Appendix

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A1: Descriptive statistics on the seven excluded schools

Table A1.1. *Descriptive statistics of friendship and bullying networks across 7 deselected schools* (N_{total} = 736 students; N_{mean} = 105; $N_{minimum}$ = 30; $N_{maximum}$ = 264)

Variable	Mean[a]		Standard deviation	Minimum		Maximum
Gender						
Boy	51.6% (8.05)					
Girl	48.4% (8.05)					
Age						
Wave 1	115 (1.86)		14.74 (0.86)	88 (4.60)		138 (1.42)
Wave 2	119 (3.31)		13.42 (1.33)	94 (4.01)		139 (0.61)
Wave 3	124 (3.42)		12.69 (1.13)	100 (3.83)		145 (0.42)
	Friendship networks			Bullying networks		
	Wave 1	Wave 2	Wave 3	Wave 1	Wave 2	Wave 3
Density	.07 (.03)	.08 (.05)	.08 (.05)	.02 (.01)	.01 (.01)	.01 (.01)
Average degree	5.06 (1.47)	4.77 (1.26)	4.98 (1.19)	0.88 (0.39)	0.81 (0.57)	0.55 (0.41)
Number of ties	554 (545.8)	536 (536.7)	546 (518.8)	101 (94.8)	107 (135.0)	75 (97.6)
% ties outside the classroom	17% (9.34)	17% (6.37)	19% (7.49)	21% (15.27)	25% (13.23)	29% (22.11)
Mutual dyads	268 (251.2)	265 (268.7)	286 (268.6)	4 (6.90)	6 (9.38)	2 (3.73)
Asymmetric dyads	540 (552.1)	535 (519.4)	516 (497.0)	182 (159.9)	198 (244.6)	145 (187.2)
Total sample (students)						
Percentage of sinks[b]	4% (7.30)	5% (9.06)	1% (1.09)	30% (4.31)	20% (13.2)	19% (8.55)
Percentage of sources[b]	2% (2.49)	3% (2.80)	1% (1.11)	19% (4.22)	14% (8.56)	14% (5.92)
Percentage of isolates[b]	9% (9.21)	17% (9.94)	16% (11.11)	35% (13.61)	51% (24.88)	59% (19.82)
Percentage of actives[b]	85% (13.07)	75% (11.35)	82% (10.98)	16% (11.19)	15% (11.35)	8% (7.11)
Tie changes						
Creating tie (0 → 1)		243 (227.9)	233 (223.7)		87 (111.3)	51 (60.6)
Dissolving tie (1 → 0)		260 (237.2)	223 (241.4)		81 (69.5)	82 (96.2)
Stable tie (1 → 1)		288 (303.3)	311 (293.3)		19 (23.9)	24 (39.5)
Jaccard index		.28 (.13)	.42 (.03)		.08 (.04)	.10 (.08)

Notes. [a] The frequency distribution of nominal variables is indicated in percentages. [b] *Sinks* are actors with zero out-ties and at least one in-tie; *Sources* are actors with at least one out-tie and zero in-ties; *Isolates* are actors with zero in-ties and zero out-ties; *Actives* are actors with at least one out-tie and as well as one in-tie.

Table A1.2. *Descriptive statistics of shared bullies and victims mechanisms across 7 deselected schools*

Configuration	1	2	3a	4a	5	6	7a	8a	9	10	11a	12a
% of		1	1	3a	1	5	6	7a	1	9	9	11a
Wave 1	12594	9.5%	3.9%	17.4%	50.5%	15.2%	3.6%	28.8%	49.5%	3.6%	4.1%	6.3%
	(17655.2)	(5.3)	(4.5)	(8.6)	(2.6)	(7.9)	(4.4)	(15.6)	(2.6)	(2.1)	(4.7)	(4.9)
Wave 2	11966	11.6%	5.1%	13.5%	50.7%	18.5%	5.2%	20.4%	49.3%	4.5%	5.4%	4.0%
	(17094.9)	(6.7)	(6.7)	(7.6)	(3.5)	(10.2)	(5.8)	(11.0)	(3.5)	(3.3)	(9.5)	(7.2)
Wave 3	11873	12.4%	2.4%	28.4%	50.6%	19.4%	3.2%	28.8%	49.4%	5.2%	1.6%	13.2%
	(16976.9)	(7.3)	(2.9)	(22.9)	(3.6)	(10.8)	(4.0)	(31.7)	(3.6)	(3.9)	(1.8)	(18.3)
Configuration			3b	4b			7b	8b			11b	12b
% of			1	3b			6	7b			9	11b
Wave 1			6.3%	32.6%			9.0%	41.4%			3.7%	14.0%
			(5.4)	(10.3)			(9.0)	(12.6)			(2.7)	(13.3)
Wave 2			9.2%	26.1%			14.1%	35.4%			3.8%	7.9%
			(12.9)	(15.9)			(20.3)	(23.9)			(6.1)	(12.0)
Wave 3			3.7%	38.1%			41.4%	63.8%			1.4%	14.4%
			(5.2)	(13.1)			(9.1)	(10.6)			(1.7)	(21.0)

