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It Takes Three: Selection, Influence, and De-Selection Processes of Depression in Adolescent Friendship Networks

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The authors of this study tested a selection–influence–de-selection model of depression. This model explains friendship influence processes (i.e., friends' depressive symptoms increase adolescents' depressive symptoms) while controlling for two processes: friendship selection (i.e., selection of friends with similar levels of depressive symptoms) and friendship de-selection (i.e., de-selection of friends with dissimilar levels of depressive symptoms). Further, this study is unique in that these processes were studied both inside and outside the school context. The authors used a social network approach to examine 5 annual measurements of data in a large ($N = 847$) community-based network of adolescents and their friends ($M = 14.3$ years old at first measurement). Results supported the proposed model: adolescents tend to select friends with similar levels of depression, and friends may increase each other's depressive symptoms as relationships endure. These two processes were most salient outside the school context. At the same time, friendships seemed to be ended more frequently if adolescents' level of depressive symptoms was dissimilar to that of their friends.

Keywords: depressive symptoms, friendships, social networks, de-selection

Adolescence has been described as a critical developmental period in which vulnerability to depressive symptoms is high, especially among girls (Cyranowski, Frank, Young, & Shear, 2000; Hankin & Abramson, 2001; Rudolph & Hammen, 1999). Research has indicated that friendships may play a role in the development of depressive symptoms (Prinstein, Cheah, & Guyer, 2005; Rose, Carlson, & Waller, 2007; Stevens & Prinstein, 2005). Negative characteristics of friendships, such as low friendship quality (e.g., Borelli & Prinstein, 2006; Burk & Laursen, 2005; Selfhout, Branje, & Meeus, 2009), may increase depressive symptoms over time. Recent research has shown links between levels of depressive symptoms in adolescents and levels of such symptoms in their friends that may provide insight into the role of friends in adolescents' depression, as adolescents tend to be similar to their friends in depressive symptoms (Prinstein, 2007; Selfhout, Branje, Raaijmakers, & Meeus, 2007). Thus, processes that underlie similarity may play a role in the development of depression. For this reason, it is important to understand what underlies similarity.

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Two processes may explain similarity in depressive symptoms within adolescent friendships. Adolescents may form friendships with others who have similar depressive symptoms (i.e., *selection*). Alternatively, friends' depressive symptoms may increase adolescents' depressive symptoms (i.e., *influence*). What is also possible but has never been accounted for is that friends may *de*-select one another because of *dis*similarity in depressive symptoms, a process that can be labeled *de-selection.* Our first aim in the current study was to examine the relative importance of three friendship processes that explain the reason that friends tend to be similar in depressive symptoms: selection, influence, and de-selection. The second aim was to explore selection, influence, and de-selection processes both inside and outside the school context.

Selection Processes and Adolescents' Depressive Symptoms

Adolescents may be similar to their friends in depressive symptoms because of selection (Kandel, 1978). The similarity–attraction theory (Berger & Calabrese, 1975; Byrne & Nelson, 1965) states that similarity in values, traits, and behaviors increases predictability, allowing individuals to communicate with less effort and with shared feelings of understanding and belongingness. This increased predictability and these positive feelings are suggested to enhance selection of friends. Thus, adolescents may form friendships with others who are similar to them in depressive symptoms.

In one study, middle adolescents and their selected peer groups within their schools were followed across a 1-year period (Hogue

& Steinberg, 2005). Adolescents tended to select peer groups with average levels of internalizing distress that were similar to their own. This study indicates that adolescents select peer groups with similar levels of internalizing distress. As the selection processes regarding depressive symptoms were not examined in the study, more research is needed to determine whether greater similarity in depressive symptoms predicts friendship selection.

Influence Processes and Adolescents' Depressive Symptoms

Influence processes offer an alternative explanation for the similarity in depressive symptoms among adolescent friends. For example, influence in depressive symptoms may occur through *co-rumination* (Rose, 2002; Rose et al., 2007); that is, depressive friends tend to mutually encourage problem talk, rehash problems, speculate about problems, and dwell on negative affect. Through co-rumination, depressive friends tend to reinforce negative thoughts and feelings, thereby increasing depressive symptoms (Rose, 2002; Rose et al., 2007). Thus, friends with depressive symptoms may increase each other's depressive symptoms through co-rumination.

In the previously described study, Hogue and Steinberg (2005) examined influence processes for internalizing distress within peer groups in addition to selection processes. Higher levels of internalizing distress in peers predicted higher scores of adolescents' own internalizing distress across 1 year, supporting influence processes concerning peer groups and internalizing distress. In two studies, investigators examined youths and their best friends over periods of 11 months (Stevens & Prinstein, 2005) and 18 months (Prinstein, 2007) in middle adolescence. In both studies, higher scores of friends' own reported depressive symptoms predicted higher adolescents' depressive symptoms, even after adolescents' depressive symptoms at the first measurement were controlled. In sum, prior research has demonstrated that in addition to selection processes, influence processes may explain why adolescents tend to be similar to their friends in depressive symptoms.

De-Selection Processes and Adolescents' Depressive Symptoms

Although selection and influence have been used to explain similarity in depressive symptoms between adolescents and their friends, one other process has not been studied yet in this context. Friendship de-selection is partially based on the theory of social corrosion (Coyne, 1976), which suggests that individuals prone to depressive symptoms lack the necessary social skills to provide support and closeness. Depressive individuals' failures to provide support and closeness are, in turn, suggested to trigger dissatisfaction and even de-selection by the less depressive dyadic partners in the relationship, thereby increasing the chances of close relationships ending (see also Borelli & Prinstein, 2006). In contrast, interaction between two similarly depressive friends is characterized by mutual feelings of understanding and high self-disclosure, which seem to increase closeness and intimacy between these friends (Rose, 2002; Rose et al., 2007). This, in turn, is suggested to lead to fewer endings of these relationships. Thus, de-selection offers an alternative explanation of why adolescents tend to be similar to their friends: similarity in depression may lead to less de-selection between friends and therefore leave adolescents with friends who tend to be similar to them. As de-selection has not been studied yet in the context of similarity in depressive symptoms within friendships, this process remains relatively unexplored. In sum, in addition to selection and influence, de-selection processes may explain why adolescents in friendships show similarity in depressive symptoms.

