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The role of student–teacher relationships in middle childhood

Zee, M.; de Bree, E.

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Students' self-regulation and achievement in basic reading and math skills: the role of student–teacher relationships in middle childhood

Marjolein Zee and Elise de Bree

Research Institute of Child Development and Education, University of Amsterdam, Amsterdam, The Netherlands

ABSTRACT

In this study, we explored both direct and indirect contributions of students' perceptions of the student–teacher relationship quality (i.e., closeness and conflict) to domains of self-regulation (i.e., task-orientation and metacognition) and basic reading and math skills (i.e., timed word reading and math performance) in middle childhood. Participants were 370 third-to-fifth graders from different regular elementary classrooms across the Netherlands. Using structural equation modelling, evidence was found for positive direct associations between student-perceived closeness and both domains of self-regulation, and a negative direct association between student-perceived conflict and task-orientation. However, indirect associations of closeness and conflict with students' achievement in basic math and reading skills, through task-orientation and metacognition, could not be established. These results suggest that students' perceptions of the relationship quality, and closeness in particular, may be especially important for their ability to regulate motivational and cognitive aspects of their own learning.

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KEYWORDS Student–teacher relationships; self-regulation; basic reading and math skills; middle childhood

Self-regulation, or students' ability to focus their behaviors, thoughts, and emotions on the attainment of their learning goals, has been widely acknowledged to facilitate mastery of complex skills, including reading and math (Blair & Diamond, 2008; Ladd, Birch, & Buhs, 1999; Pintrich, 2000). Empirical sources have attested that self-regulated learners possess a battery of skills and strategies, including metacognition, goal setting, and effortful control, that help them increase their overall reading comprehension and math performance

CONTACT Marjolein Zee  M.Zee@uva.nl  Research Institute of Child Development and Education, University of Amsterdam, P.O. Box 15776, Amsterdam NL-1001 NG, The Netherlands. Tel.: +31 20 525 1250

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during the elementary school years (Blair & Razza, 2007; Chiu, Chow, & McBride-Chang, 2007; Liew, McTigue, Barrois, & Hughes, 2008; Zee, Koomen, & Van der Veen, 2013). In addition, the more basic skills that underlie students' reading comprehension and mathematical ability, such as vocabulary, word reading accuracy, and functional addition, subtraction, and multiplication (e.g., Hoover & Gough, 1990), have been found to be predicted by their self-regulation skills (e.g., McClelland et al., 2007; Stoeger & Ziegler, 2008). Given the importance of students' self-regulation for their basic and more complex reading and math skills, further examination of potential factors associated with these skills and processes in elementary school seems warranted.

Recent research has suggested that the quality of students' relationships with their teachers may play a role in the development of their self-regulation abilities and subsequent reading and math skills (e.g., Berry, 2012; Cadima, Doumen, Verschueren, & Buyse, 2015). Building on an extended attachment perspective, these studies have postulated that high-quality relationships marked by high levels of warmth and support (i.e., *closeness*) and low levels of discordance (i.e., *conflict*) provide students with the emotional security to scaffold the development of their self-regulation skills and beliefs about the self as learner (Baker, 2006; Cadima et al., 2015; Pianta, 1999; Rudasill & Rimm-Kaufman, 2009). In a study of Cadima and colleagues (2015), for instance, teacher-reported closeness appeared to be a positive predictor of preschoolers' self-regulation, which was assessed using a short game focusing on students' attention, inhibitory control, and working memory. Other research has spawned some evidence that first-graders with self-regulation difficulties may perform better in reading and mathematics when their teachers report high levels of closeness in the student–teacher relationship (Liew et al., 2008).

In contrast to closeness, conflictuous student–teacher relationships have been theorized to pose risks to students' ability to focus their behaviors, thoughts, and emotions on the attainment of their reading- and math-related goals (Liew et al., 2008; Pianta, 1999). Indeed, there is some evidence to suggest that teacher-reported conflict is negatively associated with behavioral components of (young) students' self-regulation, including inhibitory and effortful control, attention, and discipline (e.g., Berry, 2012; Hamre & Pianta, 2001; Ladd & Burgess, 2001). Moreover, negative links between teacher-reported conflict and students' reading and math performance have also been noted, both in the early elementary grades and beyond (e.g., Hamre & Pianta, 2001; McCormick & O'Connor, 2015; Zee et al., 2013).

While making significant advancements to our understanding of the importance of student–teacher relationships for students' self-regulation and reading and math skills, much of the extant research to date has not yet explored these variables in conjunction with one another. This is unfortunate, given that the effect of affective student–teacher relationships on students' academic performance has frequently been suggested to run via factors associated with students' behaviors, thoughts, and emotions in class (e.g., Hamre & Pianta, 2001;

Roorda, Koomen, Spilt, & Oort, 2011). Additionally, most studies investigating linkages between student–teacher relationships and students’ self-regulation have predominantly concentrated on behavioral aspects of self-regulation, including inhibitory control and attention problems, thereby largely overlooking other important self-regulatory abilities, such as students’ goals, expectations, and metacognitive skills. Such more *cognitive* and *motivational* self-regulation skills may be particularly critical for students’ basic and more complex math and reading performance in later grades, as these skills may help them stay motivated, set high goals for themselves, and persist when the goings get tough (e.g., Duncan et al., 2007). In the present study, therefore, we aim to contribute to the existing research on student–teacher relationships, self-regulation, and reading and math skills, by exploring the extent to which (1) third-to-fifth grade students’ relationship perceptions (i.e., closeness and conflict) *directly* predict cognitive and motivational domains of their self-regulation (i.e., task-orientation and metacognition), and (2) *indirectly* predict their achievement in basic reading and math skills, through these self-regulation domains.