Note. Standard deviations are given between brackets. Solid lines indicate friendships, dotted lines indicate bullying relationships in the graphical representations of the configurations. Non-filled circles indicate that gender is not specified. White lines indicate that relationship is not specified. Presented percentages are nested. For example, 3a represents the percentage of dyads with shared bullies from the total number of possible dyads (1), and 4a presents the percentage of befriended dyads with shared bullies from the total number of dyads with shared bullies (3a).

[1] Possible dyads (non-specified relationship). [2] Befriended dyads. [3] Dyads (non-specified relationship) with shared bullies/victims. [4] Befriended dyads with shared bullies/victims. [5] Possible same-gender dyads (non-specified relationship). [6] Befriended same-gender dyads. [7] Same-gender dyads (non-specified relationship) with shared bullies/victims. [8] Befriended same-gender dyads with shared bullies/victims. [9] Possible cross-gender dyads (non-specified relationship). [10] Befriended cross-gender dyads. [11] Cross-gender dyads (non-specified relationship) with shared bullies/victims. [12] Befriended cross-gender dyads with shared bullies/victims.

A2: Descriptive statistics on the 17 included schools

Table A2.1. *Descriptive statistics of friendship and bullying networks across all 17 schools (N_{total} = 2130 students; N_{mean} = 125; $N_{minimum}$ = 53; $N_{maximum}$ = 306)*

Variable	Mean	Standard deviation	Minimum	Maximum
Age				
Wave 1	116 (2.44)	13.63 (0.97)	94 (3.40)	139 (0.63)
Wave 2	119 (2.25)	12.30 (1.05)	94 (4.06)	140 (0.37)
Wave 3	124 (3.84)	11.96 (2.42)	94 (6.60)	144 (1.03)

	Friendship networks			Bullying networks		
	Wave 1	Wave 2	Wave 3	Wave 1	Wave 2	Wave 3
Density	.06 (.03)	.06 (.03)	.06 (.03)	.02 (.02)	.01 (.00)	.01 (.01)
Average degree	5.87 (1.13)	6.16 (0.90)	6.31 (1.00)	1.39 (0.50)	1.04 (0.31)	0.91 (0.45)
Number of ties	739 (434.4)	766 (428.8)	789 (472.0)	170 (105.8)	128 (77.7)	112 (75.7)
% ties outside the classroom	18% (4.06)	22% (4.90)	23% (5.47)	23% (9.50)	28% (12.29)	27% (9.59)
Mutual dyads	370 (223.8)	370 (210.0)	388 (239.5)	16 (16.0)	9 (7.1)	7 (7.7)
Asymmetric dyads	719 (429.0)	779 (448.7)	785 (477.7)	303 (181.2)	237 (147.5)	207 (139.5)
Total sample (students)						
Percentage of sinks[a]	4% (3.77)	4% (6.65)	4% (7.50)	24% (6.74)	26% (6.20)	26% (5.90)
Percentage of sources[a]	2% (1.67)	1% (0.93)	1% (0.95)	19% (6.70)	16% (4.30)	16% (4.40)
Percentage of isolates[a]	6% (7.65)	6% (5.40)	7% (5.99)	31% (9.91)	40% (10.91)	43% (15.30)
Percentage of actives[a]	88% (8.02)	89% (10.06)	88% (11.23)	26% (10.54)	18% (7.58)	15% (11.10)
Tie changes						
Creating tie (0 → 1)		355 (217.1)	332 (223.7)		91 (54.2)	80 (53.3)
Dissolving tie (1 → 0)		332 (224.5)	306 (177.2)		133 (86.0)	96 (61.2)
Stable tie (1 → 1)		405 (218.8)	441 (263.6)		36 (24.0)	29 (22.9)
Jaccard index		.38 (.06)	.41 (.05)		.14 (.04)	.13 (.04)

Note. [a] *Sinks* are actors with zero out-ties and at least one in-tie; *Sources* are actors with at least one out-tie and zero in-ties; *Isolates* are actors with zero in-ties and zero out-ties; *Actives* are actors with at least one out-tie and as well as one in-tie.