It Takes Three: Selection–Influence–De-Selection Processes in Social Networks

One limitation of prior research on depressive symptoms and friendships is that selection, influence, and de-selection have been studied in isolation from each other. Prior research has focused on one relationship at a time for each adolescent, thereby leading to a focus on either selection or influence (and neglecting de-selection altogether). Recent studies have shown, however, that adolescents commonly have multiple friendships that together make up social networks (Snijders, 2001; Snijders, Steglich, & Schweinberger, 2007). Adolescents tend to use the structure of the social network to select and de-select others. For example, they tend to select the friends of their friends (Burk, Steglich, & Snijders, 2007; Van Zalk et al., 2010). Adolescents may base their choices for selecting friends more on the structure of their social networks than on potential friends' individual characteristics, such as depressive symptoms. Thus, using a social network approach may offer a more realistic perspective on selection and de-selection processes.

Moreover, within social networks of multiple friendships, adolescents may simultaneously select new friends, influence and be influenced by continuing friendships, and end other friendships. This has crucial conceptual implications, given that these three processes may feed into each other, resulting in even stronger links between adolescents' depressive symptoms and friends' depressive symptoms. For example, through de-selection, adolescents may end up with friends who are relatively similar to them in depressive symptoms. This means that de-selection may enhance opportunities for friends to influence each other. For instance, as adolescents remain in relationships in which friends are already similar to them in depressive symptoms, they may engage in more co-rumination (Rose et al., 2007) and reinforcement of negative cues in their interactions (Rudolph, Hammen, & Burge, 1994). In short, the three processes—selection, influence, and de-selection—may together be important in explaining how adolescents' depressive symptoms are linked to their friends' depressive symptoms.

In sum, we propose a *selection–influence–de-selection model of depression* in which adolescents simultaneously form friendships on the basis of similarity in depressive symptoms, become more similar to their friends because of influence processes within their continuing friendships, and wind up with more similar friends because they end relationships with friends who are dissimilar to them. Thus, selection, influence, and de-selection processes are integrated into one single model.

Confounding Factors for Selection, Influence, and De-Selection Processes

There are several confounding factors that may offer alternative explanations of why adolescents select their friends, are influenced by their friends, and de-select their friends. Prior research has

shown that similarity in age and gender predict friendship selection (Burk et al., 2007; Kandel, 1978) and de-selection (Snijders & Baerveldt, 2003). Thus, similarity in gender and similarity in age need to be controlled for selection and de-selection.

In addition, there may be two ways through which main effects of depressive symptoms affect friendship selection and de-selection. On the one hand, friends may isolate adolescents by selecting adolescents with higher depressive symptoms less and de-selecting them more than adolescents with lower levels of depressive symptoms (Huffman, 2001; Prinstein et al., 2005). On the other hand, adolescents with higher depressive symptoms may have an active role in isolating themselves: they may be more restrictive in selecting friends and de-select their friends more because their low social self-esteem makes them feel unworthy to seek out new friends and stay with their old friends (Borelli & Prinstein, 2006; Kennedy, Spence, & Hensley, 1989). Thus, depressive symptoms may result in an individual being isolated from friends through a bidirectional process: depressive adolescents may select fewer friends and de-select more friends, while friends may select depressive adolescents less and de-select these adolescents more.

Research has indicated, further, that similarity in externalizing problem behaviors plays a role in friendship selection, influence, and de-selection. Adolescents tend to select others who have similar delinquent behaviors (e.g., Burk et al., 2007; Selfhout, Branje, & Meeus, 2008) and similar drinking behaviors (e.g., Forsyth, Barnard, Reid, & McKeganey, 1998). Furthermore, adolescents seem to be influenced by their friends' delinquency (e.g., Fergusson, Swain-Campbell, & Horwood, 2002; Selfhout et al., 2008) and drinking behaviors (e.g., Poelen, Engels, Van der Vorst, Scholte, & Vermulst, 2007). Finally, similarity in delinquency has been shown to predict friendship de-selection in middle adolescence (Snijders & Baerveldt, 2003).

At the same time, both drinking (e.g., Saraceno, Munafó, Heron, Craddock, & van den Bree, 2009) and delinquency (e.g., Oland & Shaw, 2005) tend to co-occur with depressive symptoms among friends. Therefore, one alternative explanation for the selection–influence–de-selection model of depressive symptoms is that similarity in depressive symptoms is merely a marker for similarity in externalizing problem behaviors. In examining the role that similarity in depressive symptoms plays in selection, influence, and de-selection, one must control for similarity among friends in delinquency and drinking as well as in demographic background and mean levels of depressive symptoms.

Processes in Different Friendship Contexts

Research shows that adolescents have three different groups of friendships (Kerr, Stattin, & Kiesner, 2007): friends found exclusively inside school (*in-school unique*), friends found inside and outside school (*conjoint*), and friends found exclusively outside school (*out-of-school unique*). In prior research regarding depressive symptoms, investigators have allowed their adolescent participants to select and de-select only friends in school, in other words, only those friends in the in-school unique and conjoint friendships. As one study found that around one third of an adolescent's friendships are with out-of-school unique friends, not including these friendships limits the generalizability of prior results (Kerr et al., 2007). Moreover, there might be differences between peer contexts in the role of depression in friendships. Within the school context, the same people form the pool from which adolescents can select and de-select their friends. Even conjoint friends are primarily met within the school context. This may particularly limit selection and de-selection for more depressive adolescents: they tend to be more socially isolated and rejected by peers throughout high school (Brauner, 2006; Brendgen, Vitaro, Turgeon, & Poulin, 2002). Outside school, a larger variety in the pool of potential friends might be available than inside school in terms of age, interest, values, and behaviors. Depressive adolescents also may be more able to find others outside school who do not know their peer status, providing them with the opportunity to get to know these individuals' values, thoughts, and feelings in more depth. Therefore, more depressive adolescents may seek friends outside school rather than inside school. Consistent with this theory, one cross-sectional study demonstrated that adolescents with more depressive symptoms nominated more friends outside school than inside school (East & Rook, 1992). After depressive adolescents have selected more similarly depressive friends outside school, they may to start to co-ruminate, thereby reinforcing each other's depressive feelings and thoughts (Rose, 2002; Rose et al., 2007).

