The impact of peer relations on academic progress in junior high[☆]

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Abstract

The purpose of this study is to examine whether peer relations within classrooms were related to students' academic progress, and if so, whether this can be explained by students' relatedness and engagement, in line with Connell and Wellborn's self-system model. We analyzed data of 18,735 students in 796 school classes in Dutch junior high schools, using multilevel analysis. Academic progress, conceptualized as regular promotion to the next year versus grade retention, moving upward, and moving downward in the track system, was measured at the time of transition between Grades 1 and 2 (equivalent to US Grades 7 and 8). The results indicated that students who were accepted by their peers had lower probabilities to retain a grade or to move downward in the track system. Although peer acceptance was associated with relatedness and engagement, these variables did not explain why peer acceptance was associated to academic

progress. Furthermore, peer acceptance and relatedness were more strongly related in classes with more negative class climates.

Introduction

Research has established a significant link between children's relations with peers and their academic performance. Students who are poorly accepted by their classmates tend to have lower grades (Guldemond, 1994; Ollendick, Weist, Borden, & Greene, 1992; Wentzel, 2003; Wentzel & Caldwell, 1997; Wigfield, Eccles, & Rodriguez, 1998; Zettergren, 2003), lower scores on achievement tests (Buhs, Ladd, & Herald, 2006; Diehl, Lemerise, Caverley, Ramsay, & Roberts, 1998; Ladd, Coleman, & Kochendorfer, 1997; Vandell & Hembree, 1994; Zettergren, 2003), lower graduation rates (Risi, Gerhardstein, & Kistner, 2003) and a higher risk of dropping out (Hymel, Comfort, Schonert-Reichl, & McDougall, 1996; Jimerson, Egeland, Sroufe, & Carlson, 2000; Parker & Asher, 1987). Having friends at school appears to support involvement and engagement in school-related activities (Berndt, Laychak, & Park, 1990; Ladd, 1990; Vandell & Hembree, 1994; Wentzel & Caldwell, 1997) and school performance (Diehl et al., 1998; Ladd et al., 1997). Although these links have been found from childhood (e.g., Ladd, 1990) through college (e.g., Tinto, 1987), it has been suggested that relatedness to peers is particularly important and hence potentially problematic during early adolescence (Goodenow, 1993).

This article investigates whether students' relations with peers in the classroom affects their probabilities of grade retention, moving downward, and moving upward in the track system in Dutch junior high schools. From the large number of studies reporting linkages between peer relations and various educational outcomes, we would expect that there is indeed a relation. However, methodological flaws in some of the cited studies limit their significance. Furthermore, it is important to corroborate this relation for this crucial outcome variable in the Dutch educational system. Moreover, the underlying processes that might explain the link between peer relations and academic outcomes are not well understood. An explanatory pathway that is frequently cited is the self-system model of Connell and Wellborn (1991), but articles about the mediating linkages proposed by these authors either did not test them empirically (i.e., the effect of peer relations on an educational outcome was studied, with a theoretical reference to Connell and Wellborn) or only partially tested. In our paper, we tested whether the association between peer relations and academic progress is mediated by students' relatedness and, subsequently, engagement, as is in line with Connell and Wellborn's model. The following section describes this model. Thereafter, we discussed methodological issues that may limit the significance of some of the studies cited above. Then, after specifying the research questions, we described the method, the analyses, and the results.

The self-system model of Connell and Wellborn

Connell and Wellborn (1991) assigned a central role to social well-being in motivating academic performance. They posited that humans have fundamental needs for structure,

autonomy, and relatedness, and that the extent to which they can fulfill these needs within a certain context will predict their engagement in that context, and ultimately, their performance. Applied to educational contexts, the model states that interpersonal relations within the school context (with teachers, parents, and peers) provide students to a varying degree with structure, autonomy support, and relatedness. These self-system processes are then hypothesized to catalyze engagement versus disaffection toward school activities, which are considered a primary motivational influence on students' academic performance.

Connell (1990) defined the need for relatedness as "the need to feel securely connected to the social surround and the need to experience oneself as worthy and capable of love and respect" (p. 63). In line with the model, we assumed that the influence of interpersonal relations with classmates on academic progress is mediated by students' relatedness and, subsequently, engagement. Comparable expectations were pronounced in theories of the concept of belonging, which is identical to the concept of relatedness (see for a review Osterman, 2000). Connell and Wellborn applied their model within several school settings, and indeed it appeared that relatedness with classmates was associated with student engagement, which was, in turn, related to academic performance. However, they did not include peer relations per se in their analysis, so it is unclear whether these produce relatedness and hence are indirectly associated with engagement and academic performance.

Which aspects of peer relations are assumed to afford relatedness? Connell (1990) states that the need for relatedness is nourished by "the communication of interest in the individual through the dedication of natural and psychological resources and (…) the enjoyment of the individual by those in the social surround" (p. 66). In this paper, we focused on two positive aspects of peer relations: peer acceptance (i.e., the number of classmates who like the focal student) and number of friends. In the paragraph Methodological issues, we explain why it is important to consider both peer acceptance and number of friends.

However, in addition to these individualized measures of the peer environment, the general quality of peer relations in the class environment is important. It is likely that the general quality of peer interactions within the classroom (further referred to as 'class climate') influences the effect that peer acceptance and number of friends have on academic outcomes. This idea stems from social context models (e.g., Bellmore, Witkow, Graham, & Juvonen, 2004; Chang, 2004; Stormshak, Bierman, Bruschi, Dodge, & Coie, 1999), which recognize that the group norms in a social context in which children interact modify the meanings of peer relations, and hence can generate different outcomes. For the present paper, we expected that poorly accepted students would feel more isolated in classes that are characterized by poor social behaviors than in classes with prosocial climates. In a prosocial climate, poor, average, and well-accepted individuals may differ less in relatedness than in classes that are characterized by poor social climates. Therefore, we assumed that class climate influences the strength of the association (i.e., moderates the association) between individualized measures of peer relations and relatedness.

Connell and Wellborn's model ascribes a mediating role to relatedness, which is also labeled sense of belonging or connectedness. Relatedness, the presence of "secure and satisfying connections with others in one's social milieu" (Deci, Vallerand, Pelletier & Ryan, 991, p. 327), has been studied from several perspectives, such as theories of attachment, social support, and education (Furrer & Skinner, 2003). In educational studies,

measures of relatedness to the peer group comprise measures of feelings of inclusion, acceptance, and perceived support from peers. Furrer and Skinner showed that relatedness to peers uniquely contributed to student engagement, apart from relatedness to parents and teachers.

