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Selection patterns, gender and friendship aim in classroom networks

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Abstract The social networks of students, and the underlying processes of selection, can have strong effects on their psychological and academic adjustment. The effects of gender, friendship aim (intimacy or social activities) and the combination of gender and friendship aim on selection patterns (student's activity in selecting new friends, linking with friends of friends, and similarity in behavior) were studied, using two wave data from 741 students (12–14 years old) in 27 freshmen classes in Dutch high schools.

Many students did not fit the gender-typical expectations regarding friendship aim (girls preferring intimacy and boys social activities). In most classes, girls who preferred intimacy, and boys who preferred social activity, were more active in engaging in new friendships than the other girls and boys. Girls who preferred intimacy more often befriended classmates who were similar in school behaviors, whereas boys who preferred social activities more often befriended dissimilar classmates. We discuss these findings with regard to their implications for academic adjustment in terms of academic performance and wellbeing.

Keywords Gender · Friendship · Social networks · Selection · School

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Selektionsprozesse, Geschlecht und Freundschaftsziele in sozialen Netzwerken von Schülerinnen und Schülern

Zusammenfassung Soziale Netzwerke von Schülerinnen und Schülern (SuS) und die zugrundeliegenden Selektionsprozesse können starke Effekte auf psychische und akademische Anpassung haben. Die Effekte von Geschlecht, Freundschaftszielen (Intimität vs. Soziale Aktivitäten) sowie der kombinierten Wirkung beider auf Selektionsmuster (Aktivität von SuS in der Selektion neuer Freunde, der Verbindung mit Freunden von Freunden und Ähnlichkeit im Verhalten) wurden anhand der Daten von 741 12–14jährigen SuS in 27 Schulklassen niederländischer Oberschulen untersucht.

Die Freundschaftsziele zahlreicher SuS entsprachen nicht stereotypen Erwartungen (Bevorzugung von Intimität durch Mädchen und Bevorzugung sozialer Aktivitäten durch Jungen). In den meisten Klassen waren Mädchen, die Intimität bevorzugten und Jungen, die soziale Aktivität bevorzugten, aktiver in Bezug auf das Knüpfen neuer Freundschaften als andere Mädchen und Jungen. Mädchen, die Intimität bevorzugten befreundeten sich häufiger mit Klassenkamerad/inn/en, die ähnlich in Bezug auf schulbezogene Aktivitäten waren. Jungen, die soziale Aktivitäten bevorzugten, befreundeten sich häufiger mit Klassenkamerad/inn/en, die unähnlich waren. Wir diskutieren die Befunde in Bezug auf ihre Implikationen für Leistungen und Wohlbefinden im schulischen Kontext.

Schlüsselwörter Geschlecht · Freundschaft · Soziale Netzwerke · Selektion · Schule

Research on children's friendships stresses the significance of friendship in childhood and adolescence, during which they acquire important skills, attitudes and experiences that may influence their psychological and academic adjustment and professional perspectives. For example, youth who lack friends or are poorly accepted by the peer group are at risk for negative outcomes, whereas positive outcomes are often associated with affectionate peer relations (Bukowski 2001; Hartup 1996; Hartup and Stevens 1997; Nangle and Erdley 2001).

Friendship networks are not stable over time but change as children develop and enter different situations or contexts (Rubin et al. 2006). In (pre-)adolescence, friendship networks become even more important as youth spend more time with peers than during childhood and peers gradually take over some parental support roles. Moreover, when children leave primary school and enter high school, they usually have to form new friendships (Hardy et al. 2002). Consequently, the friendship selection processes in the first years of high school can be a decisive factor for their future wellbeing and education. However, knowledge of friendship selection processes is limited (Baerveldt et al. 2010).

Research indicates that boys' and girls' social networks differ. In particular, girls' networks in (pre-)adolescence are usually smaller, denser and closer than boys' networks (Benenson et al. 1997). While much is known about such outcomes of social network development, little is known about the selection processes that underlie

those outcomes. Therefore, we investigated the effect of gender and friendship aim on the selection patterns of high school students in their first years at high school, and formulated three research questions. Our *first research question* was to determine on a more broad level whether and how selection patterns differ between boys and girls in terms of activitiy level, linking (i.e., befriending friends of friends), and looking for deep similarity.

Studies on the beneficial effects of friendship are based on claims about the putative provisions of this relationship (Rubin et al. 2006). Friendship is supposed to be an important source of affection, intimacy, reliable alliance, feelings of inclusion, instrumental aid, nurturance, companionship, and enhancement of self-worth (Erdley et al. 2001; Hartup and Stevens 1997; Newcomb and Bagwell 1995). Adolescents, however, may differ in what they want from friends. A notable distinction pertains to a preference for intimacy versus doing things together (Buhrmester 1996) Adolescents' friendship selection may thus be guided by what they want from friends. Our *second research question* therefore is "what is the effect of friendship aim (preference for intimacy vs. preference for collective activity) on friendship selection patterns after the transition to high school?"

Several studies indicate that gender and friendship aim may be related. That is, girls usually prefer intimacy, whereas boys often aim for collective activities with friends (e.g., Buhrmester 1996). Hence, boys' and girls' friendship selection patterns can be expected to differ as a function of friendship aim, e.g., the degree to which boys and girls intend to become member of a friendship group. However, girls' and boy's actual friendship aims may deviate from such gender typical aims (Palmen et al. 2006), which would reduce the differences between their selection patterns. Accordingly, our *third research question* was whether differences in selection patterns would be even more pronounced among those boys and girls who show gender-typical friendship aims: i.e., boys who aim for collective activities and girls who aim for intimacy. So, this study focused on gender and differences in friendship aim (intimacy vs. social activities), and the combination of the two, as potential explanation of network changes.

