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### A social network perspective on bullying

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# **Appendix Chapter 4**

**A1: Structural Tendencies in the Bullying Networks**

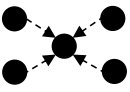


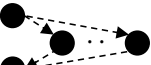
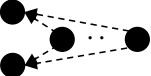
In all estimated models (see Tables 4.3 and 4.4), extra parameters were included to capture structural effects in the bullying networks. The choice of structural parameters was based on Huitsing et al. (2012a – Chapter 2), who identified the essential network parameters to model the structure of most bullying networks. The names of the network parameters are in agreement with the literature on ERGMs (see Lusher, Koskinen, & Robins, 2013, Wang, Robins, & Pattison, 2009). The structural parameters are given in Table A1, and the estimated models can be found in Appendix A3. When the estimated models also included parameters for gender and behavioral problems, the estimations of the structural parameters did not change substantially, the reason why only full uniplex models with structural and covariate parameters were presented in Appendix A3. Note that the estimates of the uniplex structural parameters change in multiplex analyses (compare with Appendix A2), suggesting that the structure of the bullying network by informant A is related to the structure of the bullying network by informant B. In the following, the uniplex structural parameters of Appendix A3 will be explained and their estimates will be discussed.

The *in-ties spread* models the spread of the distribution of the received nominations (here: incoming nominations for bullying). It was estimated significantly positive for all three informants. This implies that there was systematic variation in how frequently children were receiving nominations for bullying, with some children receiving many nominations for bullying and others none. The *shared in-ties* parameter models the tendency that multiple bullies harass the same victims. The shared in-ties parameter was positively estimated in the networks of self- and teacher-reports, whereas it was negatively estimated in the peer-reported networks, suggesting that peers report less victims of each bully than victims (through self-reports) and teachers do. Regarding uninvolved children, the parameter for *isolates* had a positive parameter estimate for all three informants (but not significantly for peer-reports), which models the tendency for a number of children to be uninvolved in bullying and victimization. The *sinks* parameter indicates the presence of children reported as bullies while not being victimized themselves. The *sinks* parameter had a positive estimate in the networks of all informants, although it was statistically significant only for teacher-reports. Finally, the *multiple two-paths* parameter was estimated positively in the teacher-reported networks, implying the presence of children who were mentioned as bullies and also mentioned as victims.

The models for each classroom (and for each informant) had the same parameter specification. For some classrooms, parameters were excluded because they could not be estimated—for example in classrooms without isolates, an *isolate* parameter estimate could not be obtained. In all models, we fixed the graph density to its observed value because this improves model convergence considerably.

The goodness of fit was assessed for all implemented graph statistics in XPNet (including the ones not directly estimated) through simulation of the networks with the estimated parameters. Not explicitly modeled statistics had acceptable goodness of fit when the deviations between observed and average simulated statistics, divided by the standard deviation of the simulated values, were less than 2 in absolute value. It appeared that the graph statistics for either informant were reasonably well estimated, with no parameters that were systematically not well estimated – with one exception: It appeared that in seven of the eighteen classrooms, the number of reciprocal nominations in the teacher-reported bullying networks were underestimated. In line with the descriptive statistics, teachers reported more reciprocal bullying than estimated with the current model specification. Other structural graph statistics as the *out-ties spread* (estimating the spread of the out-ties distribution) and sources (see the descriptive statistics in Table 4.2) were well fitted with the other parameters in the model, and therefore, they were not included in the models.

Table A1. Overview of the Uniplex Structural Parameters in the Network Models

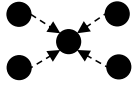


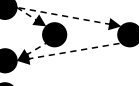
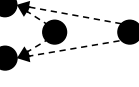
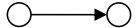




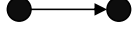
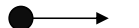
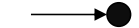
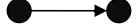
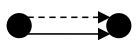




Parameter	Description	Graphical representation
<i>Degree-level parameters</i>		
In-ties spread	Spread of in-ties distribution (if positive, the distribution of received nominations is dispersed: some children receive more nominations for being a bully than others)	
Isolates	Occurrence of isolated actors (zero indegree and zero outdegree; non-involved in bullying)	
Sinks	Occurrence of children to have zero outdegree and at least one indegree (bullies)	
<i>Multiple connectivity parameters</i>		
Multiple two-paths	Tendency to have (multiple) out-ties and in-ties (bully-victims)	
Shared in-ties	In-ties-based structural equivalence (being nominated by the same children)	

