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# Forms and Functions of Aggression in Adolescent Friendship Selection and Influence: A Longitudinal Social Network Analysis

Jelle J. Sijtsema, *University of Groningen*, Tiina Ojanen, *University of South Florida*, René Veenstra, *University of Turku and University of Groningen*, Siegwart Lindenberg, *University of Groningen*, Patricia H. Hawley and Todd D. Little, *University of Kansas*

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## Abstract

*Aggressive children are known to have friends. However, less is known about the impact of aggression on friendship development and how this can differ for overt and relational (i.e., the forms) and instrumental and reactive (i.e., the functions) aggression. This longitudinal study utilized the forms and functions perspective on aggression to assess social selection and influence in adolescents' (N = 337, 12–14 years) friendship networks. Instrumentally and relationally aggressive peers became mutual friends with similar peers. Influence effects were observed in all types of aggression except overt aggression, suggesting that instrumental, reactive, and relational aggression may be the most susceptible to social influence. The findings are discussed in terms of theoretical and methodological implications for the study of aggression and adolescent friendships.*

*Keywords:* aggression; friendships; adolescence; social adjustment

## Introduction

As reciprocal relationships based on mutual commitment, friendships provide satisfaction for adolescents' increasing needs for intimacy (Buhrmester, 1996; Erwin, 1998) and offer unique benefits such as emotional and practical support (Newcomb & Bagwell, 1995; Stanton-Salazar & Spina, 2005). However, not all friendships may be equally adaptive. On average, friendships of aggressive children involve coercion and conflicts (see, e.g., Dishion, Andrews, & Crosby, 1995; Hawley, Little, & Card, 2007), but these relationships may also include positive characteristics like having fun (Hawley et al., 2007). In any case, matching levels of aggression between adolescent friends (Cairns, Cairns, Neckermann, Gest, & Gariépy, 1988; Dishion, Patterson, &

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Correspondence should be addressed to Jelle Sijtsema, Department of Sociology, University of Groningen, Grote Rozenstraat 31, 9712 GT Groningen, The Netherlands. Email: [j.j.sijtsema@rug.nl](mailto:j.j.sijtsema@rug.nl)

Griesler, 1994; Espelage, Holt, & Henkel, 2003; Poulin et al., 1997) and the propensity for increased aggression in the context of aggressive peers (Boivin & Vitaro, 1995; Espelage et al., 2003) suggest that aggressive adolescents make friends with other aggressive peers (i.e., selection similarity) and that their aggression may also be further increased by these relationships (i.e., social influence).

Few topics have elicited as much research interest and varying conceptualizations as childhood aggression. The heterogeneity of aggressive behaviors is well described (Heilbron & Prinstein, 2008; Little, Henrich, Jones, & Hawley, 2003b), but we still know little about how selection and influence in relation to the various facets of aggression affect the development of adolescent friendships over time (Crick, Murray-Close, Marks, & Mohajeri-Nelson, 2009). To the best of our knowledge, Poulin and Boivin (2000b) have thus far provided the only systematic assessment of selection and influence with respect to distinct aspects (instrumental and reactive) of aggression. In our longitudinal study, we utilized the forms and functions perspective on aggression (see Little et al., 2003b) to assess social selection and influence effects in adolescent friendships with respect to instrumental (or proactive), reactive, overt, and relational aggression.

### **Heterogeneity of Aggression and Adolescent Friendships**

Of the multiple conceptualizations of aggression, we consider four in this article (instrumental, reactive, overt, and relational aggression). In the cognitive-behavioral tradition (Bandura, 1973), instrumental or proactive aggression reflects learned use of aggression for obtaining self-serving outcomes at the expense of others (see Crick & Dodge, 1994). The concept of reactive aggression, in turn, has its theoretical basis in the aggression-frustration models (Berkowitz, 1962; Dollard, Doob, Miller, Mowrer, & Sears, 1939) where aggression is viewed in terms of defensive and angry reactions to perceived provocation.

Although both may co-occur, instrumental and reactive aggression are differentially related to social adjustment (see e.g., Card & Little, 2006). Whereas instrumental aggression is related to perceived self-efficacy, positive outcome expectations for aggression, and increased likelihood of overt delinquency over time (Boldizar, Perry, & Perry, 1989; Vitaro, Brendgen, & Tremblay, 2002), reactive aggression is characterized by hostile attribution bias, difficulties in emotion regulation, and internalizing symptoms like depression (for a review, see Crick & Dodge, 1994). Furthermore, although peer rejection typically accompanies both instrumental and reactive aggression, instrumental aggression is also related to perceived sense of humor, leadership, and popularity in terms of a reputational status in the peer group (e.g., Dodge & Coie, 1987). Reactive aggression, however, is primarily related to rejection and victimization by peers (Poulin & Boivin, 1999; Schwartz et al., 1998).

The differential effects of instrumental and reactive aggression on social adjustment imply that these behaviors are also likely to be differentially related to friendship development. Existing data indicate that instrumentally, but not reactively, aggressive boys spend time with other aggressive persons (Poulin & Boivin, 2000b; Poulin et al., 1997). These findings suggest that instrumental aggression is likely to be associated with making friends with similarly aggressive peers (i.e., selection similarity; see also Urberg, Degirmencioglu, & Tolson, 1998). Furthermore, the behavioral modeling view of aggression (Bandura, 1973) suggests that instrumental aggression is also likely to be influenced by existing relationships. Processes like social learning via behavioral

modeling and associating positive outcomes via aggressive behaviors (see Boldizar et al., 1989) are likely to allow for and increase the display of aggression in close relationships like friendships. Moreover, like school bullying (which is often a form of instrumental use of aggression) is related to social norms in the class room (see Sentse, Scholte, Salmivalli, & Voeten, 2007). Shared norms and values in friendships are likely to maintain or even increase instrumental aggression in friendship relationships.

However, the above processes are not likely to be involved in reactive aggression, consisting of more unpredictable and hostile outbursts of aggression. Therefore, reactive aggression is unlikely to be related to friendship selection or influence in the traditional sense. Though it may have implications for other features of friendship selection. For instance, given its systematic relations with rejection and victimization by peers (Card & Little, 2006; Poulin & Boivin, 2000a), reactively aggressive youth are likely to be unattractive as friends. For the same reason, their attempts to make friends may not be reciprocated by others, increasing the likelihood of unidirectional friendship nominations made by reactively aggressive youths.

Although instrumental and reactive aggression are widely studied and differential relations with social adjustment have been found, they are also highly correlated (across 36 studies a sample-weighted average correlation of .68 was found; see Card & Little, 2006). Although individual children may exhibit both types of aggression, the high correlation between instrumental and reactive aggression variables raises questions about the distinctiveness of these constructs. Furthermore, a growing line of research suggests that in addition to instrumental and reactive aggression, the concepts of overt (direct) and relational (indirect) aggression are also fruitful in the study of child and adolescent aggression (for a meta-analysis, see Card, Stucky, Sawalani, & Little, 2008). In the following, we will introduce the forms and functions approach to aggression that enables us to overcome some assessment-related concerns in instrumental and reactive aggression and examine instrumental, reactive, overt, and relational aggression in a coherent conceptual and data analytic system.