Based on the existing body of evidence, three hypotheses were formulated. First, we expected cognitive and motivational domains of self-regulation to be positively predicted by student-perceived closeness and negatively predicted by student-perceived conflict. Second, these cognitive and motivational self-regulation skills were assumed to positively predict students’ basic reading and math skills. Last, and most importantly, we hypothesized students’ perceptions of closeness to be positively associated with their math and reading outcomes, and students’ perceptions of conflict to be negatively associated with their math and reading skills, both directly and indirectly, through their self-regulation.

Method

Participants and procedure

Data were gathered as a part of a second-year course on children’s cognitive development and learning problems in the College of Child Development and Education, University of Amsterdam. For this course, undergraduates in the fields of Pedagogy, Education, and Psychology each selected one child from grades 3–5 who, under students’ supervision, completed a series of tests regarding their timed reading and math performance, and reported on their self-regulation and relationship with their teacher. Prior to taking the tests, all students were provided with a detailed, standardized protocol for assessing children’s skills, abilities, and perceptions. Moreover, students had a full opportunity to practice with, and ask questions about this protocol during a supervised, 90-min small group teaching session. To ensure reliability, the test battery only entailed tests and surveys that were relatively easy to take. The total test battery was administered individually in the child’s school or home, during the first two weeks of September 2015, and required approximately 90 min to complete. Appropriate

ethical principles and scientific practices were followed in accordance with the declaration of Helsinki. Specifically, parents received a detailed information letter and filled out a signed consent form for participation of their child.

Of the 419 children initially selected for this study, 49 (11.7%) were omitted due to missing or highly inaccurate data on the study variables. This resulted in a final sample of 370 Dutch students who attended third ($n = 100$), fourth ($n = 116$), and fifth ($n = 154$) grade of regular elementary school, respectively. These students ranged from 7.72 to 11.67 years of age, with a mean age of 9.52 ($SD = .98$). Of the total sample, 126 (34.1%) were boys, and 358 (96.8%) had Dutch as their first language. None of the children had any learning disabilities. Notably, all children came from different classrooms across the Netherlands, resulting in a truly unnested and unique sample.

Instruments

Students' perception of the student–teacher relationship

Students' perceptions of the student–teacher relationship quality were examined using a short, 12-item version of the Student Perception of Affective Relationship with Teacher Scale (SPARTS; Koomen & Jellesma, 2015). Items for this version were selected on the basis of the highest factor loadings reported in previous research (Jellesma, Zee, & Koomen, 2015; Koomen & Jellesma, 2015). The short SPARTS yields two primary dimensions, Closeness and Conflict, which parallel those of Pianta's (2001) Student–Teacher Relationship Scale. The Closeness dimension (6 items) measures students' positive feelings towards their teacher and their reliance on them in times of need and stress. A sample item includes 'I tell my teacher things that are important to me.' Conflict (6 items) provides insight into students' perception of the amount of negative behaviour, anger, and distrust in the relationship with their teacher, with items such as 'I easily have quarrels with my teacher'. The SPARTS employs a 5-point response scale, ranging from 1 (*no, that is not true*), to 5 (*yes, that is true*). Prior investigators have provided evidence for the reliability and construct validity of the SPARTS dimensions (Jellesma et al., 2015; Koomen & Jellesma, 2015). Cronbach's alphas were sufficient in this study, both for Closeness ($\alpha = .76$) and Conflict ($\alpha = .79$).

Students' self-regulation

Given that self-regulation is a multifaceted construct, both students' task-orientation and their metacognitive strategy use were considered as indicators of students' self-regulation. The motivational component of this construct was measured using the Task-Orientation Scale, which is derived from the Goal Orientation Questionnaire (Seegers, van Putten, & de Brabander, 2002). This 5-item instrument evaluates the extent to which students focus on mastering learning tasks and are able to take advantage of learning opportunities in class, with items such as 'I feel satisfied when I have learnt something new in school'.

The metacognitive component of students' self-regulation was gauged by the Self-Regulation Scale of the Motivated Strategies for Learning Questionnaire (Pintrich & de Groot, 1990). This scale consists of 6 items regarding students' effort management and metacognitive strategies, such as planning, skimming, and comprehension monitoring. A sample item includes 'I ask myself questions to make sure I know the material I have been studying'. The Task-Oriented and Self-Regulation scales were rated on 5-point Likert scales that range from 1 (*definitively not true*) to 5 (*definitively true*). The psychometric properties of both scales have been found to be adequate in previous research (e.g., Hornstra, Van der Veen, Peetsma, & Volman, 2013; Pintrich & de Groot, 1990). In this study, Cronbach's alpha was .71 for Task-Oriented, and .65 for Self-Regulation.

