A DEVELOPMENTAL PERSPECTIVE ON RECIPROCAL EFFECTS OF

TEACHER-STUDENT RELATIONSHIP AND ACHIEVEMENT ACROSS THE

ELEMENTARY GRADES

A Dissertation

by

LISA KATHERINE BARROIS

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2010

Major Subject: School Psychology

A Developmental Perspective on Reciprocal Effects of Teacher-Student Relationship

and Achievement across the Elementary Grades

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Approved by:

Chair of Committee,	Jan N. Hughes
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ABSTRACT

A Developmental Perspective on Reciprocal Effects of Teacher-Student Relationship

and Achievement across the Elementary Grades. (August 2010)

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Chair of Advisory Committee: Dr. Jan N. Hughes

The current study utilized structural equation modeling to test an indirect model

of the effects of Teacher-Student Relationship Quality (TSRQ) on reading and math

achievement via the indirect effects of TSRQ on engagement over the entire grade

school period (grades 1-5). The use of this design allowed for the testing of reciprocal

causal pathways and stationarity effects across the first five years of post-kindergarten

schooling. It was hypothesized that structural relationships between TSRQ, engagement

and achievement would vary across the grade school period with early experiences with

teachers influencing students' patterns of engagement which would become stable,

influencing future teacher-student relationships and long-term achievement.

Additionally, muti-group analyses were utilized to determine if gender or ethnicity

impacts the fit of the structural model.

Results indicated that the effect of TSRQ on engagement is invariant across time.

For both math and reading target outcomes, the null hypothesis that effects are invariant

(i.e., constant) across time could not be rejected. Additionally, results did not indicate

that gender or ethnic group membership impacted the structural fit of the model. The

current sample was limited to elementary school students and may not have provided a sufficient age span to investigate the developmental trends in teacher-student relationships that were predicted. Additionally, while the influence of TSRQ on engagement and achievement remains constant, the process through which TSRQ influences achievement may vary at different developmental periods. Study limitations and implications were also discussed.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

Children's early academic achievement is important for long-term social, emotional, and physical health. Multiple factors both within the child and outside the child influence early achievement. Recent research on factors outside the child has focused on aspects of the classroom context. By examining early academic trajectories, it is possible to examine those aspects of the classroom context that serve as risk or protective factors to current and future success. For example, high quality classroom instruction and quality teacher-student relationships all contribute to students' academic, social and behavioral outcomes (Burchinal, 2008; Matsumura, Slater & Crosson, 2008).

Observational studies of pre-k to elementary classrooms, have consistently identified two dimensions of teacher behavior that differentially relate to students' social and academic outcomes: social-emotional quality and instructional quality (Pianta et al., 2002; Mashburn et al., 2008). The dimension of social-emotional quality refers to the presence of a supportive, positive emotional tone to teacher-student interactions and the absence of negativity in teacher-student interactions. The dimension of instructional quality refers to teachers' behaviors that promote concept development and teachers' provision of quality feedback to students that has an evaluative aspect and goal of improving performance. The social-emotional quality of interactions is positively related to children's social competence and negatively related to children's development of problem behaviors (Mashburn et al., 2008). High quality emotional interactions may

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also contribute to enhanced academic achievement through an increase in motivation, attention and engagement (Pianta, Belsky, Vandergrift, Houts & Morrison, 2008). Instructional quality is positively related with academic and language development (Mashburn et al., 2008). While the dimensions of social-emotional quality and instructional quality are moderately correlated, both provide unique additional value to student outcomes (Mashburn et al., 2008).

Mounting evidence suggests that quality social-emotional relationships with significant adults impact children's development of academic, social and emotional competencies. In fact, a strong relationship with a caring adult is considered to be one of the most influential and consistent protective factors for child development (Masten, Best & Garmezy, 1990). For school-age children, research indicates that a positive relationship with teachers is one of the single most common resources available in children's social networks and may operate as a protective factor against school avoidance (Birch & Ladd, 1997), behavioral problems (Pianta, Steinberg & Rollins, 1995), and poor academic achievement (Pianta & Stuhlman, 2004).

Roles of parental and non-parental figures in children's social networks have been studied extensively, especially from the perspectives of attachment theory (Ainsworth, 1989; Furman & Buhrmester, 1985; Furman & Buhrmester, 1992; Wentzel & Wigfield, 1998) and developmental systems theory (Ford & Lerner, 1992; Lerner, 1996). Attachment theory postulates that children's early experiences with adult caregivers help them develop unique working models of the social world (Bowlby, 1982; Ainsworth, 1989), which consequently influence their psychosocial development. Systems theorists emphasize the reciprocally interacting biological, psychological and contextual processes

that produce change across development (Lerner, 1996; Lerner & Hood, 1986). Students develop a representational model for teacher-student relationships based on both previous experiences with adult caregivers as well as initial relationship experiences with teachers. A secure relationship with a teacher may provide a sense of security that allows students to meet academic and social demands in the school environment with confidence (Bowlby, 1980; Little & Kobak, 2003). Since early relational experiences shape students' representational models of the teacher-student relationship, it is beneficial to have a quality teacher-student relationship early in the developmental period.

Relationships Among Teacher Student Relationship Quality, Engagement and Achievement

Longitudinal evaluations of Teacher-Student Relationship Quality (TSRQ) reveal that relationships typified by low levels of conflict and high levels of warmth and support are associated with gains in achievement (Birch & Ladd, 1997; Hamre & Pianta, 2001; Pianta & Stuhlman, 2004). Furthermore, TSRQ has been linked with several variables that may be proximal influences on achievement such as children's level of engagement in the school environment (Birch & Ladd, 1997), classroom participation (Ladd, Birch & Buhs, 1999), as well as work habits and social skills (Pianta, Steinberg & Rollins, 1995). By investigating these proximal variables, the mechanisms by which TSRQ influences achievement may be better understood.

It is theorized that a positive teacher-student relationship leads to emotional security, which assists a child to fully engage in learning activities and scaffolds the development of key social, behavioral, and self regulatory competencies that are essential for school success (Birch & Ladd, 1997; Hamre & Pianta, 2005; Hamre & Pianta, 2001;

Hamre & Pianta, 2006; Hughes, Cavell, & Willson, 2001; Skinner & Belmont, 1993).

Empirical investigations support that a quality teacher-student relationship leads to

greater cooperative and independent, self-directed classroom participation behaviors

(Ladd, Birch & Buhs, 1999) as well as behavioral and emotional engagement (Skinner &

Belmont, 1993). Furthermore, Skinner and Belmont (1993) found that teacher support

was predictive of students' engagement in learning, defined in terms of students' effort,

attention, and persistence during the initiation and execution of learning activities, and

that student engagement and teacher behavior were reciprocally related across the school

year. In an overlapping sample from this same longitudinal study, Hughes and Kwok

(2007) demonstrated that student-teacher and parent-teacher relationship quality

indirectly effected achievement the following year by way of the student's effortful

engagement in the classroom.