To summarize, although we could not formulate strong predictions on the basis of prior research, we thought that differences might exist among out-of-school unique, conjoint, and in-school unique friendships concerning the importance of similarity in depressive symptoms for selection, de-selection, and influence processes. We therefore explored possible differences in these three processes according to peer context.

The Current Study

Using a social network approach, we sought to expand knowledge on processes that would explain why adolescent friends tend to be similar in depressive symptoms. We studied selection processes, that is, the extent to which similarity in depressive symptoms predicted dyads of adolescents who did not nominate each other as a friend turning into dyads in which at least one member nominated the other as a friend. Further, we examined de-selection processes, that is, the extent to which similarity in depressive symptoms predicted dyads in which at least one member nominated the other as a friend turning into dyads in which neither member nominated the other as a friend. We studied influence processes by examining to what extent friends' depressive symptoms predicted adolescents' depressive symptoms over time. All these three processes could explain why adolescents tend to be similar to their friends in depressive symptoms and, therefore, were estimated simultaneously. Second, we examined the previously mentioned processes in a large friendship network across 4 years, in which friends both inside and outside school were included. This method could provide more insight into friendship processes regarding differences among in-school unique, conjoint, and out-of-school unique friends.

On the basis of prior research and theories, we formed the following hypotheses:

Hypothesis 1: Selection. Adolescents select friends who are similar to them in depressive symptoms.

Hypothesis 2: De-Selection. Adolescents de-select friends who are dissimilar to them in depressive symptoms.

Hypothesis 3: Influence. Friends' depressive symptoms predict increases in adolescents' depressive symptoms over time.

Because differences in selection, de-selection, and influence processes across peer contexts have not been examined previously, we explored to what extent these three processes differed for in-school unique, conjoint, and out-of-school unique friends.

Method

Sample

Participants came from a community-based, cohort-sequential study in a medium-sized town in Sweden (with a population of about 26,000). All the schools in the town had youths in Grades 4–12 (roughly ages 10–18 years) and participated at each measurement. Annual assessments were conducted over five measurements. To form the network included in these analyses, we began with all eighth graders who participated in at least three measurements ($N = 329$; 148 girls and 181 boys; M age = 14.28 years). We focused on eighth graders because they were already attending their second year of junior high school and therefore had established their social positions in their schools and other environments. After we included the friends they nominated at each of five measurements, the final network consisted of 847 students (355 girls, and 492 boys; M age = 14.29 years). Approximately 10% of all participants were ethnic minorities. On a multivariate test, adolescents who participated at all five measurements (91%) and those who did not participate at all measurements (9%) showed no significant differences, including depressive symptoms and number of nominated friends at Measurement 1, $F(2, 839) = 0.73$, $p > .05$. No additional information was available on differences between the original population and the selected sample of 847 students in terms of language spoken at home, family incomes, and socioeconomic status of the families.

Procedure

Investigators recruited adolescents for the study by first contacting administrators of the local municipality, who in turn contacted the principals of the schools. The principals organized the subsequent data collections at the schools. Trained research assistants visited the adolescents in their classrooms during school hours. They were told about the types of questions they would answer and the time it would take to finish the questionnaires. They were also informed that their participation was voluntary and that if they chose not to participate, they could do something else instead. They were guaranteed that if they did participate in the study, their answers would never be shown to their parents, their teachers, or anyone else. Before the study took place, parents were informed about the study through community-based meetings and via letters. Before each wave, they received new information and a postage-paid postcard to return if they did not want their child to participate in the study. Only 1% of the parents did so. The parents were told that they could withdraw their child from the study at any time.

Adolescents filled out the questionnaires during regular school hours in sessions administered by trained research assistants. The teachers were not present. No participant was paid for taking part in the study; however, in each of the classes in Grades 7–12, we held a drawing for movie tickets. Youths were eligible for the drawing whether they chose to participate or not. The procedures and measures used were all approved by the Örebro University's ethics review board.

Measures

Friend nominations. Adolescents were asked to identify up to three important friends, whom we defined as "someone you talk with, hang out with, and do things with." In addition, participants identified up to 10 friends with whom they spent time in school and up to 10 friends with whom they spent time out of school. Participants were explicitly instructed that friends with whom they spent time in school could also be nominated as friends with whom they spent time out of school and vice versa. When participants nominated siblings or romantic partners as important friends, these siblings (ranging between 26% and 37% of all relationships across measurements) and romantic partners (ranging between 29% and 41% of all relationships across measurements) were excluded from the analyses. We combined the three different nominations by identifying the unique friends who were nominated at each measurement. Thus, for each participant, we annually collected up to 23 nominations of friends with whom the participant spent time with in school and in his or her free time.

Friend contexts. At each measurement, friendship nominations were used to check whether the friends that adolescents nominated were (a) friends inside the same school (i.e., in-school unique friends, ranging between 31% and 38% across measurements), (b) friends only found outside school (i.e., out-of-school unique friends, ranging between 31% and 43%), or (c) friends both inside and outside school (i.e., conjoint friends, ranging between 21% and 29% across measurements).

Depressive symptoms. Depressive symptoms were measured with the Child Depression Scale from the Center for Epidemiological Studies (Radloff, 1977). The scale consists of 20 items, with responses rated on 4-point scales ranging from *not at all* (0) to *often* (3). Participants were instructed to think about the past week and respond to items such as "[I have] worried about things I don't usually worry about," "felt scared," and "felt down and unhappy." We calculated depressive symptoms by summing all scores for each participant, creating a total score with a range from 0 to 60 (Radloff, 1977). The Cronbach's alphas ranged between .83 and .88 across the five measurements. The cross-year correlations ranged from .44 to .58. Note that in the social network analyses, changes in the total score were treated as ordinal categorical changes (see Results section).

Alcohol use. Participants completed a single item describing frequency of alcohol intoxication in the previous year: "Have you drunk so much beer, liquor, or wine that you got drunk during the last year?" (Koutakis, Stattin, & Kerr, 2008; Magnusson, Dunér, & Zetterbloom, 1975). Responses ranged from *no, it has never happened* (1) to *yes, it has happened 10 or more times* (5). Autoregressive correlations revealed a moderate degree of interindividual stability between annual measurements (r = from .68 to .67).