### **The Forms and Functions Measurement System**

In the forms and functions measurement system, instrumental and reactive aggression are viewed as two primary functions (i.e., motives) underlying observed aggressive behaviors. This view is based on decades of theoretical and empirical work suggesting that instrumental and reactive aggression are thought to emanate from distinct psychological processes: whereas instrumental aggression encompasses strategic use of aggression for obtaining personally relevant goals at the expense of others, reactive aggression describes emotionally laden responses to perceived provocation.

In addition to underlying reasons, aggressive behaviors also differ in their observed behavioral form. Specifically, aggression can take on overt (i.e., direct and visible verbal or physical aggression) or social-relational (i.e., indirect manipulation of social relationships) forms (see, e.g., Crick & Grotpeter, 1995; Heilbron & Prinstein, 2008). Using socially manipulative and strategic behavior, relationally aggressive adolescents are among the most influential and powerful members of their peer group (see Heilbron & Prinstein, 2008). However, relationally aggressive children also report loneliness, depression, and high levels of conflict and jealousy in their relationships with best friends (Grotpeter & Crick, 1996), suggesting that like overt aggression, relational aggression can have detrimental effects for close relationships like friendships.

Although the pure forms of aggressive acts may be directly assessed with questionnaire items (e.g., *'I'm the kind of person who fights with others'*), instrumental and reactive functions of aggression cannot be measured without also describing the context of an aggressive act (i.e., a form of aggression). For example, *'To get what I want, I hit and kick others'* includes the instrumental function *'To get what I want'* in combination with an overt form of aggression *'I hit and kick others'*. The functions of aggression can be statistically separated from the forms, however (see the Method section; Little et al., 2003b).

Existing research indicates that the forms and functions of aggression are related to social adjustment as expected. For instance, the instrumental function is positively related to perceived negative influence and social competence, unrelated to hostility, and negatively related to victimization whereas the reactive function is positively related to hostility and frustration intolerance (Little et al., 2003b). Pure overt and relational forms of aggression are also somewhat differently related to adjustment. Only overt aggression is positively related to peer-reported antisocial behaviors and frustration intolerance, whereas only relational aggression is positively related to self-reported victimization (see Little et al., 2003b). Furthermore, in addition to previous findings in middle childhood and early adolescence, recent findings indicate that the forms and functions analytic system of aggression is also fruitful in the study of social adjustment in early childhood (see Murray-Close & Ostrov, 2009).

Like instrumental and reactive aggression, overt and relational forms of aggression may also have unique relations with friendship development. Although both are related to perceived reputational popularity in the peer group, they are also related to low genuine likability by peers (peer rejection) and unlikely to be attractive for friendship (Dijkstra, Lindenberg, & Veenstra, 2007; Hawley, 2003; Newcomb, Bukowski, & Pattee, 1993). Although adolescents who are genuinely liked by peers are mostly prosocial and non-aggressive (Newcomb et al., 1993), adolescents who are perceived to be popular and 'cool' or who hold a central position in peer networks are often aggressive (Prinstein & Cillessen, 2003; Xie, Cairns, & Cairns, 1999). These characteristics imply that aggression may in fact attract friendship nominations from others during early adolescence, where concerns for social status peak. This pattern may apply more to overt than relational aggression. Although relational aggression is related to social prominence at the peer-group level (Heilbron & Prinstein, 2008), its relations with depression and jealousy in friendships (Crick & Grotpeter, 1995) suggest that the scheming and manipulative nature of relational aggression may make it less likely to attract desires for close relationships like friendships.

Research in behavioral genetic designs indicates that relational forms of aggression are affected by the unique environmental effects (e.g., children's peer relationships) whereas the environmental effects on physical aggression mostly come from the family context (i.e., shared environment; see Brendgen et al., 2005). This pattern suggests that social influence effects are more likely in social-relational forms of aggression and less likely in overt aggression, at least when overt aggression includes physical acts of aggression (as in the present study).

## **Present Study**

In this study, we utilized longitudinal social network analysis to examine the effects of instrumental, reactive, overt, and relational aggression on friendship selection and

influence. Although selection and influence processes in development have long been recognized, only recently has careful statistical assessment of these effects been emphasized (see, e.g., Boivin, Vitaro, & Poulin, 2005; Steglich, Snijders, & Pearson, in press). In actor-oriented social network analysis, selection and influence effects are assessed based on participants' unidirectional nominations (e.g., adolescents' friendship nominations) to other participants in a meaningful social context such as schools or grade level where individuals have repeated interactions with each other. Such contexts provide the possibility to assess parameters related to (1) the development of the network themselves (e.g., reciprocity of the nominations on average); (2) friendship selection that may be predicted by individual-level characteristics such as aggression; and (3) social influence that is reflected in the changes of individual-level characteristics like aggression based on the changes in friendship nominations (influence from both uni- and bidirectional relationships may be estimated).

Based on existing theoretical and empirical accounts, we expected that instrumental but not reactive aggression would be associated with making friends with equally aggressive peers (selection similarity). Given that reactive aggression is consistently related to rejection and victimization by peers (Poulin & Boivin, 1999; Schwartz et al., 1998), we also expected that reactive aggression would predict a high number of unidirectional friendship nominations, without these being reciprocated by others. Instrumental and reactive aggression were also expected to differ with respect to social influence. Based on theoretical views on instrumental aggression and observed linkages among social norms and bullying aggression (which is instrumental by nature; see Sentse et al., 2007), we expected to observe social influence effects on instrumental aggression. However, such social processes are unlikely to influence unpredictable and hostile reactive aggression, which was therefore not expected to be influenced by existing friendship relations.

To our knowledge, prior research has not examined friendship selection and influence processes in pure overt and relational aggression. However, based on the generally observed similarity in aggression between friends (see for a recent review, Crick et al., 2009), both relational and overt aggression may be expected to predict *making* friends with equally aggressive peers (i.e., selection similarity). This may be due to either active selection of equally aggressive friends or because aggressive peers may affiliate with each other due to a lack of available non-aggressive friends (i.e., default selection; Hektner, August, & Realmuto, 2000). Furthermore, we expected to observe social influence effects, especially in relation to the relational form of aggression. Unique environmental effects on social aggression in behavioral genetic studies (i.e., see Brendgen et al., 2005) suggest that relational aggression, rather than overt aggression, is likely to be subjected to social influence effects in friendships.