1 Selection patterns

Traditionally, social network studies examine features (e.g., transitivity, similarity) that apply to the whole network and its members. In social network research patterns are typically tested as a set of general rules or a general network theory (Wasserman and Faust 1994). When different patterns are tested simultaneously, the objective is generally to test which patterns are strongest over all network members. Differences between individuals are usually ignored. To fill this gap, Baerveldt et al. (2010) translated network level processes (e.g., transitivity) into the individual level. They suggested a framework to systematically investigate three salient selection patterns for students in classroom networks. The first regards the student's *activity level* in selecting new friends. On the network level, change rates are usually rather straightforward indicators of the average activity level in a network. An example is the number of changes in a network in a certain period, compared to the density of the network.

However, such network measures are unsuitable to test individual differences. Therefore, Baerveldt et al. (2010) proposed to assess the changes in the students' *personal* networks, in particular the number of new friendships emerging in a certain period.

The second pattern, labeled *linking*, pertains to befriending the friends of friends. This dimension refers to the well-known balance processes in networks (based on Heider's (1958) cognitive dissonance theory (see also Holland and Leinhardt 1971; Newcomb 1961). The theory assumes that individuals aim for consistency or balance in their pattern of relationships. When considering friendship, one of the effects is that many students are predicted to link friends of friends (i.e., transitivity). Baerveldt et al. (2010) suggest that this tendency is not equally strong for all students.

The third selection pattern refers to *similarity* between the student and her/his classmates. Similarity (homophily) can refer to all kinds of personal characteristics, behaviors, attitudes, and identities (cf. Rubin et al. 2006). The core idea is that students befriend each other more when they have more in common (see McPherson et al. 2001, for an overview). Following De Klepper et al. (2010), we take into account the visibility of the similarity. The general idea is that non-visible similarity matters more when students have grown to know each other better, whereas visible similarity will be relied on when such knowledge is (yet) scarce. We refer to this as deep versus superficial similarity.[1] Understanding selection patterns is important for educational science because the resulting informal group processes may interfere with students' academic achievement and wellbeing.

2 Gender, friendship aim and selection patterns

There is a large body of knowledge about gender differences in friendships en social networks (for overviews see Geary et al. 2003, and Rose and Rudolph 2006). First of all, girls are mainly befriended with girls and boys with boys (Rubin et al. 2006). As mentioned before, it has been frequently found that girls tend to interact in small groups, whereas boys tend to interact in larger groups (e.g., Benenson et al. 1997). In addition, play in boy's groups is marked by rough-and-tumble play, competition, attempts to establish dominant relationships, and constructive interaction styles, whereas girls prefer a quieter, more equitable manner and show cooperative interactions and enabling interaction styles (e.g., Buhrmester 1996). Also, girls' social-cognitive style is characterized by stronger interpersonal engagement than that of boys, including empathy (e.g., van der Graaff et al. 2014; Wölfer et al. 2012), which may be traced back on girls' higher social integration and understanding (Wölfer et al. 2012). These differences could make girls more vulnerable to friendship stress and interpersonal conflict (e.g., Benenson and Christakos 2003).

Many authors suggest that gender differences in friendship selection may be traced back on underlying variables such as activity similarity and toy preference similarity

[1] Non-visible similarity is quite similar to deep similarity. However, De Klepper et al. (2010) focused on the level of military discipline which really is nonvisible. We, however, examine visible behaviors. These behaviors are not easy to recognize immediately, but need some attention; the word *deep* instead of *non-visible* does more justice to this characteristic.

(Martin et al. 2013). In the present study we focused on adolescents' friendship aim as a potential explanation for gender differences in selection patterns. When students, regardless whether they are boys or girls, aim for intimacy, they may be expected to opt for a small number of friends they can trust, whereas students, who aim for collective activities may be expected to opt for a larger number of friends to get engaged in social activities. In new and still developing networks, as in our case, the probability that some friends do not meet expectations regarding intimacy and trust may be rather large, and as a result, the *activity level* of students will be higher. This means that these students will change potential friendships more often (that is, to initiate *and* to dissolve) to "discover" the right person to be friends with.

Also, when the quality (more intimacy, more trust, etc.) of a single friendship is more important, students can be expected to make more use of information they have about friendship candidates. They usually expect that friendships with certain candidates will be more successful, when the candidates have more in common with the student, in particular salient predictors such as similar school behavior and social norms. So, if one favors intimacy over social companionship, *deep similarity* can thus act as a significant failsafe for new friendships.

The possible effects of friendship aim on *linking* are less clear. On the one hand boys *and* girls who aim for intimacy may be more prone to follow a linking pattern because network closure (a result of linking) might help to keep the other's behavior in line, but on the other hand these students may follow less linking patterns because their networks are already closed and linking is not possible anymore.

As mentioned earlier, boys and girls may differ in friendships aims which may affect their selection patterns. Zarbatany et al. (2004) distinguish between two groups of friendship aims or needs, that is, communal needs (i.e., needs for interpersonal closeness, such as intimacy and acceptance) and agentic needs (i.e., needs for individuation, such as network access and admiration). They found that twelve-year-old girls expressed higher communal friendship need than boys, whereas boys expressed higher agentic need. Since the study of selection patterns is new, there is only some indirect and meager empirical support for gender differences in selection patterns. For instance, in their review Geary et al. (2003) conclude that friendships of girls are less stable (i.e., indicate a higher *activity level*), but this effect is not always found (e.g., Lubbers et al. 2010). With respect to *similarity* it has been found, that girls show a broader web of similarities than boys (Cairns et al. 1998). Finally, gender effects regarding *linking* are even less evident (see an extensive network study of Lubbers et al. (2010)).

Gender differences in friendship aims or needs should not be exaggerated, however, and common portrayals of male and female friendships as different "worlds" or "cultures" seem not justified (Wright 1998). Actually, many boys value communal aims and many girls express agentic needs (Palmen et al. 2006; Zarbatany et al. 2004). Therefore the present study focused not only on gender or friendship aim (intimacy vs. social activities) as potential explanation of network changes, but also on the combination of gender and friendship aim (i.e., boys who prefer social activities, boys who prefer intimacy, girls who prefer intimacy, and girls who prefer social activities).