Minor delinquency. Participants completed a survey on delinquent behaviors consisting of 22 items that was developed and validated by Magnusson et al. (1975) and updated by Kerr and Stattin (2000). Participants were asked how often in the previous year they had engaged in delinquent behaviors, such as shoplifting,

vandalism, and petty theft. Each item was rated on a 5-point scale, with responses ranging from *no, it has never happened* (1) to *more than 10 times* (5). The Cronbach's alphas ranged between .91 and .93 across the five measurements.

Strategy for Analysis

To examine selection, influence, and de-selection processes simultaneously, we used the software program Simulation Investigation for Empirical Network Analyses, or SIENA (Snijders, 2001; Snijders et al., 2007). This method has been successfully applied in adolescents to assess selection effects for personality (Van Zalk et al., in press), selection and influence effects regarding delinquency (Burk et al., 2007), and selection and de-selection processes regarding delinquency (Snijders & Baerveldt, 2003). SIENA is currently the only program available that can be used to study selection, influence, and de-selection processes simultaneously in adolescents' networks of multiple friendships. The Results section provides more details on conceptual interpretation of these three processes. For technical details regarding how SIENA distinguishes among selection, influence, and de-selection, we refer to the reader to Snijders, Steglich, and Van de Bunt (2010). See the Appendix for how the terminology in this study corresponds to terminology used in prior SIENA studies.

Results

Descriptive Statistics

Table 1 shows the development of depressive symptoms across the five measurements by gender (0 = boy, 1 = girl) and reporting individual. The summed scores of depressive symptoms in the current sample are similar to summed scores found in previous community samples among adolescents (Aebi, Metzke, & Steinhausen, 2009). The reporting individual variable was defined by four groups: adolescents, their in-school unique friends, their out-of-school unique friends, and their conjoint friends at each wave. To test whether there were differences according to gender and reporting individual in the mean levels and changes in the development of depressive symptoms, we used a repeated-measures analysis in which the factor of time represented the changes across the five waves. Two between-subjects effects were estimated: gender and reporting individual. In addition, four effects were estimated: Time, Time × Gender, Time × Reporting Individual, and Time × Gender × Reporting Individual. Two significant between-subjects effects were found: gender, $F(1, 846) = 22.6$, $p < .01$, and the main effect of reporting individual, $F(2, 846) = 53.1$, $p < .01$. Bonferroni post-hoc analyses revealed that whereas out-of-school unique friends scored significantly ($p < .01$) higher on depressive symptoms than either group of school-based friends, no differences were found in depressive symptoms among adolescents, in-school unique friends, and conjoint friends. Two significant within-subjects effects were found: time, $F(4, 840) = 67.2$, $p < .01$, and the interaction between gender and time, $F(4, 840) = 29.3$, $p < .01$. The significant effect of time showed that depressive symptoms overall tended to increase over time. To explore the interaction effect between time and gender, we performed the repeated-measures analysis for boys and girls separately. For girls, depressive symptoms significantly increased over time, $F(1,$

Table 1
Depressive Symptoms by Gender and Reporting Individual Across Five Annual Measurements

Variable	Measurement 1				Measurement 2				Measurement 3				Measurement 4				Measurement 5			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Adolescents	8.43_a	6.72	12.82_b	12.06	8.52_a	6.80	14.22_c	12.08	8.42_a	6.70	15.87_d	12.02	8.23_a	6.21	16.33_e	13.02	8.50_a	6.44	18.73_f	12.10
In-school unique friends	8.42_a	6.71	12.79_b	12.00	8.51_a	6.76	14.44_c	12.02	8.41_a	6.63	15.91_d	11.82	8.22_a	6.10	16.82_e	12.19	8.52_a	6.45	18.70_f	11.87
Conjoint friends	8.46_a	6.69	12.82_b	11.64	8.59_a	6.72	14.52_c	12.01	8.46_a	6.58	15.87_d	11.81	8.20_a	6.10	16.80_e	12.17	8.48_a	6.40	18.69_f	11.81
Out-of-school unique friends	15.46_a	6.59	22.82_b	11.52	14.42_a	6.81	24.02_c	12.14	15.33_a	6.01	26.80_d	11.93	14.60_a	6.29	28.80_e	12.75	13.52_a	6.21	29.67_f	11.65

Note. Different subscripts show differences between groups for depressive symptoms separately.

444) = 33.2, $p < .01$, but for boys, they did not, $F(1, 391) = 1.2$, $p > .05$.

The Selection–Influence–De-Selection Model of Depression

For both friendship selection and friendship de-selection, the dependent variable was changes in friendship nominations. For friendship influence, the dependent variable was changes in depressive symptoms. To distinguish between different types of changes in friendships for the 847 participants, we created one matrix for each measurement consisting of 847 × 847 cells. Each participant was represented with one row, which showed whether the participant nominated another participant as a friend (i.e., up to 23 nominations per participant). Each participant was also represented with one column, which showed whether the participant was selected as a friend. Thus, each cell showed whether a participant nominated the other participant (a value of $x_a = 1$; a *friend dyad*) or did not nominate the other participant (a value of $x_b = 0$; a *nonfriend dyad*). Self-nominations were excluded. If information about a dyad was missing (> 10% across measurements), we imputed scores according to the procedure developed by Huisman and Steglich (2008).

Two types of changes over time within cells were simultaneously studied. *Selecting a friend* refers to the change from a nonfriend dyad at one measurement to a friend dyad at the next measurement (from $x_b = 0$ to $x_a = 1$). *Deselecting a friend* refers to the change of a friend dyad at a measurement to a nonfriend dyad (from $x_a = 1$ to $x_b = 0$). Later we explain how effects on these two changes were used to examine selection and de-selection processes. These two types of changes were studied simultaneously as dependent variables in a dynamic model represented by SIENA (Snijders, 2001).

Selection processes: Similarity in depressive symptoms. For selection processes, we examined to what extent variables predicted that a nonfriend dyad at one measurement would change into a friend dyad at the next (from $x_a = 0$ to $x_b = 1$). For selection, higher positive significant values of β_k indicated that higher scores on a variable predicted a higher likelihood of selecting a friend versus not selecting a friend. The parameters β_k were estimated across all five measurements and were controlled for reciprocation and nonreciprocation of the dyad.

