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| File ID | uvapub:110208 |
| Filename | 2: The influence of affective teacher-student relationships on students' school engagement and achievement: a meta-analytic approach |
| Version | unknown |

SOURCE (OR PART OF THE FOLLOWING SOURCE):

| | |
|---|---|
| Type | PhD thesis |
| Title | Teacher-child relationships and interaction processes: Effects on students' learning behaviors and reciprocal influences between teacher and child |
| Author(s) | D.L. Roorda |
| Faculty | FMG: Research Institute Child Development and Education (CDE) |
| Year | 2012 |

FULL BIBLIOGRAPHIC DETAILS:
> http://hdl.handle.net/11245/1.374241

# The Influence of Affective Teacher-Student Relationships on Students' School Engagement and Achievement: A Meta-Analytic Approach

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## Abstract

A meta-analytic approach was used to investigate the associations between affective qualities of teacher-student relationships (TSRs) and students' school engagement and achievement. Results were based on 99 studies, including students from preschool to high school. Separate analyses were conducted for positive relationships and engagement ($k = 61$ studies, $N = 88,417$ students), negative relationships and engagement ($k = 18$, $N = 5847$), positive relationships and achievement ($k = 61$, $N = 52,718$), and negative relationships and achievement ($k = 28$, $N = 18,944$). Overall, associations of both positive and negative relationships with engagement were medium to large, whereas associations with achievement were small to medium. Some of these associations were weaker, but still statistically significant, after correction for methodological biases. Overall, stronger effects were found in the higher grades. Nevertheless, the effects of negative relationships were stronger in primary than in secondary school.

## Introduction

During the last two decades, there has been an increase in research on the importance of affective teacher-student relationships (TSRs) for students' school adjustment. The quality of TSRs has been shown significantly associated with students' social functioning (e.g., Ladd, Birch, & Buhs, 1999), behavior problems (e.g., Graziano, Reavis, Keane, & Calkins, 2007), engagement in learning activities (e.g., Skinner, Wellborn, & Connell, 1990), and academic achievement (e.g., Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008). The influence of TSRs on students' school adjustment seems long-lasting: Hamre and Pianta (2001) showed that the degree of conflict in the relationship with kindergarten teachers predicted children's grades, positive work habits, and disciplinary infractions in lower and upper elementary school, and for boys even in middle school.

A meta-analysis by Cornelius-White (2007) revealed a substantial association between person-centered teacher variables (i.e., affective variables, like empathy and warmth, and more instructional variables, such as encouraging learning and higher order thinking) and student outcomes (i.e., affective or behavioral, and cognitive outcomes). The correlations between the combined person-centered teacher variables on the one hand, and participation, positive motivation, and the composite of all cognitive student outcomes on the other, ranged from medium to large. The influence of teacher behaviors has also been shown in the research area of instructional communication. Two meta-analyses found substantial associations between verbal and nonverbal immediacy of teachers' communication and students' perceived and affective learning (i.e., engagement; Allen, Witt, & Wheeless, 2006; Witt, Wheeless, & Allen, 2004), but smaller associations between teachers' communication and cognitive learning (Witt et al., 2004).

These meta-analyses provide evidence of the impact of teacher behaviors on student outcomes. Now, work needs to be done concentrating on specific subsets of person-centered teacher behaviors. The present review focuses on the affective dimension of TSRs, inspired by Cornelius-White's (2007) findings that the affective variables 'empathy' and 'warmth' are more strongly associated with student outcomes than most other person-centered variables. We also bring in negative TSRs as a separate category, because some primary studies report that negative aspects of the TSR (e.g., conflict) have a stronger influence on students' school adjustment than positive aspects (e.g., closeness; see Baker, 2006; DiLalla, Marcus, & Wright-Phillips, 2004; Hamre & Pianta, 2001; Ladd et al., 1999). Baumeister, Bratslavsky, Finkenauer, and Vohs (2001) also provide evidence of a more general principle that bad experiences have more impact than good ones across a large range of psychological phenomena, including relationships. As outcomes, the present study focuses on learning behaviors: students' school engagement and achievement. Academic achievement was selected because it predicts further school success and career opportunities (e.g., Ensminger & Slusarcick, 1992). Students' engagement in learning tasks was included because it has regularly been found to act as a mediator between TSRs and academic achievement (e.g., de Bruyn, 2005; Furrer & Skinner, 2003; Woolley, Kol, & Bowen, 2009; Zimmer-Gembeck, Chipuer, Hanisch, Creed, & McGregor, 2006).

## Affective TSRs and Learning Behavior: Theoretical Perspectives

Several theories have been judged important for conceptualizing the role of TSRs (Davis, 2003; Martin & Dowson, 2009; Pianta, Hamre, & Stuhlman, 2003). We will briefly describe two main theoretical approaches: extended attachment and social-motivational perspectives.

Many studies are guided by an extended attachment perspective, which depends on theory and research about mother-child relationships (Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1969). Central idea in the attachment theory is that positive relationships between parents and children promote feelings of security in the child. Emotional security in turn is considered to be a necessary precondition for exploration of the environment. According to an extended attachment perspective, sensitive teachers can serve as a secure base from which children can explore the school environment and become engaged in learning activities (Birch & Ladd, 1997; Pianta, 1999; Pianta, Nimetz, & Bennett, 1997). Thijs and Koomen (2008) have found support for the central role of children's emotional security as a mediator between teacher support and children's engagement in learning tasks. Therefore, a favorable TSR is considered to stimulate learning behavior and support the child to deal with demands in the school context (Al-Yagon & Mikulincer, 2004; Hamre & Pianta, 2001; Howes, Hamilton, & Matheson, 1994; Rey, Smith, Yoon, Somers, & Barnett, 2007). A negative TSR, on the other hand, reflects a lack of security and is believed to hamper and interfere with the child's attempts to cope with demands in school. Studies based on an extended attachment perspective often assess the affective quality of a teacher's relationship with a particular student in terms of three dimensions that were originally derived from concepts and measures in the parent-child attachment theory: *Closeness* denotes the degree of warmth and openness, *conflict* reflects discordant and coercive interactions, and *dependency* refers to overly dependent and clingy behaviors of the child (Pianta, 2001). Closeness is viewed as typical of positive TSRs, in this perspective, whereas conflict is considered the most distinctive feature of negative TSRs.

Self-system theory (Connell & Wellborn, 1991) or self-determination theory (Deci, Vallerand, Pelletier, & Ryan, 1991; Ryan & Powelson, 1991) explains the association between TSRs and school adjustment slightly differently. According to these theories, for children to become motivated three basic psychological needs must be fulfilled: the need for relatedness, for competence, and for autonomy. Teachers can support these needs by showing involvement (i.e., caring for and expressing interest in the student), providing structure (i.e., setting clear rules and being consequent), and supporting autonomy (i.e., giving students freedom to make their own choices and showing connections between schoolwork and students' interests). If children's basic needs are met, their engagement in learning activities will increase (Skinner & Belmont, 1993). Consequently, they will perform better on achievement tests and receive higher grades (Skinner et al., 1990). Teacher involvement represents the affective dimension of teacher-student interactions and is conceptually derived from attachment theory (Connell & Wellborn, 1991). Likewise, relatedness is connected to the concept of emotional security. Of the three supporting behaviors, teacher involvement seems to be the most important predictor of engagement (see Skinner & Belmont, 1993; Tucker et al., 2002).

Important in both perspectives is students' engagement in school. This concept can be

defined as '….the quality of a student's connection or involvement with the endeavor of schooling and hence with the people, activities, goals, values, and place that compose it' (Skinner, Kindermann, & Furrer, 2009, p. 494). The engagement concept includes many different aspects that are organized in three broad components by Fredricks, Blumenfeld, and Paris (2004): behavioral (i.e., participation in academics as well as social or extracurricular activities), emotional (i.e., positive and negative feelings and reactions to academics, teachers, classmates, and school) and cognitive (i.e., thoughtfulness and willingness to invest in mastering of difficult skills and comprehension of complex ideas). There is, however, considerable heterogeneity within as well as overlap between these components. We therefore make no subdivisions and use engagement as one (multidimensional) concept in this review study.
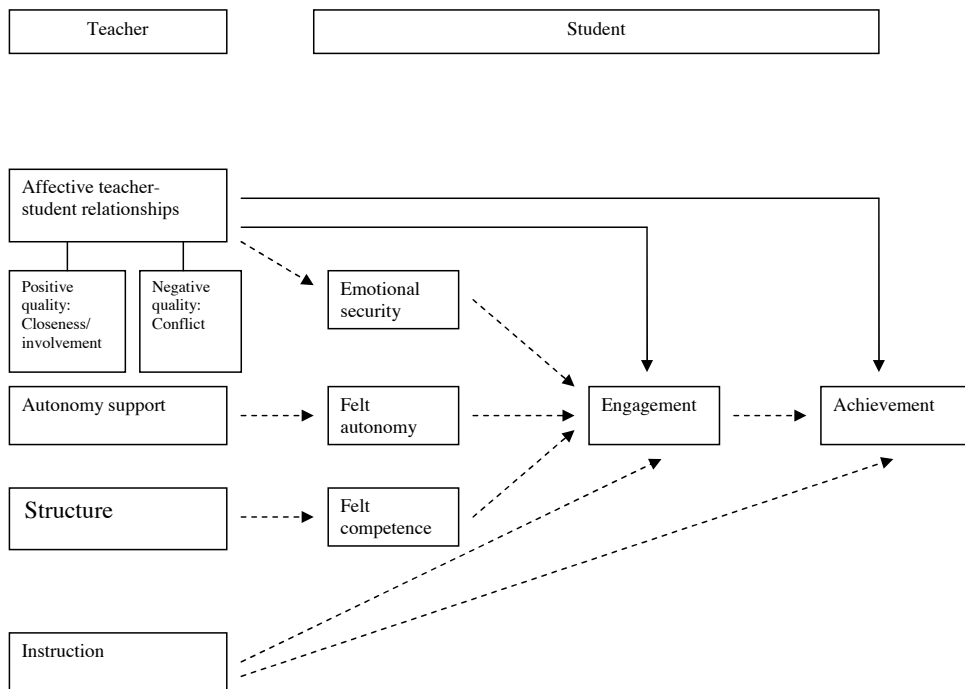


Figure 1. Theoretical model, based on extended attachment and social-motivational perspectives, representing the relations between teacher behavior and affect, student affect, student engagement, and achievement. Solid lines represent associations that were investigated in the present study, whereas dotted lines represent effects that were not investigated. Reciprocal effects between variables are expected but not depicted as the theoretical perspectives imply causality.