Individual Differences in the Effects of Teacher Student Relationship Quality

There is indication that ethnicity and gender affect teacher student relationship

quality. Reports of TSRQ vary with child ethnic group membership (Hughes & Kwok,

2006; Saft & Pianta, 2001). Previous research indicates that, compared to Caucasians and

Hispanics, teachers reports less supportive relationships with African American students

(Hughes, Gleason & Zhang, 2005). Additionally, compared with Caucasians, African

American males report more conflict in their relationships with teachers

(Mantzicopoulosa & Neuharth-Pritchett, 2003). In addition to main effects for ethnicity,

the ethnic match of a teacher and student pair affects the quality of the teacher student

relationship. When a teacher's and a child's ethnicity is the same, teachers report

relationships that are more positive, have higher levels of closeness and lower levels of

conflict (Saft & Pianta, 2001). In addition to main effects, there is also evidence that positive teacher-student relationships are more beneficial for African American students. Burchinal, Peisner-Feinberg, Pianta, & Howes (2002) found that closer teacher-student relationships are associated with improved academic outcomes for African American students. Meehan, Hughes, and Cavell (2003) reported that positive teacher-student relationships were more strongly associated with declines in aggression of African American students than Caucasian students.

Across development, teachers report closer relationships with lower levels of conflict with girls than boys (Mantzicopoulosa & Neuharth-Pritchett, 2003; Ryan, Stiller & Lynch, 1994). However, given that elementary and middle school teachers are predominantly female, these gender differences may be due to the tendency for greater closeness to be reported in relationships composed of gender-match dyads (Drevets, Benton & Bradley, 1996). Thus, boys are more likely to experience relationship difficulties with teachers.

Gender has been evaluated as a possible moderator of the relationship between TSRQ and behavioral and academic outcomes. Some studies utilizing regression analysis have investigated whether gender moderates the effects of TSRQ on outcomes. In a sample of preschool-aged children, teacher-student conflict better predicted hostile-aggressive behavior in males while teacher-student closeness better predicted school behavioral competence in females (Ewing & Taylor, 2009). Baker (2006) found that gender moderated the effect of TSRQ on reading achievement and social skills in elementary school aged children. Females with positive teacher-student relationships demonstrated better social skills than males with comparable teacher-student

relationships. Hamre and Pianta (2001) demonstrated that the relationship between ratings of teacher-student relational negativity in kindergarten and disciplinary referrals in upper elementary was stronger for males than females. However, gender did not moderate the relationship between kindergarten ratings of relational negativity and referrals in middle school. In a longitudinal sample of early elementary students, TSRQ did not interact with gender in the prediction of externalizing behavior problems from kindergarten to third grade (Silver, Measelle, Armstrong, & Essex, 2005).

Temporal Effects of Teacher Student Relationship Quality

It is evident that teacher support in the classroom environment affects students' achievement; however, the timing of these effects is unclear. While previous research has elucidated the effects of the teacher-student relationship at specific ages or grades, differences in study samples and measures of TSRQ and related outcomes do not allow for the comparison of effects across development. A longitudinal sample is necessary to explore possible variation in the effects of TSRQ across the developmental period.

Although no study has examined the invariance of the effects of TSRQ across development, researchers have investigated the consequences of TSRQ on future achievement. Hamre and Pianta (2001) reported that teacher-student relationships in kindergarten predicted school adjustment and academic achievement in fourth grade and behavior adaptation in middle school, even after controlling for verbal IQ, gender, ethnicity, behavior ratings and prior achievement. However, because they did not measure TSRQ during the interval from kindergarten to 8th grade, it is impossible to know what accounted for the long term prediction. Perhaps unmeasured child variables associated with both TSRQ and achievement, such as family background variables or

child temperament, account for the association. Or perhaps the long term prediction is due to continuous reciprocal relationships between TSRQ, child engagement and achievement that remain constant over time. In this case, the teacher-student relationship in each year of schooling would be equally important to long-term achievement. This conceptual model, referred to as the invariant reciprocal model, is presented in Figure 1, with bolded paths indicating those paths that would be expected to remain constant across development.

Alternately, perhaps early TSRQ impacts the child's behavioral orientation to school in the early grades, and this orientation mediates the effect of early TSRQ on later achievement. In this scenario, TSRQ beyond the early grades would not account for future achievement above early effects. This conceptual model, referred to as launching model and presented in Figure 2, predicts that while early TSRQ will have a significant indirect effect on achievement via the effect of TSRQ on engagement, these effects will be diminish over time, as indicated by the transition from solid to dotted lines of the structural paths from TSRQ to engagement. A longitudinal examination of TSRQ and engagement to achievement across first through third grades conducted by Hughes, Luo, Kwok and Loyd (2008) found evidence for reciprocal effects among TSRQ, engagement, and achievement in first three years of schooling as well as evidence for direct effects of first grade TSRQ, engagement, and achievement on third grade TSRQ, engagement and achievement, above year-to-year stability of each. These findings suggest TSRQ, engagement, and achievement comprise a dynamic system of reciprocal influences, at least from first to third grade. Thus, an intervention addressing these variables at any point in the first through third grades may improve academic trajectories. While these

results are promising, it is unknown which reciprocal effects continue beyond 3rd grade.

Developmental Changes in Academics and Relationships

Several research findings suggest that the effect of TSRQ on engagement and achievement may decline in importance after third grade. There is some evidence to suggest that academic trajectories become more stable after the third grade. For example, in a longitudinal study of achievement trajectories across elementary school, Pianta, Belsky, Vandergrift, Houts, and Morrison (2008) found that 98% of the change in reading achievement scores that would occur in elementary school was completed by third grade. Additionally, there is evidence of changes in relationships children experience at school. Research on the development of social perception processes provides evidence of changes in the influence of adults, such as teachers, in the development of behavioral expectations in students. Children rely on knowledge of behavioral norms in their perceptions of peers' actions. In early elementary school, childrens' perceptions of peers are more influenced by adult approval or disapproval while older childrens' perceptions are influenced by approval or disapproval from peers as well as adults (Constanzo & Dix, 1983). These findings indicate that students focus on teacher approval less with age as they increasingly consider opinions of peers. Students' supportive or critical interactions with teachers may become less important to classroom motivation as well as self-concept with age.

Analyses of cross-sectional data have indicated trends in childrens' perceptions of relationships with significant others such as teachers and peers. Children's perception of support from teachers is higher at younger ages than older ages (Furman & Buhrmester, 1992). By 5th grade, students report relying less on teachers for provision of social

support than on mothers, fathers, friends and siblings (Buhrmester & Furman, 1987).

Additional support for the notion that the importance of the teacher-student relationship may decrease in later grades can be found by examining children's self-evaluations. Children's self-evaluations are influenced by significant others' evaluations (Eccles, Barber, Jozefowicz, Malenchuk, & Vida, 1999). During 4th grade, the change in students' self-evaluations of academic competence were significantly predicted by peer ratings of the student's academic competence; however, teacher ratings did not predict change after controlling for peer evaluations (Cole, 1991). These findings suggest that children at this age rely more on information gained from peers than information from teachers. Taken together, this evidence suggests that teachers may have less influence on students as they age while peers may have more of an influence.

Social motivation theory posits that the effect of TSRQ on achievement is mediated by the effect of TSRQ on students' psychological engagement which is promoted by variables such as school belonging and motivation (Furrer & Skinner, 2003). There is evidence that the relationship between teacher support and students' motivation declines during the middle school years (grades 6-8) (Goodenow, 1993). Since teachers become less important to students' motivation, the effect of TSRQ on achievement may decline with age as well.