Engagement also has a mediating role in Connell and Wellborn's model. But what is meant by engagement? In practice, engagement appears to be an umbrella term for a multitude of concepts. Connell and Wellborn distinguished three dimensions: behavioral, emotional, and cognitive engagement. According to Fredricks, Blumenfeld, and Paris (2004), behavioral engagement pertains to involvement in learning, positive conduct, and participation in school-related activities. Evidence showed that peer relations are associated with aspects of behavioral engagement such as truancy (Kupersmidt, 1985), socially appropriate behavior, and academic effort (Wentzel, 2003). Emotional engagement refers to a student's affective reactions to the school, the classroom, and the teacher. Aspects of emotional engagement that appeared to be related to peer relations are school attachment (Moody & White, 2003), satisfaction in school (Wentzel & Asher, 1995), and achievement motivation (Kindermann, 1993; Wentzel & Asher, 1995; Wigfield et al., 1998). Cognitive engagement focuses on psychological investment in learning and self-regulation. For example, peer relations appeared to be related to self-regulated learning (Wentzel & Asher, 1995). Fredricks, Blumenfeld, and Paris suggest that the concept of engagement can best be studied by including multiple dimensions.

Although quite a few studies focused on the linkages between peer relations and engagement, most of them did not investigate whether engagement truly *mediated* the link between peer relations and academic performance. Exceptions are studies of Buhs et al. (2006) who showed that direct relations between peer relations and academic outcomes decreased in strength, but remained significant, when the mediators were entered into the equation, and of Wentzel (2003), who did not find a mediational effect of engagement.

Methodological issues

Peer relations are often studied within classrooms. The majority of studies into peer relations, however, does not use a multilevel approach, hence violates the assumption of statistical independence that is made by OLS regression. Statisticians have long recognized that ignoring nested data structures can lead to "misleading and erroneous conclusions" (Snijders & Bosker, 1999, p. 16; see also Bryk & Raudenbush, 1992; Goldstein, 1995). The hierarchical linear model, or multilevel model, incorporates error terms at the individual and the classroom level, which renders the model – unlike the OLS regression model – appropriate for testing hypotheses about individual and classroom variables. Next to these statistical arguments, it is theoretically important to distinguish between effects of individual behaviors and those of the social context. The multilevel approach allows such distinctions and thereby can avoid ecological fallacies (Goldstein, 1995; Snijders & Bosker, 1999).

Second, many studies predict academic performance at one point in time, either without controlling for prior performance and other characteristics that are strongly related to academic performance, or controlling for a too limited set of characteristics (for similar arguments, see Risi et al., 2003; Vandell & Hembree, 1994). In such cases, it is impossible to disentangle the directionality of an effect: Will children who perform well at school be

more accepted by their classmates (e.g., Austin & Draper, 1984), or will children who are well-accepted by their classmates perform better at school? School effectiveness research (e.g., Scheerens & Bosker, 1997; Teddlie & Reynolds, 2000) has stressed the need to control for prior performance and other core predictors of academic performance, such as gender, SES, and ethnicity, when testing the effect of a certain variable of interest on academic performance. In general, associations between aspects of peer relations and academic performance appear to become less strong or disappear completely when controlling for prior performance level (see Ladd et al., 1997; Risi et al., 2003; Wentzel, 2003).

Other scholars have suggested that multiple relational predictors should be considered simultaneously, to determine whether the contribution of one predictor is unique, redundant, or contingent on experiences or provisions children acquire via another predictor (e.g., Ladd et al., 1997; Risi et al., 2003; Vandell & Hembree, 1994; Wentzel & Caldwell, 1997). Although features of peer relations are often strongly interrelated (e.g., Gest, Graham-Bermann, & Hartup, 2001), they are not completely overlapping: For example, some children who are poorly accepted by their classmates do have a mutual friend, whereas some popular children do not have a friend (Parker & Asher, 1993). For peer acceptance and number of friends, some authors found additive effects (e.g., Diehl et al., 1998; Vandell & Hembree, 1994); others found redundant relations (Risi et al., 2003), while the study of Ladd et al. (1997) suggested that there are differential patterns of association depending on the outcome measure used. These findings are consistent with the view that distinct features of peer relations have distinct functions: Friendships provide affection, intimacy, and a sense of reliable alliance, peer acceptance gives students a feeling of inclusion, whereas either can provide companionship and instrumental aid (Furman & Robbins, 1985).

The present study

This study examines the impact of peer relations on students' academic progress. Three questions were addressed in this study: (1) Do peer acceptance and the number of friends predict students' academic progress, when controlled for prior performance and other relevant background characteristics?, (2) Are these relations mediated by students' relatedness and, successively, school engagement?, and (3) Does the strength of the association between peer acceptance and relatedness depend on the class climate? Based on the theory and empirical evidence outlined above, we expected to find the relations as presented in Fig. 1.

Design

Participants

Data were collected within the framework of a large-scale study in the Netherlands, the third "Longitudinal Cohort Study in Secondary Education" (VOCL'99), which was carried out jointly by the Groningen Institute for Educational Research (GION) and Statistics Netherlands (CBS; see CBS/GION, 1999; Kuyper, Lubbers, & Van Der Werf, 2003). This study followed a cohort of students from the first grade in junior high until they leave full-
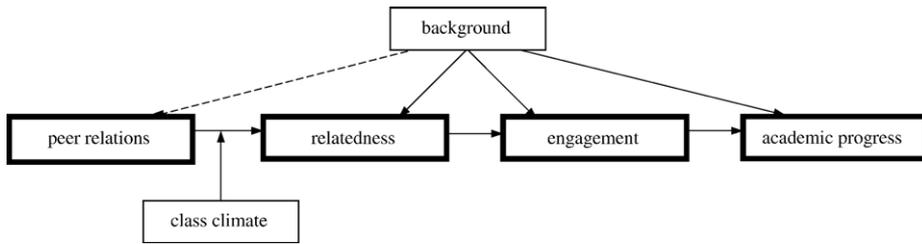
Fig. 1. Hypothesized theoretical model of the association between peer relations and students' academic progress.

time secondary education. All students (average age 13 years) who were in the first grade (equivalent to Grade 7 in the US) of a sample of 126 schools in 1999 belong to the cohort; this amounts to 19,391 students in 825 classes. The sample is representative for schools and students in Dutch secondary education (Kuyper & Van Der Werf, 2003).