Figure 1 displays a model of the relations that can be hypothesized between different categories of teacher behavior and affect, student affect, and student learning behaviors. The presented model is a blend of concepts and ideas from the various perspectives that were discussed. Direct solid arrows show the theoretically-assumed causal paths that we investigated in the present study. The dashed lines represent other highly probable associations which could not be examined in this meta-analysis, because they were only scarcely investigated in primary studies or beyond the scope of this study.

## Impact of Affective TSRs: The Role of Student, Teacher, and Study Methods Characteristics

There are indications in the literature that the influence of affective TSRs on learning could be weaker or stronger depending on specific characteristics of students and teachers. Some of these suggestions are based on well-developed theoretical perspectives, others have come up in empirical findings. With respect to student characteristics: age, gender, ethnicity, socioeconomic status (SES), and learning difficulties are mentioned. With respect to teacher characteristics, we found: gender, ethnicity, and teaching experiences. In addition, there are indications that characteristics of the study methods, such as the selected design and measures, could affect the specific associations found.

**Age of students.** Literature suggests that younger children are more strongly influenced by their relationships with adults than older children, and that students become more strongly oriented towards peers and less emotionally connected to teachers as they make the transition to middle school (Buhrmester & Furman, 1987; Hargreaves, 2000; Lynch & Cicchetti, 1997). Based on this, one would expect stronger effects of TSRs on learning for younger students as well as stronger effects for students in primary school than in secondary school. However, empirical studies did not find such effects (Baker, 2006; Cornelius-White, 2007; Tucker et al., 2002). Furrer and Skinner (2003) even found a stronger association between relatedness and behavioral engagement for older students. Because of mixed evidence, age and school effects were explored in this review study, without specific hypotheses.

**Gender of students.** Several authors have suggested that the impact of TSRs on students' learning behavior may be different for boys and girls (e.g., Baker, 2006; Hamre & Pianta, 2001). According to the *gender role socialization perspective*, girls may benefit more from close relationships with the teacher, because closeness is consistent with the greater intimacy and affiliation in social relationships, that is expected of girls (Maccoby, 1998). Likewise, girls may be more hindered by conflictual TSRs, because conflict-related behaviors like aggression and dominance are generally less accepted for girls than boys (Ewing & Taylor, 2009). In contrast, the *academic risk perspective* predicts that TSRs will have stronger effects on the school adjustment of boys, because boys are at greater risk of school failure than girls (Hamre & Pianta, 2001). Some studies provide support for the gender role socialization perspective, showing stronger associations between TSRs and school adjustment for girls (Baker, 2006; Brendgen, Wanner, Vitaro, Bukowski, & Tremblay, 2007; Murray, Waas, & Murray, 2008). Other studies provide evidence for the academic risk perspective, showing stronger effects for boys (Furrer & Skinner, 2003; Hamre & Pianta, 2001). Finally, there are also studies reporting no gender effects at all (Cornelius-White, 2007; Garner & Waajid, 2008; Hughes, 2011; Stipek & Miles, 2008; Wentzel, 1998). Therefore, two conflicting hypotheses were formulated for the present study: Based on the academic risk perspective the influence of TSRs was expected to be stronger for boys, whereas based on the gender role socialization perspective the influence was expected to be stronger for girls.

**At-risk students.** According to the academic risk perspective (Hamre & Pianta, 2001), TSRs are also anticipated to be relatively important for the learning process and outcomes of other groups of students who are at risk of school failure: ethnic minority students, students with low SES, and students with learning difficulties. For at-risk

students are considered to have more to gain or to lose than other students. The few studies that have actually investigated this, however, are inconclusive in their results. Some studies, provide support for a greater impact of TSRs on student outcomes for ethnic minority students than for Caucasian students (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Pallock & Lamborn, 2006), whereas other studies report no effects of students' ethnicity (Cornelius-White, 2007; Ewing & Taylor, 2009; Hamre & Pianta, 2001; Vedder, Boekaerts, & Seegers, 2005). In addition, the few studies that pay special attention to students' SES report no stronger or weaker influence of TSR's on learning behaviors depending on this factor (Cornelius-White, 2007; Garner & Waajid, 2008; Ladd & Burgess, 2001). Finally, as far as we know, only one study investigated the influence of learning difficulties. Overall, this study did not show a greater impact of TSRs on achievement for this at-risk group (Baker, 2006). Results, however, differed markedly depending on the specific outcome measure used. When independent test scores were taken as outcome indicator, there was no effect of learning difficulties. But when grades were taken instead, unexpectedly, TSRs appeared to be more important for the group *without* learning difficulties (Baker, 2006). In the present meta-analytic study, the academic risk hypothesis could be examined using a greater number of studies, providing stronger support than the current inconclusive findings.

**Teacher characteristics.** We have traced no primary studies investigating whether TSRs have a stronger influence on student outcomes when the teacher is, for example, male or female, or more or less experienced. To our knowledge, only the meta-analysis of Cornelius-White (2007) paid attention to the influence of teacher characteristics: gender, ethnicity, and experience. Only for teacher gender an effect was found, pointing to a stronger impact of person-centered teacher behaviors on student outcomes when the teacher was female. Based on these findings, a stronger effect of TSRs on student outcomes was expected for female teachers, in the present study. Teacher ethnicity and teaching experience were also included, but without specific hypotheses.

**Characteristics of study methods.** As shown by Baker's (2006) results regarding learning difficulties, conclusions drawn about the importance of affective TSRs for children's learning also may depend on the specific methods that are used in a study. The primary studies in this research area differ highly in their study methods, for instance the use of independent test scores versus grades or other ratings based on teacher judgments. Studies also differ with regard to the informants used (e.g., teacher, student, parent, peer, independent observer) and whether these are different or the same for TSR's and learning outcomes. Furthermore, studies also have very different designs with strongly varying time intervals between measurements of TSR's and learning behaviors. Specific methodological choices could lead to an overestimation of the impact of TSRs on children's learning, for instance due to same-informant and/or same-method bias. Therefore, we also controlled for the effects of study characteristics or methodological biases in this meta-analysis.

### Present Study

In the present study, we conducted four separate analyses of the associations between: (1) positive aspects of the TSR and engagement, (2) negative aspects of the TSR and engagement, (3) positive aspects of the TSR and achievement, and (4) negative aspects

of the TSR and achievement. We expected to find positive associations between positive aspects of the TSR and students' school engagement and achievement and negative associations between negative aspects of the TSR and students' school engagement and achievement. Associations for negative TSRs were expected to be stronger than for positive TSRs. Furthermore, we anticipated associations with engagement to be stronger than associations with achievement, because engagement has been found to act as a mediator between TSRs and achievement.

While examining associations between TSRs and learning behavior, we also controlled for methodological characteristics of the primary studies (i.e., same informant/ method, grades as indicator of achievement, cross-sectional studies) that could lead to overestimation of associations. In addition, we expected that the strength of the associations between TSRs and learning behaviors would vary across studies, and that these differences might be explained by student (i.e., grade level, primary vs. secondary school, gender, ethnicity, SES, learning problems) and teacher (i.e., gender, ethnicity, teaching experience) characteristics. We included these study methods, student, and teacher characteristics as moderators in our analyses.

## Method

### Literature Search

We used the PsychInfo and Educational Resources Information Center (ERIC) databases to retrieve relevant studies. The following keywords were used to represent affective TSRs: relationship(s), closeness, attachment, warmth, support, relatedness, involvement, affiliation, affection, affect, empathy, trust, sensitivity, responsive, like/ liking, care/caring, conflict, neglect, rejection, dislike, negativity, anger, and concern. To represent engagement, the following keywords were entered: engagement, involvement, work behavior, school adjustment, motivation, (classroom) participation, attention, work habits, task behavior, effort, persistence, school liking, school avoidance, and commitment. Achievement was represented by: achievement, performance, school results, learning, development, and attainment. Additional keywords were included in different combinations to limit the number of hits: teacher-, student-, child-, pupil-, positive-, negative-, academic-, and cognitive-. We read titles, and if necessary abstracts and full texts, to determine whether studies were relevant to include in our analyses. Our database search extends to September 2009. In addition, we contacted some of the leading authors in the field to ask whether they knew unpublished studies that would be suitable to include in our meta-analysis. Our literature search yielded a total of 810 studies.