A3: R script for calculating the number of multiple network configurations

The R-script is added as additional document.

A4: Analytical strategy (*continued*)

Model specification. Table A4.1 provides an overview of all effects, including graphical representations. All control effects were estimated freely in our models. Parameters were fixed and tested using a score-type test when configurations were absent in the observed networks.

Uniplex structural effects. Uniplex structural effects were added to the model to capture the basic tendencies of actors to form and maintain relationships. In friendship networks, actors generally have a tendency to form and maintain ties, but friendships come with certain costs; this is captured by the *outdegree* effect that is usually estimated negatively. Friendship networks are further characterized by high levels of *reciprocity*, or the tendency of actors to reciprocate friendships (actor *i* nominates (→) actor *j* which implies that actor *j* → actor *i*). In addition, friendship networks are often transitive. Therefore, we included two transitivity effects in the friendship networks. First, we included the *transitive version of the geometrically weighted edgewise shared partner*s (*GWESP*) effect which reflects the tendency that 'friends of friends become friends' (*transitive closure*; actor *i* → intermediary *h* → actor *j*; actor *i* → actor *j*). Second, we added an *interaction effect of this transitive version of the GWESP effect with reciprocity*, resulting in an effect that reflects the tendency to reciprocate a tie that leads to transitive closure (*reciprocated transitive closure*; actor *i* → intermediary *h* → actor *j*; actor *i* ↔ actor *j*; Block, 2015). In addition, we added a *cyclicity* version of the GWESP effect which reflects the tendency toward anti-hierarchy, or in other words, generalized exchange in a non-hierarchical setting (*cyclicity*; *i* → *j* → *h*; *h* → *i*).

We also included two degree-related effects to differentiate between actors who received or gave many (or few) ties in the friendship network. The *indegree-popularity* effect reflects the tendency of actors who receive many nominations to receive more nominations over time which expresses a reinforcing or maintaining process and leads to a dispersed distribution of the indegrees. The *outdegree-activity* effect expresses another reinforcing or maintaining process, namely that actors who give many nominations will give more nominations over time leading to a dispersed distribution of the outdegrees. Finally, we included the *shared outgoing friendship → reciprocated friendship* to enhance the goodness of fit of the models. This effect expresses the reciprocated tendency to nominate actors with similar outgoing ties.

Similar to the friendship model, *outdegree*, *reciprocity*, *indegree-popularity*, and *outdegree-activity* were added to the network model to capture the basic tendencies of actors to form and maintain bullying relationships. In addition, the *zero-outdegrees* effect was added which expresses the tendency to be an isolate with respect to outgoing ties. Another effect, namely *shared-popularity*, was added to the bullying model to capture basic tendencies. The *shared-popularity* effect expresses the tendency for children to nominate the same schoolmates as bullies. Due to low density of the bullying networks and a more centralized structure, the effects of *transitive closure* and *cyclicity* have not been included.

<u>Uniplex actor covariate effects.</u> To estimate how changes in the friendship and bullying networks depend on children's *age*, we included three selection effects: *similarity*, *sender*, and *receiver* effects. An effect for *same class* was included to control for the tendency of children to form ties within their classroom.