Developmental Changes in Information Processing

Based on a review of social information processing literature, Crick and Dodge (1994) posited that children's social information processing becomes increasing inflexible with age, such that initial patterns of perception and interpretation of relationships may be increasingly difficult to alter with the progression of time.

Additionally, children amass interpersonal feedback through the social responses they receive from teachers and peers in their social environment which leads to changes in self-evaluations that also become increasing rigid with age. For example, students' academic self-concept beliefs become more stable after third grade (Lau, Siu, Chik, 1998). Since self-concept affects TSRQ, engagement and achievement, the effects of TSRQ on engagment may decline with time (Gest, Rulison, Davidson & Welsh, 2008). Developmental theories provide a theoretical framework for understanding the mechanisms behind these changes.

Primacy Effects of TSRQ on Engagement and Achievement

Throughout development, children become attached to significant adults in their lives. According to attachment-related theories (Thompson, 1999), children develop representational models of relationships based on these relational experiences with significant others. A child then utilizes these models derived from early relational experiences to guide future interactions with others (Cassidy, 1999). Developmentally, these relationships differ across time. A young child will likely develop a significant attachment relationship with a parent. Then, when a child enters the school environment, a new significant relationship, the teacher-student relationship, is encountered. Attachment theorists posit that a student develops a representational model for early teacher-student relationships based both on the internal working model of relationships developed from previous experience with a primary caregiver. Howes, Rodning, Galluzzo and Myers (1988) demonstrated consistency in childrens' attachment related behaviors from parents to preschool teachers.

A secure relationship with a teacher provides a sense of security that allows a

student to meet academic and social demands in the school environment with confidence (Bowlby, 1980; Little & Kobak, 2003). Children develop mental representations of relationships with teachers based on both generalized expectations based on previous interactions with teachers and well as the history of interactions with a particular teacher. Early relational experiences will lead to generalized representational models that allow for revision, but may remain somewhat stable due to self-perpetuating effects (Thompson, 1999). Established models will guide cognitive processes through selective attention and memory, interpretative biases and non-conscious processing (Cassidy, 1999). Thus, initial relational experiences may develop a student's general internal working models of the teacher-student relationship which establishes expectations that guide the student's future interactions with teachers. Although relational models will be open to revision based on the history of interactions with a particular teacher, a student's first few years of school may serve as a sensitive period for the development of a generalized representational model of the teacher-student relationship.

Developmental systems theory also provides a framework for understanding the importance of developmental events on a time continuum (Ford & Lerner, 1992; Lerner, 1996). Children exist within networks of relationships in different settings that exist on a time continuum. These networks in which children exist have the potential to bring about internal change and change in one developmental area will be reciprocally related to changes in other developmental areas (Ford & Lerner, 1992). Changing the teacher-student relationship will be expected to reciprocally influence other developmental trajectories such as level of classroom engagement and achievement. Additionally, children demonstrate both relative plasticity as well as constraints in developmental

trajectories. Revising or changing childrens' trajectories is possible but there are points in development when environmental influences may exert a greater impact.

The life course perspective of development theory also supports the notion of sensitive periods of child development. The theory posits that as life situations change, developmental trajectories are altered (Elder, 1994; 1998). Life situations, such as being a member of a class with a given teacher, provide certain opportunities and constraints and an individual's choices are contingent on the social structure of these life situations. Individuals' lives are interdependent on the lives of those around them, so relationships with significant others, such as teachers, will place opportunities and constraints on an individual. However, individuals are not just passively influenced by their environments. Individuals construct their own life course within the context of the opportunities and constraints placed on them. Additionally, because developmental impact of a life situation will be dependent on the timing in that individual's life, the importance of the quality of a teacher-student relationship may be dependent on a student's age. The current study will utilize attachment and developmental systems theory as a basis to examine the stationarity of the effect of TSRQ on achievement across the elementary school years.

Purpose and Hypothesis

The purpose of this paper is to provide a longitudinal examination of the relationships between TRSQ, engagement and achievement across the grade school period (first grade to 5th grade). Particularly, this study aims to elucidate the process by which TSRQ influences longer-term achievement in a sample of students at-risk for reading failure. Studying students at-risk for reading failure is important as these

students are particularly susceptible to a variety of negative outcomes. For example, first grade reading failure is related to stable decreases in student's reading motivation and reading achievement across the elementary grades (Morgan, Fuchs, Compton, Cordray & Fuchs, 2008). Additionally, there is evidence that TSRQ moderates the effect of at-risk academic status on future achievement. Hamre and Pianta (2005) found that high-risk students in a supportive kindergarten classroom obtained similar first grade achievement scores as low-risk peers while high-risk students in a classroom characterized by low or moderate levels of teacher support obtained lower first grade achievement scores than low-risk peers.

In the first three elementary grades, TSRQ has an indirect effect on further achievement via the direct effect of TSRQ on students' engagement in the classroom which then influences future TSRQ (Hughes et al., 2008). However, it is unclear if these structural effects will continue. The current study utilizes structural equation modeling (SEM) to test an indirect model of the effects of TSRQ on reading and math achievement via the indirect effects of TSRQ on engagement over the entire grade school period (grades 1-5). The use of such a design will allow for the testing of reciprocal causal pathways and stationarity effects across the first five years of post-kindergarten schooling (Cole & Maxwell, 2003).

Stationarity refers to an unchanging causal structure in which the degree to which one set of variables produces change in another set of variables remains the same over time. A finding of stationarity would be consistent with the model, presented in Figure 1, that structural relationships between variables remain constant across the development. Conversely, a finding of stronger structural relationships between TSRQ and engagement

earlier in student's schooling that diminish over time, as presented in Figure 2, would be in accord with the view that early experiences with teachers influence students' patterns of engagement which will become stable, influencing future teacher-student relationships and long-term achievement.

The current study will expand upon previous literature by providing an understanding of the mechanisms by which TSRQ in grade school contributes to long-term achievement. Additionally, the current study aims to identify potential changes in the contributions of TSRQ and engagement to achievement across the grade school period. By identifying differences in the magnitude of effects of TSRQ on engagement and achievement over time, interventions to improve TSRQ may be temporally targeted.

METHOD

Participants

      Participants in the current study are comprised of a subsample of 684 students from a sample of 784 students who were participating in a larger longitudinal study on the effects of grade retention on academic achievement. Participants in the larger study were selected from 1384 first grade students from three school districts in southeast and central Texas (1 urban and 2 small city) who scored below the median on a district-wide literacy test, spoke English or Spanish, had not been previously retained in first grade and were not receiving special education services. Of the eligible students, 1,200 parents returned consent forms with 784 (65.3%) providing positive consent. Children with consent did not differ from children without consent on age, gender, ethnicity, eligibility for free or reduced lunch, or district-administered literacy test scores.

      The participants for the current study are 684 students from the original school district whose whereabouts were known at the time of the fifth year of data collection. The 684 active students did not differ from the originally recruited, inactive students on baseline variables, cognitive intelligence as measured by the Universal Nonverbal Intelligence Test (UNIT, Bracken & McCallum, 1998) or the demographic variables of age, gender, ethnicity, bilingual class placement or eligibility for free or reduced lunch. All students in bilingual class placements were instructed by teachers who were proficient in Spanish.