Students' basic math and reading skills

Students' achievement in their basic reading and math skills was obtained from their performance on individually administered tests for timed word reading and arithmetic sums. Reasons for choosing these more basic skills were that these skills are pivotal in further education and achievement. Specifically, reading comprehension depends on word reading accuracy and fluency (e.g., Hoover & Gough, 1990). Taking too much time to decode words may hamper efficient text reading and comprehension. Similarly, more complex mathematical questions require functional addition, subtraction, multiplication, and division skills. Yet, despite the importance of these abilities, the percentage of low literate and low numerate children, adolescents, and adults is quite high (e.g., Ofsted, 2011; Wentink, 2012). Not being functionally literate or numerate affects academic outcomes and well-being (e.g., Bynner & Parsons, 2006; Goldberg, Higgins, Raskind, & Herman, 2003). Consistent and continuous attention to these skills thus seems to be important.

Students' reading skills were measured using the One-Minute Test (EMT; Brus & Voeten, 1999) and Klepel (Van den Bos, Lutje Spelberg, Scheepstra, & de Vries, 1994). These tests are specifically designed to evaluate students' timed word reading (EMT) and decoding speed of pseudo words (Klepel), by asking them to read as many unrelated words as possible accurately in one or two minutes, respectively. In these tests, word length gradually increases from one to four syllables. We used raw scores in the current study, reflecting the number of correctly read words or pseudo words, with a maximum of 116 words. Cronbach's alphas for the EMT (.90) and Klepel (.92) have been found to be excellent (Evers et al., 2009–2012).

Students' math skills were derived from their performance on the Arithmetic Number Fact Test (TTR; De Vos, 1994). The TTR is a standardized, timed math test on the memorization of arithmetic facts that children take regularly in Dutch elementary schools as a measure of early mathematics acquisition. In this test, students first have to solve as many additions with numbers and outcomes below 100 as possible in 1.5 min, and subsequently as many subtractions as

possible in 1.5 min. In this study, we used the total number of correct items on each test as total scores, with a maximum of 35 additions and 35 subtractions.

Data analysis

We applied structural equation modelling to fit the hypothesized model to the data, using *Mplus* version 7.11 (Muthén & Muthén, 1998–2012). To yield robust estimates of the model's coefficients, we used maximum likelihood estimation with robust standard errors and a scaled test statistic (MLR). The choice for this estimator was based on the generally skewed nature of the student–teacher relationship dimensions. Separate models were fitted for Closeness and Conflict, to avoid potential multicollinearity between the two constructs.

The overall goodness-of-fit of the models was evaluated by the mean-adjusted χ^2 test, with non-significant chi-squares indicating satisfactory fit. Additionally, we evaluated the model's approximate fit with the root mean square of approximation (RMSEA), with values below .05 reflecting close fit, and below .08 signifying reasonable fit (Browne & Cudeck, 1992), and the Comparative Fit Index (CFI), with values $\geq .90$ indicating satisfactory fit, and values $\geq .95$ indicating close fit (Bentler, 1992). Lastly, modification indices, residual correlations, and their associated summary statistic SRMR (standardized root mean square residual) were used to evaluate component fit. Values $\leq .08$ indicate good fit of the model to the data (Kline, 2011).

Results

Preliminary analyses

Table 1 presents the correlations, means, and standard deviations of the main variables in this study. Consistent with hypotheses, students' perceptions of Closeness were positively associated with their Task-Orientation and Metacognitive Strategies. In contrast, a modest negative association was found between Conflict and Task-Orientation. Surprisingly, this relationship dimension appeared to be unrelated to Metacognitive Strategies, suggesting that high levels of Conflict in the relationship may not necessarily hamper students' ability to focus their cognitions on the attainment of their goals. Also in contradiction to our assumptions were the nonsignificant correlations of students' relationship perceptions and self-regulation with their Reading and Math skills. Hence, it may be possible that the hypothesized indirect relationships between student–teacher relationship dimensions and basic Reading and Math skills do not hold.

Means and standard deviations indicated that students perceived the relationship with their teacher to be relatively Close and Conflict-free. Generally, they were also reasonably positive about their Task-Orientation, but somewhat less optimistic about their Metacognitive Strategy use. Students' scores

Table 1. Descriptive statistics and correlations.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
<i>Student–Teacher Relationship</i>										
1. Closeness	1.00									
2. Conflict	-.49**	1.00								
<i>Self-Regulation</i>										
3. Task–Orientation	.37**	-.17**	1.00							
4. Metacognitive Strategies	.29**	-.02	.42**	1.00						
<i>Basic Math Skills</i>										
5. Math Addition	-.03	-.02	.07	-.04	1.00					
6. Math Multiplication	.00	-.01	.09	-.03	.84**	1.00				
<i>Basic Reading Skills</i>										
7. EMT	-.05	.06	-.03	-.03	.45**	.41**	1.00			
8. Klepel	-.10	.04	.02	-.02	.38**	.38**	.68**	1.00		
<i>Covariates</i>										
9. Student Age	-.08	.19**	-.11*	.01	.34**	.26**	.39**	.33**	1.00	
10. Student Gender	.05	-.07	.06	.10	-.09	-.10	-.03	-.02	-.03	1.00
<i>Descriptive Statistics</i>										
Mean	3.69	1.54	3.97	2.60	26.41	22.69	62.67	49.40	9.52	–
Standard Deviation	.76	.67	.68	.72	5.59	6.48	15.67	17.35	.98	–

* $p < .01$; ** $p < .001$.