In sum, we studied friendship selection patterns in high school classes as a function of gender, friendship aim, and the combination of gender and friendship aim. We expected that possible gender differences in selection patterns would be stronger when "girlish" girls (i.e., preferring intimacy) are compared to "boyish" boys (i.e., aiming for collective activities).

3 Method

3.1 Sample

Participants were 741 students aged 12–14 years from 27 classes of four secondary schools in four Dutch towns. An internet questionnaire was used. All students of a class filled in the questionnaire at the same time, the process being supervised by teachers who were instructed to respect privacy and to prevent contact between the students. The first questionnaire was administered two to three weeks after school started (September 2007), the second in the fourth month (January 2008). 721 students filled in the first questionnaire; 706 filled in the 2nd; 691 students filled in both. On average, one case per class was missing. Since the class sizes ranged between 19 and 31, this is agreeable for network data.

3.2 Measures

Information about *friendships* was collected by means of a nomination procedure. Students were asked to indicate their best friends in class. Each student received a code list for fellow students in the same class, so that he or she could answer the questions using the appropriate codes. Students could nominate to a maximum of 12 classmates. The method has been tested in pilot studies and was proven useful in the Netherlands since the late 80s (Baerveldt and Snijders 1994).

We measured *friendship aim* with a dichotomous item: "What is most important for you in friendships?". The item had exclusive answering categories: (1) "Being able to share secrets" or (2) "being able to do something together". A pilot study in a freshmen class on the lowest educational level demonstrated that students understood the question well and probably had no inclination to give socially desirable answers. The item correlated strongly ($r=0.46$) with a reliable one-dimensional (Cronbach's $\alpha=0.84$; highest Eigenvalue is 3.11, the rest below 1) five item scale indicating different motives for friendship.

Based on gender and friendship aim, a three category attribute was constructed: boys who prefer social activities above intimacy, girls who prefer intimacy above social activities, and a reference category combining girls who prefer social activities and boys who prefer intimacy. This variable is not an interaction effect in a traditional statistical sense. It follows our theoretical argument that gender, friendship aim, and a combination of the two, provide three different perspectives on friendship development.

Activity level was measured by the number of changes in the network; also called the rate of change. *Linking* was operationalized as a combination of three effects,

namely a transitive ties effect, a transitive triplet effect, and a 3-cycle effect. In general, this combination measures the tendency to befriend one's friends' friends. The transitive ties effect assumes that only one intermediary is sufficient for transitive closure, whereas the transitive triplet effect assumes that each extra intermediary adds proportionally to the tendency towards transitive closure. Finally, the 3-cycle effect measures the tendency to build triads were friendship nominations are not reciprocated (so the triad makes a "cycle"). If transitive closure is the driving force, the 3-cycle effect should be negative, while the other two should be positive.

In order to assess *deep similarity*, all students were asked to rate to what degree they have shown ten school behaviors over the last three months on a five point scale (ranging from *not at all* to a *definite yes*). Since the items construct a cumulative scale, a Mokken analysis was carried out. The scalability is expressed in Loevingers H (Mokken 1997; Sijtsma and Molenaar 2002). In general, H coefficients of 0.4, and 0.5 are considered, 'good', and 'very good', respectively. In order to find the most reliable scale, the answers were dichotomized (category 1 to 3 versus category 4 and 5). The analysis resulted in two scales: the first scale included four items regarding school behavior, that is, homework, being on time in class, working hard and paying attention, whereas the second scale included the remaining six behaviors, referred to as deviant behavior, which ranged from smoking to fighting and drug use. The H coefficients were 0.44 and 0.67, respectively.

4 Results

4.1 Descriptive results

Boys and girls were evenly distributed across the sample (50.2% girls). Only one class included 26.1% boys. All other classes were less skewed. Friendship aim showed a somewhat different pattern. On average 41.3% attached more importance to sharing secrets than sharing social activities. In one class only 23.1% preferred sharing secrets while in another class this was 57.7%. All remaining classes were in between. The association between gender and friendship aim was moderate (phi = 0.35; $p < 0.001$), indicating that boys more often report a preference for social activities. On class level the association was statistically significant in 16 out of 27 classes (4 classes at the 10%-level, 7 at the 5%-level and 5 at 1%-level). Most girls (59.3%) favored intimacy over social activities (and 40.7% vice versa), whereas most boys (75.6%) preferred social activities over intimacy (24.4% vice versa) showing that boys, more than girls, behaved according to their stereotype, but at the same time quite a lot (boys and girls) did not.

4.2 RSiena results

To analyze the data RSiena (built under R version 2.13.2) was used, a statistical tool for the analysis of longitudinal social network data. These models are especially designed to model network dynamics, taking into account the network structure (i.e., endogenous mechanisms, including the tendency towards reciprocal transitive

networks controlling for known indegree and outdegree[2] related network effects), individual attributes and dyadic co-variates (i.e. exogenous mechanisms such as the preference for similar others). The modeling itself is based on computer simulation: Theoretically founded mechanisms regarding friendship formation are used to simulate the process to come from one *observed* network structure to a second *observed* network structure at a subsequent time point. The model is guided by theories about how actors change their outgoing ties (as discussed in the theory section). Technically, these theories lead to so-called objective functions which determine probabilistically the making, maintaining or dissolving of ties (friendships in our case). Snijders et al. (2010) discuss extensively the basic model assumptions, data requirements, the explication of the most often used objective functions (as ours), and model selection on the one hand, and provide detailed examples of how to interpret the estimated parameters. We used the Method of Moments to estimate the parameters per class, whereas in the meta-analysis, the mean parameters were estimated based on maximum likelihood (see Ripley et al. 2013).

The density of the networks ranged between 0.07 and 0.34. On average the density was 0.02 higher at time point 2. The Jaccard index was used to determine whether enough change has been observed to model network dynamics over time (Snijders et al. 2010). All but four classes showed reasonable variation over time to assure that the chance process is gradual; one class was removed from the analysis because of a lack of change, whereas the other three were removed because of too many tie changes given the interval between the two observation points. The four classes that were removed from the meta-analysis did not differ from the remaining 23 classes in class size (except for one which was much smaller), proportion of boys, and proportion of pupils who preferred sharing secrets over sharing social activities.