The results are based on $N=18,735$ students in 796 classes.[1] Fifty percent was female ($N=9414$), 11% belonged to an ethnic minority ($N=2005$). Results from analyses that predicted the mediator variables pertained to about $N=17,000$ (for exact numbers, see Tables 3 and 4).

Procedures

The measures used in this study were derived from several sources. In January 2000 (four months after their entry into junior high), the students completed questionnaires while in their regular classes. They were assured that the information in the survey would be kept confidential. Students who were absent on the day the questionnaires were administered are missing cases.

At the same day, a written test in arithmetic was administered to assess students' performance level. The test was administered by teachers, unless school administrations requested test assistants.[2] Only four schools chose to do so. For the other schools, Statistics Netherlands had delivered the tests and teacher instructions to the schools a few days before the test administration was to take place, and collected the test material two weeks later. The results of the test were subsequently reported to the school administrations.

To assess students' academic progress within the school system, data on track and grade were collected yearly from the school records. Demographic variables were partly collected from the school records and partly from a parent questionnaire that was mailed in January 2000.

Measures

Peer relations

Peer acceptance. In the student questionnaire, students were asked to nominate a maximum total of three classmates whom they liked best. Peer acceptance was

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[1] These numbers are lower than the total number of students in the cohort due to missing values on the dependent variable (due to dropout) and ethnicity.

[2] The role of the teacher or test assistant was limited to unpacking the test material, handing out the tests, giving a short introduction, being present, and packing the administered tests.

operationalized as the number of choices students *received* from their classmates (hence peer-reported), which was standardized within classes to make the measure comparable across classes of varying size and extent of centralization (cf. Hardy, Bukowski, & Sippola, 2002).

Number of friends. A dyad of two classmates was classified as a friendship if both classmates nominated the other on both questions "Who of your classmates do you like most?" and "Who of your classmates do you meet most regularly outside school?". For both items, a maximum of three nominations could be given, so students could have up to three friends using this approach. If on both items, a student nominated a classmate who was a complete missing case for the sociometric questionnaire, this nomination was counted as a friend, because 63% of all valid multiplex nominations were mutual.

This approach yields a valid measure of the number of friends in the classroom, we believe, because it requires reciprocal as opposed to unilateral selection and it requires liking as well as shared activities. Studies using reciprocal nominations as a measure for friendship (e.g., Bukowski & Hoza, 1989; Vandell & Hembree, 1994) stressed that the use of such a measure represents a conservative test of the hypothesis that peer acceptance and friendship are unique contributors to adjustment because of the inherent overlap in the measures. In the present study, 60% of the students had at least one friend.

Background characteristics

Performance level was assessed via the administration of an arithmetic test. The test was developed by the National Institute for Educational Testing (CITO) for the VOCL study. The test consisted of twenty multiple-choice items and obtained an alpha reliability of .83.

Recommended track. The Dutch educational system is largely a tracked system. At the end of primary education, a level of secondary education is recommended to students, based on their performance on a standardized national test and on their teachers' views. This ordinal variable has nine categories, corresponding to the five track levels of Dutch secondary education and four types of dual recommendations (for two adjacent levels). The recommendations are ordered from the *lowest* (1) to the *highest* (9) track level (Table 2 presents the Dutch labels between brackets).

Track level. The actual track level, which is a class-level variable, deviates from the recommended track level for many students, because students who received a dual recommendation may be placed in a single tracked class, or conversely, because students who received a single track recommendation may be placed in combined classes of two or more tracks. Whereas the recommended track is an indicator of the student's performance level in primary education, the actual track level indicates the level at which the student receives education. The categories of the actual track level are similar to those of the recommended track level (see above). Classes that consisted of more than two tracks were coded in agreement with the median level. Dummy variables were created to represent track level (see Method of analyses).

Parental education. This variable is used as a proxy for socioeconomic status, and is indicated by the educational levels of the child's father and mother. The variable was constructed from multiple items related to the father's and mother's attendance and graduation at six levels of education. For each student, the highest of father and mother's reported

educational levels was taken as an indicator of parental education. Responses were coded from 1 (*primary education, completed or not*) to 6 (*second stage of higher education completed*).

Gender. Gender was coded 0 for boys and 1 for girls.

Ethnicity. Since the number of students with a non-Dutch background was relatively small, we only distinguished the categories *native Dutch* (value 0) and *ethnic minority* (value 1).

School engagement

School engagement was measured with three constructs, achievement motivation (an indicator of emotional engagement), educational aspiration (behavioral engagement), and integrative strategy use (cognitive engagement).

Achievement motivation was assessed using a scale of nine items. The items were selected from an instrument used by Kuyper and Swint (1996), which is in its turn an adapted version of the subscale Achievement Motivation of the PMT-K (Hermans, 1983). All items were formulated on a 4-point scale. Sample items are "Whenever we have a test, I study [*as hard, somewhat harder, harder, a lot harder*] than usual", "It is [*not important, somewhat important, important, very important*] to me to get a good report", and "When I study, I demand [*not much, little, quite a bit, a lot*] of myself". In the present study, the scale obtained an alpha coefficient of .74. Average scale scores were computed for students with valid scores on at least seven items.

Educational aspiration. Students were asked whether they planned to continue studying after finishing secondary education. Responses to this item were coded on a 5-point scale, ranging from *certainly not* to *certainly*.

Integrative strategy use. This scale is an adapted version of the scale for Cognitive Strategy Use by Pintrich and De Groot (1990). In the present study, a subscale of six items was used that pertained to the use of integrative strategies. Sample items are "When I study for a test, I [*hardly ever, sometimes, as often as not, often, nearly always*] try to put together the information from class and from the book", "I [*hardly ever, sometimes, as often as not, often, nearly always*] try to understand what the teacher is saying even if it doesn't make sense", "When I am studying a topic, I [*hardly ever, sometimes, as often as not, often, nearly always*] try to make everything fit together". In the present study, the scale obtained an alpha coefficient of .70. An average scale score was computed for all students who had valid scores on at least five items.

Relatedness

Relatedness was measured with two constructs, school well-being and self-perception of being liked.

School well-being was assessed with a six-item scale (Kuyper et al., 2003). Sample items are "I get along [*poorly, reasonably, well, very well*] with my classmates", "I find the school climate [*unpleasant, a bit nice, pretty nice, very nice*]", "I feel [*much less, a little less, equally, a little more, much more*] comfortable in this school than in my primary school". Responses were scored on a 4-point or a 5-point scale.[3] The scale obtained an alpha

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[3] The scale values of the three 4-point items were transformed into a 5-point range (i.e., 1=1, 2=2.33, 3=3.67, and 4=5; see Kuyper et al., 2003).

coefficient of .71. An average scale score was computed for all students who had valid scores on at least five items.