Note. Gender: 0 = boys, 1 = girls.

on Reading and Mathematics, lastly, were in line with mean test scores for this age group in the Netherlands (e.g., Van den Bos et al., 1994).

Measurement model

To ensure that the main constructs corresponded to the hypothesized factor structure, we first fitted a measurement model for the student–teacher relationship dimensions, self-regulation domains, and basic reading and math skills, respectively. Because the Reading and Math factors both had only two indicators, we specified equality constraints on their respective factor loadings to avoid model identification problems (Little, 2013). After imposing these identification constraints, the model fitted the data reasonably well, $\chi^2(311) = 510.94$, $p < .001$, RMSEA = .042 (90% CI [.035 – .048]), CFI = .91, SRMR = .059. According to the model's modification indices, no further model adjustments were needed to improve the model's fit. Thereby, these results provide support for the internal validity and common factor structure of the measures.

Structural equation model for student-perceived closeness

The initial structural model tested was the hypothesized mediation model with students' Gender and Age as covariates. In this model, the two self-regulation domains and Reading and Math factors were allowed to correlate. The model yielded a satisfactory fit to the data, $\chi^2(215) = 346.70$, $p < .001$, RMSEA = .041 (90% CI [.033 – .049]), CFI = .92, SRMR = .054. To identify sources of misfit, we inspected

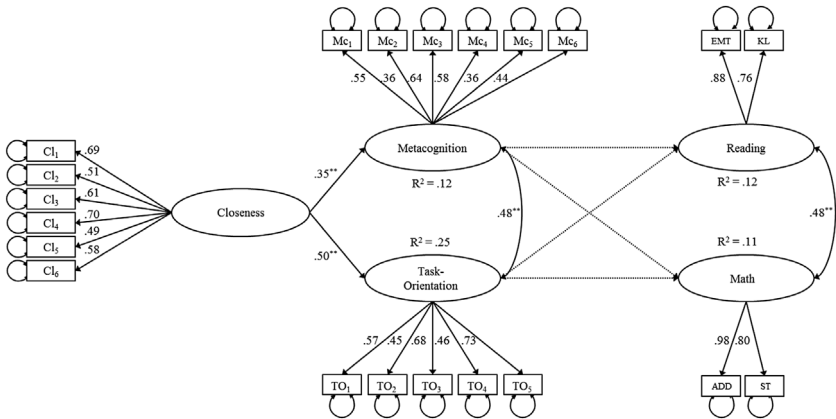


Figure 1. Final model of student-perceived closeness, self-regulation and basic reading and math skills.

Notes. Parameter estimates are standardized. Dashed lines represent non-significant paths. For reasons of parsimony, associations between covariates and outcome variables are not displayed in the model. CI = Closeness; Mc = Metacognition; TO = Task-Orientation; EMT = One-Minute Test; KL = Klepel; ADD = Addition; ST = Subtraction. ** $p < .001$.

the model's coefficients and modification indices. These sources of information indicated that only students' Age added to the prediction of students' Reading and Math skills. Therefore, we successively trimmed the non-significant covariates from the model, leading to a more parsimonious and well-fitting final model, $\chi^2(201) = 327.29$, $p < .001$, RMSEA = .041 (90% CI [.033 – .049]), CFI = .92, SRMR = .057.

Figure 1 presents the standardized coefficients of the final model for Closeness. Assessment of the model's coefficients pointed to statistically significant paths from Closeness to Task-Orientation ($\beta = .50$, $p < .001$) and Metacognitive Strategies ($\beta = .35$, $p < .001$). No statistically significant associations were found between the two self-regulation components and students' Reading and Math skills. Hence, the hypothesis that the association between student-perceived Closeness and students' Reading and Math skills is mediated by cognitive and motivational components of self-regulation could not be supported. Students' Age was significantly and positively associated with students' Reading ($\beta = .34$, $p < .001$) and Math ($\beta = .29$, $p < .001$), respectively, suggesting that students develop in their basic skills as they reach the upper elementary grades.