Tables 1 and 3 present the results obtained from SIENA analyses. The tables present the average effects and their respective standard errors. The ratio between the two follows a *t*-distribution. The *t*-statistic tests whether the mean effect is zero (the *t*-value itself is not given).

Table 1 presents the main effects of network structure on the development of friendships. Model 1 only includes structural parameters. The estimated rate of change (an indicator of the activity level) is 9.45 ($p<0.001$) (and more or less constant around 9.5 ($p<0.001$) in all models in Table 1), which means that on average students made more than nine network changes (i.e., either making a move, or withdrawing a friendship choice) between the first and second measurement point. The density effect is only included to control for the density of the observed network at the second moment of time, and is of no substantial interest. Since degree-related effects are assumed to be the potential driving forces in network dynamics (either as a structural alternative for actor covariate effects or triad level effects), they are advised to be part of all models as control mechanisms (see Snijders et al. 2010[3]). They are significant and negative showing that students with a high outdegree (i.e. nominating

[2] Indegree and outdegree equal the number of incoming and outgoing friendship choices, respectively. The two are often referred to as popularity and expansiveness of a person, respectively.

[3] The in(out)degree popularity/activity effects have been shown to be best captured by the square root specification, implying that the effects are not linear.

Table 1 Selection patterns in 23 classes in Dutch secondary schools. Results of dynamic network analysis using RSiena[a]

	Model 1 structure		Model 2a gender		Model 2b friendship aim		Model 2c gender by friendship aim	
	μ	*s.e.*	μ	*s.e.*	μ	*s.e.*	μ	*s.e.*
Density	−0.68**	0.21	−0.96***	0.24	−0.62***	0.23	−0.85***	0.20
Reciprocity	1.63***	0.08	1.62***	0.09	1.66***	0.09	1.68***	0.09
Indegree popularity (sqrt)	−0.18*	0.08	−0.23***	0.08	−0.30***	0.08	−0.32**	0.09
Outdegree popularity (sqrt)	−0.54***	0.08	−0.49***	0.09	−0.55***	0.09	−0.52***	0.09
Outdegree activity (sqrt)	−0.18***	0.05	−0.15***	0.04	−0.18***	0.04	−0.16***	0.04
Transitive ties	0.81***	0.10	0.78***	0.11	0.97***	0.12	0.85***	0.12
Transitive triplets	0.37***	0.03	0.37***	0.02	0.40***	0.02	0.40***	0.02
3-cycles	−0.21***	0.04	−0.25***	0.04	−0.25***	0.04	−0.25***	0.04
Similar (school) behavior			0.18*	0.08	0.23**	0.08	0.22**	0.08
Similar (deviant) behavior			0.17*	0.09	0.15*	0.08	0.18*	0.09
Gender (girl) ego			−0.07	0.07				
Gender (girl) alter			−0.01	0.06				
Same gender			0.37***	0.08				
Friendship aim (intimacy) ego					−0.05	0.05		
Friendship aim (intimacy) alter					−0.09	0.06		
Same friendship aim					0.06	0.06		
Intimacy and girl ego							0.07	0.06
Intimacy girl alter							0.14+	0.08
Same friendship aim, both girl							0.12*	0.06
Activities and boy ego							−0.02	0.07
Activities and boy alter							0.12+	0.07
Same friendship aim, both boy							0.14**	0.05

***$p<0.001$; **$p<0.01$; *$p<0.05$; +$p<0.10$

[a]All effects are tested two-sidedly, except the similarity effects

many friends) are less nominated by fellow classmates as new friends (outdegree popularity: $\mu=-0.54$, $p<0.001$), and that they also make less new friends (outdegree activity: $\mu=-0.18$, $p<0.001$), so it is not a self-reinforcing mechanism which is often found (a so-called Matthew effect). Also, students with a higher indegree (i.e. nominated by many classmates) have a tendency to make less new friends (indegree activity: $\mu=-0.18$, $p<0.10$).

The occurrence of selection patterns is reflected in several effects. Combined they show that the students were inclined to establish friendship groups. The reciprocity

effect is the strongest effect ($\mu = 1.63$, $p < 0.001$), implying that students answered positively to incoming friendship choices. The three effects that together represent the linking mechanism are also strong, especially the transitive triplet effect. The students strive after triadic closure, shown by a positive transitive ties effect ($\mu = 0.81$, $p < 0.001$), a negative 3-cycle effect ($\mu = -0.21$, $p < 0.001$), but also build groups larger than three persons, shown by a positive transitive triplet effect ($\mu = 0.37$, $p < 0.001$). Given that the latter is by far the most important triadic effect, students really had a propensity to starts friendships with those with whom they already had many friends in common. This suggests that they like to be a member of dense, relatively large friendship groups.

Model 2a, model 2b, and model 2c are extensions of the structural model. All three models include the two deep similarity attributes, namely 'school behavior' and 'deviant behavior', but model 2a includes the ego (student), alter (fellow student), and same gender effects; model 2b the ego, alter, and same friendship aim effects, and model 2c includes effects based on the combination of gender and friendship aim. The interpretation of the structural part of all three models remains the same: students prefer reciprocal relationships embedded in a transitive context. The first similarity effect shows that students prefer to befriend those who show similar school behaviors meaning that those who are on time (or not), do their homework (or not), work hard (or not), and take notice (or not) prefer to be friends with those who show similar behavior. In all three models, these effects are statistically significant ($\mu = 0.18$, $p < 0.05$; $\mu = 0.23$, $p < 0.01$; $\mu = 0.22$, $p < 0.01$). The second similarity effect is also significant suggesting that those who show deviant behavior (drinking, fighting, etc.) prefer to be friends with those who also show deviant behavior ($\mu = 0.17$, $p < 0.05$; $\mu = 0.15$, $p < 0.05$; $\mu = 0.18$, $p < 0.05$).