**A2: Bivariate Network Analyses: Complete Tables**

Full Table 4.3, top: Bivariate Analyses of Self- and Peer-reports

Parameter	Statistic	Self-reports				Peer-reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	$\chi^2$	Est.	Std. Err.	Est.	$\chi^2$
In-ties spread		-0.04	(0.20)	0.11	18	0.46	(0.10)**	0.03	28*
Isolates		1.51	(0.57)*	0.00	10	1.04	(0.70)	0.00	5
Sinks		0.60	(0.47)	0.00	8	0.57	(0.64)	0.00	6
Multiple two-paths		0.05	(0.06)	0.04	162**	-0.17	(0.07)*	0.08	319**
Shared in-ties		0.01	(0.09)	0.07	157**	-0.51	(0.10)**	0.09	65**
<i>Dyadic covariates</i>									
Girl-girl		Ref.				Ref.			
Mixed-sex		0.14	(0.41)	1.77	55**	0.15	(0.19)	0.24	41**
Boy-boy		-0.24	(0.21)	0.08	33*	0.19	(0.21)	0.24	27†
<i>Actor covariates</i>									
INT prob.									
Sender		-0.07	(0.26)	0.02	11	0.20	(0.28)	0.09	12
Receiver		-0.48	(0.31)	0.00	7	-0.09	(0.11)	0.00	13
Abs. dif.		0.28	(0.23)	0.00	5	-0.02	(0.15)	0.00	11
EXT prob.									
Sender		-0.14	(0.20)	0.05	11	-0.04	(0.19)	0.00	4
Receiver		0.43	(0.23)*	0.02	10	0.01	(0.09)	0.00	18
Abs. dif.		0.07	(0.14)	0.00	13	-0.02	(0.15)	0.07	17
<i>Multivariate relations</i>									
Arc self-report and peer-report (Arc-AB)		1.93	(0.24)**	0.63	83**				
In-ties self-report and peer-report (In-2-star-AB)		0.22	(0.06)**	0.06	917**				
Out-ties self-report and peer-report (Out-2-star-AB)		0.11	(0.07)	0.08	467**				
In-ties self-report and out-ties peer-report (Mixed-2-star-AB)		0.23	(0.06)**	0.05	204**				
Out-ties self-report and in-ties peer-report (Mixed-2-star-BA)		0.05	(0.01)**	0.00	410**				

Full Table 4.3, middle: Bivariate Analyses of Self- and Teacher-reports

Parameter	Statistic	Self-reports				Teacher-reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	$\chi^2$	Est.	Std. Err.	Est.	$\chi^2$
In-ties spread		0.14	(0.19)	0.17	23	0.62	(0.20)**	0.28	35*
Isolates		1.42	(0.57)*	0.00	11	2.26	(0.59)**	0.00	6
Sinks		0.69	(0.47)	0.00	7	1.02	(0.49)*	0.00	5
Multiple two-paths		0.00	(0.06)	0.05	207**	0.07	(0.09)	0.11	764**
Shared in-ties		0.01	(0.09)	0.06	124**	0.13	(0.03)**	0.00	86**
<i>Dyadic covariates</i>									
Girl-girl		Ref.				Ref.			
Mixed-sex		0.03	(0.33)	0.89	42**	-1.46	(0.27)**	0.59	63**
Boy-boy		-0.06	(0.17)	0.00	21	-0.27	(0.23)	0.49	69**
<i>Actor covariates</i>									
INT prob.									
Sender		0.06	(0.32)	0.31	13	0.07	(0.23)	0.26	23
Receiver		-0.75	(0.31)*	0.00	6	0.00	(0.21)	0.20	24
Abs. dif.		0.31	(0.21)	0.00	6	0.04	(0.15)	0.00	14
EXT prob.									
Sender		-0.09	(0.20)	0.00	7	0.34	(0.13)*	0.00	8
Receiver		0.50	(0.23)*	0.00	9	0.16	(0.12)	0.00	19
Abs. dif.		-0.08	(0.21)	0.14	17	0.12	(0.11)	0.00	20
<i>Multivariate relations</i>									
Arc self-report and teacher-report (Arc-AB)		0.96	(0.14)**	0.04	18				
In-ties self-report and teach.-report (In-2-star-AB)		0.18	(0.04)**	0.02	529**				
Out-ties self-report and teacher-report (Out-2-star-AB)		0.04	(0.06)	0.06	355**				
In-ties self-report and out-ties teach.-report (Mixed-2-star-AB)		0.13	(0.07)*	0.08	392**				
Out-ties self-report and in-ties teach.-report (Mixed-2-star-BA)		0.10	(0.09)	0.12	543**				