Structural equation model for student-perceived conflict

The hypothesized mediation model for Conflict, including students' Age and Gender, showed quite sound goodness of fit, $\chi^2(215) = 279.07$, $p < .001$, RMSEA = .028 (90% CI [.018 – .037]), CFI = .96, SRMR = .048. To make sure that

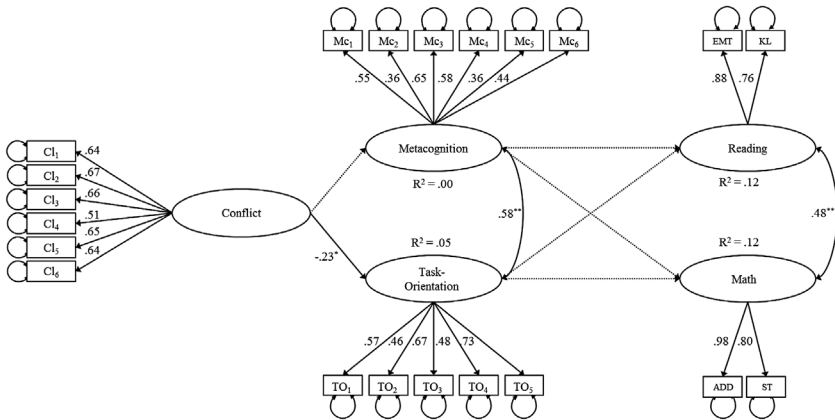


Figure 2. Final model of student-perceived conflict, self-regulation and basic reading and math skills.

Notes. Parameter estimates are standardized. Dashed lines represent non-significant paths. For reasons of parsimony, associations between covariates and outcome variables are not displayed in the model. Cl=Closeness; Mc=Metacognition; TO=Task-Orientation; EMT=One-MinuteTest; KL=Klepel; ADD=Addition; ST=Subtraction. $**p < .001$; $*p < .01$.

there were no possible sources of misfit in this already well-fitting model, we critically inspected the model's path estimates and modification indices. On this basis, non-significant covariates were successively trimmed to obtain the most parsimonious model. No further model improvements appeared to be necessary. Consequently, the model with Age as covariate of students' Reading and Math skills was accepted as the final model: $\chi^2(201) = 263.90$, $p < .001$, RMSEA = .029 (90% CI [.018 – .038]), CFI = .96, SRMR = .050.

The final Conflict Model is depicted in Figure 2. Student-perceived Conflict was negatively associated with students' Task-Orientation ($\beta = -.23$, $p < .01$), but not with their Metacognition. Additionally, the two domains of self-regulation did not appear to be associated with students' Reading and Math skills. Thus, similar to student-perceived Closeness, there was no indirect relationship between students' perceptions of Conflict and their achievement in basic Reading and Math skills, through domains of self-regulation. The paths from students' Age to their basic Reading ($\beta = .34$, $p < .001$) and Math skills ($\beta = .30$, $p < .001$), lastly, were both statistically significant.

Discussion

This study explored associations between students' perceptions of the student-teacher relationship quality, their self-regulation, and their basic reading and math skills in middle childhood. Our results provided evidence for the contention that the quality of the student-teacher relationship is associated with students' ability to regulate their own learning. First, students who perceived

the relationship with their teacher to be close were found to be likely to focus on mastering learning tasks and make use of metacognitive strategies in class. This result echoes our expectations as well as previous findings from Zee and colleagues (2013), which indicated that upper elementary children's motivational beliefs, including their task-orientation and academic efficacy, are positively linked to their reports of closeness in the relationship with their teacher. Notably, closeness explained more variance in task motivation than in metacognitive strategy use, suggesting that warm and nurturing student–teacher relationships may be particularly important for *motivational* domains of self-regulation. This is perhaps not surprising, given that the student–teacher relationship quality is, in part, a reflection of students' social adjustment in class and therefore more proximal to motivational and behavioural aspects of students' learning than to cognitive features (Hamre & Pianta, 2001).

Secondly, students' perceptions of relational conflict were found to be negatively associated with their task-orientation, but not with their metacognitive strategy use. These different patterns of relationships for student-perceived closeness and conflict lend credence to the attachment-based idea that those two dimensions reflect two relatively distinct qualities of the relationship, as opposed to falling along an underlying continuum. Consistent with suggestions from motivational theorists (e.g., Connell & Wellborn, 1991; Furrer & Skinner, 2003), it is possible that conflictuous student–teacher relationships do matter for students' opportunity to develop beliefs, orientations and values that corroborate their learning goals, but make no difference for their choice and use of cognitive strategies in class. Indeed, when students dislike their teachers and feel that their teachers fail to show interest and involvement in them, they are probably less likely to take advantage of learning opportunities, and consequently feel unmotivated to master their schoolwork (Furrer & Skinner, 2003; Murray & Greenberg, 2000). Yet, despite such negative relationship experiences, students may still be encouraged by teachers' instructional practices and strategies to regulate aspects of their cognition, including their effort management and metacognitive strategy use (e.g., Weiner & Schunk, 1996).