All study variables were assessed for normality and outliers. No outliers were identified in the analysis variables. No variables had values that exceeded the recommended cutoff values of 2 for skewness and 7 for kurtosis (West, Finch & Curran, 1995). The overall rate of missingness on study variables for the 684 students was 16.5%. Attrition analysis was conducted using a series of t-tests in SPSS to determine if those participants with and without complete data differed on demographic or study variables at baseline. The participants with complete data did not differ from those without complete data on study variables or the demographic variables of gender, ethnicity, cognitive ability or socio-economic status at baseline supporting the assumption that data were missing at random.

Of the 684 study participants, 383 were male (53.1%). The ethnic composition was 38.7% Hispanic, 33.3% Caucasian, 23.0% African American and 3.5% other. In year 1 of the study, when all participants were in first grade, their mean age was 6.5 (SD = 0.38). The UNIT (Bracken & McCallum, 1998) was utilized in first grade to measure participant's cognitive ability. The mean IQ was 93.09 (S.D. = 14.50). Based on family income at year 1, 58.6% were eligible to receive free or reduced lunch. Special education services were received by 5.3% of students at year 1.

Measures

Annual assessments of all measures were completed for 5 years, beginning when participants were in first grade. Tests of reading and math achievement were individually administered by trained undergraduate and graduate students each school year, with at least 8 months separating each yearly assessment. In the spring of each school year, teachers were mailed a questionnaire packet for each student containing a measure of the

teacher's perception of student engagement and teachers' perceptions of the teacher-student relationship. Teachers were compensated $25 for completing and returning the questionnaires.

Teacher-student relationship. The 22-item Teacher Student Relationship Inventory (TSRI; Hughes, Cavell, & Willson, 2001) is adapted from the Network of Relationships Inventory (Furman & Buhrmester, 1985), a child-report measure of relationship quality informed by Robert Weiss's (1974) theory of the provision of social support. Items were modified so that teachers report on a 5-point Likert-type scale their provision of six types of social support (affection, admiration, intimacy, satisfaction, nurturance, and reliable alliance) and conflict in their relationships with individual students. Exploratory factor analysis followed by confirmatory factor analysis on the larger longitudinal sample at year 1 identified three factors: Warmth (13 items), Intimacy (3 items) and Conflict (6 items). Example Warmth scale items included "This child give me many opportunities to praise him/her" and "I enjoy being with this child". Example Intimacy Scale items included "This child shares secrets and private feelings with me". Example Conflict scale items included "This child and I often argue or get upset with each other" and "I often need to discipline this child". The six items on the conflict scale were reverse coded for the current study, to facilitate the subsequent measurement model of teacher student relationship conflict. Thus we refer to this variable as low conflict. The internal consistency for the Conflict scale was .91. Because the warmth and intimacy scales were moderately correlated (.43) and both measure the supportive dimension of teacher-student relationships, a composite 16-item Support scale was created from the combined warmth and intimacy items (alpha = .94 for time 1). The TSRI has

demonstrated good current and predictive validity (Meehan, Hughes, & Cavell, 2003; Hughes & Kwok, 2006, 2007).

Child engagement. In years 1-3 of the study, a teacher-report, 10-item scale consisting of 8 items from the Conscientious scale of the Big Five Inventory (BFI; John & Sirvastava, 1999) as well as 2 items from the Social Competence Scale (Conduct Problems Prevention Research Group, 2004) that provided further information about classroom engagement (attention, effort, persistence and cooperative participation in learning) was used to measure child engagement. The BFI is conceptualized as a measure of personality traits. However, selected items from the Conscientious scale are comparable to items employed by other researchers to evaluate classroom engagement (Ladd et al., 1999; Ridley, McWilliams & Oates, 2000). Example items from the BFI include "Perseveres until the task is finished", "Is a reliable worker" and "Is easily distracted" (reverse scored). Items from the Social Competence Scale were "Turns in homework" and "Sets and works toward goals". All items are rated from 1 to 5.

In years 3-5 of the study, a teacher-report, 18-item scale adapted from the teacher-report and student-report engagement scales (Skinner, Zimmer-Gembeck & Connell, 1998) were used. Items selected from the student report engagement scale were rephrased from the teacher's perspective. Included items address behavioral engagement (e.g. "Tries hard to do well in school"), interest (e.g. "Pays attention to things that interest him/her") and emotional engagement (e.g. "Feels discouraged"; reverse scored). All items are rated from 1-4. In order to model students' engagement over time, the two measures of engagement were equated so that scores from the two measures are comparable.

Academic achievement. The *Woodcock Johnson Tests of Achievement*, 3rd edition (WJ-III; Woodcock, McGrew, & Mather, 2001) is an individually administered measure of academic achievement for individuals ages 2 to adulthood. For the purposes of the current study, the WJ-III Broad Reading W Scores (Letter-Word Identification, Reading Fluency and Passage Comprehension subtests) and the WJ-III Broad Math W Scores (Calculations, Math Fluency and Math Calculation Skills subtests) were utilized. Based on the Rasch measurement model, the Reading and Math W scores yield equal interval scales which facilitates modeling growth in the underlying latent achievement (Khoo, West, Wu, & Kwok, 2006). Extensive research documents the construct validity and reliability of the WJ-III and its predecessor (Woodcock & Johnson, 1989; Woodcock et al., 2001).

If a student spoke any Spanish, the *Woodcock-Muñoz Language Test* (Woodcock & Muñoz-Sandoval, 1993) was administered to determine the child's language proficiency in English and Spanish. If the results indicated strengths in Spanish, students were administered the *Bateria Woodcock-Muñoz-Revisada* (*Batería-R;* Woodcock & Muñoz, 1996) the first four years of the study and the updated *Bateria III Woodcock-Muñoz* (*Batería-III;* Muñoz-Sandoval, Woodcock, McGrew, & Mather, 2005) the last year of the study. The *Bateria Woodcock-Muñoz-Revisada* is the comparable Spanish version of the *Woodcock Johnson Tests of Achievement, Revised*, while the *Bateria III Woodcock-Muñoz* is the comparable Spanish version of the *Woodcock Johnson Tests of Achievement, 3rd edition*. W scores from the *Bateria-* R are equated to W scores from the WJ-R, the predecessor of the WJ-III (Woodcock & Muñoz, 1996).

Overview of Data Analysis

Multiple imputation was utilized to generate ten complete data sets to account for missing data. Descriptive and correlational analyses will be employed to describe the patterns of measured variables To test the nature of the structural relationships between the study variables, a five-wave, longitudinal model was tested utilizing structural equation modeling techniques (SEM). First, a model of the effects of TSRQ and engagement on achievement were examined in order to obtain the most parsimonious model with good fit. Then, to test for invariance of structural effects, a model in which indicators are constrained to have the same factor loadings at each time period was compared to a model in which indicators are free to vary. Finally, to determine if gender or ethnicity impacts the fit of the structural model, the Satorra-Bentler adjusted Chi-square different test (Satorra, 2000) was employed to examine possible group differences on structural paths. To determine ethnic group differences, three dummy variables were created (African American vs. other groups; Hispanic vs. other groups; Caucasian vs. Other groups). Since previous research indicates that teacher-student relationships with African American students qualitatively differ from those with Hispanic or Caucasian students, multigroup analyses were utilized compare model fit differences between African American and Caucasian students as well as African American and Hispanic students.

