Supporting Information to:

Contents

S1: Detailed information on sample, participants, and data collection

This study was part of a larger project, called *Pathways to Victimization*, aimed at investigating victimization and evaluating the effectiveness of a victimization prevention program in Swiss kindergartens (Alsaker & Valkanover, 2012). Because of the specific topic of the current study, we used only the pre-test data from before the prevention program was implemented (collected from December 2004 to January 2005) that includes information provided by children, teachers, and parents. Although attendance at kindergarten in Switzerland is voluntary, most children attend preschool education in kindergarten two years before they go to compulsory primary school, which starts after their seventh birthday. Children in kindergartens are together in stable mixed-age groups.

Kindergartens were selected using a clustered sampling design, where the initial sampling unit was the community, then the school, and finally the classroom. The communities were selected from the Canton of Bern on the basis of a series of criteria: region, size of the town, urban or rural areas, and socio-economic factors. Once communities had been chosen, school authorities were asked for permission to conduct the study in their school/kindergarten. Teachers were asked to participate and parents were asked permission for their children's participation. Following legal advice obtained by the Department of Education of the Canton of Bern, passive consent was obtained from parents.

For the present study, we used a sample for which teachers and parents filled out in-depth questionnaires. Data stemmed from 402 children in 25 kindergartens. The participation rate was high; only 2.5% of the parents refused participation for their child. Overall, the mean age in the sample was 5.8 years (SD = 0.58). For 97% of the children in the sample, age ranged between 4 years 8 months and 6 years 7 months. The remaining children (3%) were older due to delayed entry into schooling. The percentage of children whose parents had a low educational level, at maximum a certificate for primary education, was 18%. The

percentage of native Swiss children (at least one parent born in Switzerland) was 56%. The others parents came from European (23%) or African/Asian (8%) countries. Parental information was missing for 13% of the parents.

When the data were collected, it was decided to increase the quality of teacher reports by offering them a 2.5 hour workshop prior to data collection procedures. The workshop was provided to ensure that teachers all received the same information regarding definitions of peer victimization, including how persistent victim problems differ from peer conflicts in general and the varied manifestations of aggression and victimization (i.e., direct and indirect forms). Teachers were also shown a sample questionnaire and invited to ask questions about the questionnaire to ensure their understanding of the rating scale and specific items. The goal was to reduce biases across teachers in their understanding of aggression and increase uniformity of reporting on their students' victimization experiences.

S2: Internalizing and Externalizing behavior

Internalizing and externalizing behavior were derived from several subscales on externalizing (open aggression, verbal aggression, ODD) and internalizing (withdrawal, anxiety, depressive symptoms) behavior (see, e.g., Perren & Alsaker, 2006; von Gruenigen, Kochenderfer-Ladd, Perren, & Alsaker, 2012). Because the network estimations limited the number of possible effects in the models, we combined subscales into two broader scales that are commonly used (Campbell, Shaw, & Gilliom, 2000; Eisenberg et al., 2001). Confirmatory factor analysis showed that the items for internalizing and externalizing behavior loaded on one single construct (see the Tables below). Principal component analysis showed for externalizing behavior that there appeared one factor with an Eigenvalue larger than 1 that explained 45% of the variation. For internalizing behavior, also one factor appeared with an Eigenvalue larger than 1 that explained 33% of the variation.

Externalizing behavior	Factor loadings
1. He/she is physically aggressive (hits, kicks, bites).	.68
2. He/she destroys his/her own or other people's belongings.	.66
3. He/she incriminates other children.	.59
4. He/she insults other children or shouts at them.	.78
5. He/she speaks pejoratively about others	.53
6. He/she has frequent and age-inadequate temper tantrums.	.63
7. He/she is extremely defiant and disobedient	.77
8. He/she argues frequently with me/us.	.68

Internalizing behavior	Factor loadings
1. He/she worries about a lot of things	.55
2. He/she is nervous and tense	.64
3. He/she is easily irritated	.63
4. He/she is easily frightened	.55
5. He/she is anxious	.59
6. He/she is scared of (many) new situations (in kindergarten).	.44
7. He/she seems to be unhappy, saddened	.59
8. He/she speaks pejoratively about him/herself	.39
9. He/she looks a little sad	.70

S3: Detailed statistical network modeling and meta-analysis

Statistical network modeling. The observed victimization networks as reported by the different informants were analyzed using statistical network models. We used Exponential Random Graph Models (Lusher, Koskinen, & Robins, 2013; Robins, Pattison, Kalish, & Lusher, 2007), which were estimated using the program *XPNet* (Wang, Robins, & Pattison, 2009). Using ERGMs, the presence of a relation in a network is predicted from several predictor variables, for which parameters are estimated; these are specified in the model. These parameters can be specified at the dyadic (relational: between two persons), triadic (involving three persons), and higher-order (more than three persons) level. The combination of the parameters represents the dependence structure of the observed social network, and parameters can be interpreted as representing the outcome of structural processes in the network. Parameters are estimated through simulated maximum likelihood (Lusher et al., 2013)

Two networks as reported by two informants were investigated simultaneously in bivariate ERGMs (Lazega & Pattison, 1999; Robins, Pattison, & Wang, 2009) with parameters involving both networks, enabling investigation of the agreement between informants in terms of similarity in network structure and co-occurrence of observed relations. Although trivariate models involving all three informants would be relevant, examination of two different networks simultaneously is currently the maximum for the available software.