Third, our structural models could not support the hypothesis that motivational and cognitive domains of self-regulation act as mediators of the association between the student–teacher relationship quality and students' achievement in basic reading and math skills. Neither student-perceived closeness and conflict, nor students' task-orientation and metacognitive strategies were linked to their reading and math ability. These findings are in contrast with theoretical arguments that the pathway from student–teacher conflict and closeness to academic abilities is most likely indirect (e.g., Eisenberg, Valiente, & Eggum, 2010; Hughes, Wu, Kwok, Villarreal, & Johnson, 2012; Roorda et al., 2011). Results from both cross-sectional (Zee et al., 2013) and longitudinal studies (Hughes et al., 2012) have also indicated that students' motivational beliefs and competence beliefs may fully mediate the associations between student-reported closeness

and conflict and math and reading achievement. One reason for the absence of indirect associations is that the timed reading and math tests used in this study may be less affected by affective and instructional processes in class than other measures of achievement, including overall grades, reading comprehension, and vocabulary. Especially when students grow older, their mathematics acquisition and decoding speed may become more automatized and therefore, more independent from levels of teacher warmth and support.

Limitations and future directions

The present study is not without its limitations. A first caveat to interpreting the findings is that the data are cross-sectional and correlational in nature. As such, we cannot draw any conclusions about causal relationships in this study. Moreover, given that self-regulation is generally presumed to be achieved through reciprocal interactions between students' behaviours, cognitions, and their environment (Weiner & Schunk, 1996), there is a possibility that bidirectional relationships existed between the main variables presented in this study. Therefore, it may be advisable for future researchers to employ longitudinal, cross-lagged designs to disentangle such complex relationships.

Second, unlike prior work on students' self-regulation student-teacher relationships and academic adjustment, we used timed word reading and math tests as indicators of their achievement in basic reading and math skills. Although these skills are certainly relevant, they do not provide a comprehensive view of students' academic performance in middle childhood. To gain further insight into the direct and indirect contributions of the student-teacher relationship quality to domains of students' self-regulation and their performance in school, more extensive standardized assessments in which several skills are addressed, including students' reading comprehension and problem solving skills, may be warranted.

Third, the ratio between experimenters and children in this study was 1:1. This large number of different experimenters may, to some extent, have confounded the results of this study. Yet, it should be noted that the large majority of experimenters were studying for a degree in the Pedagogical or Educational Sciences. For them, the test battery was a first opportunity to get acquainted with diagnosis and treatment of learning disabilities. As such, these students were quite motivated to take the tests in an accurate way. Moreover, students were provided with a detailed, standardized protocol as well as training opportunities, thereby minimizing the possibility of test confounds.

Fourth, one of the strengths of this study is that we concentrated on student-perceived closeness and conflict, rather than the oft-used teacher reports of those two constructs. It should be noted, however, that students also reported about motivational and cognitive domains of self-regulation. This might have led to a slight overestimation of the strength of relationships, due to shared

method variance. We did attempt to control for this type of bias, however, by creating a psychological separation in the measurement of the main constructs, and ensuring children's confidentiality and anonymity. These procedures might have reduced the salience of contextually provided retrieval cues, eliminated children's evaluation apprehension, and decreased their tendency respond in a socially desirable way (cf. Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Moreover, we employed CFA to test whether a single factor could account for all the variance in the data. Results indicated that the five factors of interest can be reliably distinguished and thus reflect different constructs. Nevertheless, it would be useful for future research to use multiple methods (e.g., classroom observations, questionnaires, ability tests) and data sources (teachers, students, parents) to advance understanding of the relationships between the student–teacher relationship quality, self-regulation, and academic achievement.

Conclusion

The present study's results corroborate and extend prior research on linkages between the student–teacher relationship quality and young children's self-regulation (e.g., Cadima et al., 2015), by suggesting that the early benefits of high-quality student–teacher relationships for students' self-regulation may go beyond the first years of schooling. Specifically, our models indicated that middle childhood students who experience relationships marked by high levels of closeness and low levels of conflict generally tend to hold learning orientations that drive their willingness to master and persist at academic tasks. Moreover, warm and nurturing relationships seem to provide students with opportunities for metacognitive skill development. This is an important finding, given that student-teacher closeness, though gradually declining, has been presumed to offer students the support needed to successfully navigate social, motivational, and academic challenges of the upper elementary years (e.g., Furrer & Skinner, 2003; Zee et al., 2013). Hence, teachers should be increasingly made aware that the quality of their daily interactions with a child may have implications for the child's orientations to, and strategies for learning, which may eventually affect their academic achievement as well.

Additionally, whereas most studies on linkages between student–teacher relationships and self-regulation have predominantly focused on teacher-reports of the student–teacher relationship, or have measured only one dimension of this dyad (Berry, 2012; Cadima et al., 2015; Zee et al., 2013), this study has demonstrated that *students'* ratings of the relationship quality, and closeness in particular, also play a role in motivational and cognitive aspects of their self-regulation. This focus on student perceptions is essential, as prior research has reported a general lack of concordance between teacher and student reports of the quality of student–teacher relationships (e.g., Koomen & Jellesma, 2015; Wu, Hughes, & Kwok, 2010). An increased focus on children's perceptions of

