeling of outdegree distribution, indegree distribution, geodesic distance, and triadic census significantly which indicates that we were better able to account for these features of the grade friendship network. Based on optical inspection, small deviations likely had a relatively large impact on the overall fit for these fit indices.

Sensitivity analysis. We performed additional analyses to find out whether unsatisfactory fit was caused by number of friendship nominations (available upon request). Because students could

nominate as many (or few) closest friends as they desired within their grade, some students may have nominated a large number of friends, which might make it harder to fit the networks. Hence, similar to other recent SIENA studies (e.g., Rambaran et al., 2015), we considered all ties of students with extreme outdegrees (arbitrarily cut-off point set at > 25) as missing (resulting in 8-16% missing ties between observations). Although we were mainly successful in improving the fit for indegree distribution, analyses of the restricted model and unrestricted model revealed no clear differences in findings.

Goodness of fit results for directed friendship networks belonging to Appendix S6.
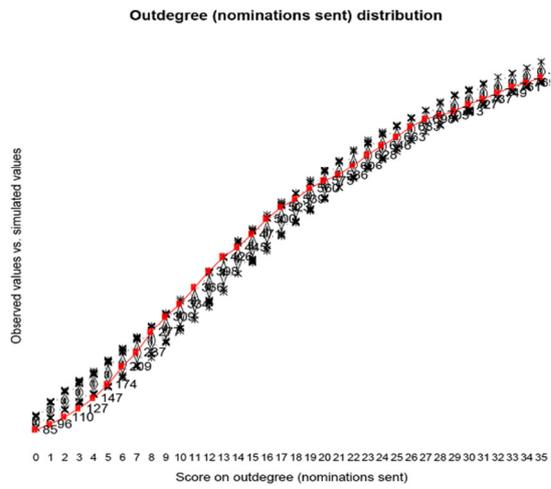

Fig. S2A
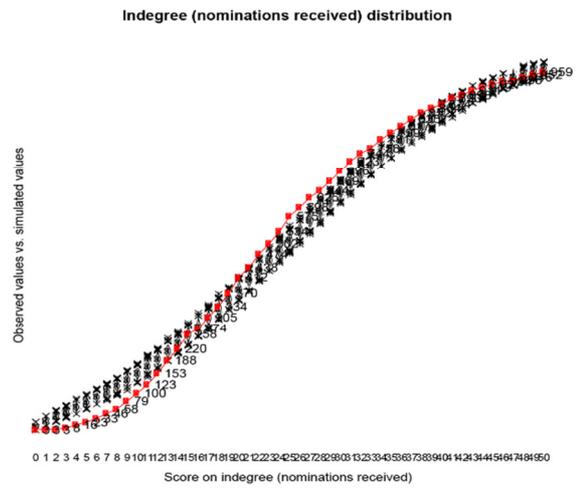
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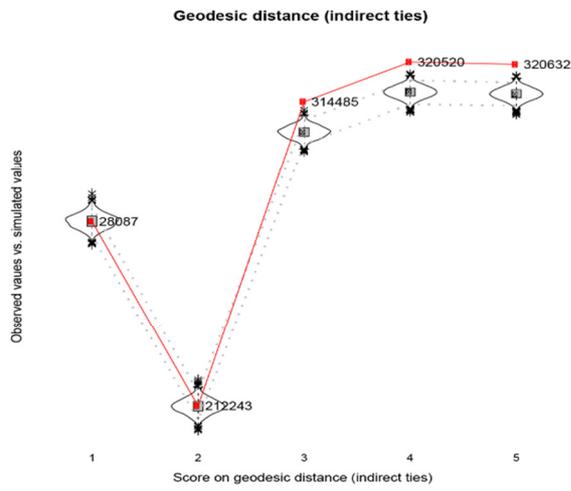
Fig. S2C
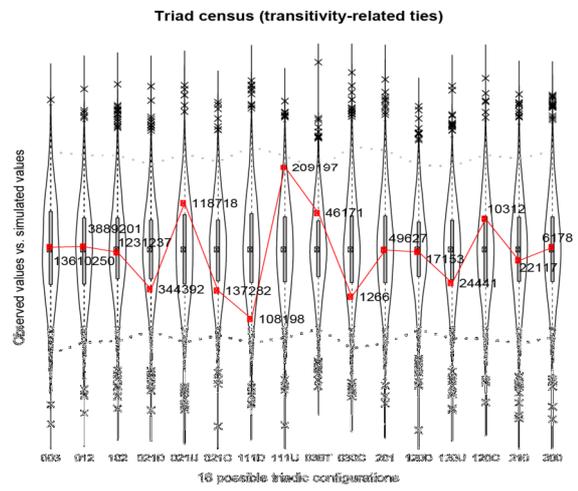
Fig. S2D
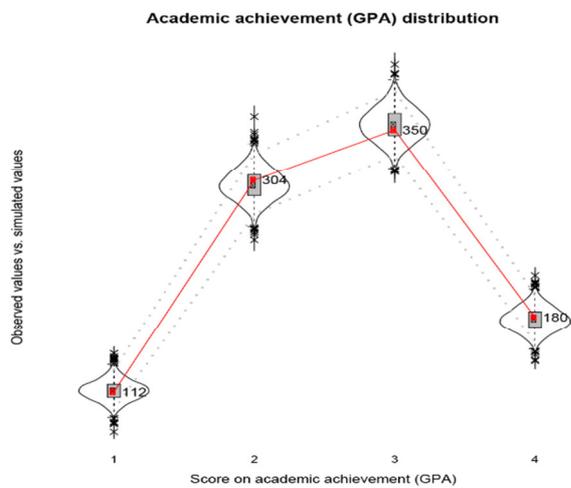
Fig. S2E
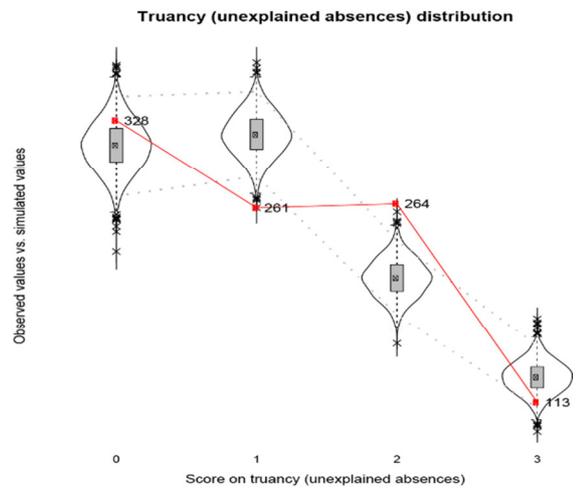
Fig. S2F

Figure S2. Goodness of fit results of auxiliary statistics belonging to Model 1 in Table S2 in Appendix S2. Four auxiliary network statistics (outdegree, indegree, geodesic distance, triadic census) and two auxiliary behavior statistics (GPA and truancy) were computed. In each figure (Fig. 2A-F), violin plots represent the distribution of the simulated values for each statistic, and how 'far' the simulated values depart from the observed values as indicated with a solid red line.