Some classrooms were excluded from the estimations because too few nominations were given in these classrooms. Classrooms were excluded if it turned out that model estimations did not converge. Practically, it means that for at least one of the networks constructed from self, peer, or teacher reports, the number of victim-aggressor nominations was below 10. This number was determined after estimations failed to converge and should

not be considered as a rule of thumb. Thus, the results can only be generalized to classrooms with a reasonable number of victim-aggressors relationships reported (in our data 10 relationships).

Meta-analyses. The results of the models for each classroom were combined in a meta-analytic procedure. First, the multiple estimations from the imputed datasets were combined as described by Rubin (1987), by taking the mean of the five estimations and obtaining the standard errors adjusted for the difference between the imputations. Next, the single adjusted estimates for each classroom were combined with a meta-analysis using the R-package metaphor (Viechtbauer, 2010). For an accessible description, see Lubbers and Snijders (2007). The estimated mean parameter represents an aggregated mean estimate across classrooms (along with a standard error), and the accompanying standard deviation represents the degree to which the true parameter (corrected for unreliability) varies across classrooms. Significant variation over the classrooms for this standard deviation was tested using a χ^2-test with the degrees of freedom equal to the number of classrooms minus 1.

S4: Structural tendencies in the victimization networks

In all estimated models (see Tables 3 and 4 of the related manuscript), univariate parameters for the networks on their own were included to capture structural effects in the victimization networks. The choice of structural parameters was based on Huitsing et al. (2012), who identified the essential network parameters to model the structure of most bullying/victimization networks. The names of the network parameters are in agreement with the literature on ERGMs (see Lusher et al., 2013; Wang et al., 2009). The univariate structural parameters are given in Table S4.1, and its estimations can be found in Appendices S5 and S6. When the estimated models also included parameters for sex and internalizing and externalizing behavior, the estimations of the structural parameters did not change substantially, which is the reason why complete uniplex models with structural and covariate parameters were presented in Appendix S7. Note that the estimates of the uniplex structural parameters change in multiplex analyses (compare the parameter estimates of Appendix S5 with Appendix S6), which is natural because of the strong dependence between the reports of informants A and B.

In the following, the structural parameters in the univariate analyses of Appendix S6 will be explained and their estimates will be discussed. These parameters are also explained in Table S4.1.

The *in-nominations spread* models the spread of the distribution of the received nominations (here: incoming nominations for being aggressive). It was estimated significantly positive for all three informants (*Parameter Estimates [P.E.s]* = 0.79, *p*<.01; 0.91, *p*<.01; 1.06, *p*<.01). This implies that there was systematic variation in how frequently children were receiving nominations for being aggressive, with some children receiving many nominations for being aggressive to others and others none. The *shared in-nominations* parameter models the tendency that multiple aggressors harass the same victims. The shared

in-nominations parameter was positively estimated in the networks of self (*P.E.* = 0.14, *p*<.05) and teacher reports (*PE* = 0.17, *p*<.05), whereas it was negatively estimated in the peer reported networks (*PE* =-0.34, *p*<.05), suggesting that peers report fewer victims of each aggressor 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: *P.E.s* = 1.53, *p*<.01; 0.82, *p*=.21; 2.20, *p*<.01), which models the tendency to be uninvolved in aggression and victimization. The parameter for *aggressors* (sinks*)* indicates the presence of children reported as aggressors while not being victimized themselves (children with only received nominations for victimizing others). The *sinks* parameter had a positive estimate in the networks of all informants, although it was statistically significant only for teacher reports (*P.E.* = 1.13, *p*<.05). Finally, the *multiple two-paths* parameter was estimated positively in the teacher-reported networks (*P.E.* = 0.15, *p*<.01), implying the presence of children who were mentioned as aggressors and also mentioned as victims.
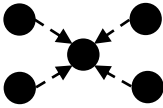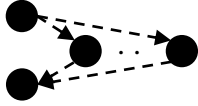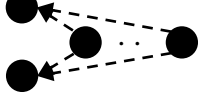
The models for each classroom (and for each informant) had the same parameter specification. For some classrooms, parameters were excluded because they could not be estimated—for example in classrooms without isolates, an *isolate* parameter estimate could not be obtained. In all models, we fixed the graph density to its observed value because this improves model convergence considerably.