<u>Multiplex structural effects.</u> Multiplex effects were added to the model to control how changes in one dependent network are influenced by changes in the other dependent network. Two dyadic effects were added that controlled for the main effects of friendship on bullying and vice versa. These effects gave the likelihood that an outgoing bullying tie would result in a friendship tie in the same dyad at subsequent time points and vice versa (*bullying → friendship* and *friendship → bullying*). At the degree-level, cross-network dependencies were estimated for the outdegree (i.e., given nominations) of one independent network (friendship

or bullying) that leads to an outgoing tie in the other dependent network (*bullying outdegree → friendship outdegree* and *friendship outdegree → bullying outdegree*). For example, nominating schoolmates for bullying leads to nominating (other) schoolmates for friendships. Comparably, indegrees (i.e., received nominations) for one relationship can lead to indegrees for the other dependent network (*bullying indegree → friendship indegree* and *friendship indegree → bullying indegree*). It was also tested whether children nominating many friends became nominated as bullies (by others) (*friendship outdegree → bullying indegree*), or whether nominating many others as bullies (i.e., being a victim) led to being a friend (of others) (*bullying outdegree → friendship indegree*).

Furthermore, two mixed triadic effects were added to the bullying model to control for mechanisms which correspond to the shared bullies and shared victims mechanisms. It was estimated whether being friends with a victim led to victimization by the bully of the friend over time (*being friends with victims → being bullied*). Also, it was estimated whether children would be bullied by friends of their bullies over time (*being bullied → being bullied by friends of bully*).

Uniplex results

Uniplex network descriptives. Table A2.1 displays means and standard deviations of the uniplex descriptive statistics for the seventeen school-level networks. Children nominated on average six schoolmates as their best friends and one schoolmate as their bully. On average, 21% of the friendships and 26% of bullying occurred outside the classroom. The Jaccard index indicates the amount of stability in the networks (Snijders, Van de Bunt, et al., 2010). The proportion of stable relationship was low for bullying (a Jaccard index of at least .20 is recommended), but this had no consequences for model convergence in the seventeen schools.

On average, most children, 88%, were both nominated as friends and nominated others as friends (actives, children with both in-ties and out-ties). For bullying, only 20% of the children were actives. Whereas only 6% of the children were isolates (children with no out-ties and in-ties) in the friendship network, 38% of the children were not involved in the bullying network. In addition, 17% of the children nominated others as bullies but did not receive bullying nominations (sources). For friendships, on average only 1% of the children were sources. On average, 4% of the children were nominated by schoolmates as a friend but did not nominate anyone as a friend themselves (sinks). For bullying, 25% of the children were sinks.

Network results. Table A4.2 presents the results for the uniplex structural and uniplex actor covariate effects. The first part of Table A4.2 presents the results for the friendship networks. Children tended to be selective in nominating schoolmates as their best friends (*outdegree*, $PE = -3.03$, $p < .001$). In addition, the positive reciprocity parameter indicates that friendship nominations were likely to be reciprocated ($PE = 2.53$, $p < .001$). Also, children were likely to become friends with friends of friends (*transitive closure*, $PE = 1.68$, $p < .001$). Nevertheless, these friendships were not likely to be reciprocated (*reciprocated transitive closure*, $PE = -0.62$, $p < .001$), given the main effect of reciprocity that captures these mutual friendships. The negative effect for *cyclicity* indicates that there was a tendency for the friendship networks to be hierarchically ordered ($PE = -0.21$, $p < .001$). In addition, the negative *indegree-popularity* effect shows that the more children were nominated by others as friends the less they attracted extra friendship nominations over time ($PE = -0.27$, $p < 0.001$).

For bullying, it was also found that children tended to be selective in nominating schoolmates as their bullies (*outdegree*, $PE = -3.97$, $p < .001$). In addition, bullying relationships were found to be reciprocated (*reciprocity*, $PE = 0.47$, $p < .001$). Bullying was found to be quite stable over time. This stability was characterized by children who were nominated as bullies to receive more nominations over time (*indegree-popularity*, *PE* = 0.62, $p < .001$). Nevertheless, children nominating others as bullies were not found to increase this tendency further over time (*outdegree-activity*, *PE* = -0.01, $p = .92$). In addition, the effect for *zero outdegrees* showed that many children did not nominate any schoolmates as their bullies (*PE* = -3.45, $p < .001$).

The results for the uniplex actor covariate effects show that children were more likely to befriend children from the same classroom (*same class*, *PE* = 0.38, $p < .001$) and the same age (*similarity age*, *PE* = 0.73, $p < .001$). For bullying, it was found that boys were more likely to receive bullying nominations (*receiver gender*, *PE* = 0.36, $p < .001$) and were less likely to mention others as bullies (*sender gender*, *PE* = -0.11, $p = .01$) than girls. Furthermore, children were more likely to nominate same gender bullies (*same gender*, *PE* = 0.28, $p < .001$), bullies from the same class (*same class*, *PE* = 1.05, $p < .001$) and the same age (*similarity age*, *PE* = 1.09, $p < .001$).