### Inclusion and Exclusion Criteria

We formulated the following criteria to determine whether studies should be included in our meta-analysis: (a) Studies had to report sufficient statistical information to calculate an effect size for either relationships and engagement or relationships and achievement, or both. (b) Studies had to measure TSRs, engagement, and achievement as separate concepts. Studies that combined different concepts in one measure (e.g., engagement and achievement joined together as a more general concept of school adjustment) were not

included in our meta-analysis. (c) Studies with students from preschool to twelfth grade were included. (d) TSRs had to be measured at the same time or before engagement and achievement, because in the present meta-analysis TSRs are considered as independent variables and engagement and achievement as dependent variables. (e) TSRs had to be measured at the dyadic level. Studies measuring relationships at the group level, such as classroom climate (e.g., Mashburn et al., 2008; Ponitz, Rimm-Kaufman, Grimm, & Curby, 2009) or teacher styles (see for instance review study of Wubbels & Brekelmans, 2005), were not included, because previous research has shown that the quality of TSRs differs across children in the classroom (e.g., Hamre & Pianta, 2001). (f) Studies had to be reported in English.

In addition, for certain concepts, scales were excluded from the analyses, mostly for theoretical reasons: (a) TSRs: *Dependency* was excluded because studies using multiple methods to examine relationship quality have doubted the validity of dependency as a measure of dyadic relationship quality (Doumen, Verschueren, Buyse, De Munter, Max et al., 2009; Spilt & Koomen, 2009). Moreover, primary studies often did not include this dimension or only as part of a composite score together with closeness and conflict (Baker, 2006; Rey et al., 2007). *Autonomy support*, *structure*, and *instructional support* were not included because these concepts relate more to behavior management and learning support than to the affective quality of the TSR. (b) Engagement: With respect to behavioral engagement, we did not include scales that measured *participation in extracurricular activities*, because these activities are not primarily directed at academic learning. Concerning emotional engagement, we did not include *feelings and reactions to teachers and classmates*, because feelings and reactions to teachers are part of our independent variable (TSRs) and feelings and reactions to peers are part of peer relationships, which are typically considered *predictors* of engagement in literature rather than outcomes (Malecki & Demaray, 2003; Wentzel, 1998). (c) Achievement: Only measures reflecting actual performance were included: test scores, grades, teacher reports, self-reported grades, or combinations of these measures. We did not include *academic self-concept* (e.g., Olsson, 2009) or *self efficacy* (e.g., Dorman, 2001), because such scales reflect students' feelings and beliefs about themselves rather than their actual performance. In addition, achievement was not further subdivided into subject areas, because many studies used only a composite measure.

## Multiple Effect Sizes Within Primary Studies

When papers reported more than one effect size per predictor-outcome association, only one was selected. For inclusion of multiple effect sizes, which are based on the same sample, in one analysis, violates the assumption of independence of units of analysis (Lipsey & Wilson, 2001; Mullen, 1989). First, some studies measured TSRs and/or engagement/achievement at several occasions (e.g., Gest, Welsh, & Domitrovich, 2005; Hamre & Pianta, 2001; Skinner & Belmont, 1993). In these cases we used the first occasion on which the TSR was measured. For engagement or achievement, we selected the first measurement occasion that was scheduled simultaneously or after the measurement of the TSR.

Second, several studies used more than one concept (e.g., behavioral *and* emotional engagement, school liking *and* school avoidance, math *and* reading achievement) or

instrument (e.g., teacher *and* child report, questionnaires *and* observations, tests *and* grades) to measure TSRs, engagement, and/or achievement. In these cases, all relevant effect sizes were averaged into one effect size per study.

Third, some samples were used in multiple papers. For example, several papers used participants from the NICHD Study of Early Child Care and Youth Development (e.g., Belsky et al., 2007; O'Connor & McCartney, 2006; Pianta & Stuhlman, 2004). Or some authors wrote more than one paper about a single research sample (e.g., Hughes, 2011; Hughes, Gleason, & Zhang, 2005; Hughes & Kwok, 2006; Hughes, Luo, Kwok, & Loyd, 2008). In case of overlapping samples, we selected one paper for each sample to be included based on three criteria: high amount of information, large sample size, and published. Thirty papers were excluded from our meta-analysis due to overlapping samples.

Fourth, some papers provided information about multiple studies, using different samples (Bao & Lam, 2008; Ladd et al., 1999; McCombs et al., 2008). In those cases, each study was entered separately in the analyses.

Fifth, some papers provided separate effect sizes for different subgroups in their sample (e.g., for boys and girls in Hamre & Pianta, 2001; for kindergarten en first grade in Valeski & Stipek, 2001). If those different groups of students were in the same classroom and shared the same teacher (e.g., the boys and girls in Hamre & Pianta, 2001), we averaged the effect sizes across groups and entered the paper as a single study in the analyses. Non-overlapping subsamples were included as separate studies in the analyses.

### Participants

Our final sample consisted of 92 papers, describing 99 studies (*k*) from 1990 to 2011. In total, 129,423 students (*N*) were included in our analyses; sample sizes varied from 42 to 39,553 students. Studies do not always report about the number of teachers, however, at least 2,825 teachers (range 3 to 701 teachers per study) were included in our sample. For our analyses, we made a distinction between primary (*k*=63) and secondary school studies (*k*=31). Primary school studies covered: preschool, kindergarten, and elementary school, and secondary school studies: middle school, junior high school, and high school. Five studies included students from both primary and secondary school. Studies were conducted in the USA (*k* = 77), Canada (*k*=2), Europe (*k*=9), Asia (*k*=6), Australia (*k*=4), and Africa (*k*=1). Studies were published journal articles (*k* = 88), in press papers (*k*=1), dissertations (*k*=6), book chapters (*k*=1), conference papers (*k*=2), and a conference poster (*k*=1).

### Coding of Studies

Each study was coded twice: once by the first or third author, and once by one of four trained graduate or undergraduate students. Intraclass correlations (ICCs) indicating interrater reliability ranged from .82 to 1.00. These ICCs indicate excellent agreement according to the guidelines of Cicchetti and colleagues (2006). Disaccordance between raters was partly due to disagreements about whether a certain scale truly measured engagement or a related concept. In those instances, the first author consulted the other authors to make a final decision. In other cases, disaccordance was caused by errors in coding.

Table 1. Effect sizes, number of students, and methodological and student characteristics for individual studies