## **Method**

### *Participants*

Data were initially collected in grades six through nine of a medium-sized urban, residential, and commercial community in the North East of the USA (see Walls & Little, 2005) and was representative of this ethnically and socioeconomically diverse district (64 percent European Americans, 17 percent African Americans, 6 percent Hispanic, and 13 percent Other). For this study, we used the data collected in the sixth grade.

Informed parental consent and child assent yielded a participation rate of 80 percent; (N = 337, 48.7 percent girls; 12–14 years of age). The data were collected in three measurement occasions with six-month measurement intervals (fall of the sixth grade, spring of the sixth grade, and fall of the seventh grade). The overall rate of missing data over time was 4.01 percent and was imputed by utilizing the Markov Chain Monte Carlo (MCMC) algorithm in the SAS Proc MI procedure (SAS Institute).

### *Measures*

*Friendship Networks.* Adolescents were asked to nominate up to 18 friends in their school and grade levels. Each school had one to three classes with the number of participants in the networks varying between 21 and 59 depending on the number of classes that participated in the data collection at each school. By the third measurement occasion, the participants moved to a larger middle school in the area. However, the network composition remained the same across the measurement occasions (i.e., the data included nominations among the adolescents that were already indicated from the first measurement occasion).

Data matrices consisting of dichotomous, unidirectional friendship relations (nominations) were constructed for each network: the nomination was either present (rated 1) or absent (rated 0). The degree of reciprocity in these nominations was estimated in the networks on average (reflected in reciprocity as a network characteristic) as well as with respect to the specific aggression variables.

*Previous Acquaintance.* In the questionnaire where adolescents nominated friends in school, they were also asked to report whether the relationship was more than six months long. For this dichotomous 'previous acquaintance' variable the value 0 indicates that the duration was less than six months or that there was no friendship present at all. To control for the potentially confounding effects of the preexisting friendships to the selection and influence parameters, this variable was used in the analysis as a network covariate (reflecting information about the ties in the networks). Because relationships like friendships among the participants (actors in the networks) exist also prior to the arbitrary first assessment point, effects such as social influence effects would likely be inflated without this statistical control.

*Aggression Variables.* Instrumental, reactive, overt, and relational aggression were all assessed with the forms and functions of aggression questionnaire by Little et al. (2003b). In this analysis system, instrumental and reactive aggression represent the underlying functions (motives) of aggressive behaviors whereas overt and relational aggression reflect the observed behavioral forms of aggression. Items for overt aggression ( $\alpha = .79$ ) described direct/visible verbal or physical aggression (e.g., 'I'm the kind of person who hits and kicks others'). Items for relational aggression ( $\alpha = .62$ ) describe indirect/socially manipulative forms of aggression (e.g., 'I'm the kind of person who spreads rumors about others' and 'I'm the kind of person who tells someone I'm not their friend anymore').

Overt and relational aggression were assessed with items that are unidimensional in their construction (i.e., they measure the pure form variance only). Instrumental and reactive functions of aggression, on the other hand, were assessed in the context of the form of aggression and therefore contain two sources of variance per item (i.e., each item contains form variance and function variance). An example of an instrumental

relational item is 'To get what I want, I spread rumors about others'. To separate the variance due to the functions underlying each item, one conducts a series of regression analyses among the variables. For example, an instrumental-relational item is regressed on to the pure relational aggression scale and the residual information is saved. This procedure teases apart the information due to the functions and removes their shared variance with the forms of aggression. As detailed by Little, Brauner, Jones, Nock, and Hawley (2003a), each composite item (e.g., an instrumental-overt aggression item such as 'I often start fights to get what I want') is regressed on the pure form scale score. The residuals from these regressions are averaged to produce a scale reflecting the pure instrumental function of aggression. This new scale score represents individual differences in the underlying function of aggression (see Little et al., 2003a, for details).

For the estimation of the social influence part in the longitudinal analyses, we recoded the aggression scores into positive, absolute values, ranging from 1 to 10. This is needed because the Siena program cannot estimate social influence when the outcome variable (in this case aggressive behavior) contains decimals or is negative.

### *Analysis Strategy*

Friendship selection and influence processes were assessed with the Siena 3.1 module of the StOCNET 1.8 program package (freely downloadable at [stat.gamma.rug.nl/stocnet](http://stat.gamma.rug.nl/stocnet); see also Boer, Huisman, Snijders, Wichers, & Zeggelink, 2007), which was developed for longitudinal social network analysis. We utilized the meta-analytic procedure for actor-based network-behavioral models as used by Snijders and Baerveldt (2003). The multilevel procedure consists of two general steps. Firstly, network behavioral models are separately estimated for each network. Each model is identically specified to simultaneously estimate the relative contributions of homophilic selection and social influence on aggressive behavior (separately for forms and functions), while controlling for various network, interpersonal, and individual effects. Specifically, each model includes parameters representing structural network effects (i.e., density, reciprocity, transitivity, and three cycles; see the Appendix for an explanation of these effects), homophilic selection effects based on gender, aggression, previous acquaintance, individual aggression trajectories, and influence effects relating to aggressive behavior. The second step consists of a meta-analysis of the parameter estimates across school grades and testing the mean and variance of parameter values between school grades to identify whether each parameter demonstrates a main effect across school grades (by tests of the mean parameter) and whether they significantly differ between school grades (by tests of the variance).

Firstly, we performed an initial test of transitivity to make sure our friendship networks adhered to the expected structure of friendship networks (i.e., positive reciprocity and transitivity; these models are not reported here). Secondly, we tested the effects for selection and influence *simultaneously* across the three data waves. Preliminary analyses indicated that the observed network, selection, and influence effects did not differ between the two measurement intervals; therefore we reported parameter estimates observed across the entire 12-month assessment period (i.e., reflecting the original T1, T2, and T3 measurements) in this article. Aggression was added to the model as an individual-level characteristic to estimate its effect on the activity of making friendship nominations, desirability as a friend (receiving nominations), and similarity in mutual friendship selection, and as a behavioral outcome. In the latter case, the network structure was used to predict changes in aggression over time.

To estimate the parameters in the selection part of the analysis, the program first calculates the changes between the measurement occasions and the rate parameters (i.e., the average number of change opportunities per period). The socialization part of the analysis follows a similar procedure, but the rate parameters now indicate the average change in aggressive behavior. Model parameters are then estimated given the model specifications described above. The estimation process uses an iterative stochastic approximation (MCMC) algorithm (for details of Siena estimation, see Snijders, Steglich, & Schweinberger, 2007). Effect sizes for the parameter estimates were calculated based on the density parameter in the selection analyses and based on the tendency parameter in the socialization analysis by taking the natural logarithm of the odds ratio divided by 1.81 (see Chinn, 2000).