To address Hypothesis 1, that is, whether similarity in depressive symptoms predicted friendship selection, we examined to what extent similarity in depressive symptoms between all nonfriends predicted (a) selecting a friend or (b) not selecting a friend. This effect was labeled *depression: selection similarity*. See Table 2 for the results. Results confirmed Hypothesis 1. Higher depression: selection similarity predicted a higher probability of selection over nonselection ($\beta_k = 1.62$, $SE = 0.61$, $p < .01$). In other words, higher similarity in depressive symptoms between an adolescent and another person in the network predicted a higher chance for the adolescent selecting this other person as a friend. Thus, selection processes seem to partially explain why adolescents tend to be similar to their friends.

Selection processes: Confounding factors. We controlled the previously described effect of depression: selection similarity on friendship selection for effects of mean levels of depressive symptoms, network effects, and similarity in the factors gender, age, delinquency, and drinking. We now describe the results for each of these effects.

Effects of mean levels of depressive symptoms on selection were controlled in two ways. First, we controlled for effects of *depression: adolescents select*, which refers to how adolescents' mean levels of depressive symptoms predict how often they select friends. Second, we controlled for effects of *depression: friends*

Table 2
Social Network Model Pertaining to Friendship Selection, De-selection, and Influence Processes in Depressive Symptoms

Variable	β_k	*SE*
Selection		
Reciprocated relationship	2.54***	0.04
Triadic relationship	0.35***	0.01
Gender: selection similarity (0 = boy, 1 = girl)	0.61***	0.05
Age: selection similarity	1.30***	0.14
Depression: adolescents select	0.04	01.62
Depression: friends select	−0.25***	0.06
Depression: selection similarity	1.62***	0.61
Delinquency: selection similarity	1.73***	0.12
Drinking: selection similarity	2.34**	0.34
Depression: friend context	0.02	0.04
Depression: selection similarity ∗ friend context: inside	0.03	0.05
Depression: selection similarity ∗ friend context: outside	1.86***	0.43
De-selection		
Reciprocated relationships	−0.01	0.22
Triadic relationships	−0.09	0.11
Gender: de-selection similarity	−0.12	0.13
Age: de-selection similarity	0.00	0.02
Depression: adolescents de-select	2.17***	0.17
Depression: friends de-select	0.52***	0.12
Depression: de-selection similarity	−1.87***	0.56
Delinquency: de-selection similarity	0.02	0.02
Drinking: de-selection similarity	0.03	0.04
Depression: friend context	0.03	0.05
Depression: de-selection similarity ∗ friend context: inside	0.05	0.07
Depression: de-selection similarity ∗ friend context: outside	0.08	0.09
Influence		
Baseline depressive symptoms	−0.12	0.11
Friends' depressive symptoms	0.79***	0.09
Friends' drinking	0.18***	0.02
Friends' delinquency	0.02	0.05
Friend context	0.04	0.08
Friends' depressive symptoms ∗ friend context: inside	0.03	0.06
Friends' depressive symptoms ∗ friend context: outside	0.53***	0.08

Note. The following effects were estimated in the reported model but were omitted from the table for reasons of clarity: outdegree, gender ego, gender alter, age ego, age alter, delinquency ego, delinquency alter, drinking ego, drinking alter (for both selection and de-selection), and the quadratic effect of depressive symptoms on depressive symptoms (for influence). All estimates in the table and text are adjusted for these effects. *Friend context* has two conditions: *inside* refers to the contrast between friends found exclusively inside school (coded as 1) versus other friends (−1), and *outside* refers to the contrast between friends found exclusively outside school (1) versus other friends (−1). Thus, a significant positive interaction between these friend context conditions and other effects shows that these other effects are larger for the condition coded as 1.
** $p < .05$. *** $p < .001$.

select, which refers to how adolescents' mean levels of depressive symptoms predict how often they are being selected by friends. Results demonstrated the depression: friends select effect was negative and significant ($\beta_k = -0.25$, $SE = 0.06$, $p < .01$), indicating that higher levels of adolescents' depressive symptoms predicted adolescents being selected by fewer friends than expected by chance. The depression: adolescents select effect was not significant ($\beta_k = 0.04$, $SE = 1.62$, $p > .10$), indicating that adolescents' depressive symptoms did not affect how often they selected friends. Thus, findings demonstrated that we needed to take into account the effects of adolescents' mean levels of depressive symptoms on how often they selected friends. Nevertheless, even after controlling for these effects, we found that adolescents still tended to select others with similar levels of depressive symptoms.

We additionally controlled for several effects of the structure of the network of friendships on selecting a friend. We discuss only two network effects that are relevant for our hypotheses: *reciprocated relationship* and *triadic relationship* effects. It was crucial for us to control for reciprocated relationship and triadic relationship effects because these two effects offer alternative explanations of why adolescents form friendships, over and above effects of depressive symptoms. Reciprocated relationship effects refer to the tendency to form reciprocated friendships (for selection). Reciprocated relationship effects were found to be positive and significant ($\beta_k = 2.64$, $SE = 0.04$, $p < .01$), indicating that adolescents tend to reciprocate their friendships. Triadic relationship effects refer to the tendency to form triadic friendships. Effects of triadic relationship were significant and positive ($\beta_k = 0.25$, $SE = 0.01$, $p < .01$), indicating that adolescents tend to directly select the friends of their friends over time. Thus, effects of the network structure on selection were significant and, therefore, needed to be controlled.

Table 2 furthermore shows the effects of similarity in gender, age, delinquency, and drinking on friendship selection. The *gender: selection similarity* effect was significant and positive ($\beta_k = 0.63$, $SE = 0.05$, $p < .05$), suggesting that boys select boys more than girls and girls select girls more than boys. Furthermore, the *age: selection similarity* effect was positive and significant ($\beta_k = 1.30$, $SE = 0.14$, $p < .01$), suggesting that adolescents tended to select friends of the same age. Furthermore, the *delinquency: selection similarity* effect was positive and significant ($\beta_k = 1.73$, $SE = 0.12$, $p < .01$), indicating that adolescents tended to select friends with similar delinquent behaviors. Finally, the *drinking: selection similarity* effect was positive and significant ($\beta_k = 2.34$, $SE = 0.34$, $p < .01$), indicating that adolescents tended to select friends with similar drinking behaviors. These similarity effects were controlled for the main effects of gender, age, delinquency, and drinking, which are not presented in Table 2. In sum, findings indicated that even after friendship selection based on mean levels of depressive symptoms as well as similarity in gender, age, delinquency, and drinking were controlled, similarity in depressive symptoms still predicted friendship selection.