Self-perception of being liked. Students were asked whether they thought they were less or more well-liked than their classmates were. The responses were scored on a five-point scale.

The moderator Class climate

Class climate was assessed with an eight-item scale in the student questionnaire. The scale was largely based on a subset of items in the School Climate Test developed by Veugelers and De Kat (1998). All selected items concern student–student interactions, and were phrased with a general reference (e.g., "In our class, students treat each other fairly", "In our class, students trust each other", and (inverse direction) "In our class, students bully each other") rather than a personal reference (e.g., "My classmates treat me fairly"). Students were asked to what extent each statement applied to their classroom. Responses were scored on a five-point scale, ranging from 1 (*hardly ever*) to 5 (*almost all the time*). The internal consistency of the scale was high ($\alpha = .81$). An average scale score was computed for students who had valid scores on at least seven items. These average scale scores were then averaged over all students in a class.

Dependent variable

Academic progress in the school system was based on students' grade and track in subsequent cohort years. For students' *academic progress*, students were assigned to one of four categories[4]: (a) *promotion to the next year*, if the student was promoted to the second grade of the track he or she started in; (b) *grade retention*, if the student had to repeat the first grade; (c) *downward mobility among tracks*, if the student was promoted to the second grade of a lower track; (d) *upward mobility among tracks or skipping a grade*, if the student either attended the second grade of a higher track or the third grade of the same track he or she started in. Students who left school during or at the end of the first school year ($N = 302$) were excluded, as dropouts could not be distinguished from students who moved to another city or had other reasons to change schools. The category *promotion to the next year* served as a reference category in the analyses.

Missing values

Missing values for the explanatory variables at the individual level were imputed using the EM algorithm of Dempster, Laird, and Rubin (1977). This algorithm replaces missing values on the basis of estimates of means, variances, and covariances of a partially observed data matrix. Missing values for the binary variable ethnicity were imputed on the basis of the student's family name and the language they spoke at home. However, if these data were inconclusive, the missing values for ethnicity were not imputed. Data for the variable gender were complete.

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[4] For students who started in combined tracks (e.g., MAVO–HAVO), moving to a singular track is only seen as downward or upward movement if that track was not included in the combination they attended in the first year, and vice versa.

Method of analysis

After presenting descriptive statistics and zero-order correlations, a series of multilevel regression analyses was conducted, which predict academic progress while testing for mediator and moderator effects (see Baron & Kenny, 1986). In the analyses, students formed the level 1 units, which are nested within school classes, the level 2 units (e.g., Goldstein, 1995; Snijders & Bosker, 1999). We used multilevel analysis instead of two-level structural equation modeling (SEM), as two-level SEM is less versatile with regard to categorical outcome variables, class-level predictors, and moderator effects. A series of multilevel analyses generates a similar result.

Mediation requires that (a) peer relations have a direct effect on academic progress, as well as on the mediators; (b) the mediators have an effect on academic progress; (c) the direct effect of peer relations on academic progress disappears when the mediating variables are entered into the equation. In case of partial mediation, the direct effect does not disappear but is significantly reduced. Moderation requires a significant effect of the *interaction* between peer acceptance and the moderating variable (class climate) on academic progress. For correct interpretation, the main effects of peer acceptance and class climate have to be included as well.

With several mediators and a moderator, the analyses were carried out in three stages, in which the dependent variables are successively academic progress, engagement, and relatedness. For all analyses, all explanatory variables, except binary and dummy variables, were standardized to ease the interpretation of the results. That is, the effect sizes of standardized predictors are comparable. As is usual, interactions between two (standardized) variables were not standardized. Since the main effects were standardized, interaction effects are not collinear with the main effects.

In the first stage, *academic progress* was the dependent variable. Multinomial logistic regression analysis was used, as this is a non-ordered categorical outcome variable. The software MIXNO (Hedeker, 1999), a program for multilevel nominal logistic regression, was used to perform the analyses. Since the data of academic progress were not very informative due to their limited variability (see the section Descriptive statistics), a significance level of .05 was used. Logistic regression models are multiplicative models. When we denote the regression coefficient b, we can interpret the value of this coefficient by stating that a unit increase in the explanatory variable will multiply the log odds for an event (e.g., grade retention) with e^b. So, regression coefficients smaller than 1 imply a decrease of the log odds, and coefficients larger than 1 imply an increase of the log odds. Differently expressed, a unit increase in the explanatory variable is associated with a percentage change of $100(e^b - 1)$ of the log odds.

First, an empty model of students' progress was estimated in order to determine the total variance and the initial deviance for later reference, since the difference in deviance between two subsequent models is a measure of goodness of fit. Then, the following sets of variables were added in four steps: students' background (Model A2), peer relations (Model A3), relatedness (Model A4), and engagement (Model A5).

For Model A3, we first entered peer acceptance and number of friends each separately (not in table); then, they were entered simultaneously along with their interaction effect in order to see whether their effects were unique, redundant, or contingent on each other (Model A3).

It was not sufficient to model linear effects of performance level and track level (from Model A2 onwards), as it was expected that the extremes of these variables are particularly relevant for

academic progress. That is, for grade retention and downward movement among tracks, the lower extreme of performance (representing failure) is assumed to be relevant (whereas distinctions between satisfactory, good, and outstanding are not); for upward movement among tracks, the upper extreme (representing outstanding results) is assumed to be relevant. For a more optimal control of the (initially) strong effects of track level and performance level, we used (a) the linear effect of performance level (*PL*) as well as a quadratic spline for negative and positive scores on the variable performance level (see Snijders and Bosker, 1999, p. 189):

$$f_1(\text{PL}) = \text{PL} \qquad \text{(performance level linear effect)}$$

$$f_2(PL) = \begin{cases} \text{PL}^2 & \text{(for PL} \leq 0) \\ 0 & \text{(for PL} > 0) \end{cases} \quad \text{(performance level quadratic effect} \atop \text{negative scores)}$$

$$f_3(PL) = \begin{cases} 0 & \text{(for PL} \leq 0) \\ \text{PL}^2 & \text{(for PL} > 0) \end{cases} \quad \text{(performance level quadratic effect} \atop \text{negative scores)}$$

Performance level was standardized, so the value 0 represented the average.