## Results

### *Descriptive Statistics*

Friendship network composition by gender, along with the number of ties, density, and percentage of reciprocal dyads in each network in the three data waves, are reported in Table 1. As can be seen here, most networks were equally split by gender and the density of the networks seemed to decrease over time. That is, fewer nominations were made over time. Furthermore, means and standard deviations of the aggression variables as observed in each network at the three measurement occasions are reported in Table 2. Mean levels of the forms and functions of aggression were fairly equal across the networks.

### *Instrumental and Reactive Aggression: Friendship Selection and Influence*

Multilevel network effects, along with selection and influence effects for the instrumental and reactive functions of aggression, are reported in Table 3. As reflected in the negative density effect, the networks became less dense over time. That is, adolescents were less inclined to *just* nominate classmates as friends. Instead, they favored friendships that were mutual (positive reciprocity effect) and they preferred being friends with the friends of their friends (transitivity). Note that school grades differed significantly from each other in the level of transitivity, as indicated by the variance estimates. The negative three-cycle effect indicates that friendship triplets were characterized by a hierarchy and not by generalized reciprocity; some adolescents were more popular friends than others within the triplet. Further, we controlled for the general received and given nominations of adolescents in the network (as indicated by the activity and popularity of alter effects).

Previous acquaintance and gender similarity were also included in the models. As reflected in the positive previous acquaintance effect, friendship selection over time was more likely when adolescents had already been friends by the first measurement occasion. Moreover, the positive gender similarity effect indicates that adolescents were more likely to nominate friends of the same gender.

Also shown in Table 3, instrumental aggression had a positive rate effect, suggesting that instrumentally aggressive adolescents had more opportunities for changing their ties (i.e., dropping, creating, *or* maintaining ties). Furthermore, a positive interaction effect between selection similarity and reciprocity parameter indicates that instrumentally aggressive adolescents were likely to become mutual friends with other instrumentally aggressive peers. There was no selection effect from reactive aggression.



**Table 1. Gender Composition, Number of Ties, Density, and Percentage of Reciprocal Dyads per School Grade Network in the Three Waves of Data**

Network	Sex		T1		T2		T3					
	N	Boys	Girls	Reciprocal dyads (percent)		Reciprocal dyads (percent)		Reciprocal dyads (percent)				
				Number of ties	Density	Number of ties	Density	Number of ties	Density			
1	21	12	9	125	.30	45.34	96	.23	37.14	54	.13	28.57
2	30	15	15	210	.24	40.94	227	.26	36.75	108	.12	24.14
3	50	32	18	339	.14	28.90	280	.11	28.44	159	.07	31.40
4	59	25	34	462	.14	35.88	437	.13	28.53	207	.06	26.99
5	36	20	16	209	.17	33.12	186	.15	25.68	107	.09	28.92
6	38	17	21	276	.20	44.50	249	.18	39.11	135	.10	42.11
7	47	21	26	387	.18	42.80	416	.19	43.94	283	.13	43.65
8	56	31	25	439	.14	45.18	378	.12	38.97	229	.07	36.31
Total	337	173	164									

**Table 2. Network Composition by Gender, along with the Means and Standard Deviations (SDs) of Aggression in Each Network in the Three Waves of Data**

Network	N		T1				T2				T3															
	Sex		Overt aggression		Relational aggression		Instrumental aggression		Reactive aggression		Overt aggression		Relational aggression		Instrumental aggression		Reactive aggression									
	Boys	Girls	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD								
1	21	12	1.33	(.53)	1.36	(.49)	-.02	(.17)	.06	(.47)	1.43	(.55)	1.30	(.31)	-.06	(.20)	-.02	(.30)	1.23	(.27)	1.23	(.27)	-.02	(.18)	-.05	(.33)
2	30	15	1.22	(.29)	1.30	(.28)	-.06	(.15)	-.02	(.33)	1.67	(.20)	1.28	(.33)	.00	(.13)	.05	(.33)	1.13	(.23)	1.13	(.22)	.00	(.19)	.02	(.37)
3	50	32	1.29	(.47)	1.31	(.50)	.01	(.23)	.07	(.47)	1.21	(.36)	1.21	(.33)	.03	(.13)	.15	(.34)	1.18	(.22)	1.15	(.17)	.00	(.12)	.12	(.51)
4	59	25	1.29	(.39)	1.34	(.35)	.00	(.24)	-.02	(.45)	1.28	(.46)	1.33	(.40)	-.08	(.18)	.03	(.37)	1.28	(.30)	1.32	(.37)	-.01	(.17)	-.02	(.40)
5	36	20	1.21	(.34)	1.30	(.40)	-.04	(.19)	.07	(.46)	1.43	(.56)	1.49	(.41)	-.07	(.29)	.11	(.43)	1.29	(.30)	1.30	(.37)	.02	(.18)	.14	(.47)
6	38	17	1.35	(.61)	1.54	(.66)	-.10	(.34)	-.10	(.34)	1.25	(.42)	1.34	(.43)	.03	(.13)	.03	(.19)	1.17	(.20)	1.17	(.22)	-.03	(.25)	.06	(.35)
7	47	21	1.19	(.42)	1.22	(.35)	-.01	(.21)	-.05	(.30)	1.32	(.47)	1.30	(.29)	-.03	(.13)	.01	(.29)	1.18	(.26)	1.20	(.24)	.01	(.16)	-.05	(.31)
8	56	31	1.30	(.42)	1.31	(.37)	-.01	(.17)	-.11	(.28)	1.21	(.36)	1.26	(.31)	-.02	(.10)	-.06	(.24)	1.14	(.26)	1.15	(.23)	.01	(.16)	-.01	(.26)
Total	337	173																								

**Table 3. Friendship Selection and Influence: Multilevel Estimates per Functions of Aggression**

	N	M (SE)	Effect size	Variance	$\chi^2$	df <sup>a</sup>
<i>Network effects</i>						
Density	337	-1.83 (.05)**	—	.0162	5.48	7
Reciprocity	337	1.23 (.06)**	.68	.0270	6.34	7
Transitivity	337	.18 (.01)**	.10	.0019	14.88*	7
3-cycles	337	-.24 (.03)**	-.13	.0056	3.72	7
Activity alter	337	-2.88 (.70)**	-1.59	2.3764	2.52	7
Popularity alter	337	.92 (.39)*	.51	.7885	2.89	7
Previous acquaintance	337	.55 (.05)**	.30	.0299	6.50	7
Gender similarity between actors	337	.28 (.05)**	.15	.0206	10.18	7
<i>Instrumental aggression</i>						
Selection effects on friendship						
Rate effect	290	1.21 (.34)	—	.7961	3.08	6
Nominations received	337	-.01 (.09)	-.01	.0430	2.82	7
Nominations given	337	-.12 (.08)	-.07	.0930	13.67	7
Similarity between actors × reciprocity	337	.52 (.23)*	.29	.6333	7.01	7
Influence effects of friendship						
Tendency	337	-.00 (.05)	—	.0050	1.11	7
Quadratic tendency	337	-.17 (.05)**	—	.0230	6.08	7
Similarity × reciprocity	198	5.20 (2.57)*	2.87	26.6203	5.15	3
<i>Reactive aggression</i>						
Selection effects on friendship						
Rate effect	337	-.07 (.13)	—	.2181	6.86	7
Nominations received	337	.03 (.05)	.02	.0128	5.19	7
Nominations given	337	.02 (.06)	.01	.0473	9.71	7
Similarity between actors × reciprocity	337	-.09 (.20)	-.05	.5035	7.11	7
Influence Effects of Friendship						
Tendency	337	.03 (.04)	—	.0050	1.83	7
Quadratic tendency	337	-.02 (.02)	—	.0079	6.34	7
Similarity × reciprocity	248	3.15 (1.25)*	1.74	5.1629	2.55	4

\*  $p < .05$ , \*\*  $p < .01$ ; two-tailed tests.