De-selection processes. For de-selection processes, we examined to what extent variables predicted that a friend dyad at one measurement would change into a nonfriend dyad at the next (from $x_a = 1$ to $x_b = 0$). For each independent variable, higher positive significant values of β_k indicated that higher scores on an independent variable predicted a higher likelihood of de-selecting a friend versus not de-selecting a friend. The parameters β_k were estimated across all five measurements and controlled for reciprocation and nonreciprocation of the dyad.

To test Hypothesis 2, which states that adolescents de-select friends who are dissimilar to them in depressive symptoms, we examined whether similarity in depressive symptoms between adolescents and their nominated friends predicted either de-selecting or not de-selecting those friends. This effect was labeled *depression: de-selection similarity*. Findings in Table 2 show that the depression: de-selection similarity effect was negative and significant, $\beta_k = -1.87$, $SE = 0.56$, $p < .01$, indicating that similarity between adolescents and friends predicted less de-selection between them. Therefore, Hypothesis 2 was supported: similarity in depressive symptoms predicted less de-selection.

De-selection processes: Confounding factors. We controlled the previously described effect of depression: de-selection similarity on friendship de-selection for effects of mean levels of depressive symptoms, network structure, and similarity in the factors of gender, age, delinquency, and drinking.

Regarding effects of mean levels of depressive symptoms on friendship de-selection, findings showed that the *depression: adolescents de-select* effect was significant and positive ($\beta_k = 2.17$, $SE = 0.17$, $p < .01$). This suggests that higher levels of depressive symptoms in adolescents predicted a higher likelihood of adolescents' de-selecting their friends than that expected by chance. Further, the *depression: friends de-select* effect was significant and positive ($\beta_k = 0.52$, $SE = 0.12$, $p < .01$), showing that adolescents' higher depressive symptoms predicted adolescents' being de-selected by friends more than expected by chance. Thus, effects of adolescents' mean levels of depressive symptoms on de-selection were significant and, therefore, needed to be controlled.

Effects of the network structure and similarity in the factors of gender, age, delinquency, and drinking on subsequent de-selection were all nonsignificant (β_k = from -0.12 to 0.11, SE = from 0.01 to 0.22, $p > .05$). Thus, unlike friendship selection, no support was found for differences in ending of friendships according to gender, age, structure of the social network, delinquency, or drinking.

Influence processes: Similarity in depressive symptoms. For influence processes, the dependent variable was represented by changes in adolescents' depressive symptoms. SIENA treats changes in depressive symptoms as ordinal categorical values (Snijders et al., 2007) and models changes in friendships and changes in depression as two interdependent processes, thereby controlling each for the other. This means that positive significant effects of the variables of interest on these change scores of depressive symptoms indicated that higher scores on the variable in question predicted a greater increase in adolescents' depressive symptoms than that expected by chance, with all other effects of independent variables (including those in selection and de-selection) held constant. We controlled for distribution and trend in depressive symptoms by including both the linear tendency of change and quadratic tendency of change in the categorical scores of depressive symptoms (Snijders et al., 2010).

Next, we examined Hypothesis 3, which states that friends' depressive symptoms predicted changes in adolescents' depressive symptoms over time. This effect was labeled *friends' depressive symptoms*. As seen in Table 2, Hypothesis 3 was confirmed: higher scores of friends' depressive symptoms predicted increases in adolescents' depressive symptoms over time ($\beta_k = 0.75$, SE =

0.09, $p < .01$). Thus, support was found for influence processes as an explanation of why adolescents tend to be similar to their friends in depressive symptoms.

Influence processes: Confounding factors. To ensure that similarity in depressive symptoms, and not similarity in externalizing problems, explained the results for influence processes, we additionally included (a) friends' delinquency and (b) friends' drinking when predicting changes in adolescents' depressive symptoms. See Table 2 for the results. Friends' delinquency did not predict increases in adolescents' depressive symptoms over time ($\beta_k = .02$, *SE* .05, $p > .05$). In contrast, friends' drinking did predict increases in adolescents' depressive symptoms over time ($\beta_k = 0.18$, $SE = 0.02$, $p < .001$). Nevertheless, friends' depressive symptoms predicted adolescents' depressive symptoms even after these effects were controlled. Thus, the alternative explanation that results regarding friendship influence in depressive symptoms can be explained by effects of friends' externalizing problem behaviors on adolescents' depressive symptoms was not supported.

Friend context differences in selection, influence, and de-selection. To explore differences in selection, influence, and de-selection according to friend context, we examined several interaction effects. First, to examine differences in selection effects for friends from different contexts, we examined two types of interaction effects: (a) the interaction between friend context: inside (coded as 1 = in-school unique friends and −1 = other friends) and the effect of depression: selection similarity, (b) the interaction between friend context: outside (coded as 1 = out-of-school unique friends and −1 = other friends) and the effect of depression: selection similarity. Additionally, we examined whether these two friend context variables interacted with depression: de-selection similarity on subsequent de-selection. Finally, we examined whether the two friend context variables interacted with effects of friends' depressive symptoms on subsequent depressive symptoms in adolescents.

Results showed that the two interactions of the friend context variables with depression: de-selection similarity were not significant ($\beta_k < 0.12$, $SE < 0.10$, $p > .05$). This indicates that the role of depressive symptoms in de-selection processes was similar for both school-based friends and out-of-school unique friends. Nevertheless, two other interaction effects were significant. The interaction between depression: selection similarity and friend context: outside was positive and significant ($\beta_k = 1.86$, $SE = 0.43$, $p < .01$). To further explore differences between out-of-school unique friends and other friends in selection effects, we studied two separate networks: one in which only out-of-school unique friends were included ($n = 305$), and one in which both in-school unique friends and conjoint friends were included ($n = 542$). For the group consisting of both in-school friends and conjoint friends ($\beta_k = 1.32$, $SE = 0.32$, $p < .01$) and for the group of out-of-school unique friends ($\beta_k = 2.11$, $SE = 0.48$, $p < .01$), adolescents tended to select friends with similar depressive symptoms. The effect was larger, however, for out-of-school unique friends than for other friends. In sum, adolescents' own levels of depressive symptoms seem to affect selecting and being selected by friends within school, who also may be found outside school, to a similar extent as selecting and being selected by out-of-school friends. Nevertheless, similarity in depressive symptoms between adolescents and their friends seems to be more important when adolescents are selecting out-of-school unique friends than when they are selecting friends in the school context.