(b) a set of dummy variables to represent track level. As some categories of academic progress were empty for the lower track levels, these dummies were excluded from the analyses. This seemed reasonable given the marginal probabilities and the smaller number of cases in the lowest categories.

In the second stage, the mediators concerning *engagement* became the dependent variables, and in the final stage, the mediators concerning *relatedness*. For these analyses, multilevel linear regression analyses were carried out using MLwiN (Goldstein et al., 1998). A level of significance of $p < .01$ is now used, since the dependent variables are much more informative and the sample size is large. The dependent variables were standardized. For engagement, four models were estimated: first, the empty model (Model B1), then, the background variables were added (Model B2), then peer relations (Model B3), and lastly relatedness (Model B4). For the analyses of relatedness, five models were estimated: first, the empty model (Model C1), then, the background variables were added (Model C2), then peer relations (Model C3), then the main effect of class climate (Model C4) and its interaction with peer acceptance (Model C5).

Results

Descriptive statistics

At the time of transition from the first to the second school year, 95% of the students were promoted to the next year ($N = 17,882$), whereas 2% moved downward ($N = 334$), 2% moved upward or skipped a grade ($N = 288$), and 1% were retained ($N = 234$).

Table 1 presents zero-order correlations between the variables at the individual level. All explanatory variables have low bivariate correlations with students' progress, which is largely due to the binary and very skewed nature of academic progress (see Table 1). The highest correlation between two predictors is .69 (performance level and recommended

Table 1
Zero-order correlations between the individual-level variables (all pairwise Ns>8000)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Performance level														
2. Recommended track level	.69													
3. Parental education	.31	.39												
4. Female (binary)	−.11	.03	−.02											
5. Ethnic minority (binary)	−.13	−.14	−.28	.00										
6. Peer acceptance	−.02	.01	.03	.04	−.04									
7. Number of friends	.10	.15	.12	.14	−.07	.38								
8. Self-perception being liked	−.06	−.06	−.04	−.06	.10	.15	.07							
9. School well-being	.03	.06	.04	.06	−.07	.09	.06	.21						
10. Achievement motivation	.05	.08	.01	−.01	.15	−.01	.01	.10	.18					
11. Aspiration	.18	.20	.09	.04	.11	−.02	.03	.04	.09	.24				
12. Integrative strategy use	.14	.14	.07	−.05	.03	−.01	.02	.08	.19	.45	.20			
13. Grade retention (dummy)	.05	.10	.00	−.05	.00	−.03	−.01	−.02	−.01	.01	.00	.01		
14. Downward mobility (dummy)	−.03	−.02	−.02	−.04	.02	−.04	−.02	−.01	−.02	.02	.00	−.01	−.02	
15. Upward/skipping grade (dum.)	.03	.02	.01	.02	.01	−.01	−.02	−.01	.00	.03	.02	.03	−.02	−.01

Note. Correlations significant at the 0.01 level are indicated by the use of italics.

track level). The correlation between peer acceptance and number of friends was $r=.38$ ($p<.01$).

At class level (not in table), class climate was significantly correlated with track level ($r=.52$, $p<.01$). Class climate was not significantly correlated with the dispersion[5] of the unstandardized values of peer acceptance. So, a potential moderating effect of class climate is not an artifact of differences in the dispersion of peer acceptance before standardization. At the individual level, perception of class climate was significantly correlated with peer acceptance and number of friends, but these correlations were not substantial (rs<.10; $p<.01$).

Predicting academic progress

Table 2 presents the results of the analyses of academic progress. First, an empty model was estimated (Model A1). In this model, the probabilities of promotion to the next year, downward

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[5] The dispersion of the unstandardized values of peer acceptance was measured using Snijders' index for graph heterogeneity J (Snijders, 1981). This measure reflects the dispersion of the unstandardized number of nominations received by students within a class, and is normalized with respect to the density of nominations within a class.

Table 2
Logistic multilevel model predicting academic progress (downward mobility among tracks, grade retention, and upward mobility among tracks versus regular promotion to the next year; $N=18,735$): coefficients and standard errors for the final model, the variance at class level and the model fit

Step	Fixed effects	Downward mobility among tracks		Grade retention		Upward mobility or grade skipping	
	Fixed effects final model	Coeff.	SE	Coeff.	SE	Coeff.	SE
A1	Intercept	−9.665	1.168	−4.552	0.196	−4.500	0.356
A2	Performance level linear	−0.245	0.286	−0.509	0.331	0.530	0.404
	Performance level quad. pos.	−0.561*	0.231	−0.167	0.274	−0.002	0.349
	Performance level quad. neg.	0.174	0.284	−0.183	0.170	−0.146	0.342
	Recommended track	−0.489*	0.181	−0.192	0.151	0.770*	0.222
	Parental education	−0.403*	0.079	−0.111	0.088	0.258*	0.105
	Female	−1.026*	0.152	−0.917*	0.168	0.473*	0.149
	Ethnic minority	−0.062	0.266	0.265	0.203	0.631*	0.270
	Mean performance level	0.814	0.296	−0.026	0.184	1.240*	0.419
	Track level 6 (mavo–havo)	3.379*	1.176	0.381*	0.201	−1.986*	0.429
	Track level 7 (havo)	6.609*	1.182	0.878*	0.394	−2.238*	0.790
	Track level 8 (havo–vwo)	6.568*	1.189	0.879*	0.305	−6.649*	0.756
	Track level 9 (vwo)	6.500*	1.271	1.293*	0.535	−9.015*	1.880
A3	Peer acceptance	−0.181*	0.081	−0.364*	0.109	−081	0.104
	Number of friends	−0.068	0.080	0.113	0.094	−0.033	0.108
	Peer acceptance × N friends	−0.022	0.065	0.002	0.073	−0.011	0.094
A4	Self-perception being liked	−0.104	0.069	−0.034	0.064	−0.028	0.097
	School well-being	−0.028	0.073	−0.061	0.075	−0.014	0.095
A5	Achievement motivation	−0.049	0.090	0.107	0.097	0.290*	0.105
	Aspiration	−0.081	0.082	−0.006	0.087	0.177	0.109
	Integrative strategy use	−0.039	0.087	−0.094	0.102	0.130	0.097
	Mean achievement motivation	0.167	0.112	0.135	0.075	−0.025	0.145
	Variance	Variance		Variance		Variance	
A1	Variance class-level	4.496		0.669		18.380	
A2	Residual variance class-level	1.484		0.264		9.464	
A3	Residual variance class-level	1.480		0.272		9.544	
A4	Residual variance class-level	1.489		0.149		4.135	
A5	Residual variance class-level	1.517		0.158		4.193	
	Model fit	Deviance (df)					
A1	Original deviance model A1	8,120.9					
A2	Difference in deviance A1−A2	1,309.3 (36)*					
A3	Difference in deviance A2−A3	21.1 (9)*					
A4	Difference in deviance A3−A4	12.1 (6)					
A5	Difference in deviance A4−A5	42.4 (12)*					