4.3 Selection, gender, and friendship aim

Model 2a also contains the ego, alter, and same gender effects[4]. They show, as expected and always found in the literature, that boys prefer boys, and girls prefer girls to befriend with. The ego and alter effects are not significant. Model 2b includes the ego, alter, and same aim effects. No effect was found to be statistically significant, suggesting that, controlling for the structural friendship mechanisms and the two similarity effects, those having the same friendship aim were not inclined to become friends with each other. In short, in contrast to gender, friendship aim does not explain friendship formation. Model 2c combines both attributes. Controlled for all other effects, girls who favor intimacy clearly have a preference for girls who also favor intimacy, whereas boys who like social activities have a preference for boys who also like social activities. In both cases the alter effects are also statistically significant, whereas the ego effects are not. The interpretation of all three effects taken together is summarized in Table 2.

[4] We have not specified separate hypotheses regarding the ego, alter and same effects. For interpretation purposes, we added all three effects. Leaving out either the ego or alter effect would result in an incomplete 'preference for similarity' picture (although the overall interpretation would hardly be different).

Table 2 The combined ego, alter, and same attribute effects: boys preferring social activities and girls preferring intimacy

Ego	Alter		Ego	Alter	
	Boys preferring social activities	Reference group		Girls preferring intimacy	Reference group
Boys preferring social activities	0.22	−0.05	Girls preferring intimacy	0.25	−0.01
Reference group	0.09	0.11	Reference group	0.06	0.04

All variables are centered in RSiena. This means that the proportion boys who prefer social activities is 0.6965 (instead of 1) and the proportion persons belonging to the reference group is −0.3035 (instead of 0). For instance, the upper left cell of Table 2 is calculated as follows: $-0.0193^{5} \times 0.6965 + 0.1245 \times 0.6965 + 1 \times 0.1449 = 0.2181$ (rounded to 0.22 in Table 2), whereas the lower left cell is calculated as: $-0.0193 \times -0.3035 + 0.1245 \times 0.6965 + 0 \times 0.1449 = 0.0926$, The left side of this table shows that boys who value social activities in friendships, are inclined to befriend boys who also value social activities (coefficient is 0.22), whereas the students in the reference group (girls and boys who value intimacy in friendships taken together) do not show a clear inclination: they almost equally prefer boys who like social activities and the reference group. The right side of this table tells a more or less similar story for girls. In contrast to the reference group that has no clear preference, girls who look for intimacy prefer others girls that also look for intimacy. Another way of looking at these values is calculating the log odds ratio of two alternatives. The ratio of a boy preferring social activities selecting another boy preferring social activities over a person in the reference group is $e^{0.22}/e^{-0.05} = 1.31$. The same pattern is found for girls preferring intimacy. The odds ratio is $e^{0.25}/e^{-0.01} = 1.30$. Individuals in both reference groups are indifferent (the log odds ratios are approximately 1.0, what was already shown by the almost equal values in the lower row of Table 2).

Table 1 and 2 illustrate what we expected, namely that the combination of gender and aim predicts the emergence of new friendships better than the friendship aim effect and the gender effect separately.

Table 3 leaves aside the gender effect and the friendship aim effect and entirely focuses on the combination of the two. Model 3a relates deep similarity to boys who prefer social activities, whereas Model 3b relates this to girls who prefer intimacy. Both models include ego, alter, and similarity effects, plus the interaction between rate of change (activity level) and boys who favor social activities and girls who favor intimacy, respectively. The interpretation of the structural part and the similarity part remain the same in comparison with former models. This also holds for the ego, alter, and similarity effects as they are explained in Table 2.

Regarding the activity level, Model 3a and model 3b show that both boys who favor social activities (*rate* = 0.22 in both models) and girls who favor intimacy more often change their network than boys preferring intimacy and girls preferring social activities (*rate* = 0.20, and *rate* = 0.08, respectively). The effects are not significant over all classes. Taken together, all positive effects (either significant or not),

[5] The figures in Table 2 are based on the four decimal output provided by RSiena.

Table 3 Selection patterns in 22[a] classes in Dutch secondary schools. Results of dynamic network analysis using SIENA

	Model 3a Boys preferring social activities		Model 3b Girls preferring intimacy	
	μ	*s.e.*	μ	*s.e.*
Density	−0.81***	0.17	−0.97***	0.15
Reciprocity	1.72***	0.07	1.70***	0.07
Indegree popularity (sqrt)	−0.25**	0.00	−0.26***	0.06
Outdegree popularity (sqrt)	−0.55***	0.06	−0.54***	0.06
Outdegree activity (sqrt)	−0.15**	0.04	−0.16***	0.04
Transitive ties	0.88***	0.12	0.98***	0.12
Transitive triplets	0.40***	0.02	0.38***	0.02
3-cycles	−0.27***	0.03	−0.26***	0.02
Similar (school) behavior	0.20+	0.11	0.24*	0.10
Similar (deviant) behavior	0.25*	0.10	0.16	0.10
Intimacy and girl ego	0.06	0.06	0.03	0.08
Intimacy and girl alter	0.17*	0.06	0.13*	0.06
Same group	0.15*	0.06	0.12*	0.06
Social activities and boy ego	−0.04	0.06	0.01	0.06
Social activities and boy alter	0.14*	0.06	0.13*	0.05
Same group	0.15	0.10	0.15	0.09
Interaction school behavior similarity and activities/boy	−0.47**	0.15		
Interaction deviant behavior similarity and activities/boy	0.07	0.21		
Interaction school behavior similarity and intimacy/girl			0.37+	0.20
Interaction deviant behavior similarity and intimacy/girl			−0.25	0.20
Rate	10.4***	2.08	10.4***	2.54
Interaction rate and social activities/boy	0.22	0.16[b]	0.22	0.17[d]
Interaction rate and intimacy/girl	0.20	0.18[c]	0.08	0.19[c]