Table A4.2 shows that no relation was found between friendships and bullying on the dyadic level in the meta-analysis (*bullying → friendship*, *PE* = -0.12, $p = .48$; *friendship → bullying*, *PE* = -0.14, $p = .26$). At the degree-level, it was found that both bullies and victims were less likely to attract friendship nominations (*bullying indegree → friendship indegree,* *PE* = -0.10, $p = .01$ and *bullying outdegree → friendship indegree*, *PE* = -0.04, $p = .01$). Moreover, children mentioned by many classmates as friends were nominated less as a bully over time (*friendship indegree → bullying indegree*, *PE* = -0.12, $p = .03$).

On the mixed triadic effects, we did not find that friends of victims were more likely to be bullied by the bullies of their friends over time (*being friends with victims → being bullied*, *PE* = 0.08, $p = .15$). We did find that children tended to be victimized by the friends of their bullies over time (*being bullied → being bullied by friends of bullies*, *PE* = 0.32, $p < .001$). This seems to suggest that bullies tend to bully the victims of their friends, but not the friends of their victims. Due to convergence problems in nine schools, the two mixed triadic effects were fixed. For the *being friends with victims → being bullied* effect, the score-type test was non-significant, indicating that the parameter did not add significantly to the model. For the *being bullied → being bullied by friends of bullies* the score-type test was significant. The results of the score-type tests indicated that including the effect would have added significantly to the model and that, in line with our results for the other eight schools, the parameter would have had a positive effect on the formation and maintenance of bullying ties.

Table A4.1. *Parameters in the network model*

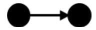
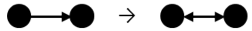
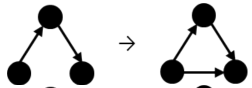
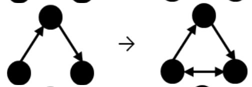
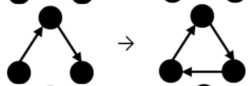
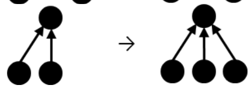
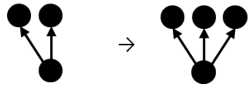
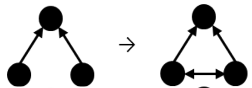
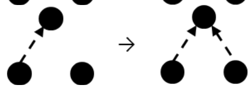
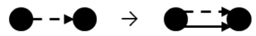
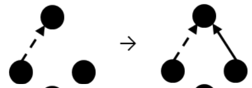
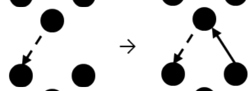
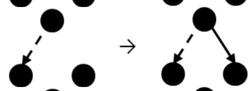
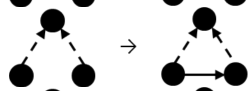
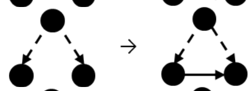
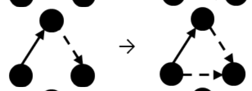
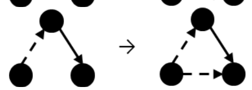
	Parameter	RSiena effect name	Explanation	Graphical representation
	Uniplex structural effects			
1	Rate function (period 1)	~	The frequency with which actors have the opportunity to make one change	
2	Outdegree	density	Basic tendency to have ties	
3	Reciprocity	recip	Tendency towards reciprocation	
4	Transitive closure	gwespFF	Transitive closure ($i \rightarrow h \rightarrow j$; $i \rightarrow j$)	
5	Reciprocated transitive closure	gwespFF * recip	Reciprocated transitive closure	
6	Cyclicity	gwespBB	Tendency toward generalized exchange in a non-hierarchical setting	
7	Indegree-popularity	inPopSqrt	Reinforcing or maintaining process: Actors with high indegrees will receive more nominations, leading to a dispersed distribution of the indegrees	
8	Outdegree-activity	outActSqrt	Reinforcing or maintaining process: Actors with high outdegrees will give more nominations, leading to a dispersed distribution of the outdegrees	
9	Reciprocated outbound shared partner	gwespFB * recip	Reciprocated tendency to nominate actors with shared outgoing ties	
10	Shared popularity	sharedPop	Tendency to nominate the same actors	
11	Zero outdegrees	outTrunc(1)	Tendency to be an isolate with respect to outgoing ties	
	Uniplex actor covariate effects			
12	Sender	egoV	Actors with higher values on X have a higher outdegree	
13	Receiver	altV	Actors with higher values on X have a higher indegree	
14	Same	sameV	Ties occur more often between actors with same values on V	
15	Similarity	simV	Ties occur more often between actors with similar values on V	