Second, the interaction effect of friends' depressive symptoms with friend context: outside on changes in adolescents' depressive symptoms was positive and significant ($\beta_k = 0.53$, $SE = 0.08$, $p < .01$). Follow-up analyses indicated that effects of friends' depressive symptoms on adolescents' depressive symptoms were present both for out-of-school unique friends ($\beta_k = 0.84$, $SE = 0.17$, $p < .01$) and other friends ($\beta_k = 0.53$, $SE = 0.11$, $p < .01$), but as demonstrated by the interaction effect, the effect was significantly higher for out-of-school unique friends than other friends. Thus, influence processes regarding depressive symptoms seem to be stronger for out-of-school unique friends than for either in-school unique friends or conjoint friends.

In sum, findings indicate that selection, influence, and de-selection processes account for similarity in depressive symptoms between adolescents and friends both inside and outside the school context. Nonetheless, similarity in depressive symptoms was a stronger predictor for selection of out-of-school unique friends than for selection of in-school unique friends and conjoint friends. Further, out-of-school unique friends' depressive symptoms predicted stronger increases in adolescents' depressive symptoms than did other friends' depressive symptoms.

Discussion

Our first aim in the current study was to examine the relative importance of three processes that may explain how friends' depressive symptoms are linked to adolescents' depressive symptoms over time: selection (i.e., adolescents tend to form friendships with others who have similar depressive symptoms), influence (i.e., friends' depressive symptoms predict increases in adolescents' depressive symptoms), and de-selection (i.e., adolescents end friendships with friends who are dissimilar to them in depressive symptoms). One important contribution of the current study is the integration of these three processes into one model: the selection–influence–de-selection model. In this model, the three processes together result in adolescents' being even more similar to their friends than would have resulted from any of the three processes alone. For example, through both selection and de-selection, adolescents seem to filter out dissimilar friends from their friendships, leaving them with more relatively similar friends. This means that these processes seem to lead adolescents with higher levels of depressive symptoms to have friends with relatively higher levels of depressive symptoms and adolescents with lower levels of depressive symptoms to have friends with relatively lower levels of depressive symptoms. Prior research has indicated that friends who are similarly high in depressive symptoms are especially likely to engage in co-rumination (Rose et al., 2007), thereby increasing opportunities for influence processes. That is, as relatively similar adolescents continue to be friends due to selection and de-selection processes, these friends may engage in co-rumination, thereby influencing each other's depressive symptoms. Therefore, selection and de-selection seem to increase possibilities for influence processes to occur.

Further, these findings may have implications for future research on the role of friendships in other problem behaviors. Past research on the role of friends in substance use (Ennett & Bauman, 1994; Kandel, 1978; Urberg, Degirmencioglu, & Pilgrim, 1997),

delinquency (Dishion, Spracklen, Andrews, & Patterson, 1996; Selfhout et al., 2008), and sexual activities (Jaccard, Blanton, & Dodge, 2005) has shown the need to control for selection effects in studies of influence processes. The current findings indicate that in the case of friendship influence on adolescents' depressive symptoms, adjustments must be made for both selection and de-selection. Therefore, in previous research on the role of friends in other problem behaviors, the extent to which friends influence adolescents' problem behaviors may have been overestimated. In sum, researchers investigating similarity in problematic behaviors need to incorporate selection, influence, and de-selection simultaneously in order to avoid overestimating the relative importance of one of these processes.

Another contribution of the current study is that the role of depressive symptoms in selection, influence, and de-selection was controlled for a range of confounding factors. Most important, although we found that adolescents tend to select their friends on the basis of similarity in drinking and delinquency, this finding did not explain why adolescents select and de-select their friends on the basis of similarity in depressive symptoms. Perhaps similarity in depressive symptoms has a unique role in friendship selection and de-selection, over and above similarity in other problem behaviors.

In a similar vein, friends' depressive symptoms seem to affect adolescents' depressive symptoms irrespective of friends' self-reported delinquency and drinking behaviors. Influence processes regarding externalizing problem behaviors between friends do not seem to explain why friends influence each other's depressive symptoms. Whereas processes such as deviancy training (Dishion & Patterson, 2006) may explain influence effects for externalizing problem behaviors, co-rumination between depressive friends (Rose et al., 2007) may explain how friends influence each other's depressive symptoms. Nevertheless, because problems seldom come alone and depressive symptoms co-occur with externalizing problem behaviors (Saraceno et al., 2009), it is possible that these processes interact with each other to make friends' influence even stronger. In future studies, researchers should examine interactions between friendship influence processes in externalizing problem behaviors and friendship influence processes in depressive symptoms.

Our second aim in the current study was to explore potential differences in selection, influence, and de-selection processes inside and outside the school context. Between 30% and 40% of all friendships in this community sample were exclusively outside the school, which indicates that these friends form a large part of the friendship networks adolescents have. In the present study, we have expanded prior findings (Prinstein, 2007; Stevens & Prinstein, 2005) regarding selection and influence by showing that selection, influence, and de-selection occur both outside and inside school. Moreover, as almost one third of the friends were found outside school, current findings are more generalizable to adolescents' friendships than prior studies that were limited to friendships within school. Thus, the processes discussed take place across different friend contexts.