| Author | Year | Students (N) | School (grades) | inf./ ach. | month. | girls | ethn. maj. | low SES | learn. dif. | $r_{pe}$ | $r_{ne}$ | $r_{pa}$ | $r_{na}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Allen & Fraser | 2007 | 141 | p (4-5) | d/- | 0 | - | - | - | - | .11 | - | .05 | - |
| Al-Yagon & Mikulincer | 2004 | 205 | p (3-5) | d/- | 0 | 45 | - | - | 48 | - | - | .19 | -.33 |
| Ang | 2005 | 266 | p (4-6) | d/g | 0 | 52 | 81 | - | - | - | - | .22[a] | -.03[a] |
| Baker | 2006 | 1310 | p (0-5) | d/- | 9 | 52 | 29 | 70 | - | - | - | .18 | -.29 |
| Bao & Lam | 2008 | 48 | p (5) | pe: s/- pa: d/t | 0 | 44 | - | - | - | .57 | - | .16 | - |
| Bao & Lam | 2008 | 99 | p (5) | s/- | 0 | 45 | - | - | - | .37 | - | - | - |
| Birch & Ladd | 1997 | 206 | p (k) | s/- | 0 | 48 | 73 | - | - | .35[b] | -.26[b] | - | - |
| Bos et al. | 2008 | 866 | s (7-9) | pe: s/- pa: d/g | 0 | 45 | 78 | - | - | .37 | - | .00 | - |
| Brendgen et al. | 2006 | 302 | p (0-6) | d/- | 42 | 47 | 100 | - | - | - | - | - | -.26 |
| Close & Solberg | 2008 | 427 | s (9-10) | pe: s/- pa: d/g | 0 | 55 | 5 | 78 | - | .64 | - | .29 | - |
| Crosnoe et al. | 2004 | 12095 | s (7-12) | d/g | 12 | 48 | 54 | - | - | - | - | .23[a] | - |
| Daly et al. | 2009 | 123 | s (7-8) | s/- | 0 | 52 | 0 | 83 | - | .29 | - | - | - |
| Daniels et al. | 2001 | 66 | p (0-2) | s/- | 0 | 53 | 77 | 30 | - | .29[c] | - | - | - |
| Davis | 2001 | 82 | p (4-5) | d/g | 0 | 55 | 84 | - | - | - | - | -.03 | - |
| Davis & Bischoff | 2009 | 93 | s (9) | s/- | 0 | 70 | 34 | 39 | - | .06 | - | -.09 | - |
| Davis et al. | 2010 | 333 | s (8) | d/g | 0 | 55 | 72 | 6 | 6 | - | - | .18[c] | - |
| Davis & Lease | 2007 | 344/495 | s (-) | d/g | pe: 0 pa: 10 | 49 | - | - | - | .21 N=344 | - | .27[c] N=495 | - |
| de Bruyn | 2005 | 749 | s (7) | d/g | ne: 0 na: 3 | 51 | - | - | - | - | -.23 | - | -.19 |
| Decker et al. | 2007 | 44 | p (0-6) | d/t | 0 | 41 | 0 | - | - | .29 | - | -.08 | - |
| Demaray & Malecki | 2002 | 125 | s (6-8) | s/- | 0 | 52 | 9 | 64 | - | .43 | - | - | - |
| DeSantis King et al. | 2006 | 974 | s (6-12) | s/- | 0 | 65 | 35 | 60 | - | .43 | - | - | - |
| DiLalla et al. | 2004 | 42 | - (5-8) | s/- | 0 | 45 | 98 | - | - | - | - | -.02 | -.32 |
| Doumen et al. | in press | 131 | p (0) | d/- | 4 | 50 | 90 | - | - | .33[a] | -.27[a] | - | - |
| Downer et al. | 2010 | 145 | p (-1) | d/- | 0 | 57 | 91 | - | - | .20 | -.17 | - | - |
| Elias & Haynes | 2008 | 282 | p (3) | d/g | 0 | 54 | 1 | 60 | - | - | - | -.01 | - |
| Faircloth & Hamm | 2005 | 5530 | s (9-12) | s/- | 0 | 53 | 57 | - | - | .32[f] | - | .33[f] | - |
| Furrer & Skinner | 2003 | 641 | p (3-6) | d/g | 0 | 49 | 95 | - | - | - | - | .16 | - |
| Garcia-Reid et al. | 2005 | 226 | s (7) | s/- | 0 | 59 | 0 | 85 | - | .35 | - | - | - |
| Garner & Waajid | 2008 | 74 | p (-1) | d/t | 3 | 46 | 15 | 49 | - | - | - | .31 | -.25 |
| Gest et al. | 2005 | 383 | p (3-5) | d/- | 0 | 45 | 99 | - | - | .11 | - | - | - |
| Gorman et al. | 2002 | 351 | s (10) | d/g | 0 | 49 | 50 | - | - | - | - | .65 | - |
| Graziano et al. | 2007 | 73 | p (0) | d/t | 0 | 54 | 66 | - | - | - | - | .27 | - |
| Gruman et al. | 2008 | 1003 | p (2-5) | d/- | 0 | 47 | 82 | 35 | - | .35 | - | .01 | - |
| Hallinan | 2008 | 39553 | s (6-10) | s/- | 0 | 53 | 19 | - | - | .28[a] | - | - | - |
| Hamre & Pianta | 2001 | 179 | p (0-4) | e: s/- a: d/- | 30 | 49 | 60 | 27 | - | .22 | -.45 | .08 | -.24 |
| Harrison et al. | 2007 | 124 | p (1) | d/t | 0 | 49 | - | - | - | .26 | -.22 | -.03 | -.08 |
| Henricsson & Rydell | 2006 | 91 | p (3-6) | s/- | 42 | 48 | 84 | - | - | - | - | .05 | -.28 |
| Howes et al. | 2008 | 1806 | p (-1) | d/- | 3 | 51 | 42 | 57 | - | - | - | .04 | - |
| Huang | 2008 | 11323 | s (-) | s/- | 0 | 51 | - | 12 | 16 | - | - | .05[a] | -.13[a] |
| Hughes | 2011 | 714 | p (2-4) | d/t | 12 | 47 | 34 | 66 | 100 | .20 | -.36 | .07 | -.21 |
| Jerome | 2009 | 351 | p (-1) | d/t | 3 | 47 | 0 | 81 | - | - | - | - | -.10 |
| Justice et al. | 2008 | 133 | p (-1) | d/t | 0 | 44 | 69 | 75 | - | - | - | .21 | -.02 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Justice et al. | 2008 | 133 | p (-1) | d/t | 0 | 44 | 69 | 75 | - | - | - | .21 | -.02 |
| Klem & Connell | 2004 | 1750 | p (3-5) | d/- | 0 | 49 | 9 | 85 | - | .22[c] | - | - | - |
| Klem & Connell | 2004 | 1347 | s (6-8) | d/- | 0 | 51 | 39 | 58 | - | .18[c] | - | - | - |
| Kong | 2008 | 19477 | - (4-10) | s/- | 0 | 51 | - | - | - | .64[d] | - | - | - |
| Ladd et al. | 1999 | 200 | p (0) | d/t | 4 | 48 | 74 | 37 | - | - | - | .33 | - |
| Ladd et al. | 1999 | 199 | p (0) | d/t | e: 1 a: 4 | 52 | 81 | - | - | .06 | -.37 | .24 | -.18 |
| Ladd & Burgess | 2001 | 385 | p (0-1) | d/t | 9 | 50 | 77 | 37 | - | .17[b] | -.19[b] | .09[b] | -.14[b] |
| Learner & Kruger | 1997 | 150 | s (11-12) | s/- | 0 | 61 | - | - | - | .47[a] | - | - | - |
| Lee | 2007 | 318 | s (7) | d/g | 0 | 47 | - | - | - | - | - | .32 | - |
| Malecki & Demaray | 2003 | 206 | - (5-8) | d/- | 0 | 53 | 39 | - | - | - | - | .32[a] | - |
| Mantzicopoulos & Neuharth-Pritchett | 2003 | 108 | p (1) | d/t | 0 | 51 | 78 | 33 | - | - | - | .06 | -.27 |
| Mantzicopoulos & Neuharth-Pritchett | 2003 | 123 | p (0) | d/t | 0 | 51 | 78 | 33 | - | - | - | .17 | -.16 |
| Mantzicopoulos & Neuharth-Pritchett | 2003 | 133 | p (-1) | d/t | 0 | 51 | 78 | 33 | - | - | - | .10 | -.24 |
| Martin & Marsh | 2008 | 598 | s (8-10) | s/- | 0 | 41 | - | - | - | .58[d] | - | - | - |
| Mboya | 1995 | 874 | s (8-12) | s/- | 0 | - | 100 | - | - | .23 | - | - | - |
| McCombs et al. | 2008 | 370 | p (0-1) | s/- | 0 | - | 65 | - | - | .33 | - | - | - |
| McCombs et al. | 2008 | 2097 | p (0-3) | d/- | 0 | 51 | 38 | - | - | .20 | - | - | - |
| McDonald Connor et al. | 2005 | 787 | p (1) | d/t | 0 | - | - | 10 | - | - | - | .11 | - |
| Mercer & DeRosier | 2008 | 1193 | p (3) | d/g | 0 | 51 | 68 | - | - | - | - | .40 | - |
| Muller et al. | 1999 | 4787 | s (10-12) | d/t | 24 | 49 | 75 | - | - | - | - | .01[b] | - |
| Murray | 2008 | 99 | p (0) | d/t | 0 | 51 | 85 | 40 | - | .18 | -.43 | .22 | -.34 |
| Murray | 2009 | 104 | s (6-8) | e: s/- a: d/- | e: 0 a: 3 | 54 | 5 | 99 | 11 | .54 | -.42 | .13 | -.25 |
| Murray & Greenberg | 2000 | 170 | p (5-6) | d/- | 0 | 44 | 65 | - | 34 | .17 | -.18 | - | - |
| Murray et al. | 2008 | 145 | p (0) | d/- | 0 | 54 | 8 | 77 | - | .18 | -.22 | - | - |
| Murray & Zvoch | 2011 | 171 | - (5-8) | d/- | 0 | 60 | 0 | 97 | 9 | .21 | -.18 | - | - |
| Myers | 2007 | 154 | p (-1) | d/- | 0 | 45 | 46 | 100 | - | - | - | .22 | -.06 |
| Natvig et al. | 2003 | 947 | s (7-9) | s/- | 0 | 50 | - | - | - | .29 | - | - | - |
| NICHD network | 2004 | 952 | p (0-1) | d/- | - | 52 | 81 | 25 | - | .07[a] | -.18[a] | - | - |
| NICHD network | 2005 | 772 | p (1) | d/t | 0 | - | 79 | 21 | - | - | - | - | -.14[e] |
| Palermo et al. | 2007 | 95 | p (-1) | s/- | 0 | 48 | 54 | 22 | - | - | - | .33 | -.32 |
| Pallock & Lamborn | 2006 | 164 | s (9-10) | s/- | 0 | 60 | 37 | - | - | .43 | - | .09 | - |
| Parent et al. | 2009 | 178 | p (0-1) | d/t | 12 | - | - | - | - | - | - | .17 | -.16 |
| Patrick et al. | 2007 | 602 | p (5) | pe: s/- pa: d/g | 0 | 51 | 95 | - | - | .53 | - | .27 | - |
| Peisner-Feinberg et al. | 2001 | 334 | p (0) | d/t | 0 | 49 | 69 | - | - | - | - | .09 | - |
| Pianta & Nimetz | 1991 | 49 | p (0-1) | s/- | 9 | 53 | 57 | 20 | - | .14 | - | - | - |
| Pianta et al. | 1997 | 55 | p (-1-0) | e: s/- a: d/t | e: 12 a: 0 | 40 | 31 | 100 | - | .34 | -.33 | .38 | -.37 |
| Rey et al. | 2007 | 89 | p (3-6) | d/- | 0 | 53 | 0 | 100 | - | .31 | - | .11 | - |
| Sakiz | 2007 | 316 | s (7-8) | s/- | 0 | 60 | 62 | - | - | .51 | - | - | - |
| Skinner & Belmont | 1993 | 144 | p (3-5) | d/- | 0 | - | 94 | - | - | .41 | - | - | - |
| Skinner et al. | 2009 | 1018 | p (3-6) | d/- | 0 | - | 95 | - | - | .44 | -.50 | - | - |
| Skinner et al. | 1990 | 220 | p (3-6) | d/t | 0 | 51 | 88 | - | - | .23 | - | -.02 | - |
| Somers et al. | 2008 | 118 | s (9) | pe: s/- pa: d/g | 0 | 64 | 0 | - | - | .42 | - | .20 | - |
| Stiller & Ryan | 1992 | 624 | s (7-8) | s/- | 0 | 47 | - | - | - | .41 | - | - | - |