***p-value < 0.001; **p-value < 0.01; *p-value < 0.05; +p-value < 0.10

[a]The estimation of the RSiena parameters failed to converge in one class. This concerned a class with a low density

[b]Over all classes the effect is not statistically significant. Taking together only the positive effects (based on Fisher's method for combining independent p-values; see Ripley et al. 2013), the effect is statistically significant at a 1% level

[c]Over all classes the effect is not statistically significant. Taking together only the positive effects, the effect is statistically significant at the 5% level

[d]Over all classes the effect is not statistically significant. Taking together only the positive effects, the effect is statistically significant at the 0.1% level

however, are statistically significant (see footnotes Table 3). The interaction effect between boys who favor social activities and deep similarity with respect to school behavior is negative and statistically significant over all classes ($\mu = -0.47$; $p < 0.05$). This suggests that boys who aim for social activities do find friends among those who are not similar with respect to school behavior. So next to a general preference for

similar friends with respect to school behavior, boys who like social activities tend to also look outside this group for classmates who share these activities. In contrast, the interaction effect between girls who like intimacy and school behavior is positive in most classes, but does not reach the level of statistical significance over all classes together ($\mu = 0.37$; $p < 0.10$). Next to a general preference for similar friends with respect to school behavior girls who like intimacy tend to look more for friends among those who are similar. Taking these results together, there is a tendency to establish friendship with those who are similar with respect to school behavior and deviant behavior, but the former effect is less strong for boys who favor social activities and stronger for girls who prefer intimacy. Regarding the linking effect we did not find satisfying results.[6]

5 Discussion

Rapidly changing friendship patterns in the beginning of a school year might interfere with academic achievement and personal wellbeing. We investigated gender, friendship aim and selection patterns in classroom networks of young adolescents. The strong structural effects on friendship formation were as expected, and in line with the network literature (Rivera et al. 2010). These effects indicate that the strongest predictors of network formation are usually general network mechanisms such as the tendency towards reciprocity and transitivity. However, even controlling for those strong structural effects, gender effects on network formation were found. Our finding that gender similarity is a strong predictor of friendship formation is in line with the large body of literature indicating that youth are drawn to others of the same sex (Rubin et al. 2006). However, friendship selection might also be guided by what adolescents want from friends. Nevertheless friendship aim appeared not to be a strong predictor of selection patterns in this study. This result is in keeping with a recent study that showed that playmate selection in preschool is more explained by gender similarity than by activity or toy preference similarity (Martin et al. 2013). In line with recent studies (Palmen et al. 2006; Zarbatany et al. 2004), we observed that the friendship aim of a significant percentage of boys and girls actually differed from the gender differences typically reported in the literature (i.e., girls prefer intimacy, whereas boys aim for collective activities with friends; Buhrmester 1996). This raised the question whether friendship aim could amplify gender effects. Actually, our analyses showed that the similarity effect was stronger when taking into account such gender-typical friendship aims (girls aiming for intimacy and boys aiming for social activities) additionally to gender. Because no clear hypotheses regarding selection patterns followed from the current literature, our study was primarily exploratory. The results and their interpretation are discussed below.

[6] We encountered difficulties in disentangling the three described linking effects and all interaction effects incorporating linking. Using only one linking mechanism, would have resolved the problems on class level. This means that on the class level it would have been possible to present satisfying results. However, we choose not to, because on a meta-level no satisfying results have been found regarding the linking pattern.

First, we found that the *activity levels* of both girlish girls and boyish boys were larger than those of the reference group (other girls and boys). In other words, students with more gender-typical friendship goals (boys *and* girls) were more prone to initiate new friendships in the beginning of friendship formation. This was an unexpected finding. Perhaps boyish' boys are still in the middle of the friendship formation process, and even after several months have a strong need to start new friendships to fulfill their aims (doing things together). For girlish girls this is probably different because, as we argued, a large number of friends does not correspond with their aim for intimacy. It is more likely that they replace friendships for new ones with better intimacy perspectives. So, although the reasoning is quite different, the results are the same. Both gender-typical groups are more active than the reference group. So, boys preferring intimacy and girls preferring social activities are less active. This asks for thorough in depth qualitative research in the future.

Second, we found no conclusive results regarding the effects of gender/aim on *linking*. In the baseline model, linking was represented by the combination of three effects, namely a transitive ties effect (formation of ties within a triad), a transitive triplet effect (formation of ties beyond the threesome, implying group formation), and a 3-cycle effect (formation of ties within a non-hierarchical order). In the more complex models, different combinations of transitivity related effects were active in different networks (school classes) and consequently, it was not feasible to perform a meta-analysis over all classes. Although we had no clear hypotheses, another approach might have provided more plain results regarding linking (see below).

Third, we found that adolescents tend to establish friendships with those who are *similar* with respect to school behavior and deviant behavior. However, the former effect is less strong for boys who favor social activities, whereas it is stronger for girls who prefer intimacy. Regarding the gender-typical girl, we may assume that she is still in the process of optimizing her (relatively small) number of intimate relations, exchanging unsatisfying friendships for new candidates. Since deep similarity is not "visible" at first sight, students might choose friends who later on turn out to be not as similar as they thought they would be. We therefore assume that the effect of deep similarity among girlish girls will probably become stronger as time progresses. In contrast, boys who aim for social activities focus on similar boys, but also find friends among those who are not similar with respect to school behavior. Their need for larger groups for doing things together may explain why they are less choosy than gender-typical girls. Besides, being involved in social activities simply does not require deep level similarity the same way it does for exchanging intimacy. It could also be that school behaviors of others are not good predictors for social companionship. Perhaps perceived (i.e., experienced) similarity in school behavior would be a better predictor (cf. Martin et al. 2011).