Full Table 4.3, bottom: Bivariate Analyses of Peer- and Teacher-reports

Parameter	Statistic	Self-reports				Teacher-reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	$\chi^2$	Est.	Std. Err.	Est.	$\chi^2$
In-ties spread		0.68	(0.12)**	0.06	32*	0.69	(0.21)**	0.38	42**
Isolates		0.82	(0.66)	0.00	6	2.26	(0.57)**	0.00	4
Sinks		0.60	(0.65)	0.00	9	1.11	(0.47)*	0.00	5
Multiple two-paths		-0.10	(0.07)	0.09	370**	0.06	(0.02)**	0.00	490**
Shared in-ties		-0.29	(0.04)**	0.00	49**	0.15	(0.02)**	0.00	95**
<i>Dyadic covariates</i>									
Girl-girl		0.21	(0.20)	0.31	44**	-1.51	(0.24)**	0.50	71**
Mixed-sex									
Boy-boy		0.32	(0.25)	0.44	41**	-0.29	(0.30)	0.93	175**
<i>Actor covariates</i>									
<i>INT prob.</i>									
Sender		0.17	(0.19)	0.01	7	0.14	(0.17)	0.09	18
Receiver		-0.38	(0.14)**	0.00	13	-0.18	(0.14)	0.02	19
Abs. dif.		-0.10	(0.17)	0.06	15	-0.09	(0.15)	0.01	13
<i>EXT prob.</i>									
Sender		0.15	(0.17)	0.02	6	0.50	(0.16)**	0.06	16
Receiver		0.21	(0.10)*	0.00	19	0.20	(0.09)*	0.00	22
Abs. dif.		0.06	(0.18)	0.24	33	0.16	(0.16)	0.10	25
<i>Multivariate relations</i>									
Arc peer-report and teacher-report (Arc-AB)		0.93	(0.18)**	0.33	47**				
In-ties peer-report and teacher-report (In-2-star-AB)		0.10	(0.04)*	0.03	1041**				
Out-ties peer-report and teacher-report (Out-2-star-AB)		0.07	(0.07)	0.07	414**				
In-ties peer-report and out-ties teach.-report (Mixed-2-star-AB)		0.06	(0.06)	0.06	1281**				
Out-ties peer-report and in-ties teach.-report (Mixed-2-star-BA)		0.03	(0.06)	0.05	561**				

**A3: Full Table 4.4: Univariate Analyses with Gender and Problem Behaviors**

Parameter	Statistic	Self-reports		Peer-reports		Teacher-reports	
		Mean parameter Est.	Standard deviation $\chi^2$	Mean parameter Est.	Standard deviation $\chi^2$	Mean parameter Est.	Standard deviation $\chi^2$
In-ties spread		0.79 (0.14)**	27 <sup>†</sup>	0.91 (0.14)**	50**	1.06 (0.21)**	61**
Isolates <sup>a</sup>		1.53 (0.53)**	7	0.82 (0.65)	4	2.20 (0.54)**	4
Sinks		0.71 (0.45)	7	0.79 (0.63)	5	1.13 (0.49)*	5
Multiple two-paths		0.07 (0.05)	272**	-0.07 (0.09)	723**	0.15 (0.02)**	1199**
Shared in-ties		0.14 (0.06)*	140**	-0.34 (0.12)*	171**	0.17 (0.05)**	113**
<i>Dyadic covariates</i>							
Girl-girl		Ref.		Ref.		Ref.	
Cross-gender		0.00 (0.31)	55**	0.08 (0.21)	57**	-1.42 (0.23)**	58**
Boy-boy		0.01 (0.20)	24	0.22 (0.18)	33*	-0.23 (0.21)	72**
<i>Actor covariates</i>							
INT prob.							
Sender		0.20 (0.24)	15	0.15 (0.19)	10	0.04 (0.18)	23
Receiver		-0.55 (0.20)*	6	-0.29 (0.11)*	21	-0.13 (0.13)	21
Abs. dif.		0.22 (0.19)	7	0.07 (0.13)	15	0.05 (0.14)	14
EXT prob.							
Sender		-0.20 (0.18)	14	-0.06 (0.15)	11	0.38 (0.16)*	19
Receiver		0.56 (0.20)**	16	0.15 (0.11)	31*	0.33 (0.19) <sup>†</sup>	29*
Abs. dif.		-0.01 (0.11)	15	0.09 (0.16)	30*	0.17 (0.17)	23

Note. <sup>†</sup>  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$ . The mean parameter is an unstandardized aggregated estimate across classrooms. The standard deviation represents the degree to which estimates vary across classrooms ( $N = 18$ ).

<sup>a</sup>  $N_{\text{classrooms}}$  peer-reports = 14,  $N_{\text{classrooms}}$  teacher-reports = 16. Abs. dif. = Absolute difference score.