| Study | Year | N | School | inf/ach | month | girls | ethn. maj | low SES | learn. dif | $r_{pe}$ | $r_{ne}$ | $r_{pa}$ | $r_{na}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stipek & Miles | 2008 | 301 | p (0-1) | ne: s/- na: d/t | 0 | 50 | 34 | 100 | - | - | -.52 | - | -.18 |
| Tanners Surace | 2000 | 124 | p (3-5) | d/t | 5 | 51 | - | - | - | - | - | -.03 | - |
| Thijs & Koomen | 2008 | 79 | p (0) | s/- | 0 | 47 | - | - | - | .56 | - | - | - |
| Trentacosta & Izard | 2007 | 142 | p (0-1) | d/- | 0 | 49 | 1 | 40 | - | - | - | .20 | - |
| Tucker et al. | 2002 | 96 | - (1-12) | s/- | 0 | 61 | 0 | 80 | - | .63 | - | - | - |
| Valeski & Stipek | 2001 | 225 | p (0) | d/- | 0 | 53 | 34 | 100 | - | .15 | - | .06 | - |
| Valeski & Stipek | 2001 | 127 | p (1) | d/- | 0 | 44 | 34 | 100 | - | .18 | - | .04 | - |
| Valiente et al. | 2008 | 264 | p (-) | d/g | 0 | 54 | 30 | 17 | - | .44 | - | .32 | - |
| Vedder et al. | 2005 | 338 | p (-) | s/- | 0 | - | 56 | - | - | .12 | - | - | - |
| Verkuyten & Thijs | 2002 | 1090 | p (5-6) | s/- | 0 | 49 | 63 | - | - | .33[b] | - | .01 | - |
| Webb | 2008 | 375 | p (-1) | d/t | 0 | 49 | 32 | 34 | - | - | - | .26 | .04 |
| Wentzel | 1997 | 248 | s (8) | s/- | 0 | 50 | 92 | - | - | .36 | - | - | - |
| Wentzel | 1998 | 167 | d/g | 13 | 49 | 92 | - | - | - | - | - | .16 | - |
| Woolley et al. | 2009 | 848 | s (6-8) | s/- | 0 | 49 | 0 | 76 | - | .58[b] | - | .10[b] | - |
| Zimmer-Gembeck et al. | 2006 | 324 | s (10-11) | s/- | 0 | 52 | 80 | - | - | .59 | - | .35 | - |

*Note 1*. School = schooltype (p = primary school, s = secondary school); for grades, -1 = preschool, k = kindergarten, 1 = grade 1, etc.; inf. = informant (s = same, d = different) / ach. = grades vs. test scores (g = grades, t = test scores); month. = months between; girls = gender of students (% girls); ethn. maj. = ethnicity of students (% majority); low SES = SES (% disadvantaged); learn. dif. = learning difficulties (in %); pe = positive relationships and engagement; ne = negative relationships and engagement; pa = positive relationships and achievement; na = negative relationships and achievement; e = engagement; a = achievement $r_{pe}$ = correlation between positive relationships and engagement; $r_{ne}$ = correlation between negative relationships and engagement; $r_{pa}$ = correlation between positive relationships and achievement; $r_{na}$ = correlation between negative relationships and achievement

*Note 2*. [a] = correlation provided by author
[b] = correlation based on standardized regression coefficient/increment in $R^2$
[c] = correlation calculated based on Mean and SD or percentages
[d] = correlation based on factor correlations
[e] = information received by personal correspondence with author
[f] = correlation calculated based on Structural Equation Models

Each study was coded for the following sample characteristics: school type (0 = preschool, kindergarten, and/or elementary school; 1 = middle, junior high, and/or high school); number of students; average grade level (mean of the grades students were in; -1 = preschool, 0 = kindergarten, 1 = grade 1, etc.); student gender (percentage of girls); student ethnicity (percentage of ethnic majority students); SES (percentage of students with low SES); learning difficulties (percentage of students with academic risk); teacher gender (percentage of females); teacher ethnicity (percentage of ethnic majority teachers); and teaching experience (in years).

In addition, three characteristics of the study methods were coded to control for methodological biases of the primary studies: *informant/method*, *grades vs. test scores*, and *months between predictor and outcome*. *Informant/method* was coded to control for the effect of shared method variance. It indicates whether studies used same (e.g., student report for both TSRs and engagement or teacher report for both TSRs and achievement) or different informants/methods (e.g., teacher report for TSRs and observations for engagement or student report for TSRs and grades for achievement) for independent and dependent variable (0 = same informant/method, 1 = different informant/method). *Grades vs. test scores* was coded because grades rely on teacher judgment and might therefore be more strongly related with TSRs than more objective test scores. It indicates whether a study used grades (= 0) or test scores (= 1) to measure students' achievement. Studies that used both grades *and* test scores as indication of achievement, and studies that used teacher reports or self-reported grades were not categorized and therefore not

included in analyses based on this methodological characteristic. *Months between* was coded because it is likely that the strength of associations depends on the study design (i.e., cross-sectional vs. longitudinal). It indicates the number of months between the measurement of TSRs and engagement/achievement outcomes.

## Calculation of Effect Sizes

If available, we used *Pearson's correlation coefficient r* as effect size. If studies did not report correlations, we contacted the authors to ask whether they could send us the correlation of interest. In case correlations could not be retrieved, we estimated correlations based on statistics provided in the article. If only ANOVA results were reported, we used the formula of Mullen (1989, p. 44) to translate *F* into *r*. Some articles only reported factor correlations, which are usually an overestimation of *Pearson's r*. We used the correction for attenuation formula (Spearman, 1904) to translate these factor correlations into correlations. In addition, for some articles we calculated correlations based on means and standard deviations or percentages. Furthermore, for five studies standardized regression coefficients were used as effect size, or a correlation was estimated based on increment in $R^2$. We should note that coefficients from multiple regression analyses generally underestimate zero-order correlations, because they are corrected for the influence of other predictors. Inclusion of statistic (0 = other statistic, 1 = regression coefficient) as a moderator in our analyses showed that if negative relationships and engagement ( $\beta$ = .26, $p < .01$) and positive relationships and achievement ( $\beta$ = -.35, $p < .01$) were considered, effect sizes were indeed smaller if they were based on regression coefficients. However, for both positive relationships and engagement ( $\beta$ = .02, $p = .31$) and negative relationships and achievement ( $\beta$ = .03, $p = .77$), effect sizes based on regression coefficients did not differ significantly from effect sizes based on other statistics. Finally, for one study (see Table 1), we calculated the effect size by multiplying coefficients of Structural Equation Models.

We converted the correlations into Fisher's *Z* (Lipsey & Wilson, 2001; Mullen, 1989). To facilitate interpretation, the resulting overall effect sizes were transformed back to correlations (Lipsey & Wilson, 2001; Mullen, 1989).

## Analyses

Analyses were conducted with SPSS, using SPSS macros published by Lipsey and Wilson (2001). Effect sizes were weighted by their inverse variance ($N - 3$).

First, four overall effect sizes were estimated: for positive relationships and engagement, negative relationships and engagement, positive relationships and achievement, and negative relationships and achievement. Second, we investigated moderator effects of methodological and sample characteristics. We estimated the effects of the moderators separately, because most of the studies in our dataset did not report about all moderators included in the analyses. Including more than one moderator at the same time would lead to a decrease in power. To control for possible overlap between moderators, we inspected the correlations between the moderator variables. Correlations are available on request from the first author.

## Fixed and Random Effects Models

For the present study, we chose to report both fixed and random results for the overall

effect sizes. Random effects models allow generalizations, beyond the particular set of studies included in the meta-analysis, to comparable studies that have been or might be conducted, whereas fixed effects models only permit inferences about the studies included in the meta-analysis (Schmidt, Oh, & Hayes, 2009). However, tests of random effects have less statistical power to detect significant effects than tests of fixed effects. Most moderator variables were only occasionally investigated in previous research, and findings are often inconclusive. Therefore, we decided to explore moderator effects in fixed effects models, to maximize the power to find relationships between moderators and effect sizes, rather than trying to make inferences to other studies not included in our analyses.

## Results

### Descriptives

Effect sizes, methodological, and student characteristics of the individual studies are presented in Table 1. Teacher characteristics for the individual studies are available on request from the first author. Descriptives for the continuous and categorical moderators are reported in Tables 2 and 3, respectively.