5.1 Strengths, limitations and future research

By using state of the art network RSiena analyses, we were able to overcome many of the analytical problems and misinterpretations of former analytical methods. The networks showed sufficient changes over time required for RSiena analyses. However, more complex models did not converge in all classroom networks, making it diffi-

cult to draw conclusions over all classes. A rise of complexity in models, in particular when analyzing many interaction effects, might lead to convergence problems. Nevertheless, at present no other network model comes close to the high quality of RSiena types of modeling. In addition, the network measures were up to technical standards from the perspective of social network tradition, the friendship nomination procedure has been proven reliable in many other studies, the Mokken scales used to analyze similarity regarding school behaviors were reliable, and the measurement of friendship aim was tested in a pilot study.

The measurement of friendship aim, however, was rather coarse. The forced choice between intimacy and social activities split the students into two friendship aim groups. Group discussions in the classes suggest that this dichotomization of friendship aim may be a simplification of reality. Also, an analysis of items about friendship motives revealed that nearly *all* students, girls and boys, preferred some intimacy and trust (sharing secrets) in friendships. This suggests that differences between preferences for intimacy may be less important than differences in preferences for social activities.

The present study is one of the first systematical investigations of the effects of individual attributes on selection patterns. Consequently, our study had a strong explorative character, which is reflected in some of its limitations and recommendations for future research studying selection patterns.

First, in order to grasp network dynamics such as activity level more thoroughly, longitudinal data collected at several time points may be needed (e.g., van de Bunt et al. 1999). Second, we faced some problems in the analysis of the linking patterns. Different combinations of transitivity related effects were active in different networks, thus hampering our meta RSiena analysis. Future research should focus on the circumstances under which specific combination of transitivity effects occur and on the usefulness of other mechanisms to assess linking. Third, to overcome the speculative nature of some of our interpretations, we hope that upcoming studies will investigate different types of actor attributes more thoroughly. This might, for an example, include the study of the correspondence of friendship aims with the provisions of their friends through time (cf. Palmen et al. 2010). Also another analysis of similarity, e.g., using the distinction between visible and invisible similarity (De Klepper et al. 2010) might fit our analysis better.

Despite these limitations the present study showed that it is possible to investigate the effect of individual differences on social networks. Traditionally, social network studies examine features that apply to the whole network and its members. More specific, our findings indicate that the combination of gender and friendship aim explain friendship selection patterns of adolescents after the transition to high school.

5.2 Implications

Our work may have several implications for educational practices. First, frequent changes in one's circle of friends might draw upon the quality of collaborative school work. If the collaborative relationships are no longer build upon friendships, but upon neutral, perhaps even troubled relationships, the individual and group performance might suffer. This suggest that in the beginning of a school year, the teacher could

better decide him or herself on group composition than the students who will probably follow friendship lines in composing a collaborative group. Second, given that school work is more easily exchanged and shared among friends, those who are more active in making friends benefit more from others' work than those who are not that active. On the other hand, if friendships go sour quite easily, investments made in others (e.g. lending out homework) can be "thrown away money". If students are aware of this, they might be reluctant in sharing information. Third, breaking and forming friendships is time consuming (for example, through extensive use of social media). Students may be more devoted to contacting peers than to their school work (cf. negative effects of preoccupation with romantic relations; Davila et al. 2004). So possibly those students who have less fluctuation might have more time to focus on academic work. Fourth, dissolving friendships is a harmful event, especially for those who loose friends against their will, and even worse, if the event was unexpected. Their academic achievement might suffer from this. In contrast, those who are not that active might benefit. Fourth, we found that the friendship aims of a significant percentage of boys and girls differed from what previous research commonly portrays as boys' and girls' friendships as two different "worlds" or "cultures". Researchers and teachers should be careful not to exaggerate gender differences in peer relations and have an eye for both exceptions and agreements to stereotypes. Finally, making and keeping friends is an important developmental task. As described in the Introduction, the lack of friends can be accompanied by many risks. For example, friendless children are more likely to be lonely and to be victimized by peers (Rubin et al. 2006). Social network analysis can provide teachers and school psychologists with information about the social relations in a class, including the identification of loners at risk for adjustment problems.[7]

References

Baerveldt, C., & Snijders, T. A. B. (1994). Influences on and from the segmentation of networks: Hypotheses and tests. *Social Networks, 16*(3), 213–232.

Baerveldt, C., van de Bunt, G. G., & de Federico de la Rúa, A. (2010). Why and how selection patterns in classroom networks differ between students. The potential influence of networks size preferences, level of information, and group membership. *REDES, 19,* 272–298.

Benenson, J. F., & Christakos, A. (2003). The greater fragility of females' versus males' closest same-sex friendships. *Child Development, 74*(4), 1123–1129.

Benenson, J. F., Apostoleris, N. H., & Parnass, J. (1997). Age and sex differences in dyadic and group interaction. *Developmental Psychology, 33,* 538–543.

Buhrmester, D. (1996). Need fulfilment, interpersonal competence, and the developmental contexts of early adolescent friendship. In W. M. Bukowski, A. F. Newcomb, & W. W. Hartup (Eds.), *The company they keep: Friendship in childhood and adolescence* (pp. 158–185). Cambridge: Cambridge University Press.

Bukowski, W. M. (2001). Friendship and the worlds of childhood. In D. W. Nangle & C. A. Erdley (Eds.), *The role of friendship in psychological adjustment* (pp. 93–105). San Francisco: Jossy-Bass.

van de Bunt, G. G., van Duijn, M. A. J., & Snijders, T. A. B. (1999). Friendship networks through time: An actor-oriented dynamic statistical network model. *Computational & Mathematical Organization Theory, 5,* 167–192.

[7] The schools participating in this study received classroom network pictures and a small manual how to interpret and use them. Afterwards, many teachers reported to find the pictures very useful.

Cairns, R. B., Xie, H., & Leung, M. C. (1998). The popularity of friendship and the neglect of social networks: Toward a new balance. In A. H. Cillessen & W. M. Bukowski (Eds.), *Sociometry then and now: Building on six decades of measuring children's experiences with the peer group* (pp. 25–53). San Francisco: Jossey-Bass.

Davila, J., Steinberg, S., Kachadourian, L., Cobb, R., & Fincham, F. (2004). Romantic involvement and depressive symptoms in early and late adolescence: The role of a preoccupied relational style. *Personal Relationships, 11,* 161–178.