* $p<.05$.

mobility, grade retention, and upward mobility for a class with a zero random effect were estimated as $1/(1+e^{-4.111}+e^{-4.200}+e^{-5.507})=.966$, $e^{-4.111}/(1+e^{-4.111}+e^{-4.200}+e^{-5.507})=.016$, $e^{-4.200}/(1+e^{-4.111}+e^{-4.200}+e^{-5.507})=.014$, and $e^{-5.507}/(1+e^{-4.111}+e^{-4.200}+e^{-5.507})=.004$, respectively. These estimates are weighted averages, so the larger the intraclass

correlations, the less well these estimates may agree with the unweighed averages presented earlier. The intraclass correlation of upward mobility and grade skipping is particularly high.

Subsequently, the background variables were entered (see Model A2). This significantly improved the model fit (decrease in deviance 1309.3; $df=36$; $p<.001$). Since the background variables only serve as control variables, their effects will not be discussed here.

In Model A3, peer acceptance, number of friends, and their interaction were entered. This improved the model fit significantly (decrease in deviance 21.1; $df=9$; $p<.05$). One standard deviation increase in peer acceptance reduces the odds of *downward mobility* by 18% (i.e., $100(e^{-0.204}-1)$), and *grade retention* by 32% (i.e., $100(e^{-0.381}-1)$), net of the other effects. This means that with equal background characteristics, well accepted students have a lower probability to retain a grade or to move downward in the track system than poorly accepted students. The effect of peer acceptance on *upward mobility and grade skipping* is not significant. When the number of friends was added to Model A2 on its own, it only had a significant effect on the odds of downward mobility (regression coefficient= -0.130; SE=0.065; $Z=-2.00$; $p=.046$; not in table), but this effect became insignificant when entered simultaneously with peer acceptance (see Model A3). Hence, the number of friends does not uniquely contribute to the prediction when controlling for peer acceptance. Also, the interaction effect was insignificant (see Model A3), which implies that the effects of peer acceptance and number of friends are not contingent on each other.

Next, the mediators pertaining to relatedness were added to the model (see Model A4). The decrease in deviance was not significant (decrease in deviance 12.1; $df=6$; *ns*). We found that (A) relatedness did not predict grade retention and track mobility, and (B) the parameter estimates for peer acceptance hardly decreased in magnitude once their effects were controlled for relatedness. Therefore, relatedness as operationalized in the present study does not mediate the relation between peer relations and academic progress in Grade 1.

Finally, the mediators pertaining to engagement were entered into the equations (Model A5; see Table 2). This significantly reduced the deviance (decrease in deviance 42.4; $df=12$; $p<.001$). However, only achievement motivation had a significant effect on upward mobility and grade skipping. One standard deviation increase in achievement motivation increased the odds of upward mobility and grade skipping by 34%, which implies that students who are more motivated as compared to their classmates have higher odds of moving upwards, net of the other effects.[6] The parameter estimates of peer acceptance hardly decreased when the engagement variables (among which achievement motivation) were entered. So, peer acceptance has an effect on downward mobility and grade retention that cannot be explained by students' engagement (coefficients are -0.181 and -0.364, respectively). For upward mobility, peer acceptance did not have an effect in the first place (even before controlling for achievement motivation).

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[6] As the decrease in deviance was too large to be explained by achievement motivation alone, it was expected that a composite score of the engagement variables might have significant effects even though the separate scores were not significant. However, when we replaced the engagement variables by a composite score, only the odds of upward mobility were affected significantly by the composite score (regression coefficient=0.894; SE=0.202; $Z=4.43$; $p<0.001$; deviance of this model 6,717.8; not in table).

Table 3
Coefficients and standard errors for multilevel model B4 predicting engagement (Achievement Motivation, Aspiration, and Integrative Strategy Use)

Step	Fixed effects	Achievement motivation N=17,635		Aspiration N=14,199		Integrative strategy use N=17,745	
	Fixed effects final models	Coeff.	SE	Coeff.	SE	Coeff.	SE
B1	Intercept	−0.030	0.014	−0.095	0.014	0.036	0.013
B2	Performance level	−0.043*	0.012	0.049*	0.013	0.058*	0.012
	Recommended track	0.048*	0.016	0.163*	0.017	0.067*	0.016
	Parental education	0.009	0.008	0.033*	0.009	0.019	0.008
	Female	−0.042*	0.015	0.080*	0.017	−0.113*	0.015
	Ethnic minority	0.470*	0.026	0.490*	0.028	0.173*	0.025
	Mean performance level	0.086*	0.017	0.027	0.018	0.036*	0.017
B3	Peer acceptance	−0.029*	0.008	−0.032*	0.009	−0.028*	0.008
	Number of friends	0.006	0.009	0.001	0.009	−0.005	0.008
	Peer acceptance × N friends	−0.007	0.006	0.002	0.007	0.002	0.006
B4	School well-being	0.181*	0.008	0.080*	0.008	0.179*	0.008
	Self-perception being liked	0.047*	0.008	0.026*	0.008	0.049*	0.008
	(Explained) Variance	Var.	R^2	Var.	R^2	Var.	R^2
B1	Total variance	1.002	–	1.004	–	1.001	–
B2	Residual variance and R^2	0.968	3.4%	0.931	7.3%	0.970	5.1%
B3	Residual variance and R^2	0.968	3.4%	0.930	7.4%	0.970	5.1%
B4	Residual variance and R^2	0.931	7.1%	0.922	8.2%	0.933	6.8%
	Model fit	Deviance (df)		Deviance (df)		Deviance (df)	
B1	Original deviance	49,473.9		39,913.1		49,911.2	
B2	Difference deviance B1–B2	375.5 (6)*		729.5 (6)*		326.4 (6)*	
B3	Difference deviance B2–B3	2.4 (3)		5.7 (3)		0.0 (3)	
B4	Difference deviance B3–B4	693.1 (2)*		116.7 (2)*		681.1 (2)*	

 * $p < .01$.