*Table 2. Descriptive statistics for continuous moderator variables*

|  | Positive TSRs and engagement | | Negative TSRs and engagement | | Positive TSRs and achievement | | Negative TSRs and achievement | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Mean (SD) | Range | Mean (SD) | Range | Mean (SD) | Range | Mean (SD) | Range |
| Months between predictor-outcome | 1.28 (4.64) | 0-30 | 4.00 (7.96) | 0-30 | 3.20 (7.71) | 0-42 | 6.14 (11.98) | 0-42 |
| Average grade level | 4.82 (3.55) | -1-11.5 | 2.03 (2.79) | -1-7 | 3.76 (3.70) | -1-11 | 1.52 (2.62) | -1-7 |
| Student gender (% girls) | 51.55 (6.08) | 40-70 | 50.45 (4.59) | 40-60 | 50.24 (4.88) | 40-70 | 48.65 (3.21) | 40-54 |
| Student ethnicity (% majority) | 48.86 (34.63) | 0-100 | 56.89 (33.12) | 0-95 | 53.18 (30.55) | 0-98 | 57.72 (29.81) | 0-100 |
| SES (% disadvantaged) | 64.55 (28.66) | 17-100 | 66.79 (32.00) | 25-100 | 52.82 (30.50) | 6-100 | 54.30 (30.53) | 12-100 |
| Learning difficulties (in %) | 38.53 (42.54) | 9-100 | 38.53 (42.54) | 9-100 | 36.08 (39.32) | 5.6-100 | 43.70 (40.92) | 11-100 |
| Teacher gender (% female) | 93.00 (9.97) | 70-100 | 98.63 (2.56) | 94-100 | 92.60 (9.56) | 74-100 | 94.08 (9.39) | 74-100 |
| Teacher ethnicity (% majority) | 86.94 (15.59) | 60-100 | 91.29 (11.50) | 67-100 | 89.78 (11.96) | 60-100 | 91.93 (8.42) | 78.9-100 |
| Teaching experience (in years) | 13.73 (5.15) | 4.05-20.17 | 13.87 (4.98) | 4.05-20.17 | 13.08 (4.53) | 4.05-20.17 | 12.59 (5.08) | 4.05-20.17 |

*Note.* Average grade level ranges from preschool (= -1) to mid-twelfth grade

*Table 3. Descriptive statistics for categorical moderator variables*

|  | Positive and engagement | Negative and engagement | Positive and achievement | Negative and achievement |
| --- | --- | --- | --- | --- |
|  | Studies (*k*) | Studies (*k*) | Studies (*k*) | Studies (*k*) |
| *Informant/method* | | | | |
| Same | 35 | 5 | 10 | 4 |
| Different | 26 | 13 | 51 | 24 |
| *Grades vs. test scores* | | | | |
| Grades | - | - | 16 | 2 |
| Test scores | - | - | 22 | 16 |
| *Primary vs. secondary school* | | | | |
| Primary | 35 | 15 | 42 | 24 |
| Secondary | 23 | 2 | 17 | 3 |

*Note.* *k* is number of studies

Table 4. *Overall effect sizes for the associations between affective TSRs and learning behaviors*

| | Positive TSRs-engagement | | | Negative TSRs-engagement | | | Positive TSRs-achievement | | | Negative TSRs-achievement | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *r* (95% CI) | *k* | *N* | *r* (95% CI) | *k* | *N* | *r* (95% CI) | *k* | *N* | *r* (95% CI) | *k* | *N* |
| | | | | | Total dataset | | | | | | | |
| Fixed | .39 (.38 - .39) | 61 | 88,417 | -.32 (-.34 - -.30) | 18 | 5847 | .16 (.15 - .17) | 61 | 52,718 | -.15 (-.17 - -.14) | 28 | 18,944 |
| Random | .34 (.28 - .39) | | | -.31 (-.38 - -.24) | | | .16 (.13 - .20) | | | -.18 (-.22 - -.15) | | |
| | | | | | Primary school | | | | | | | |
| Fixed | .26 (.25 - .28) | 35 | 13,750 | -.34 (-.36 - -.31) | 15 | 4823 | .14 (.12 - .16) | 42 | 14,127 | -.19 (-.21 - -.17) | 24 | 6726 |
| Random | .27(.22 - .32) | | | -.32 (-.39 - -.24) | | | .14 (.10 - .19) | | | -.18 (-.23 - -.14) | | |
| | | | | | Secondary school | | | | | | | |
| Fixed | .30 (.30 - .31) | 23 | 54,923 | -.25 (-.32 - -.19) | 2 | 853 | .16 (.15 - .17) | 17 | 38,343 | -.13 (-.15 - -.12) | 3 | 12,176 |
| Random | .40 (.35 - .45) | | | -.31 (-.48 - -.11) | | | .20 (.13 - .28) | | | -.16 (-.21 - -.10) | | |

*Note 1.* All effect sizes are significant at *p* < .01
*Note 2.* *k* is number of studies

## Overall Effect Sizes and Moderators

Overall effect sizes for the total dataset and separate effect sizes for primary and secondary school studies are presented in Table 4. Correlations below .10 are considered as small, between .10 and .25 as small to medium, around .25 as medium, between .25 and .40 as medium to large, and above .40 as large (based on Lipsey & Wilson, 2001, p. 147).

The results for the effects of the moderator variables are reported in Table 5. Notice, that the direction of the standardized regression coefficients ( β) should be interpreted differently for positive and negative effect sizes. If the overall effect size is positive (i.e., for positive relationships and engagement and for positive relationships and achievement), a positive regression coefficient means that effect sizes are *stronger* for studies that score higher on the moderator variable; a negative regression coefficient means that effect sizes are *weaker* for studies that score higher on the moderator variable. If the overall effect size is negative (i.e., for negative relationships and engagement and for negative

Table 5. *Effects of moderator variables for total dataset on the associations between TSRs and learning outcomes*

| | Positive TSRs-engagement | | | Negative TSRs-engagement | | | Positive TSRs-achievement | | | Negative TSRs-achievement | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | *p* | *k* | β | *p* | *k* | β | *p* | *k* | β | *p* | *k* |
| | | | | Methodological characteristics | | | | | | | | |
| Informant (0 = same, 1 = different) | -.334 | <.001 | 61 | .330 | <.001 | 18 | .114 | <.001 | 61 | -.388 | <.001 | 28 |
| Grades vs. test scores (0 = grades, 1 = test) | - | - | - | - | - | - | -.620 | <.001 | 38 | -.006 | .970 | 18 |
| Months between predictor-outcome | -.106 | <.001 | 60 | -.034 | .733 | 17 | -.133 | <.001 | 61 | -.488 | <.001 | 28 |
| | | | | Student characteristics | | | | | | | | |
| School type (0 = primary, 1 = secondary) | .170 | <.001 | 58 | .218 | .016 | 17 | .083 | .011 | 59 | .386 | <.001 | 27 |
| Average grade level | .089 | <.001 | 58 | -.165 | .063 | 18 | .227 | <.001 | 58 | -.319 | .007 | 27 |
| Student gender (% girls) | -.175 | <.001 | 55 | .318 | .009 | 17 | .103 | .002 | 58 | .095 | .366 | 26 |
| Student ethnicity (% majority) | .045 | .264 | 50 | -.074 | .428 | 16 | -.127 | <.001 | 51 | .070 | .568 | 23 |
| SES (% disadvantaged) | .247 | <.001 | 26 | -.578 | <.001 | 10 | .342 | <.001 | 30 | -.474 | <.001 | 19 |
| Learning difficulties (in %) | -.315 | .238 | 4 | -.622 | .046 | 4 | .163 | .604 | 5 | -.670 | .011 | 4 |
| | | | | Teacher characteristics | | | | | | | | |
| Teacher gender (% female) | -.369 | .005 | 17 | .716 | .022 | 8 | -.131 | .105 | 20 | -.196 | .155 | 12 |
| Teacher ethnicity (% majority) | .372 | .115 | 12 | -.088 | .747 | 8 | .491 | <.001 | 17 | -.242 | .082 | 12 |
| Teaching experience (in years) | -.305 | .112 | 12 | .175 | .203 | 10 | .386 | .032 | 11 | .063 | .816 | 7 |

*Note 1.* Standardized beta coefficients are reported
*Note 2.* *k* is number of studies

relationships and achievement), a positive regression coefficient means that effect sizes are *weaker* (i.e., closer to zero) for studies that score higher on the moderator variable, whereas a negative regression coefficient means that effect sizes are *stronger* (i.e., further away from zero) for studies that score higher on the moderator variable.

Our moderator analyses showed that the strength of the effect sizes differed significantly between primary and secondary school studies (see Table 5). Therefore, we also calculated the overall effect sizes separately for primary and secondary school. For primary school, we will separately report about the influence of student and teacher characteristics, if they differ from the results of the total dataset. Results of these moderator analyses will not be reported separately for secondary school, because in many cases there were not enough studies to perform these analyses.

### Overall Effect Sizes

The overall effect sizes for the associations between both positive relationships and engagement ($r = .39$, $p < .01$ for fixed effects model; $r = .34$, $p < .01$ for random effects model) and negative relationships and engagement ($r = -.32$, $p < .01$ for fixed effects model; $r = -.31$, $p < .01$ for random effects model) were medium to large. The associations between both positive relationships and achievement ($r = .16$, $p < .01$ for both fixed and random effects models) and negative relationships and achievement ($r = -.15$, $p < .01$ for fixed effects model; $r = -.18$, $p < .01$ for random effects model) were small to medium.