relational conflict and closeness may deepen our understanding of students' own appreciation of the relationship, and its associations with their academic adjustment in upper elementary school.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- Baker, J. A. (2006). Contributions of teacher–child relationships to positive school adjustment during elementary school. *Journal of School Psychology, 44*, 211–229. doi:<http://dx.doi.org/10.1016/j.jsp.2006.02.002>
- Bentler, P. M. (1992). On the fit of models to covariances and methodology to the Bulletin. *Psychological Bulletin, 112*, 400–404. doi:<http://dx.doi.org/10.1037/0033-2909.112.3.400>
- Berry, D. (2012). Inhibitory control and teacher–child conflict: Reciprocal associations across the elementary-school years. *Journal of Applied Developmental Psychology, 33*, 66–76. doi:<http://dx.doi.org/10.1016/j.appdev.2011.10.002>
- Blair, C., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology, 20*, 899–911. doi:<http://dx.doi.org/10.1017/S0954579408000436>
- Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*, 647–663. doi:<http://dx.doi.org/10.1111/j.1467-8624.2007.01019.x>
- Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*, 230–258. doi:<http://dx.doi.org/10.1177/0049124192021002005>
- Brus, B. T., & Voeten, M. J. M. (1999). *Eén-Minut-Test: Vorm A en B. Verantwoording en handleiding* [One Minute Reading Test. Manual]. Nijmegen: Verantwoording en handleiding. Berkhout.
- Bynner, J., & Parsons, S. (2006). *New light on literacy and numeracy*. London: NRDC.
- Cadima, J., Doumen, S., Verschuere, K., & Buyse, E. (2015). Child engagement in the transition to school: Contributions of self-regulation, teacher–child relationships and classroom climate. *Early Childhood Research Quarterly, 32*, 1–12. doi:<http://dx.doi.org/10.1007/s10802-015-0060-5>
- Chiu, M. M., Chow, B. W. Y., & McBride-Chang, C. (2007). Universals and specifics in learning strategies: Explaining adolescent mathematics, science, and reading achievement across 34 countries. *Learning and Individual Differences, 17*, 344–365. doi:<http://dx.doi.org/10.1016/j.lindif.2007.03.007>
- Connell, J. P., & Wellborn, J. G. (1991). Competence, autonomy, and relatedness: A motivational analysis of self-system processes. In M. R. Gunnar & L. A. Sroufe (Eds.), *Minnesota Symposium on Child Psychology* (Vol. 22, pp. 43–77). Hillsdale, NJ: Erlbaum.
- De Vos, T. (1994). *Tempo Test Rekenen* [Tempo Test Mathematics]. Handleiding Tempo-Test-Rekenen (2nd ed.). Lisse: Swets Test Publishers.
- Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., . . . Sexton, H. (2007). School readiness and later achievement. *Developmental Psychology, 43*, 1428–1446. doi:<http://dx.doi.org/10.1037/0012-1649.43.6.1428>

- Eisenberg, N., Valiente, C., & Eggum, N. D. (2010). Self-regulation and school readiness. *Early Education and Development, 21*, 681–698. doi:<http://dx.doi.org/10.1080/10409289.2010.497451>
- Evers, A., Egberink, I. J. L., Braak, M. S. L., Frima, R. M., Vermeulen, C. S. M., & Van Vliet-Mulder, J. C. (2009–2012). *COTAN documentatie* [COTAN documentation]. Amsterdam: Boom.
- Furrer, C., & Skinner, E. (2003). Sense of relatedness as a factor in children's academic engagement and performance. *Journal of Educational Psychology, 95*, 148–162. doi:<http://dx.doi.org/10.1037/0022-0663.95.1.148>
- Goldberg, R. J., Higgins, E. L., Raskind, M. H., & Herman, K. L. (2003). Predictors of success in individuals with learning disabilities: A qualitative analysis of a 20-year longitudinal study. *Learning Disabilities Research & Practice, 18*, 222–236. doi:<http://dx.doi.org/10.1111/1540-5826.00077>
- Hamre, B. K., & Pianta, R. C. (2001). Early teacher–child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development, 72*, 625–638. doi:<http://dx.doi.org/10.1111/1467-8624.00301>
- Hoover, W. A., & Gough, P. B. (1990). The simple view of reading. *Reading and Writing, 2*, 127–160. doi:<http://dx.doi.org/10.1007/BF00401799>
- Hornstra, L., Van der Veen, I., Peetsma, T., & Volman, M. (2013). Developments in motivation and achievement during primary school: A longitudinal study on group-specific differences. *Learning and Individual Differences, 23*, 195–204. doi:<http://dx.doi.org/10.1016/j.lindif.2012.09.004>
- Hughes, J. N., Wu, J. Y., Kwok, O., Villarreal, V., & Johnson, A. Y. (2012). Indirect effects of child reports of teacher–student relationship on achievement. *Journal of Educational Psychology, 104*, 350–365. doi:<http://dx.doi.org/10.1037/a0026339>
- Jellesma, F. C., Zee, M., & Koomen, H. M. (2015). Children's perceptions of the relationship with the teacher: Associations with appraisals and internalizing problems in middle childhood. *Journal of Applied Developmental Psychology, 36*, 30–38. doi:<http://dx.doi.org/10.1016/j.appdev.2014.09.002>
- Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York, NY: Guilford.
- Koomen, H. M., & Jellesma, F. C. (2015). Can closeness, conflict, and dependency be used to characterize students' perceptions of the affective relationship with their teacher? Testing a new child measure in middle childhood. *British Journal of Educational Psychology, 85*, 1–19. doi:<http://dx.doi.org/10.1111/bjep.12094>
- Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: Related spheres of influence? *Child Development, 70*, 1373–1400. doi:<http://dx.doi.org/10.1111/1467-8624.00101>
- Ladd, G. W., & Burgess, K. B. (2001). Do relational risks and protective factors moderate the linkages between childhood aggression and early psychological and school adjustment? *Child Development, 72*, 1579–1601. doi:<http://dx.doi.org/10.1111/1467-8624.00366>
- Liew, J., McTigue, E. M., Barrois, L., & Hughes, J. N. (2008). Adaptive and effortful control and academic self-efficacy beliefs on achievement: A longitudinal study of 1st through 3rd graders. *Early Childhood Research Quarterly, 23*, 515–526. doi:<http://dx.doi.org/10.1016/j.ecresq.2008.07.003>
- Little, T. D. (2013). *Longitudinal structural equation modeling*. New York, NY: The Guilford Press.
- McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy,