Goodness of Fit

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 all informants 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 victimization networks were underestimated. In line with the descriptive statistics, teachers reported more reciprocal victimization than estimated with the current model specification. Other structural graph statistics as the *out-nominations spread* (estimating the spread of the out-nominations distribution) and *victims* (sources, see the descriptive statistics in Table 2 of the manuscript) were well fitted with the other parameters in the model, and therefore, they were not included in the models.

Table S4.1. Overview of the Uniplex Structural Parameters in the Network Models

Parameter	Description	Graphical representation
Individual-level parameters		
In-nominations spread	Spread of the distribution of the in-nominations for aggression (if positive, the distribution of received nominations is dispersed: some children receive more nominations for being aggressive than other classmates)	
Isolates	Occurrence of isolated actors (zero in-nominations and zero out-nominations; non-involved in victimization)	
Sinks	Occurrence of children to have zero out-nominations and at least one in-nomination (pure aggressors)	
Multiple connectivity parameters		
Multiple two-paths	Tendency to have (multiple) out-nominations and in-nominations (aggressive victims)	
Shared in-nominations	In-nominations-based structural equivalence (being nominated by the same children)	

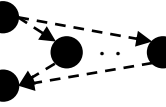**S5: Bivariate Network Analyses: Complete Tables**
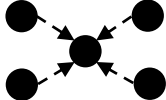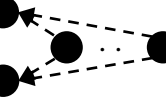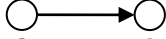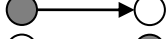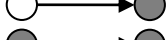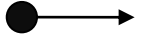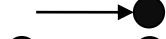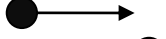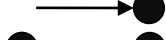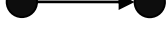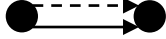
Full Table 3, top (manuscript): Bivariate Analyses of Self- and Peer reports

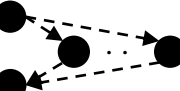| Parameter	Statistic	Self-reports				Peer reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	χ^2	Est.	Std. Err.	Est.	χ^2
In-nominations spread		-0.04	(0.20)	0.11	18	0.46	(0.10)**	0.03	28*
Isolates		1.51	(0.57)*	0.00	10	1.04	(0.70)	0.00	5
Sinks		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-nominations		0.01	(0.09)	0.07	157**	-0.51	(0.10)**	0.09	65**
Relational covariates									
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[†]
Individual covariates									
INT									
Victim		-0.07	(0.26)	0.02	11	0.20	(0.28)	0.09	12
Aggressor		-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									
Victim		-0.14	(0.20)	0.05	11	-0.04	(0.19)	0.00	4
Aggressor		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
Multivariate relations									
Self-report and peer report (Arc-AB)		1.93	(0.24)**	0.63	83**				
In-nom. self-report and peer report (In-2-star-AB)		0.22	(0.06)**	0.06	917**				
Out-nom. self-report and peer report (Out-2-star-AB)		0.11	(0.07)	0.08	467**				
In-nom. self-report and out-nom. peer report (Mixed-2-star-AB)		0.23	(0.06)**	0.05	204**				
Out-nom. self-report and in-nom. peer report (Mixed-2-star-BA)		0.05	(0.01)**	0.00	410**				
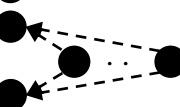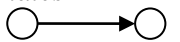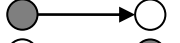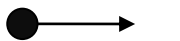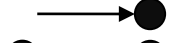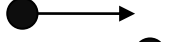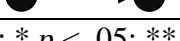
Full Table 3, middle (manuscript): Bivariate Analyses of Self- and Teacher reports

Parameter	Statistic	Self-reports				Teacher reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	χ^2	Est.	Std. Err.	Est.	χ^2
In- nominations 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-nominations		0.01	(0.09)	0.06	124**	0.13	(0.03)**	0.00	86**
Relational covariates									
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**
Individual covariates									
INT									
Victim		0.06	(0.32)	0.31	13	0.07	(0.23)	0.26	23
Aggressor		-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									
Victim		-0.09	(0.20)	0.00	7	0.34	(0.13)*	0.00	8
Aggressor		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
Multivariate relations									
Self-report and teacher report (Arc-AB)		0.96	(0.14)**	0.04	18				
In-nom. self-report and teach.-report (In-2-star-AB)		0.18	(0.04)**	0.02	529**				
Out-nom. self-report and teacher report (Out-2-star-AB)		0.04	(0.06)	0.06	355**				
In-nom. self-report and out-nom. teach.-report (Mixed-2-star-AB)		0.13	(0.07)*	0.08	392**				
Out-nom. self-report and in-nom. teach.-report (Mixed-2-star-BA)		0.10	(0.09)	0.12	543**				