RESULTS

Preliminary and Correlational Analyses

In order to account for missing data, SAS software, version 9.1 was utilized to impute 10 complete data sets using data that were present for study variables including covariates such as gender and ethnicity to estimate values for the missing data (Rubin, 1987; Schafer, 1997). Regression imputation was utilized in order to preserve the greatest amount of data and increase power (Roth, 1994). Coefficients from these ten imputed data sets were averaged together when analyses were performed using MPLUS software (Muthén & Muthén, 2006).

The means and standard deviations for study variables are presented by gender and ethnicity in Table 1. Correlations among study variables, across and within-waves are presented in Table 2. Both across and within-wave correlations are consistent with previous research. At each time period, the relationship variable of Support was positively and significantly correlated with engagement (range = .57-.68; M = .60; SD = .05), reading achievement (range = .09-.12; M = .10; SD = .02), and math achievement (range = .08-.20; M = .13; SD = .05). Each time period, teacher-student low conflict was positively and significantly correlated with engagement (range of r = .51-.60; M = .53; SD = .04) and reading achievement (range = .09-.19; M = .15; SD = .04). Teacher-student low conflict and math achievement were positively and significantly related at all time periods except time 1 (range = .14-.19; M = .17; SD = .02). At all time periods, engagement was positively and significantly related to reading achievement (range = .24-.33; M = .28; SD = .03) and math achievement (range = .15-.31; M = .25; SD = .07).

Gender, cognitive ability and African American ethnicity were selected for inclusion as covariates in the analysis since evidence from previous research suggest these variables affect TSRQ, engagement and achievement. African American status was selected as a covariate as previous research indicates that, compared to Caucasians and Hispanics, teachers reports less supportive relationships with African American students (Hughes, Gleason & Zhang, 2005). Gender was selected as a covariate since teachers report closer relationships with lower levels of conflict with girls than boys (Mantzicopoulosa & Neuharth-Pritchett, 2003; Ryan, Stiller & Lynch, 1994). The correlations between selected covariates and study variables are presented in Table 3. At times 1 and 3-5, cognitive ability was positively and significantly associated with teacher-student relationship low conflict and support, behavioral engagement, and reading and math achievement. At time 2, cognitive ability was positively and significantly related to teacher-student relationship low conflict, behavioral engagement and reading and math achievement. At all five time periods, African American ethnicity was negatively and significantly associated with teacher-student relationship low conflict and support, behavioral engagement and reading and math achievement. At all five time periods, gender was negatively and significantly associated with teacher-student relationship low conflict and support as well as behavioral engagement. At time 2, gender was positively and significantly associated with math achievement. At times 3-5, gender was negatively and significantly associated with reading achievement. Since the variables of gender, African American ethnicity and cognitive ability were related to predictors and outcomes, they are entered as covariates in the model. The hypothesized model controls

for the effects of gender, African American ethnicity and cognitive ability on the TSRQ, engagement and achievement at the first time period.

Structural Model Results

Structural analyses were conducted in MPLUS (Muthén & Muthén, 2006) since MPLUS allows for adjustment for clustering effects. All models were estimated using the "type = imputation" feature of MPLUS which reports average parameter estimates and standard errors across the ten data sets, generating more stable estimates. Since students were grouped within classrooms, the "type=complex" cluster feature was utilized to address the nested structure (e.g. within classrooms) of the data by adjusting the standard errors of estimated coefficients. The cluster variable was the student's classroom at time 1. Students were grouped in 200 classrooms with an average number of 3.42 (SD=2.27) students in each class. The maximum likelihood estimation method with robust standard errors was utilized to estimate the hypothesized models (MLR; Muthén & Muthén, 2006).

Measurement model. The measurement models of the proposed latent variables were examined. The latent construct of TSRQ was indicated by the TSRI low Conflict and Support scales. The invariance of factor loading of the TSRQ model over the five waves was tested by evaluating the chi-square statistics between with and without the factor loadings of the same indicators constrained to be equal across waves. The chi-square difference test was not significant, $(\chi^2_{\text{diff}}(4) = 3.412, p = .064)$, indicating that the relationship between the two indicators and the latent construct are invariant across the five waves. The measurement model of the proposed latent variable of achievement was indicated by the WJ-III Broad Reading and Broad Math scores. This measurement model yielded a poor fit, indicating that reading and math measure different constructs. Thus,

two hypothesized five-wave longitudinal models were tested, one with reading

achievement as the target outcome and one with math achievement as the target outcome.

    Hypothesized model. The model (see Figure 2) posits reciprocal effects between

TSRQ, engagement and reading and math achievement across first through fifth grade,

while controlling for previous levels of analysis variables (TSRQ, engagement, and

reading and math achievement) as well as covariates (gender, cognitive ability, and

African American ethnicity). Model fit was evaluated utilizing three fit indices: the

Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA),

and the Standardized Root Mean Square Residual (SRMR). According to Hu and Bentler

(1999), CFI values greater than .90 may indicate a reasonably good fit of the researcher's

model. Browne & Cudeck (1993) state RMSEA values between .05 and .08 suggest

reasonable error of approximation. Kline (2005) states that SRMR values less than .10

are typically considered favorable.

    Reading achievement. Initially, the model fit was inadequate [χ^2 (199) =

1205.651, *p* = .000; CFI = .885; RMSEA = .086; SRMR = .101]. Several changes were

made based on modification indices that were theoretically justifiable and not

inconsistent with the hypothesized model. Structural paths of the effect of African

American ethnic status on achievement were added at each time period. For each

variable, several direct effects across time were added. Specifically, a structural path of

the effect on TSRQ at time 1 on time 3 was added. Structural paths of the effects of

student engagement at time 1 on times 3 and 4 as well as time 3 on time 5 were added.

Also, a structural path of the effect of reading achievement at time 3 on reading

achievement at time 5 was added. These added paths are consistent with the view that

there is some hierarchical building of skills such that mastery of foundation skills predict longer term growth in achievement (Scarborough, 1998).

The fit of the revised modified model (see Figure 3) was adequate [χ^2 (186) = 962.595, p = .000; CFI = .911; RMSEA = .078; SRMR = .083]. For clarity, parameter estimates of covariance and covariates in the model are presented in Table 4 and Table 5 respectively. TSRQ at each wave consistently predicted student engagement at the next wave, with control for previous level of engagement. Also, student engagement at earlier waves consistently predicted reading achievement at later waves, with control for previous levels of achievement. Additionally, the model included reciprocal paths for previous reading achievement to later engagement as well as previous levels of engagement to later levels of TSRQ. Some of the reciprocal paths, but not all, were significant. Unexpectedly, some structural paths of the effects of previous engagement on subsequent levels of TSRQ were negative and significant (e.g., Eng1 to TSRQ2; Eng 3 to TSRQ4, and Eng 4 to TSRQ5). This finding may be indicative of a suppression effect due to the high correlation between TSRQ and engagement and the strong effect of previous TSRQ on future TSRQ. A suppression effect may occur when a variable has a non-negative correlation with an outcome variable, but a negative partial regression coefficeient when used in conjunction with another variable that is positively correlated with the outcome variable (Cohen & Cohen, 1983; Darlington, 1968). In the present case, although the bivariate correlations between engagement and subsequent TSRQ were positive, some of the cross-year path coefficients were negative, indicating a suppression effect.