Effect sizes often differed depending on methodological characteristics of the primary studies. For all associations, the effect of *informant/method* was significant: Effect sizes for the influence of TSRs on engagement were larger in studies that used the same informant for the measurement of both independent and dependent variables. Contrary to expectations, the effect sizes for the influence of TSRs on achievement were larger in studies that used different informants. More specific, for studies that used the same informant for both independent and dependent variable, effect sizes were .41 for positive relationships and engagement, -.42 for negative relationships and engagement, .14 for positive relationships and achievement, and -.13 for negative relationships and achievement, whereas effect sizes for the studies that used different informants were .23, -.30, .17, and -.19 respectively (for fixed effects models; $p < .01$ for all associations). *Grades vs. test scores* had a significant effect on the association between positive relationships and achievement but not on the effect size of negative relationships on achievement. Effect sizes of positive relationships on achievement were larger in studies that used grades as indicators of students' achievement. More explicit, effect sizes were .24 for positive relationships and -.15 for negative relationships, whereas effect sizes were .07 and -.15, respectively, if test scores were used as indicator of achievement (for fixed effects models; $p < .01$ for all associations). *Months between* had a significant effect on all associations, except negative relationships and engagement: Associations between positive relationships and both engagement and achievement were stronger in studies with fewer months between the measurement of the independent and dependent variables. Unexpectedly, the association between negative relationships and achievement was stronger in studies with more months between the measurement of relationships and achievement. To obtain some indication whether associations hold over years, effect sizes were calculated separately for longitudinal studies that measured

learning outcomes at least one grade later than the TSR: Effect sizes were .20 ($k$ = 5) for positive relationships and engagement, -.32 ($k$ = 4) for negative relationships and engagement, .16 ($k$ = 9) for positive relationships and achievement, and -.21 ($k$ = 6) for negative relationships and achievement (for fixed effect models; $p$ < .01 for all associations).

## Student Characteristics as Moderators

The effect of age was studied using the variables *average grade level* and *primary versus secondary school* (see Table 5). All associations, except negative relationships and engagement, were significantly influenced by *average grade level*. Unexpectedly, the effect sizes were larger in studies conducted in higher grades. In addition, the effect sizes were significantly different between *primary and secondary school*, with effect sizes for positive relationships and both engagement and achievement being larger in secondary school studies. In contrast, the associations of negative relationships with both engagement and achievement were stronger in primary school studies. *Student gender* was also a significant moderator for all predictor-outcome associations, except negative relationships and achievement. Associations of both positive and negative relationships with engagement were stronger in samples with more boys, whereas effect sizes for positive relationships and achievement were larger in samples with more girls. *Student ethnicity* had a significant effect on the association between positive relationships and achievement only, with effect sizes being larger in samples with less ethnic majority students. The effect of *SES* was significant and in the same direction for all predictor-outcome associations, with associations being larger in samples with more students with a low SES. The number of students with *learning difficulties* significantly influenced the strength of the associations of negative relationships with both engagement and achievement; associations were stronger in samples with more students with learning difficulties.

If the analyses were conducted with primary school studies only, the effect of *average grade level* ( $\beta$ = -.57, $p$ < .01) on the association between negative relationships and engagement was significant, with larger effect sizes being reported in studies performed in higher grades, whereas the effect on the association between positive relationships and achievement ( $\beta$ = -.02, $p$ = .72) was not significant. In addition, the effect of *ethnicity of students* on positive relationships and engagement was significant ( $\beta$ = .32, $p$ < .01), with stronger associations being found in studies with more ethnic majority students, whereas the effect on positive relationships and achievement ( $\beta$ = .11, $p$ = .10) was not significant. Finally, three of the four effects of *SES* were not significant without the secondary school studies: positive relationships and engagement ( $\beta$ = -.05, $p$ = .69), positive relationships and achievement ( $\beta$ = -.07, $p$ = .50), and negative relationships and achievement ( $\beta$ = -.20, $p$ = .14).

## Teacher Characteristics as Moderators

 *Teacher gender* had a significant effect on the associations with engagement only, with larger effect sizes being reported in samples with more male teachers. *Teacher ethnicity* significantly influenced the association between positive relationships and achievement only; associations were stronger in samples with more ethnic majority teachers. *Teaching*

*experience* had a significant effect on the association between positive relationships and achievement only, with larger effect sizes being reported in samples with teachers who had more years of teaching experience.

Without the secondary school studies, the effect of *gender of teachers* ( β = .22, *p* = .25) on positive relationships and engagement was not significant.

### Publication Bias

We checked for publication bias by calculating correlations between the effect sizes of the individual studies and their sample size. If publication bias is present, we would expect to find significant negative correlations between sample size and effect size, because larger samples have more power to detect small effects and are therefore more likely to be published. None of the correlations between sample size and effect size were significant (*r*s = -.08 – .13, *p* > .05). We also checked the scatterplots, with effect sizes displayed on the horizontal axis and sample sizes on the vertical axis. Correlations and scatterplots did not indicate publication bias.


## Discussion

Recent meta-analyses  have provided broad evidence of the impact of teacher behaviors on student outcomes (Allen et al., 2006; Cornelius-White, 2007; Witt et al., 2004). The present study aimed to generate more specific knowledge on this topic by focusing on subsets of both teacher behaviors and student outcomes. Different from previous meta-analyses, we concentrated on the affective dimension of relationships between teachers and individual children and also added negative TSRs. Students' school engagement and achievement were chosen as outcome variables. Separate analyses were performed for positive and negative aspects of the TSR in relation to both engagement and achievement.

### Overall Associations Between TSRs and Students' Engagement and Achievement

All analyses showed significant associations between the investigated variables, providing further support for the notion formulated in prior research literature and review studies that TSRs influence students' school engagement and achievement (e.g., Bergin & Bergin, 2009; Davis, 2003; Hamre & Pianta, 2001; Pianta et al., 2003; Skinner & Belmont, 1993). As expected (e.g., Birch & Ladd, 1997; Ladd et al., 1999), the analyses revealed positive associations between positive TSRs and both engagement and achievement, and negative associations between negative relationships and both engagement and achievement.

Based on previous research (e.g., Baker, 2006; Hamre & Pianta, 2001; Ladd et al., 1999), we expected to find stronger associations for negative than for positive aspects of the TSR. This was not supported by the results for the total dataset and seems to be just the opposite for secondary school studies. This gives the impression that positive aspects of the TSR are at least as important for students' school adjustment as negative aspects. However, if analyses were conducted for primary school studies only, the overall associations with engagement were somewhat stronger for negative relationships than

for positive relationships. This latter finding is in agreement with our hypothesis, which was based on findings in primary school studies (Baker, 2006; DiLalla et al., 2004; Hamre & Pianta, 2001; Ladd et al., 1999).

As expected, the associations with engagement were stronger than the associations with achievement. According to Hamre and Pianta (2001), TSRs are partly a measure of social adjustment, and therefore more proximal to behavioral than academic outcomes. Furthermore, engagement has been found to act as a mediator between TSRs and achievement (e.g., de Bruyn, 2005; Hughes et al., 2008; Woolley et al., 2009; Zimmer-Gembeck et al., 2006). The mediating role of engagement could not be investigated in the meta-analysis, because most primary studies did not investigate this. However, some studies did provide information about the association between engagement and achievement. The overall effect size for this association was .29, $p < .01$ (for fixed effects model; $k$ = 26), which is in line with a mediating role of engagement. Although the associations between both positive and negative relationships and achievement were modest, they were still significant and appeared to hold over time. This influence of affective TSRs is notable, because achievement is known to be largely dependent on stable child and family characteristics, such as IQ and SES (Jensen, 1969; Pianta, Belsky, Vandergrift, Houts, & Morrison, 2008).

In sum, the overall associations between TSRs and engagement and achievement provided support for the investigated parts of our theoretical model (Figure 1): affective TSRs were associated with both students' school engagement and achievement. In line with the self-determination theory, the smaller associations with achievement seem to suggest that the effect of TSRs on achievement runs partly via engagement. The mediating role of emotional security in the associations between TSRs and learning behaviors, could not be explored because primary studies scarcely investigated this. In addition, the influence of autonomy support, structure, and instruction were not investigated because they were beyond the scope of the present study.

### Differences in Results Due to Methodological Characteristics

The moderator analyses suggested that the overall effect sizes could be somewhat overestimated due to methodological biases in some of the primary studies. First, associations with engagement were stronger in studies that used the same informant/method (e.g., teacher or observation) for the measurement of both relationships and engagement. This seems to indicate that the impact of TSRs on engagement is overestimated due to shared informant/method variance in part of the primary studies. However, even though associations were stronger in studies that used the same informant, both positive and negative TSRs were still significantly associated with engagement in studies that used different informants/methods. Unexpectedly, associations with achievement appeared to be stronger in studies that used *different* informants/methods. Studies using the *same* informant/method used either teacher or student reports of students' achievement. Perhaps, student and teacher reports of achievement are less valid than more objective measures, like independent test scores and grades (Kuncel, Credé, & Thomas, 2005), which could explain why associations are weaker if the same informant reported on both relationships and achievement. Second, associations between positive relationships and achievement were stronger in

studies that used grades as indicator of achievement. Although the association between positive TSRs and test scores was only small, this association was still significant. The association between negative relationships and achievement was the same whether grades or achievement tests were used as outcome variable. Probably, associations between positive relationships and grades were stronger than with independent test scores, because grades rely on teacher judgments and might therefore be more strongly influenced by teachers' affect for students than more objective measures of achievement, such as achievement tests or observations. To prevent this bias, future studies should use more objective measures of achievement, or use school grades that are given by other teachers than the teachers with whom relationship quality was measured.