Table A4.1 (continued)

	Parameter	RSiena effect name	Explanation	Graphical representation
	Multiplex structural effects			
16	W → X	crprod	Effect of a tie in network W on a tie in network X (for same dyad *i* → *j*)	
17	W indegree → X indegree	inPopIntn	Effect of indegree in network W on indegree in network X	
18	W outdegree → X indegree	outPopIntn	Effect of outdegree in network W on indegree in network X	
19	W outdegree → X outdegree	outActIntn	Effect of outdegree in network W on outdegree in network X	
20	Shared outgoing W → X	from	Shared outgoing W ties contribute to the tie X	
21	Shared incoming W → X	sharedIn	Shared incoming W ties contribute to the tie X	
22	Mixed W-X two-paths → X	to	Mixed W-X two-paths contribute to the tie X	
23	Mixed X-W two-paths → X	cl.XWX	Mixed X-W two-paths contribute to the tie X	
	Multiplex actor covariate effects			
24	Same V * shared outgoing W → X	covNetNet	Tendency of shared outgoing W ties to contribute to the tie X for triad with actor *i* and *j* with same values on V	
25	Same V * shared incoming W → X	covNetNetIn	Tendency of shared incoming W ties to contribute to the tie X for triad with actor *i* and *j* with same values on V	

Note. Solid lines indicate friendship relationships, dotted lines indicate bullying relationships in the graphical representations of the parameters.

Table A4.2. *RSiena meta-analysis for friendship and bullying (Model 2)*

Parameter	*PE*	(*SE*)	*p*	*N schools*
Friendship				
Uniplex structural effects				
Rate function (period 1)	12.70	(0.84)	<.001	17
Rate function (period 2)	11.80	(0.89)	<.001	16
Outdegree	-3.03	(0.12)	<.001	17
Reciprocity	2.53	(0.07)	<.001	17
Transitive closure	1.68	(0.05)	<.001	17
Reciprocated transitive closure	-0.62	(0.13)	<.001	17
Cyclicity	-0.21	(0.02)	<.001	17
Indegree-popularity	-0.27	(0.03)	<.001	17
Outdegree-activity	0.02	(0.02)	.22	17
Reciprocated outbound shared partner	-0.44	(0.09)	<.001	16
Uniplex actor covariate effects				
Class				
Same	0.38	(0.05)	<.001	17
Age				
Receiver	0.003	(0.001)	.01	17
Sender	0.00	(0.001)	.75	17
Similarity	0.73	(0.10)	<.001	17
Multiplex structural effects				
Bullying → friendship	-0.12	(0.18)	.48	15
Bullying indegree → friendship indegree	-0.10	(0.04)	.01	17
Bullying outdegree → friendship indegree	-0.04	(0.02)	.01	17
Bullying outdegree → friendship outdegree	0.03	(0.03)	.32	17
Bullying				
Uniplex structural effects				
Rate function (period 1)	12.63	(0.99)	<.001	17
Rate function (period 2)	12.76	(1.25)	<.001	16
Outdegree	-3.97	(0.27)	<.001	17
Reciprocity	0.47	(0.08)	<.001	15
Shared popularity	-0.03	(0.01)	.03	16
Indegree-popularity	0.62	(0.05)	<.001	17
Outdegree-activity	-0.01	(0.08)	.92	17
Zero outdegrees	-3.45	(0.24)	<.001	17

Table A4.2 (continued)