Math achievement. As with reading, the initial model fit was inadequate [χ^2 (200) = 1253.930, *p* = .000; CFI = .871; RMSEA = .078; SRMR = .083]. Consistent with the reading model, several changes were made based on modification indices that were theoretically justifiable and were not inconsistent with the hypothesized model. Structural paths of the effect of African American ethnic status on achievement were added at each time period. A structural path of the effect on TSRQ at time 1 on time 3 was added. Structural paths of the effects of student engagement at time 1 on times 3 and 4 as well as time 3 on time 5 were added. Structural paths of the effect of math achievement at time 1 on time 3, time 2 on time 4 and time 3 on time 5 were added. Additionally, the covariance between TSRQ at time 2 and engagement at time 2 was removed as it gave a very high standard error and did not change the interpretation of the model.

The fit of the modified model (see Figure 4) was adequate [χ^2 (190) = 984.226, *p* = .000; CFI = .903; RMSEA = .078; SRMR = .083]. For clarity, parameter estimates of covariance and covariates in the model are presented in Table 6 and Table 7 respectively. As with the reading model, the effect of TSRQ on engagement was significant at each time period. In contrast with the reading model, prior levels of engagement predicted subsequent achievement only at time 1 to 2 and time 4 to 5. Consistent with the reading model, the model included reciprocal paths for previous reading achievement to later engagement as well as previous levels of engagement to later levels of TSRQ. Again, some of the reciprocal paths, but not all, were significant. Also, some structural paths of the effects of previous engagement on later levels of TSRQ were negative and significant. As with the reading outcome model, this may be due to suppression effects.

Tests of invariance of structural effects. To test whether effects were invariant across time, measurement models in which the loadings between TSRQ and engagement or engagement and achievement were constrained to be the same over the five waves were compared to unconstrained models in which the loadings were free to vary. For both math and reading target outcomes, the chi-square difference tests were not statistically significant, indicating that the effects of TSRQ on engagement and engagement on achievement were invariant across time. While it was anticipated that the effects of TSRQ on engagement would vary across time, the null hypothesis that effects are invariant across time could not be rejected.

Multi-group Analyses

Muti-group analyses were utilized to determine if gender or ethnicity impacts the fit of the structural model. The Satorra-Bentler adjusted Chi-square different test (Satorra, 2000) was employed to examine possible group differences on structural paths. In order to test moderation by gender, the gender variable was removed as a covariate. Similarly, to test moderation by African American status, the African American variable was removed as a covariate.

First, gender differences on the reading and math models were examined. For reading outcomes, the fit of a constrained model with the structural paths from TSRQ to engagement and engagement to achievement constrained to be equal across males and females [χ^2 (305) = 982.19, p = .000] was compared to the fit of an unconstrained model [χ^2 (289) = 969.75, p = .000]. For the outcome of reading achievement, the constrained and unconstrained models did not differ in fit indicating that males and females do not differ in the effects of TSRQ on reading achievement. Likewise, for math outcomes, the

fit of a constrained model [χ^2 (305) = 1057.03, p = .000] was compared to the fit of an unconstrained model [χ^2 (289) = 1055.66 , p = .000]. For the outcome of math achievement, the constrained and unconstrained models did not differ in fit indicating that males and females do not differ in the effects of TSRQ on math achievement.

To compare differences by ethnicity, two dummy variables were created using African Americans as the referent group, one comparing African Americans to Caucasians and one comparing African Americans to Hispanics. Then, two comparisons were made. First, those of African American ethnicity were compared with those of Caucasian ethnicity. For the outcome of reading, the constrained [χ^2 (305) = 714.97, p = .000] and unconstrained models [χ^2 (289) = 688.31, p = .000] did not differ in fit indicating that African Americans and Caucasians do not differ in the effects of TSRQ on reading achievement. Similarly, for the outcome of math, the constrained [χ^2 (305) = 738.86, p = .000] and unconstrained models [χ^2 (289) = 725.52, p = .000] did not differ in fit indicating that African Americans and Caucasians do not differ in the effects of TSRQ on math achievement. Second, those of African American ethnicity were compared with those of Hispanic ethnicity. For the outcome of reading, the constrained [χ^2 (305) = 782.63, p = .000] and unconstrained [χ^2 (289) = 783.726, p = .000] models did not differ in fit indicating that African Americans and Hispanics do not differ in the effects of TSRQ on reading achievement. Similarly, for the outcome of math, the constrained [χ^2 (305) = 760.12, p = .000] and unconstrained [χ^2 (289) = 737.56, p = .000] models did not differ in fit indicating that African Americans and Hispanics do not differ in the effects of TSRQ on mathematics achievement.

DISCUSSION

The current study provided a longitudinal examination of the relationships between TRSQ, engagement and achievement across the grade school period (first grade to 5th grade). It was hypothesized that structural relationships between TSRQ, engagement and achievement would vary across the grade school period with early experiences with teachers influencing students' patterns of engagement which would become stable, influencing future teacher-student relationships and long-term achievement. However, chi-square difference tests indicated that the effect of TSRQ on engagement is invariant across time. Thus, for both math and reading target outcomes, the null hypothesis that effects are invariant (i.e., constant) across time could not be rejected.

TSRQ may be significant for different reasons at different developmental periods. For example, as peer relationships increase in importance in middle school, Wentzel (1998) found that teachers still make a unique contribution to middle school students' classroom functioning that is different from the contribution of peers. Students' relationships with teachers uniquely contribute to students' interest in class and pursuit of socially responsible goals while relationships with peers uniquely contribute to the pursuit of pro-social goals. While the influence of TSRQ on engagement and achievement remains constant, the process through which TSRQ influences achievement may vary at different developmental periods.

For younger students, it may be that a perceived sense of security from the teacher-student relationship is the process through which TSRQ influences engagement

and achievement. Teachers may serve as attachment figures to younger students. A secure attachment with a teacher will provide a sense of security that allows a student to meet academic, social and behavioral demands in the school environment (Bowlby, 1980; Little & Kobak, 2003). Conversely, for older students, it may be that the influence of teacher-student interactions on a student's perceived sense of academic competence is the process through with TSRQ influences engagement and achievement. Students in the later elementary years more accurately identify and utilize social comparison cues than students in the early elementary years (Weinstein, Marshall, Sharp & Botkin, 1987). As they get older, students develop perceptions of their own academic competence based on patterns of interactions between themselves and the teacher as well as interactions between peers and the teacher (Gest, Domitrovich & Welsh, 2005; Hughes, Dyer, Lou & Kwok, 2009).

It was hypothesized from an Attachment Theory and a Developmental Systems Theory that early experiences with teachers influence students' patterns of engagement which will become stable, influencing future teacher-student relationships and long-term achievement. The current sample was limited to elementary school students and may not have provided a sufficient age span to investigate the developmental trends in teacher-student relationships that would be predicted by Attachment and Developmental Systems Theory. As students transition to middle school, relationships qualitatively change as students change classes throughout the day, hindering the ability of students to form and benefit from quality relationships with teachers. While teacher-student relationships continue to be predictive of academic outcomes as children age, middle and junior high

school students report having poorer relationship quality with teachers compared with elementary school students (Lynch and Cicchetti 1997; Wentzel, 1998).