Full Table 3, bottom (manuscript): Bivariate Analyses of Peer and Teacher reports

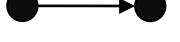| Parameter	Statistic	Peer reports				Teacher reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	χ^2	Est.	Std. Err.	Est.	χ^2
In-nominations spread		0.68	(0.12)**	0.06	32*	0.69	(0.21)**	0.38	42**
Isolates		0.82	(0.66)	0.00	6	2.26	(0.57)**	0.00	4
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-nominations		-0.29	(0.04)**	0.00	49**	0.15	(0.02)**	0.00	95**
Relational covariates									
Girl-girl									
Mixed-sex		0.21	(0.20)	0.31	44**	-1.51	(0.24)**	0.50	71**
Boy-boy		0.32	(0.25)	0.44	41**	-0.29	(0.30)	0.93	175**
Individual covariates									
INT									
Victim		0.17	(0.19)	0.01	7	0.14	(0.17)	0.09	18
Aggressor		-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
EXT									
Victim		0.15	(0.17)	0.02	6	0.50	(0.16)**	0.06	16
Aggressor		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
Multivariate relations									
Peer report and teacher report (Arc-AB)		0.93	(0.18)**	0.33	47**				
In-nom. peer report and teacher report (In-2-star-AB)		0.10	(0.04)*	0.03	1041**				
Out-nom. peer report and teacher report (Out-2-star-AB)		0.07	(0.07)	0.07	414**				
In-nom. peer report and out-nom. teach.-report (Mixed-2-star-AB)		0.06	(0.06)	0.06	1281**				
Out-nom. peer report and in-nom. teach.-report (Mixed-2-star-BA)		0.03	(0.06)	0.05	561**				

S6: Full Table 4 (manuscript): Univariate Analyses with Sex and INT and EXT Behavior

Parameter	Statistic	Self-reports				Peer reports				Teacher reports			
		Mean parameter		Standard deviation		Mean parameter		Standard deviation		Mean parameter		Standard deviation	
		Est.	Std. Err.	Est.	χ^2	Est.	Std. Err.	Est.	χ^2	Est.	Std. Err.	Est.	χ^2
In-nominations spread		0.79	(0.14)**	0.10	27†	0.91	(0.14)**	0.20	50**	1.06	(0.21)**	0.44	61**
Isolates [a]		1.53	(0.53)**	0.00	7	0.82	(0.65)	0.00	4	2.20	(0.54)**	0.00	4
Sinks		0.71	(0.45)	0.00	7	0.79	(0.63)	0.00	5	1.13	(0.49)*	0.00	5
Multiple two-paths		0.07	(0.05)	0.04	272**	-0.07	(0.09)	0.13	723**	0.15	(0.02)**	0.00	1199**
Shared in-nominations		0.14	(0.06)*	0.02	140**	-0.34	(0.12)*	0.16	171**	0.17	(0.05)**	0.02	113**
Relational covariates													
Girl-girl		Ref.				Ref.				Ref.			
Cross-sex		0.00	(0.31)	0.95	55**	0.08	(0.21)	0.44	57**	-1.42	(0.23)**	0.42	58**
Boy-boy		0.01	(0.20)	0.20	24	0.22	(0.18)	0.23	33*	-0.23	(0.21)	0.45	72**
Individual covariates													
INT													
Victim		0.20	(0.24)	0.19	15	0.15	(0.19)	0.00	10	0.04	(0.18)	0.15	23
Aggressor		-0.55	(0.20)*	0.00	6	-0.29	(0.11)*	0.05	21	-0.13	(0.13)	0.05	21
Abs. dif.		0.22	(0.19)	0.00	7	0.07	(0.13)	0.00	15	0.05	(0.14)	0.01	14
EXT													
Victim		-0.20	(0.18)	0.09	14	-0.06	(0.15)	0.00	11	0.38	(0.16)*	0.08	19
Aggressor		0.56	(0.20)**	0.10	16	0.15	(0.11)	0.09	31*	0.33	(0.19)†	0.22	29*
Abs. dif.		-0.01	(0.11)	0.00	15	0.09	(0.16)	0.16	30*	0.17	(0.17)	0.12	23

Note. † $p < .10$; * $p < .05$; ** $p < .01$. The mean parameter is an unstandardized aggregated estimate across classrooms. The standard deviation represents the degree to which estimates vary across classrooms ($N = 18$). [a] $N_{classrooms}$ peer reports = 14, $N_{classrooms}$ teacher reports = 16. Abs. dif. = Absolute difference score.

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