Nonetheless, findings indicate that the role of similarity in depression for two processes, namely selection and influence, was larger for out-of-school unique friends than either in-school unique friends or conjoint friends. Why are friends outside school more important for selection and influence than friends within school or in both contexts? There may be two reasons for this difference. First, selection and de-selection may be more restricted within schools because of peer status within schools. Within the school context, depressive adolescents may be less popular throughout high school (Brauner, 2006; Brendgen et al., 2002). Outside school, depressive adolescents may be able to find others who do not know their peer status in the school context and would have the opportunity to become more familiar with their values, thoughts, and feelings. Depressive adolescents may therefore have more opportunities outside school to find friends who match their depressive symptoms than they do inside school. Second, our findings of the descriptive analyses of this study may provide more insight into why depressive adolescents seek out similarly depressed adolescents outside school. These findings indicate that out-of-school unique friends showed consistently higher depressive symptoms than both in-school unique friends and conjoint friends. Adolescents with higher depressive symptoms themselves may therefore seek out out-of-school unique friends more on the basis of depressive symptoms. Further, as co-rumination processes (Rose, 2002; Rose et al., 2007) occur more frequently at higher levels of depressive symptoms, adolescents may be more influenced by depressive out-of-school unique friends than by other friends. Thus, out-of-school unique friends may be the most depressive friends and, therefore, may be more easily selected by depressive adolescents, perhaps acting as greater agents of influence. In sum, these results at least show that including only friends within school limits knowledge of peer processes regarding depressive symptoms: peers outside school may pose a greater risk factor for adolescents' developing depressive symptoms than friendships in school, which are usually the focus of empirical study. Researchers should explore why friends outside school could be a greater risk factor than friends inside school.

An interesting finding is that the adolescents had their own active role in isolating themselves from friends. Our results indicate that friend isolation is a two-sided process, in which both friends and adolescents play active roles. Friends seem to isolate adolescents more by selecting adolescents with higher depressive symptoms less often and de-selecting them more often than adolescents with lower levels of depressive symptoms (see also Huffman, 2001; Prinstein et al., 2005). On the other hand, adolescents with higher depressive symptoms themselves seem to de-select friends more often. Therefore, bidirectional transactional models as applied to relationship interactions (Goodman & Tully, 2008; Kuczynski, 2003; Lerner & Damon, 2006; Sameroff, 1991) seem to extend to adolescent–friend interactions regarding depressive symptoms as well. Both adolescents and their friends simultaneously tend to influence the formation and stability of adolescents' social relationships on the basis of levels of depressive symptoms. In sum, the findings provide unique empirical support for bidirectional transactional models regarding depressive symptoms, in which both depressive adolescents themselves and their friends play roles in the development of relationships between them.

The current study has several limitations that should be mentioned. First, regarding influence processes, the current study is built on prior literature concerning communication between friends with higher levels of depressive symptoms (e.g., Rose, 2002; Rose et al., 2007); nevertheless, this interaction itself was not studied. Second, aspects of the friendships themselves, such as

support or conflict, and their role in similarity in depressive symptoms between adolescents and their friends were not studied and should be further examined. Nevertheless, prior research has shown that whereas friendship quality may moderate effects of friends' depressive symptoms on adolescents' depressive symptoms, effects of friends' depressive symptoms on adolescents' depressive symptoms are found in both high- and low-quality friendships (Prinstein, 2007). Regardless, the way that friendship quality moderates selection, influence, and de-selection processes may additionally provide insight into how characteristics of friendships interact with characteristics of friends in adolescents' depressive symptoms. Another limitation is that in the current study, the roles of similarity in peer status, popularity, and positive behaviors that may matter for friendship selection were not contrasted with the role of similarity in depressive symptoms in friendship selection. For example, one study indicated that friends copy each other's prosocial behaviors (Haselager, Hartup, van Lieshout, & Riksen-Walraven, 1998). In the future, researchers should examine to what extent similarity in depressive symptoms plays a unique role in friend selection compared with these other factors. A final limitation is that in this study, we focused entirely on friendships and excluded romantic relationships and sibling relationships. We selected this focus because the focus of prior theory and empirical results has been friendship processes, not sibling or romantic relationships. Still, the question remains to what extent these processes occur in romantic and sibling relationships in adolescence.

The experience of depressive symptoms has obvious implications for life quality, and adolescents are particularly vulnerable to depressive symptoms. Much remains to be learned about the role friends play in the development of adolescents' depression, but the importance of friendships in adolescence suggests that friends might provide important clues. Concerning selection and influence, the effects that friends have on youths' depressive symptoms seem to be under the youths' control to some extent, as youths choose some friends and avoid others, but to some extent, they are not, as their friends also make active choices on the basis of youths' depressive symptoms. That youths with similarly high depressive symptoms simultaneously tend to choose each other, tend to influence each other's depression, and tend to end relationships with those who are dissimilar to them in levels of depressive symptoms is troubling. These processes within friendships seem to interact to make adolescents even more vulnerable to friendship influence in depression.

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(*Appendix follows*)

Appendix

Terminology of the Current Study and Corresponding Simulation Investigation for Empirical Network Analyses Terms

Term for effect in current study	SIENA term	Conceptual meaning
Selection	Network evolution: Evaluation function	The extent to which independent variables predict a change in friendships from being absent to being present
De-selection	Network evolution: Endowment function	The extent to which independent variables predict a change in friendships from being present to being absent
Influence	Behavioral evolution	The extent to which behaviors/characteristics of friends predict changes in the same behaviors/characteristics of adolescents and vice versa
Reciprocated relationships	Reciprocity	Tendency to form/end reciprocated friendships
Triadic relationships	Transitivity	Tendency to form/end triadic friendships
Adolescents select	Evaluation ego	Tendency for adolescents to select friends based on adolescent's mean level on independent variable
Friends select	Evaluation alter	Tendency for friends to select adolescents based on adolescent's mean level on independent variable
Selection similarity	Evaluation similarity	Tendency for adolescents and friends to select each other based on similarity between adolescents and friends in independent variable
Adolescents de-select	Endowment ego	Tendency for adolescents to de-select friends based on adolescent's mean level on independent variable
Friends de-select	Endowment alter	Tendency for friends to de-select adolescents based on adolescent's mean level on independent variable
De-selection similarity	Endowment similarity	Tendency for adolescents and friends to de-select each other based on similarity between adolescents and friends in independent variable
Influence: Baseline (variable)	Behavior (variable) tendency	Overall tendency of the dependent variable to change over time
Influence: Friend (variable)	Behavior (variable) total similarity	Tendency of friends to become more similar in the variable (characteristics/behaviors) over time: friend's characteristic/behaviors predict changes in adolescent's characteristics/behaviors

Note. Conceptual meaning = the interpretation of the selection/de-selection effects only in the current study. With other variables or effects included in SIENA models, the conceptual meaning changes (Snijders, et al., 2010).

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