Consistent with previous research, correlational analyses revealed that African American racial/ethnic membership was negatively associated with teacher-student relationship conflict and support, behavioral engagement and reading and math achievement across all five elementary years (Saft & Pianta, 2001). This finding contrasts with previous findings that a closer teacher-student relationship is associated with improved academic outcomes for African American students (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002). This difference in findings may relate to variations in study samples. The current sample was selected on the basis of scoring below the median on a district-wide literacy test. Since at-risk children may be more affected by TSRQ, the finding that gender and ethnicity did not moderate the effects of TSRQ may not generalize to average achieving samples.

Across the five years, being male was negatively associated with teacher-student relationship low conflict and support and behavioral engagement. At year 2, being male was positively associated with math achievement. At years 3 through 5, being male was negatively associated with reading achievement (Mantzicopoulosa & Neuharth-Pritchett, 2003; Ryan, Stiller & Lynch, 1994). These findings are consistent with previous research that teachers report closer relationships with lower levels of conflict with girls than boys (Mantzicopoulosa & Neuharth-Pritchett, 2003; Ryan, Stiller & Lynch, 1994).

The TSRQ variable for the current study was indicated by the TSRI Low Conflict and Support scales. The invariance of the factor loadings of the TSRQ model was tested over the five waves of data. Results indicated that the relationships between the two

indicators and the latent construct are invariant across the five waves. These findings indicate that the relative contribution of support and low conflict to TSRQ is constant across the elementary grades.

The current study evaluated a model positing reciprocal effects between TSRQ, engagement and reading and math achievement across first through fifth grade. For the target outcome of reading, TSRQ at each year consistently predicted student engagement at the subsequent year, with control for previous level of engagement. Additionally, student engagement at each year consistently predicted reading achievement at the next year, with control for previous levels of achievement. In addition to the year to year stability of the constructs of reading and math achievement, some lag effects beyond 1 year were present indicating that mastering foundational skills may facilitate longer-term achievement.

For the target outcome of math, TSRQ at each year consistently predicted student engagement at the subsequent year, with control for previous level of engagement. However, in contrast with the reading model, prior levels of engagement only predicted subsequent achievement from year 1 to year 2 and year 4 to year 5. This difference in findings between reading and math outcomes may be due to the fact that the current sample was selected on the basis of scoring below the district median on a state-wide test of literacy skills. For those students who struggle in reading, relationship support from teachers may be more significant to motivation to try hard and to persist on reading tasks. These findings demonstrate that, for children who are lower achieving in reading, a high quality teacher-student relationship is beneficial to future reading achievement. Overall, these findings extend previous research demonstrating cross year effects of TSRQ on

engagement and achievement across the first three years of school by demonstrating cross

year effect of TSRQ on engagement and achievement the entire elementary period

(Hughes, Luo, Kwok & Loyd, 2008).

Limitations

The findings of this study should be interpreted in the context of study limitations.

The current study relies exclusively on a teacher report measure for the assessment of

TSRQ. Teacher report measures have their strengths. An extensive research demonstrates

the predictive validity of teacher report measures of relationship quality (Birch & Ladd,

1997; Pianta, Steinberg & Rollins, 1995). Teacher report measures of TSRQ are

moderately correlated with observers' ratings (Boesen, 1998). However, teacher reports

lack information about students' perceptions which may be important to understanding

students' motivation and engagement. Alternatives to teacher reports include children's

reports of TSRQ and observations. Child report measures provide information about

students' perceptions. However, childrens' perceptions of TSRQ show low

correspondence with teacher reports (Murray, Murray & Waas, 2008). Classroom

observation systems provide an understanding of the context of relationship based

interactions and may be less biased than self-report measures. However, such measures

are less comprehensive and less detailed than teacher or self report measures (Pianta,

1999). Utilizing multiple methods of measurement may offer the most comprehensive

assessment of TSRQ.

Furthermore, the current study relied exclusively on teacher-report for the

measure of student engagement. Since different teachers reported on TSRQ in a given

year and engagement the subsequent year, concerns with method effects are partially

reduced. Perhaps an observational measure of engagement would provide more precise measurement of student engagement. Furthermore, the fact that same source reported on TSRQ and Engagement within a given year may have contributed to the strong within-wave correlation between these two constructs, which led to the observed suppression effects.

Due to insufficient numbers of gender and ethnic matched teacher-student dyads, the current study did not examine the effects of gender or ethnic match of teacher and student pairs. When a teacher's and a child's ethnicity is the same, teachers report relationships that are more positive, have higher levels of closeness and lower levels of conflict (Saft & Pianta, 2001). Similarly, greater closeness is reported in relationships composed of gender-matched dyads (Drevets, Benton & Bradley, 1996).

Implications and Future Directions

These finding have implications for understanding the importance of the contributions of quality teacher-student relationships to student's achievement. The importance of TSRQ does not decline across the elementary grades. Although educators may believe that younger students are more dependent on a quality teacher-student relationship, student in later elementary are just as affected by a quality teacher-student relationship. Educators aiming to bolster student performance should develop and evaluate teacher training to build high support, low conflict relationships with students. Additionally, educators should examine the practice of utilizing multiple specialist teachers rather than one generalist teacher for upper elementary students. When students must change classes throughout the day, it may become more difficult for students to form and benefit from quality relationships with teachers.

It is valuable to note that while there were mean effects of African American status, African American status did not moderate the effects of TSRQ on engagement and achievement. However, African American status had a direct, negative effect on achievement across the elementary years. Achievement gaps between African American and Caucasian students as well as male and female students pervade in the United States (Duncan and Magnuson, 2005; Rampey, Dion, & Donahue, 2009). While around half of the achievement gap measured in test scores between African Americans and Caucasians is present when children start school, early experiences in the school environment have the ability to prevent the further increase of this gap (The Future of Children, 2005; Hughes & Kwok, 2007). Although African American students are less likely to experience supportive, low conflict relationships with teachers, the effects of a quality teacher-student relationship on engagement and achievement are equivalent to those of non-African American students across the elementary years. Therefore, improving the quality of teacher-student relationships for African American students is a potential strategy for decreasing the growth of the achievement gap between racial groups after students enter school.

Additionally, future research may focus on changes in the relationships between TSRQ, engagement and achievement as students transition from elementary to middle school. Although teacher-student relationships continue to be predictive of academic outcomes post the elementary school years, middle and junior high school students report having poorer relationship quality with teachers compared with elementary school students (Lynch and Cicchetti 1997; Wentzel, 1998). The examination of effect of TSRQ across a longer period of time, starting in elementary school and continuing across the

middle school years, would be beneficial in order to better evaluate developmental trends in the effects of TSRQ.

It may also be beneficial for future research to examine the influence of child variables such as personality or temperament that may influence the development of positive teacher-student relationships and engagement. For example, Ladd et al. (1999) found that students' preliminary behavioral styles in kindergarten predicted that quality of teacher-student interactions. Possibly, such child variables may contribute to changes in both TSRQ and engagement, thus accounting for some of the observed effects.