<sup>a</sup> In some networks some parameters could not be analyzed in the meta-analysis due to large standard errors ( $SE > 5.0$ ).

Regarding social influence effects, there was a negative quadratic tendency toward instrumental aggression. That is, highly aggressive adolescents tended to decrease their instrumental aggression over time. Interactive effects between similarity and reciprocity parameters indicated that both instrumental and reactive aggression were adopted from mutual friends. Contrary to our expectations, influence effects were observed not only for instrumental but also for reactive aggression.

### *Overt and Relational Aggression: Friendship Selection and Influence*

Table 4 shows selection and influence effects with respect to the overt and relational forms of aggression. The structural network effects for this model are also reported here but are not discussed because these are practically equivalent to the effects obtained in the previous model (as the analyses are based on the same networks). There were no selection effects regarding overt aggression. Furthermore, the positive rate effect for relational aggression indicates that relationally aggressive adolescents also had increased opportunities for changing their ties in the networks. A marginal interactive effect between selection similarity and reciprocity indicated that relational aggression was to some extent associated with making friends with equally relationally aggressive peers. From the social influence part of the analysis we see that both overt and relational aggression followed a positive quadratic tendency, implying that those who were high on overt or relational aggression had a tendency to increase this form of aggression over time. Social influence effects were observed as expected. Specifically, relational aggression increased based on social influence in reciprocated friendships (interactive effect between similarity and reciprocity parameter) whereas there was no influence effect for overt aggression.

## **Discussion**

The aim of the present study was to examine selection and influence effects in adolescent friendships with respect to specific aspects of aggression as defined in the forms and functions measurement system (Little et al., 2003b). Longitudinal social network modeling indicated that instrumental, reactive, overt, and relational aggression had unique and meaningful effects on friendship selection and influence during early adolescence, mostly in line with our expectations.

Relationally aggressive adolescents selected similar friends, and relational aggression was adopted from friends. This pattern provides evidence for a unique relationship between friendship and relationally aggressive behavior during adolescence regardless of the reactive and instrumental functions of relational aggression. However, overt forms of aggression appeared to be unrelated to similarity in friendship selection and influence. Although social influence and selection effects for overt forms of aggression have been found elsewhere (see Boivin & Vitro, 1995; Cairns et al., 1988), our findings suggest that when assessed as a pure overt behavioral form (separated from relational aggression or the underlying functions of aggression), overt aggression may no longer be subjected to similarity in friendship selection or social influence in existing relationships.

Our findings on the instrumental and reactive functions of aggression were in line with the following hypotheses: adolescents selected friends based on similar levels of instrumental aggression, but there was no selection similarity based on reactive aggression. These results are in accordance with Poulin et al. (1997) and Poulin and Boivin

**Table 4. Friendship Selection and Influence: Multilevel Estimates per Forms of Aggression**

	N	M (SE)	Effect size	Variance	$\chi^2$	df <sup>a</sup>
<i>Network effects</i>						
Density	337	-1.80 (.05)**	—	.0179	7.17	7
Reciprocity	337	1.19 (.07)**	.66	.0263	2.63	7
Transitivity	337	.17 (.01)**	.09	.0020	16.04*	7
3-cycles	337	-.21 (.03)**	-.12	.0085	5.47	7
Activity alter	271	-2.79 (.68)**	-1.54	1.3426	1.88	5
Popularity alter	301	.44 (.44)	.24	.7992	3.49	6
Previous acquaintance	337	.53 (.05)**	.29	.0222	3.29	7
Gender similarity between actors	337	.26 (.04)**	.14	.0261	7.98	7
<i>Overt aggression</i>						
Selection effects on friendship						
Rate effect	337	-.06 (.03)	—	.0342	10.26	7
Nominations received	337	.01 (.01)	.01	.0027	3.69	7
Nominations given	337	-.01 (.02)	-.01	.0015	3.86	7
Similarity between actors × reciprocity	301	-.19 (.22)	-.10	.7094	6.48	6
Influence effects of friendship						
Tendency	337	-.06 (.06)	—	.0459	9.88	7
Quadratic tendency	337	.07 (.02)**	—	.0052	6.06	7
Similarity × reciprocity	136	2.28 (1.76)	1.26	1.0342	2.38	2
<i>Relational aggression</i>						
Selection effects on friendship						
Rate effect	337	.08 (.03)	—	.0268	5.22	7
Nominations received	337	.02 (.01)	.01	.0010	2.58	7
Nominations given	337	.01 (.01)	.01	.0021	3.39	7
Similarity between actors × reciprocity	301	.45 (.24) <sup>†</sup>	.25	.1368	2.05	6
Influence effects of friendship						
Tendency	337	-.01 (.04)	—	.0212	13.89	7
Quadratic tendency	337	.04 (.01)**	—	.0018	6.69	7
Similarity × reciprocity	307	5.78 (1.40)**	3.19	17.2025	4.99	7

<sup>†</sup>  $p < .10$ , \*  $p < .05$ , \*\*  $p < .01$ ; two-tailed tests.

<sup>a</sup> In some networks some parameters could not be analyzed in the meta-analysis due to large standard errors ( $SE > 5.0$ ).

(2000b), who found that only instrumentally or proactively aggressive boys spent time and made friends with other aggressive boys. However, contrary to our hypotheses, reactive aggression did not predict unpopularity as a friend. This suggests that although reactive aggression is consistently related to rejection by peers at the peer-group level (Poulin & Boivin, 1999; Schwartz et al., 1998), this pattern of rejection may not translate into the formation of close relationships like friendships.

As expected, instrumental but not reactive aggression was adopted from mutual friends. That is, adolescents who had instrumentally aggressive friends became more instrumentally aggressive over time. This influence effect is in accordance with the behavioral modeling view of aggression (Bandura, 1973), which argues that due to the positive outcome expectations for aggressive behaviors, adolescents reinforce each other's aggression and thus may further adopt such behaviors from their friends. To our knowledge, the present findings are the first to specify a friendship influence effect on instrumental aggression. In fact, our findings contradict those of Poulin and Boivin (2000b), who found no influence effects for instrumental (proactive) aggression.