Mediators as dependent variables

Since student relatedness and engagement, as operationalized in our study, were not related to students' progress, we have found no support for the mediational hypothesis. However, we have tested only a part of our theoretical model, since we have not yet regarded the direct relations between peer acceptance and number of friends, engagement, and relatedness. Also, we have not considered the moderating hypothesis yet. Were those relations supported in our study?

This section presents the results of the multilevel analyses of the mediators, treated as *dependent variables*. All mediators were standardized. As linear multilevel regression analysis was used, the effects are linear as opposed to the multiplicative effects in the previous sections. Apart from the variance and deviance of all models, only the parameter estimates of the final models were presented (Tables 3 and 4). Track level and quadratic effects of individual performance level had no or only minor effects on the mediators and were therefore excluded.

Table 4
Coefficients and standard errors for the final multilevel model C5 predicting relatedness (School Well-Being and Self-Perception Being Liked)

Step	Fixed effects	School well-being $N=17,985$		Self-perception being liked $N=16,730$	
	Fixed effects final models	Coeff.	SE	Coeff.	SE
C1	Intercept	−0.031	0.013	0.058	0.012
C2	Performance level	−0.012	0.012	−0.033*	0.012
	Recommended track	0.020	0.016	−0.026	0.016
	Parental education	0.001	0.008	−0.009	0.009
	Female	0.085*	0.015	−0.162*	0.015
	Ethnic minority	−0.099*	0.025	0.340*	0.026
	Mean performance level	−0.080*	0.018	−0.027	0.017
C3	Peer acceptance	0.104*	0.008	0.744*	0.078
	Number of friends	0.028*	0.008	0.052*	0.009
	Peer acceptance × N friends	0.0002	0.006	−0.036*	0.006
C4	Class climate	0.209*	0.012	0.037*	0.010
C5	Class climate × peer acceptance	−0.029*	0.007	−0.156*	0.021
	(Explained) Variance and R^2	Variance	R^2	Variance	R^2
C1	Total variance	1.002	–	1.001	–
C2	Residual variance and R^2	0.990	1.2%	0.982	1.9%
C3	Residual variance and R^2	0.978	2.4%	0.940	6.1%
C4	Residual variance and R^2	0.947	5.5%	0.939	6.2%
C5	Residual variance and R^2	0.946	5.6%	0.936	6.5%
	Model fit	Deviance	(df)	Deviance	(df)
C1	Original deviance	50,472.7	–	47,422.8	–
C2	Difference in deviance C1–C2	124.3*	(6)	277.0*	(6)
C3	Difference in deviance C2–C3	246.6*	(3)	736.5*	(3)
C4	Difference in deviance C3–C4	259.6*	(1)	13.9*	(1)
C5	Difference in deviance C4–C5	16.7*	(1)	53.8*	(1)

* $p<.01$.

Student engagement. Table 3 shows the deviance and variance components of the models pertaining to students' engagement. Although peer acceptance had small but significant effects on all three engagement variables, the model fit for none of the engagement variables was improved by adding peer relations (Model B3). The mediators pertaining to relatedness, namely school well-being and self-perception of being liked, significantly improved the fit for all dependent variables (Model B4).

Table 3 also shows the final models for student engagement. Both school well-being and (to a lesser extent) self-perception of being liked had significant effects on the three engagement variables. However, the variables pertaining to relatedness did not mediate the relation between peer relations and engagement, since direct effects of peer relations on engagement were small (Model B3, parameter estimates not in table) and these small effects were not reduced by entering the mediators pertaining to relatedness (Model B4, Table 3).

Relatedness. Table 4 shows the deviance and variance components of the analyses pertaining to relatedness. The effect of peer relations (Model C3), the main effect of class
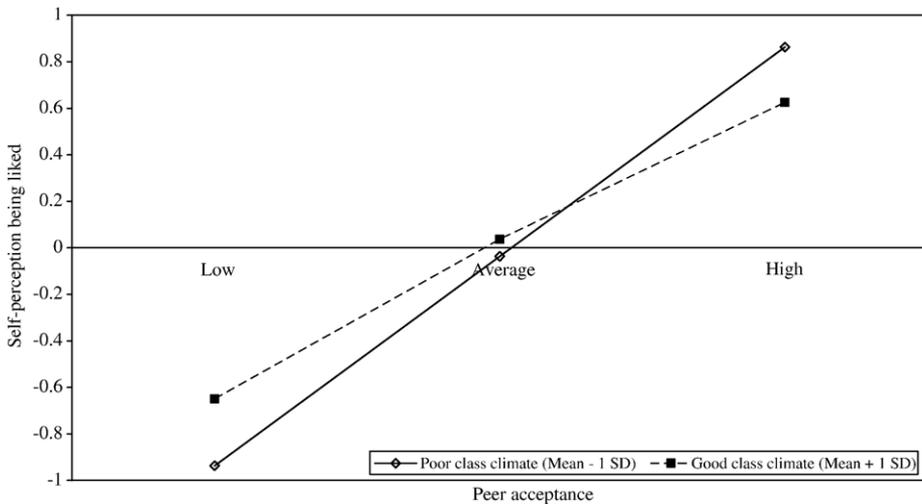
Fig. 2. The moderating role of class climate on the association between peer acceptance and self-perception being liked.

climate (Model C4), and the moderator effect of class climate (Model C5) all significantly improved the fit of the two dependent variables.

Table 4 presents the final models for relatedness. Both peer acceptance and number of friends contributed to students' school well-being and perception of being liked, but the effect of number of friends was small. The interaction between the two predictors was negative for self-perception of being liked, which implies that the effects are to a certain degree redundant. So, both peer acceptance and number of friends can improve the self-perception of being liked, but the effects only add up to approximately the extent of the largest effect of the two.

Class climate only slightly moderates the relation between peer acceptance and school well-being. However, its main effect is much stronger. This implies that in more positive class climates, the school wellbeing of all individuals is estimated to be larger, for well accepted students and for poorly accepted students. The small but significant interaction effect indicates that the differences between high and low accepted students as to their school well-being is a bit smaller in relatively positive class climates than in relatively poor class climates.

Class climate moderates the relation between peer acceptance and self-perception of being liked quite considerably. Its main effect is smaller but significant as well. Fig. 2 illustrates the moderator effect. It appears that the relation between peer acceptance and self-perception of being liked is stronger in classes with relatively poor climates than in classes with relatively good climates. The intersection of the two lines in Fig. 2 shows that poorly accepted students are better off (in terms of their self-perception of being liked) in relatively positive class climates, but well accepted students are better off in relatively poor class climates. These results might indicate that the "pecking order" is more visible in more negative class climates.