Parameter	*PE*	(*SE*)	*p*	*N schools*
Uniplex actor covariate effects				
Boy				
Receiver	0.36	(0.05)	<.001	17
Sender	-0.10	(0.04)	.01	17
Same gender	0.28	(0.05)	<.001	17
Class				
Same	1.05	(0.13)	<.001	17
Age				
Receiver	na	na		
Sender	na	na		
Similarity	1.09	(0.18)	<.001	17
Multiplex structural effects				
Friendship → bullying	-0.14	(0.12)	.26	17
Friendship indegree → bullying indegree	-0.12	(0.06)	.03	17
Friendship outdegree → bullying indegree	0.01	(0.03)	.66	17
Friendship outdegree → bullying outdegree	-0.02	(0.02)	.45	17
Being friends with victims → being bullied	0.08	(0.05)	.15	8
Being bullied → being bullied by friends of bullies	0.32	(0.06)	<.001	8

A5: Goodness of Fit (GoF) statistics

Introduction and explanation. The goodness of fit for our models were calculated for four network indices: 1) the distribution of nominations received (indegrees), 2) the distribution of nominations given (outdegrees), 3) the geodesic distances in the networks, and 4) the triad census, all for both friendship and bullying for each school separately.

The goodness of fit of the models is estimated using the observed values for each network, summed over all waves except the first, and the values of the simulated network. The observed data should be within the range of the values of the simulated network to indicate an acceptable goodness of fit; this is confirmed by a *p*-value larger than .05.

The network index of *geodesic distance* represents the shortest path between two actors in a network. If actors are not connected (neither directly nor indirectly through others), the distance between them is infinite (or undefined). The bullying network is sparser with fewer network closure patterns than the friendship network, leading to less connected actors. Therefore, the geodesic distances are much larger in the bullying network than in the friendship network.

The *triad census* is a set of the different kinds of triads – relationships between three actors – that are possible in a network. Wasserman and Faust (1994, pp. 564–568) state that there are sixteen isomorphism classes for the sixty-four different triads that may exist. The possible triads can be labeled according to the following scheme: 1) the number of mutual (M) dyad in the triad; 2) the number of asymmetric (A) dyads in the triad; 3) the number of null(N) dyads in the triad; and 4) a character to distinguish further among the types: T is for Transitivity, C is for Cyclic, U is for Up, and D is for Down. This labeling scheme is also called the M-A-N-scheme.

Results of the goodness of fit statistics. Table A5.1 gives the *p*-values of the network indices for both networks for each school separately. The graphical representations of the

GoF, showing the observed values and the simulated values, are available upon request.

Overall, the goodness of fit of the bullying network seems to be acceptable for all four network indices, with a few exceptions. The indegree, outdegree, and geodesic distance of the friendship network also seem to fit well. The triad census of the friendship network had for many schools less acceptable GoF statistics. After adding the *shared outgoing friendship → reciprocated friendship* effect (see Appendix 2), the goodness of fit for the triad census increased slightly. Looking at the plotted observed and simulated values for the schools separately, there are no M-A-N-triads that are systematically under- or overestimated. If only one of the sixteen M-A-N-triads is not estimated sufficiently, the statistics indicate that the model is not acceptable. Given that we did not find systematic deviations, we considered the models as acceptable for our research purposes.

Table A5.1. *Goodness of Fit statistics for the uniplex networks for the individual schools*

	Friendship				Bullying			
	Indegree	Outdegree	Geodesic distance	Triad census	Indegree	Outdegree	Geodesic distance	Triad census
1	.80	.26	.13	.16	.31	.003	.65	.15
2	.74	.19	.52	.22	.52	.91	.11	.66
3	.12	.07	.53	.00	.19	.64	.62	.59
4	.10	.63	.29	.00	.53	.10	.08	.44
5	.16	.01	.004	.00	.78	.04	.47	.58
6	.23	.07	.04	.00	.09	.00	.27	.11
7	.55	.04	.01	.00	.09	.21	.03	.06
8	.11	.001	.01	.00	.10	.24	.26	.12
9	.83	.93	.99	.28	.93	.66	.78	.99
10	.68	.31	.01	.00	.21	.64	.45	.66
11	.03	.51	.05	.00	.34	.001	.25	.36
12	.18	.01	.76	.10	.84	.16	.98	.81
13	.85	.43	.00	.00	.13	.00	.81	.62
14	.46	.94	.45	.23	.23	.03	.65	.86
15	.46	.00	.01	.00	.01	.00	.80	.34
16	.80	.02	.72	.01	.52	.84	.59	.33
17	.07	.29	.51	.01	.81	.61	.69	.77