Methodological issues may account for the above discrepancy. Firstly, Poulin and Boivin (2000b) did not analyze selection and influence simultaneously and may thus have underestimated the influence effects. Secondly, our measures of aggression differed substantially (i.e., we assessed the *functions* of aggression separately) from those used by Poulin and Boivin (2000b). It is also plausible that teacher reports used in the previous study did not adequately capture all aggressive behaviors among the children—strategic use of aggression may often take place between the children without the teachers' knowledge. Thirdly, the sample used by Poulin and Boivin (2000b) consisted of younger children (fourth to sixth grade). As aggressive children are likely to selectively associate with other deviant peers and influence effects may take place later on (Patterson, Reid, & Dishion, 1992), influence effects in aggression may not be observable until the adolescent years. Steinberg and Monahan (2007) also showed that susceptibility to peer influence follows an inverted U shape, with a peak around the age of 14. Given the age of our participants (12–14 years), it may thus not be surprising that influence effects were strong. It should be noted that evidence for influence was found although we controlled for structural network effects and gender similarity—without such statistical controls, what appears to be influence may sometimes be explained by factors like same-gender affiliation.

However, contrary to our expectations, reactive aggression was also adopted from mutual friends. Given the overall maladaptive adjustment patterns related to reactive aggression (e.g., rejection and victimization by peers) and the unlikely role of socially shared norms and values in maintaining and reinforcing reactive aggression, this effect was unexpected. The effects size for the influence effect on reactive aggression was smaller than that observed for instrumental aggression, but nonetheless, this effect was positive and significant. One explanation for this effect may be a methodological one: when reactive aggression is measured as an underlying function (motivation) for observed behaviors, it may in fact be subjected to social influence effects. It may also be that reactive aggression may sometimes lead to positive outcomes (i.e., fighting off a bully may lead to a decrease in victimization), and partly similar underlying psychological processes may account for its social transmission as observed in instrumental aggression. However, this issue needs to be clearly examined more in depth in future research.

Although the effects observed for overt and relational forms of aggression were mostly in line with our hypotheses, one contrasting finding was observed: overt

aggression was not subjected to selection similarity. As reasoned by the 'default selection' hypothesis (Hektner et al., 2000), we would have expected that overtly aggressive adolescents would flock together because they are likely unpopular as friends. As hypothesized, we found no social influence effects for overt aggression. In adolescence, aggressive behaviors thus become more covert (i.e., relational) and less overt (i.e., physical and observable; Hawley, 2003). Similar findings have recently been encountered already in early childhood where older children ( $M$  age = 45.09 months) were less likely than their younger peers to display overt aggression whereas no age differences in the levels of relational, instrumental, and reactive aggression were encountered (Murray-Close & Ostrov, 2009). This finding and the current study suggest that overt forms become less adaptive over time and thus decrease in frequency whereas covert forms remain stable or increase.

To our knowledge, the present study provides the first longitudinal evidence on the associations between relational aggression and adolescent friendship development (see Heilbron & Prinstein, 2008). A marginally significant trend suggested a weak selection similarity for relational aggression, and clearly significant influence effects indicated that relational aggression was further adopted from mutual friends. These findings extend and complement the findings of a longitudinal study on relational aggression (Burr, Ostrov, Jansen, Cullerton-Sen, & Crick, 2005) where the number of mutual friendships of girls predicted relational aggression in early childhood one year later. In addition, Heilbron and Prinstein stated that social aggression serves as a means to maintain and establish friendship in later childhood as well, suggesting that more subtle forms of aggression are adaptive in general.

The present study has some limitations as well. Firstly, our friendship nominations were limited to the school grade. Although adolescent peer relations are mostly captured by the school grade, about 35 percent of the relations are situated outside school (Smith & Inder, 1990). Given that the outside school context is largely unsupervised and thus may elicit higher rates (and perhaps more severe forms) of aggression, our study left out a small but plausibly influential aspect of friendships that influences the development of adolescent aggression. The findings of Kiesner and Pastore (2005) indicated that antisocial behaviors may be more accepted outside than inside of school. Secondly, at least at this time, the Siena software does not allow for assessing the quality of friendship relations. That is, friendship relations may vary in strength, ranging from a friendly to a best friend relationship. In the present study, we were not able to examine the selection and influence effects on aggression with respect to the quality of the network relationships. As adolescents were simply asked to nominate their friends, it is possible that these nominations captured especially their best friends with whom they are likely to have close interactions with. This may partly explain the observed, relatively strong influence (and to some extent selection) effects, which may not have been as visible in weaker friendship affiliations.

In the future, it would be worthwhile to examine whether the functions of aggression maintain the behavioral forms, or perhaps vice versa. Furthermore, it has been suggested that overt aggression may develop into relational forms rather than vice versa (see Heilbron & Prinstein, 2008). In the present study, we neither found selection similarity nor social influence for overt aggression. This suggests that a declining trend in the overt forms of aggression during early adolescence may be related to its socially less rewarding role in friendship development; these effects were not observed for relational aggression.

Examining whether the adoption of aggressive behaviors is linked to other measures of social status is warranted. Given that popular or 'cool' peers display more aggressive behavior (Prinstein & Cillessen, 2003; Xie et al., 1999), these adolescents may also function as a role model for non-befriended peers to increase their own social status (i.e., 'basking in reflected glory'; Dijkstra, Cillessen, Lindenberg, & Veenstra, in press). In relation to our study, this process implies that friends not only influence each other's aggressive behavior but that popular or 'visible' peers can also exert a certain influence on adolescents who want to fit in or be regarded as popular.

Notwithstanding the limitations, the present findings are the first to explicate longitudinal social selection and influence processes in adolescent friendships with respect to the heterogeneity of adolescent aggression. The forms and functions measurement system utilized here has also theoretical implications. For instance, the forms and functions of aggression were differentially and meaningfully related to friendship selection and influence, showing some effects which might have been confounded in existing studies due to the intertwined nature of the assessed variables. Furthermore, the current application of social network analysis enabled us to control for structural network effects in adolescent friendships (e.g., reciprocity, transitivity) and to distinguish between the co-occurring social selection and influence processes (Burk, Steglich, & Snijders, 2007; Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010), which is appropriately done only via the simultaneous assessment of these processes. Furthermore, the inclusion of the previous acquaintance variable in the models enabled an accurate estimation of social influence effects (which may be inflated without such statistical control), and the meta-analysis approach to assessment allowed us to control for potential variance differences in the assessed friendship relations and aggression variables between the individual networks.