Given the strong association between class climate and track level (see Descriptive statistics), we might suspect that class climate only ostensibly moderated the relation between peer acceptance and self-perception of being liked, but that the real moderator is track level. This would lead to an entirely different interpretation. Additional analyses however showed that this is not the case. Although track level slightly moderated the association, its effect disappeared when the much stronger moderator effect of class climate was entered in the analyses.[7]

Discussion

This study examined the association between peer relations in the classroom and students' academic progress. Data were used from about 18,000 students who participated in a longitudinal study in secondary education in The Netherlands. Our first research question was whether peer acceptance and the number of friends within the classroom had direct effects on academic progress, when controlled for prior performance level and background characteristics. The results in this study showed that both peer acceptance and the number of friends had significant effects on downward mobility and grade retention, when considered separately, but not on upward mobility. When peer acceptance and the number of friends were entered simultaneously, the number of friends appeared to be redundant.

Although the odds ratios are substantial, the probabilities that a student has to repeat a grade or move downward in the track system are not. Therefore, peer acceptance does not have a large effect in absolute terms on this outcome variable. Nevertheless, the outcomes are relevant for two reasons. First, the probabilities of grade retention and downward mobility may be small *per year* (and smaller in the first than in later grades; see the doctoral thesis of Lubbers, 2004), but the probability that a student might need to repeat a grade or move downward *at least once* in their school career is quite substantial (for the first three years alone, the combined cumulative percentage is over 20%). Furthermore, the odds ratios change little over time. Second, obviously, the probabilities of grade retention and downward mobility are small for students who do relatively well at school, and for those students, peer acceptance has little effect in absolute terms. But among students who had either insufficient or barely sufficient grades on their fall term report, the probabilities of grade retention and downward movement were much larger and, for this group, peer acceptance is much more relevant.

Our second research question was whether the link between peer relations and academic progress was mediated by students' relatedness and engagement, as hypothesized by Connell and Wellborn. Although peer acceptance and the number of friends predicted relatedness, and this in turn predicted engagement as hypothesized, the two groups of variables did not mediate the link between peer relations and students' academic progress. Specifically, the direct effect of peer relations on academic progress hardly decreased when the mediators were entered.

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[7] With track level and its moderator effect added to model C5, the coefficient of peer acceptance was 0.770 (*SE* 0.087), track level −0.040 (SE 0.025), track level×peer acceptance 0.006 (SE 0.009), class climate 0.037 (SE 0.010), class climate×peer acceptance −0.164 (SE 0.024).

Our third research question was whether the effect of peer acceptance on relatedness was moderated by the social climate in a classroom. Class climate only slightly moderated the relation between peer acceptance and students' school well-being. A stronger moderating effect was found for class climate on the association between peer acceptance (as measured by sociometric nominations of classmates) and self-perception of being liked. It appeared that poorly accepted students felt *less* liked in relatively poor class climates than in relatively positive climates, whereas well-accepted students felt *more* liked in relatively poor than in relatively positive climates. Poorly accepted students may receive most of the negative peer treatments that are more common in poorer class climates. The finding that the well-accepted students feel *more* accepted in poorer than in more positive climates suggests that the pecking order is more visible when negative peer treatments are more common, as is consistent with the ideas of Coie (1990).

It should be noted that our theoretical model, derived from Connell and Wellborn, assumes that peer relations "cause" academic progress, and statistical terminology of regression analysis (e.g., "explanatory variables", "(in)direct effects") leads one to suspect that this is indeed what we (and other authors using regression analysis) tested. However, regression analysis cannot determine causality. Therefore, the present findings may also imply that academic progress causes peer acceptance. This does not seem plausible though, since academic progress was measured half a year later than peer relations and, more importantly, we controlled quite intensively for prior performance. Nevertheless, the possibility cannot be ruled out that the association between peer relations and academic progress (controlled for prior performance) is brought about by a same underlying cause, such as deviant behavior (Parker & Asher, 1993), prosocial behavior, or self-regulatory skills (Wentzel & Asher, 1995).

A limitation of the study is that the data collection was not originally designed to test parts of the model of Connell and Wellborn. Therefore, measures of relatedness and, more particularly, engagement were not optimal. Relatedness was measured with two variables, one of which based on a single item. For engagement, we considered only three dimensions: achievement motivation, aspiration, and integrative strategy use. Although it is quite common in this field to focus on a limited number of dimensions of engagement, a more elaborate approach would improve the model.

In summary, the present study supports a relation between peer acceptance and students' academic progress, when controlling for prior performance level and student background. The large and representative sample, a longitudinal design, and the use of appropriate methods to account for the nested data structure and to control for relevant predictors inspires confidence in the results. Moreover, these results were not only found for the time of transition between Grade 1 and Grade 2 in junior high (as presented in this study) but also for the time of transition between Grades 2 and 3 (equivalent to Grades 8 and 9 in the US; see the doctoral thesis of Lubbers, 2004). The fact that the underlying mechanisms of the association between peer relations and academic progress were not clarified by including relatedness and engagement suggests that the self-system model does not provide an adequate explanation for this association. This is supported by the fact that Wentzel (2003) also found that relatedness and engagement did not mediate the relation between peer status and GPA, and even Connell and Wellborn (1991) have not demonstrated a mediational effect of engagement, although they found relations between relatedness and engagement,

and between engagement and academic outcomes. However, Buhs and Ladd (2001) and Buhs et al. (2006) found that (chronic) peer exclusion and classroom participation partially mediated the link between peer rejection and academic outcomes. Taken together, the evidence seems to indicate that the association between *peer rejection* and academic outcomes can partly be explained by the self-system model, but that alternative mediational pathways need to be identified for the link between *peer acceptance* and academic outcomes. Also, as indicated earlier, we cannot rule out the possibility that the association between (positive) peer relations and academic outcomes, controlled for prior performance, is caused by a third characteristic. Further research is needed to identify alternative explanations.

Future research needs to develop a decreasingly abstract model with refined assumptions. For example, the model is not specific about whether the contributions of distinct friends should be valued equally. Several scholars (e.g., Berndt, 1999; Caldwell, McNamara, & Wentzel, 2004) argued that some friends may have a positive impact on students, whereas others have no impact or a negative impact. In order to study this, a more in-depth study is required that takes into account the quality of specific peer relations and peers' scholastic behaviors and orientations.

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