- vocabulary, and math skills. *Developmental Psychology*, 43, 947–959. doi:<http://dx.doi.org/10.1037/0012-1649.43.4.947>
- McCormick, M. P., & O'Connor, E. E. (2015). Teacher–child relationship quality and academic achievement in elementary school: Does gender matter? *Journal of Educational Psychology*, 107, 502–516. doi:<http://dx.doi.org/10.1037/a0037457>
- Murray, C., & Greenberg, M. T. (2000). Children's relationship with teachers and bonds with school an investigation of patterns and correlates in middle childhood. *Journal of School Psychology*, 38, 423–445. doi:[http://dx.doi.org/10.1016/S0022-4405\(00\)00034-0](http://dx.doi.org/10.1016/S0022-4405(00)00034-0)
- Muthén & Muthén (1998–2012). *Mplus user's guide* (6th ed.). Los Angeles, CA: Author.
- Ofsted. (2011). *Removing barriers to literacy*. Retrieved from www.ofsted.gov.uk/publications/090237
- Pianta, R. C. (1999). *Enhancing relationships between children and teachers*. Washington, DC: American Psychological Association.
- Pianta, R. C. (2001). *STRS: Student-teacher Relationship Scale: Professional manual*. Lutz, FL: Psychological Assessment Resources.
- Pintrich, P. (2000). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 452–502). San Diego, CA: Academic.
- Pintrich, P. R., & de Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology*, 82, 33–40. doi:<http://dx.doi.org/10.1037/0022-0663.82.1.33>
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879–903. doi:<http://dx.doi.org/10.1037/0021-9010.88.5.879>
- Roorda, D. L., Koomen, H. M. Y., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. *Review of Educational Research*, 81, 493–529. doi:<http://dx.doi.org/10.3102/00346543114>
- Rudasill, K. M., & Rimm-Kaufman, S. E. (2009). Teacher–child relationship quality: The roles of child temperament and teacher–child interactions. *Early Childhood Research Quarterly*, 24, 107–120. doi:<http://dx.doi.org/10.1016/j.ecresq.2008.12.003>
- Weiner, B., & Schunk, D. H. (1996). Modeling and self-efficacy influences on children's development and self-regulation. In J. Juvonen & K. Wentzel (Eds.), *Social motivation* (pp. 154–180). Cambridge: Cambridge University Press.
- Seegers, G., van Putten, C. M., & de Brabander, C. J. (2002). Goal orientation, perceived task outcome and task demands in mathematics tasks: Effects on students' attitude in actual task settings. *British Journal of Educational Psychology*, 72, 365–384. doi:<http://dx.doi.org/10.1348/000709902320634366>
- Stoeger, H., & Ziegler, A. (2008). Evaluation of a classroom based training to improve self-regulation in time management tasks during homework activities with fourth graders. *Metacognition and Learning*, 3, 207–230. doi:<http://dx.doi.org/10.1007/s11409-008-9027-z>
- Van den Bos, K. P., Lutje Spelberg, H. C., Scheepstra, A. J. M., & de Vries, J. R. (1994). *Handleiding de Klepel* [Manual De Klepel]. Nijmegen: Berkhout.
- Wentink, H. (2012). *Leren Lezen en Schrijven is een Kunst: Voorkomen van Laaggeletterdheid bij Leerlingen met Specifieke Onderwijsbehoeften* [Learning to Read and Write is an Art: Prevention of Low Literacy in Students with Specific Educational Needs]. Hengelo: Hogeschool Edith Stein.

- Wu, J. Y., Hughes, J. N., & Kwok, O. M. (2010). Teacher–student relationship quality type in elementary grades: Effects on trajectories for achievement and engagement. *Journal of School Psychology, 48*, 357–387. doi:<http://dx.doi.org/10.1016/j.jsp.2010.06.004>
- Zee, M., Koomen, H. M. Y., & Van der Veen, I. (2013). Student–teacher relationship quality and academic adjustment in upper elementary school: The role of student personality. *Journal of School Psychology, 51*, 517–533. doi:<http://dx.doi.org/10.1016/j.jsp.2013.05.003>