The effect sizes obtained in the present study were larger for influence than selection effects. This overall pattern of findings suggests that instrumental, reactive, and relational aggression were more likely to be adopted from friends rather than used as a selection criterion for these relationships. However, our findings also suggest, especially in the case of instrumental and (to some extent) relational aggression, that adolescents both select their friends on the basis of similarity and *reinforce* each other's aggressive behaviors within friendships. Such a vicious cycle is likely to lead to more severe forms and higher frequencies of instrumentally and relationally aggressive behaviors over time.

## References

- Bandura, A. (1973). *Aggression: A social learning analysis*. Englewood Cliffs, NJ: Prentice-Hall.
- Berkowitz, D. (1962). *Aggression: A social psychological analysis*. New York: McGraw-Hill.
- Boer, P., Huisman, M., Snijders, T. A. B., Wichers, L. H. Y., & Zeggelink, E. P. H. (2007). *StOCNET: An open software system for the advanced statistical Analysis of social networks (version 1.8)* [computer software]. Groningen: ICS/Science Plus.
- Boivin, M., & Vitaro, F. (1995). The impact of peer relationships on aggression in childhood: Inhibition through coercion and or promotion through peer support. In J. M. Cord (Ed.), *Coercion and punishment in long-term perspectives* (pp. 183–197). New York: Cambridge University Press.
- Boivin, M., Vitaro, F., & Poulin, F. (2005). Peer relationships and the development of aggressive behavior in early childhood. In R.E. Tremblay, W. Hartup, & J. Archer (Eds.), *Developmental origins of aggression* (pp. 183–197). New York and London: The Guilford Press.



- Boldizar, J. P., Perry, D. G., & Perry, L. C. (1989). Outcome values and aggression. *Child Development, 60*, 571–579.
- Brendgen, M., Dionne, G., Girard, A., Boivin, M., Vitaro, F., & Perusse, D. (2005). Examining genetic and environmental effects on social aggression: A study of 6-year-old twins. *Child Development, 76*, 930–946.
- Buhrmester, D. (1996). Need fulfillment, interpersonal competence, and the developmental contexts of early adolescent friendship. In W. Bukowski, A. Newcomb, & W. Hartup (Eds.), *The company they keep. Friendship in childhood and adolescence* (pp. 158–185). New York: Cambridge.
- Burk, W. J., Steglich, C. E. G., & Snijders, T. A. B. (2007). Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development, 31*, 397–404.
- Burr, J. E., Ostrov, J. M., Jansen, E. A., Cullerton-Sen, C., & Crick, N. R. (2005). Relational aggression and friendship during early childhood: 'I won't be your friend!' *Early Education and Development, 16*, 161–183.
- Cairns, R. B., Cairns, B. D., Neckermann, H. J., Gest, S. D., & Gariépy, J. L. (1988). Social networks and aggressive-behavior—Peer support or peer rejection. *Developmental Psychology, 24*, 815–823.
- Card, N. A., & Little, T. D. (2006). Proactive and reactive aggression in childhood and adolescence: A meta-analysis of differential relations with psychosocial adjustment. *International Journal of Behavioral Development, 30*, 466–480.
- Card, N. A., Stucky, B. D., Sawalani, G. M., & Little, T. D. (2008). Direct and indirect aggression during childhood and adolescence: A meta-analytic review of gender differences, intercorrelations, and relations to maladjustment. *Child Development, 79*, 1185–1229.
- Chinn, S. (2000). A simple method for converting an odds ratio to effect size for us in meta-analysis. *Statistics in Medicine, 19*, 3127–3131.
- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social-adjustment. *Psychological Bulletin, 115*, 74–101.
- Crick, N. R., & Grotpeter, J. K. (1995). Relational aggression, gender, and social-psychological adjustment. *Child Development, 66*, 710–722.
- Crick, N. R., Murray-Close, D., Marks, P. E. L., & Mohajeri-Nelson, N. (2009). Aggression and peer relationships in school-age children. In K.H. Rubin, W. Bukowski, & B. Laursen (Eds.), *Handbook of peer interactions, relationships, and groups* (pp. 287–302). New York and London: The Guilford Press.
- Dijkstra, J. K., Cillessen, A. H., Lindenberg, S., & Veenstra, R. (in press). Basking in reflected glory and its limits: Why adolescents hang out with popular peers. *Journal of Research on Adolescence*.
- Dijkstra, J. K., Lindenberg, S., & Veenstra, R. (2007). Same-gender and cross-gender peer acceptance and peer rejection and their relation to bullying and helping among preadolescents. *Developmental Psychology, 43*, 1377–1389.
- Dishion, T. J., Andrews, D. W., & Crosby, L. (1995). Antisocial boys and their friends in early adolescence—Relationship characteristics, quality, and interactional process. *Child Development, 66*, 139–151.
- Dishion, T. J., Patterson, G., & Griesler, P. (1994). Peer adaptations in the development of antisocial behavior: A confluence model. In R. Huesmann (Ed.), *Aggressive behavior: Current perspectives* (pp. 61–95). New York: Plenum.
- Dodge, K. A., & Coie, J. D. (1987). Social-information-processing factors in reactive and proactive aggression in children's peer groups. *Journal of Personality and Social Psychology, 53*, 1146–1158.
- Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression*. New Haven, CT: Yale University Press.
- Erwin, P. (1998). *Friendship in childhood and adolescence*. New York: Routledge.
- Espelage, D. L., Holt, M. K., & Henkel, R. R. (2003). Examination of peer-group contextual effects on aggression during early adolescence. *Child Development, 74*, 205–220.
- Grotpeter, J. K., & Crick, N. R. (1996). Relational aggression, overt aggression, and friendship. *Child Development, 67*, 2328–2338.
- Hawley, P. H. (2003). Prosocial and coercive configurations of resource control in early adolescence: A case for the well-adapted Machiavellian. *Merrill-Palmer Quarterly, 49*, 279–309.