De Klepper, M. C., Sleebos, E., van de Bunt, G. G., & Agneessens, F. (2010). Similarity in friendship networks: Selection or influence? The effect of constraining contexts and non-visible attributes. *Social Networks, 32,* 82–90.

Erdley, C. A., Nangle, D. W., Newman, J. E., & Carpenter, E. M. (2001). Children's friendship experiences and psychological adjustment: Theory and research. In D. W. Nangle & C. A. Erdley (Eds.), *The role of friendship in psychological adjustment* (Vol. 91, pp. 5–24). San Francisco: Jossey-Bass.

Geary, D. C., Byrd-Craven, J., Hoard, M. K., Vigil, J., & Numtee, C. (2003). Evolution and development of boys' social behavior. *Developmental Review, 23,* 444–470.

van der Graaff, J., Branje, S., Wied, M. D., Hawk, S., Lier, P. V., & Meeus, W. (2014). Perspective taking and empathic concern in adolescence: Gender differences in developmental changes. *Developmental Psychology, 50*(3), 1–8.

Hardy, C. L., Bukowski, W. M., & Sippola, L. K. (2002). Stability and change in peer relationships during the transition to middle-level school. *Journal of Early Adolescence, 22,* 117–142.

Hartup, W. W. (1996). The company they keep: Friendships and their developmental significance. *Child Development, 67,* 1–13.

Hartup, W., & Stevens, N. (1997). Friendships and adaptation in the life course. *Psychological Bulletin, 121,* 355–370.

Heider, F. (1958). *The psychology of interpersonal relations*. New York: Wiley.

Holland, P. W., & Leinhardt, S. (1971). Transitivity in structural models of small groups. *Comparative Group Studies, 2,* 107–124.

Lubbers, M., Snijders, T., & van der Werf, M. P. C. (2010). Dynamics of peer relationships across the first two years of junior high as a function of gender and changes in classroom composition. *Journal of Research on Adolescence, 21*(2), 488–504.

Martin, C. L., Fabes, R. A., Hanish, L., Leonard, S., & Dinella, L. M. (2011). Experienced and expected similarity to same-gender peers: Moving toward a comprehensive model of gender segregation. *Sex Roles, 65,* 421–434. doi:10.1007/s11199-011-0029-y.

Martin, C. L., Kornienko, O., Schaefer, D. R., Hanish, L. D., Fabes, R. A., & Goble, P. (2013). The role of sex of peers and gender-typed activities in young children's peer affiliative networks: A longitudinal analysis of selection and influence. *Child Development, 84,* 921–937. doi:10.1111/cdev.12032.

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology, 27,* 415–444.

Mokken, R. J. (1997). Nonparametric models for dichotomous responses. In R. K. Hambleton & W. J. van der Linden (Eds.), *Handbook of modern Item Response Theory* (pp. 351–367). New York: Springer.

Nangle, D. W., & Erdley, C. A. (Eds.). (2001). *The role of friendship in psychological adjustment*. San Francisco: Jossy-Bass.

Newcomb, T. M. (1961). *The acquaintance process*. New York: Holt, Rinehart and Winston.

Newcomb, A. F., & Bagwell, C. L. (1995). Children's friendship relations: A meta-analytic review. *Psychological Bulletin, 117,* 306–347.

Palmen, H. M. H., van Roij, C. J. L. M., Vermande, M. M., Dekovic, M., & van Aken, M. A. G. (2006). Sekseverschillen in vriendschapsbehoeften [Gender differences in friendship needs]. *Kind en Adolescent, 27,* 44–56.

Palmen, H., Vermande, M. M., Dekovíc, M., & van Aken, M. A. G. (2010). Machiavellianism in elementary school children: Risk and adaptation. In C. T. Barry, P. K. Kerig, K. K. Stellwagen, & T. D. Barry (Eds.), *Narcissism and machiavellism in youth: Implications for the development of adaptive and maladaptive behavior* (pp. 233–249). Washington: American Psychological Association.

Ripley, R. M., Snijders, T. A. B., Boda, Z., Vörös, A, & Preciado, P. (2013). *Manual for SIENA version 4.0*. Oxford: University of Oxford, Department of Statistics, Nuffield College.

Rivera, M. T., Soderstrom, S. B., & Uzzi, B. (2010). Dynamics of dyads in social networks: assortative, relational, and proximity mechanisms. *Annual Review of Sociology, 36,* 91–115.

Rose, A. J., & Rudolph, K. D. (2006). A review of sex differences in peer relationship processes: potential trade-offs for the emotional and behavioral development of girls and boys. *Psychological Bulletin, 132*(1), 98–131.

Rubin, K. H., Bukowski, W., & Parker, J. (2006). Peer interactions, relationships, and groups. In N. Eisenberg (Ed.), *Handbook of Child Psychology (6th ed.): Social, emotional, and personality development* (pp. 571–645). New York: Wiley.

Sijtsma, K., & Molenaar, I. W. (2002). *Introduction to nonparametric item response theory*. Thousand Oaks: Sage.

Snijders, T. A. B., van de Bunt, G. G., & Steglich, C. E. G. (2010). Introduction to Actor-based models for network dynamics. *Social Networks, 32,* 44–60.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. New York: Cambridge University Press.

Wölfer R., Cortina, K. S., & Baumert, J. (2012). Embeddedness and empathy: How the social network shapes adolescents' social understanding. *Journal of Adolescence, 35,* 1295–1305.

Wright, P. H. (1998). Toward an expanded orientation to the study of sex differences in friendship. In D. J. Canary & K. Dindia (Eds.), *Sex differences and similarities in communication: Critical essays and empirical investigations of sex and gender in interaction* (pp. 41–63). Mahwah: Lawrence Erlbaum Associates Inc.

Zarbatany, L., Conley, R., & Pepler, S. (2004). Personality and gender differences in friendship needs and experiences in preadolescence and young adulthood. *International Journal of Behavioral Development, 28,* 299–310.