In addition, moderator analyses showed that the effects of positive relationships were typically stronger in studies with fewer months between the measurement of relationships and engagement/achievement. This indicates that the effect sizes for positive relationships might be strongly influenced by the use of cross-sectional designs in most primary studies. Unexpectedly, the association between negative relationships and achievement was stronger in studies with more months between the measurement of independent and dependent variable. One possible explanation for this latter finding could be a cumulative effect of negative TSRs. In this way, negative relationships and low achievement intensify each other, leading to stronger effects over time. In addition, it has been suggested that conflict is a more child-driven aspect of the TSR, which is relatively stable across the school years and strongly related to children's externalizing behaviors (Justice, Cottone, Mashburn, & Rimm-Kaufman, 2008). Closeness, on the other hand, is theorized to be a more dyadic TSR construct, which is only moderately associated with child characteristics and less stable across the years (Jerome, Hamre, & Pianta, 2008; Silver, Measelle, Armstrong, & Essex, 2005). Therefore, positive aspects of the TSR may have only a short-term effect on children's learning behaviors, whereas the cascading impact of negative TSRs and children's externalizing behaviors may become more strong over time.

Finally, as usual in meta-analytic research, we used zero-order correlations because they can be compared across studies. Correlations, however, could be an overestimation of the unique effects of TSRs on engagement/achievement.

### Moderating Influences of Students' Age

We also investigated whether the strength of the associations between TSRs and students' outcomes was influenced by students' age. The results for grade level suggest that TSRs are more important for the academic adjustment of older children. This is a remarkable finding, considering suggestions made in previous literature that students become increasingly independent from teachers and more focused on peers as they grow older (Buhrmester & Furman, 1987; Hargreaves, 2000; Lynch & Cicchetti, 1997). Especially the positive quality of TSRs, or closeness, seems to become more important as age increases and students make the transition to secondary school. Previous research has found that students become less engaged as they grow older (Marks, 2000; McDermott, Mordell, & Stoltzfus, 2001). Perhaps, TSRs are more important for older students, because they face new academic challenges due to their lower engagement and the increasing complexity of the school system (Hamre & Pianta, 2001). Unfortunately, relationships with teachers

tend to become less positive as students grow older (e.g., Furrer & Skinner, 2003). In contrast with the findings for grade level, the analyses for primary vs. secondary school studies indicate that negative aspects of the TSR have more impact on primary than on secondary school students. Murray (2009) suggested that there may be a developmental shift in the importance of specific aspects of TSRs, with negative dimensions of the relationships being more important for the school adjustment of younger children, and positive aspects being more important for adolescents. Our findings seem to support this idea.

There are also other explanations possible for the differences found between primary and secondary school studies. Students in secondary school usually have several teachers during the school day, whereas primary school students generally spend most of their time with the same teacher. In addition, there are differences in professional roles of teachers in the two school types (e.g., more emphasis on teacher control and discipline and less personal and positive TSRs in secondary school; Bergin & Bergin, 2009; Hargreaves, 2000), which could lead to more dissatisfaction with levels of teacher support among secondary school students. Perhaps, less contact moments and a perceived lack of support make secondary school students more sensitive for the degree of support they receive from their teachers. Lastly, differences in effects could also be explained by methodological differences between primary and secondary school studies. Secondary school studies more often used student reports for both relationships and engagement as well as a cross-sectional design. Both could have lead to inflated associations between variables.

## Moderating Influences of Other Child Characteristics

Concerning the effect of students' gender on the importance of TSRs, we found support for academic risk as well as gender role socialization perspectives. For both positive and negative relationships and engagement, the effects were stronger in studies with more boys, providing evidence of the academic risk perspective. Previous research has found that boys are generally less engaged than girls (e.g., Bos, Sandfort, de Bruyn, & Hakvoort, 2008; Furrer & Skinner, 2003; Ladd & Burgess, 2001; Verkuyten & Thijs, 2002). Perhaps TSRs are more important for the engagement of boys, because boys have more to gain or to lose (Hamre & Pianta, 2001). In contrast, for positive relationships and achievement, associations were stronger in studies with more girls, supporting the gender role socialization perspective (Ewing & Taylor, 2009; Maccoby, 1998). Girls generally are already more engaged than boys, but sharing a positive relationship with their teachers can still have an additional influence on their achievement.

The academic risk hypothesis (Hamre & Pianta, 2001) states that at-risk children, including children with a low SES, ethnic minority status, and/or learning difficulties, will be more strongly influenced by the quality of the TSR than normative children. Overall, the results for the total dataset seemed to provide convincing support for this hypothesis: All analyses for SES were significant and indicated that TSRs are more influential for students who are academically at risk due to their low SES. In addition, results indicated that negative TSRs are more deteriorating for students academically at risk because of learning difficulties. Probably, having a conflictual relationship with their teacher adds an extra burden for students with learning difficulties, further

diminishing their engagement and achievement. However, support for the academic risk hypothesis is less strong with regard to student ethnicity: Only the association between positive relationships and achievement was significantly stronger for ethnic minority students. Students' ethnicity did not influence the associations with negative relationships, suggesting that negative TSRs are important for the school functioning of all students.

Whereas the analyses of the total dataset overall provided support for the academic risk hypothesis (Hamre & Pianta, 2001), this evidence is less strong in the analyses of the primary school studies only. For the primary school studies only, the effect of SES was only significant for negative relationships and engagement and not for the other three associations, which is consistent with previous primary school studies (Garner & Waajid, 2008; Ladd & Burgess, 2001). Concerning ethnicity, the results for primary schools were against the academic risk perspective, with positive relationships being less important for the engagement of ethnic minority students. Future studies could further investigate the importance of TSRs for different ethnic minority groups (see Hughes et al., 2005; Murray et al., 2008).

### Moderating Influences of Teacher Characteristics

We conclude that, overall, effects of teacher characteristics were limited. The few effects that were found were difficult to interpret, due to the lack of theoretically-based hypotheses. Teacher gender influenced the associations with engagement, but not with achievement. Unexpectedly, the results showed substantially stronger effects for samples with more male teachers, although these effects were less apparent in primary school studies. Teachers' ethnicity and experience had a significant influence on the association between positive relationships and achievement only, with stronger effects being found in samples with more ethnic majority teachers and more experienced teachers. Perhaps, it would be more relevant for future research to investigate the influence of both gender and ethnic match between teacher and student (cf., Ewing & Taylor, 2009; Hamre & Pianta, 2001). This was not possible in this meta-analysis, because the primary level studies did not provide information about the gender and ethnic matches in their samples.

### Qualifications

A first qualification that should be taken into account is that TSRs were considered as independent and engagement and achievement as dependent variables, based on leading theories. This meta-analysis, however, does not permit conclusions about causality. Moreover, most primary studies used cross-sectional designs, which further hinders conclusions about causality. Still, for the few studies that did measure TSRs and learning outcomes in different school years, associations were significant, which provides some support for the predictive role of affective TSRs. Second, we only reported fixed model results for the moderator analyses, which precludes generalization to studies not included in the present analyses. Fixed effects models were used, because they have more power to detect significant results. Third, primary studies did not provide information about all student and teacher characteristics that we included as moderators in our analyses. This limited the possibilities to investigate multiple moderators together

in one analysis. Future studies should provide more complete information about the characteristics of their sample. Fourth, in many cases moderator analyses could not be conducted for secondary school studies. It should be noted that moderator effects for secondary school students can not be simply inferred from the differences in results between the total dataset and the primary school studies only. The moderating effects of student and teacher characteristics for secondary school students need to be further investigated in future research.

### Recommendations for Future Research

The present study leads to recommendations for future research. First, future research, and especially secondary school studies, should consider to include negative aspects of the relationship (e.g., conflict, distrust). Second, as mentioned before, most secondary school studies use student reports for the measurement of both relationships and engagement. Perceptions of secondary school students usually have high quality (Wubbels & Brekelmans, 2005). However, there is a risk that associations are inflated because of shared informant and shared method variance. Therefore, use of multiple informants and methods is recommended for future research, especially for secondary school studies. Third, as most studies on the influence of affective TSRs are cross-sectional, it would be interesting for future studies to focus on students' growth trajectories across different school years, and to investigate how the relationships with different teachers create deflections (either positive or negative) from students' average growth trajectories for engagement and achievement. Fourth, we found that negative TSRs were more important for students with learning difficulties. However, only a few studies actually reported the number of students with learning difficulties in their sample. Even less studies reported about the number of students with behavioral problems, for which reason this could not be studied. It is important that future research focuses more on students with learning difficulties and behavioral problems and further investigates the impact of TSRs on academic functioning in (sub)clinical populations.

## Conclusion

This meta-analytic review provided evidence for the importance of both positive and negative aspects of the TSR for students' learning at school. Overall, associations of TSRs with engagement and achievement were substantial. However, some associations were less strong, although still significant, in longitudinal studies, in studies that used different informants for independent and dependent variables, and if independent test scores were used as indicators of achievement. In contrast with strong assumptions in the literature, affective TSRs remained important, or were even *more* influential, for older students, even into late adolescence. Overall, TSRs were more important for children who were academically at risk, in particular for children from disadvantaged economic backgrounds and children with learning difficulties. It was less clear whether TSRs were more important for boys or for girls. Finally, there was no convincing support for the moderating role of teacher characteristics.

The associations found suggest that while affective TSRs are important, they are not sufficient to improve students' learning behaviors. There are many other teacher factors

(e.g., instruction quality, autonomy support, and structure; see O'Connor & McCartney, 2007; Skinner et al., 2009), which were beyond the scope of this study, that also influence engagement and achievement. Still, findings indicate that school psychologists could use the affective quality of the TSR as starting point for promoting school success (Malecki & Demaray, 2003). A focus on affective TSRs seems to be especially relevant for students at risk for academic maladjustment.

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*References marked with an asterisk indicate studies included in the meta-analysis.*

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