- Hawley, P. H., Little, T. D., & Card, N. A. (2007). The allure of a mean friend: Relationship quality and processes of aggressive adolescents with prosocial skills. *International Journal of Behavioral Development, 31*, 170–180.
- Heilbron, N., & Prinstein, M. (2008). A review and reconceptualization of social aggression: adaptive and maladaptive correlates. *Clinical Child and Family Psychology Review, 11*, 176–217.
- Hektner, J. M., August, G. J., & Realmuto, G. M. (2000). Patterns of temporal changes in peer affiliation among aggressive and nonaggressive children participating in a summer school program. *Journal of Clinical Child Psychology, 29*, 603–614.
- Kiesner, J., & Pastore, M. (2005). Differences in the relations between antisocial behavior and peer acceptance across contexts and across adolescence. *Child Development, 76*, 1278–1293.
- Knecht, A., Snijders, T. A. B., Baerveldt, C., Steglich, C., & Raub, W. (2010). Friendship and delinquency: Selection and influence processes in early adolescence. *Social Development*. doi: 10.1111/j.1467-9507.2009.00564.x.
- Little, T. D., Brauner, J., Jones, S. M., Nock, M. K., & Hawley, P. H. (2003a). Rethinking aggression: A typological examination of the functions of aggression. *Merrill-Palmer Quarterly, 49*, 343–369.
- Little, T. D., Henrich, C. C., Jones, S. M., & Hawley, P. H. (2003b). Disentangling the ‘whys’ from the ‘whats’ of aggressive behaviour. *International Journal of Behavioral Development, 27*, 122–133.
- Murray-Close, D., & Ostrov, J. M. (2009). A longitudinal study of forms and functions of aggressive behavior in early childhood. *Child Development, 80*, 828–842.
- Newcomb, A. F., & Bagwell, C. L. (1995). Children’s friendship relations: A meta-analytic review. *Psychological Bulletin, 117*, 306–347.
- Newcomb, A. F., Bukowski, W. M., & Pattee, L. (1993). Children’s peer relations—a metaanalytic review of popular, rejected, neglected, controversial, and average sociometric status. *Psychological Bulletin, 113*, 99–128.
- Patterson, G. R., Reid, J. B., & Dishion, T. J. (1992). *Antisocial boys: A social interactional approach*. Eugene, OR: Castalia Publishing Company.
- Poulin, F., & Boivin, M. (1999). Proactive and reactive aggression and boys’ friendship quality in mainstream classrooms. *Journal of Emotional and Behavioral Disorders, 7*, 168–177.
- Poulin, F., & Boivin, M. (2000a). Reactive and proactive aggression: Evidence of a two-factor model. *Psychological Assessment, 12*, 115–122.
- Poulin, F., & Boivin, M. (2000b). The role of proactive and reactive aggression in the formation and development of boys’ friendships. *Developmental Psychology, 36*, 233–240.
- Poulin, F., Cillessen, A. H. N., Hubbard, J. A., Coie, J. D., Dodge, K. A., & Schwartz, D. (1997). Children’s friends and behavioral similarity in two social contexts. *Social Development, 6*, 224–236.
- Prinstein, M. J., & Cillessen, A. H. N. (2003). Forms and functions of adolescent peer aggression associated with high levels of peer status. *Merrill-Palmer Quarterly, 49*, 310–342.
- Schwartz, D., Dodge, K. A., Coie, J. D., Hubbard, J. A., Cillessen, A. H., Lemerise, E. A., et al. (1998). Social-cognitive and behavioral correlates of aggression and victimization in boys’ play groups. *Journal of Abnormal Child Psychology, 26*, 431–440.
- Sentse, M., Scholte, R., Salmivalli, C., & Voeten, M. (2007). Person-group dissimilarity in involvement in bullying and its relation with social status. *Journal of Abnormal Child Psychology, 35*, 1009–1019.
- Smith, A. B., & Inder, P. M. (1990). The relationship of classroom organisation to cross-age and cross-sex friendships. *Educational Psychology, 10*, 127–140.
- Snijders, T. A. B., & Baerveldt, C. (2003). A multilevel network study of the effects of delinquent behavior on friendship evolution. *Journal of Mathematical Sociology, 27*, 123–151.
- Snijders, T. A. B., Steglich, C., & Schweinberger, M. (2007). Modeling the co-evolution of networks and behavior. In K. Van Montfort, H. Oud, & A. Satorra (Eds.), *Longitudinal models in the behavioral and related sciences* (pp. 41–71). Mahwah, NJ: Lawrence Erlbaum.
- Stanton-Salazar, R. D., & Spina, S. U. (2005). Adolescent peer networks as a context for social and emotional support. *Youth & Society, 36*, 379–417.

Steglich, C., Snijders, T. A. B., & Pearson, M. (in press). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*.

Steinberg, L., & Monahan, K. C. (2007). Age differences to resistance to peer influence. *Developmental Psychology, 43*, 1531–1543.

Urberg, K. A., Degirmencioglu, S. M., & Tolson, J. M. (1998). Adolescent friendship selection and termination: The role of similarity. *Journal of Social and Personal Relationships, 15*, 703–710.



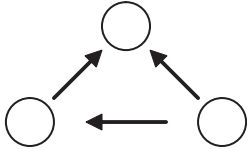
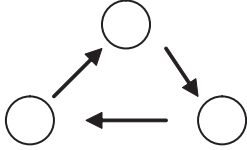
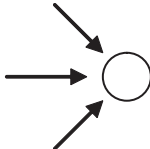
Vitaro, F., Brendgen, M., & Tremblay, R. E. (2002). Reactively and proactively aggressive children: Antecedent and subsequent characteristics. *Journal of Child Psychology and Psychiatry, 43*, 495–505.

Walls, T. A., & Little, T. D. (2005). Relations among personal agency, motivation, and school adjustment in early adolescence. *Journal of Educational Psychology, 97*, 23–31.

Xie, H. L., Cairns, R. B., & Cairns, B. D. (1999). Social networks and configurations in inner-city schools: Aggression, popularity, and implications for students with EBD. *Journal of Emotional and Behavioral Disorders, 7*, 147–155.

### Appendix

#### Explanation of the network effects

Effect	Explanation	Graphical presentation
Density	Preference for ties to arbitrary others, reflects the denseness of a network (positive value = increasing likelihood for ties over time; negative value = decreasing likelihood of ties over time).	
Reciprocity	Preference for mutual ties.	
Transitivity	Preference for ties with the friends of your friends. Provides a measure for network closure.	
3-Cycles	Negative values denote preference for hierarchical ties in the networks. Positive values indicate generalized reciprocity.	
Rate	Basic parameter indicating the number of opportunities to make changes.	
Popularity alter	General number of received nominations by other actors.	

**Appendix Continued**

<i>Effect</i>	Explanation	Graphical presentation
Activity alter	General number of given nominations by other actors.	
<i>Selection effects</i>		
Nominations Received (popularity)	Preferences for nominating actors who have high or low values on a certain individual characteristic (also ‘in degree’)	
Nominations Given (activity)	Activity in nominating actors, based on certain individual characteristics (also called ‘out degree’)	
Similarity	Preferences for unilateral ties with similar others (i.e., actors that have similar values on a certain individual level covariate).	
Similarity × reciprocity	Preferences for mutual ties with similar others (i.e., actors that have similar values on a certain individual level covariate).	
<i>Influence effects</i>		
Tendency	Linear tendency to have high values on a certain behavior. Negative values indicate a tendency to report low scores on behavior. Positive values indicate a tendency to report high scores on behavior.	
Quadratic tendency	Models deviations from the linear tendency, as can be seen in U-shaped or reverse U-shaped distributions of behavior	
Similarity	Socialization effect of certain characteristics. Measures if behavioral scores are increased or decreased based on unilateral ties.	
Similarity × reciprocity	Socialization effect of certain characteristics. Measures if behavioral scores are increased or decreased based on mutual ties.	