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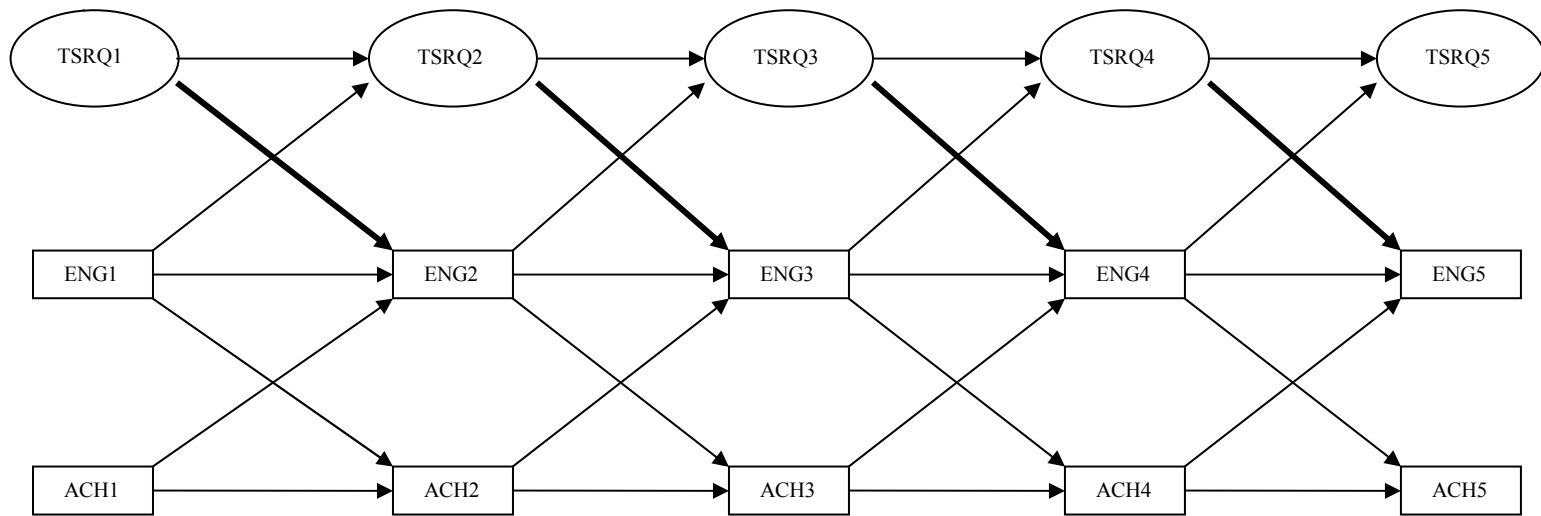
Figure 1. Invariant reciprocal model. The consistency of bold lines to across time periods illustrates a stable pattern of effects. TSRQ = Teacher-student relationship quality ENG = Engagement; ACH = Achievement.
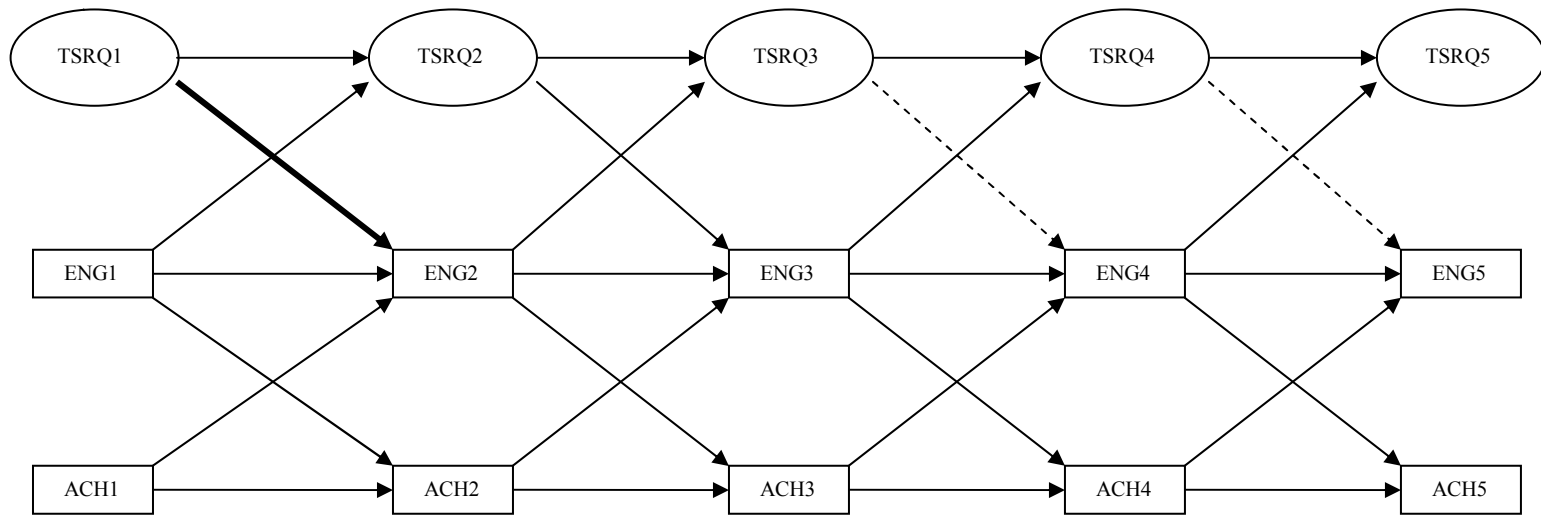
Figure 2. Launching model. The transition form bold lines to dashed lines illustrate the hypothesized diminishing of effects of TSRQ on engagement over development. TSRQ = Teacher-student relationship quality ENG = Engagement; ACH = Achievement.

TSRI-CO1 TSRI-SU1 TSRI-CO2 TSRI-SU2 TSRI-CO3 TSRI-SU3 TNSI-CO4 TSRI-SU4 TSRI-CO5 TSRI-SU5

.74 (.04) .71 (.03) ..80 (.03) .71 (.02) ..74 (.03) ..64 (.03) ..76 (.03) ..64 (.03) ..72 (.03) ..61 (.03)

47 (.10)

TSRQ1 1.07 (.19) TSRQ2 .37 (.14) TSRQ3 1.06 (.10) TSRQ4 1.15 (.13) TSRQ5

.25 (.09) -.35 (.17) .17 (.07) .03 (.06) .23 (.08) -.23 (.10) .33 (.08) -.43 (.14)

.24 (.04)

.23 (.05)

.29 (.06)

ENG1 .38 (.08) ENG2 .22 (.08) ENG3 .17 (.08) ENG4 .15 (.09) ENG5

.12 (.04) .06 (.04) .09 (.02) .04 (.03) .06 (.02) -.00 (.03) .07 (.02) .03 (.03)

.23 (.05)

ACH1 .67 (.03) ACH2 .79 (.02) ACH3 ..84 (.02) ACH4 .68 (.05) ACH5

-.21 (.04) -.11 (.03) -.08 (.02) -.08 (.02) -.02 (.02)

AA1 AA2 AA3 AA4 AA5
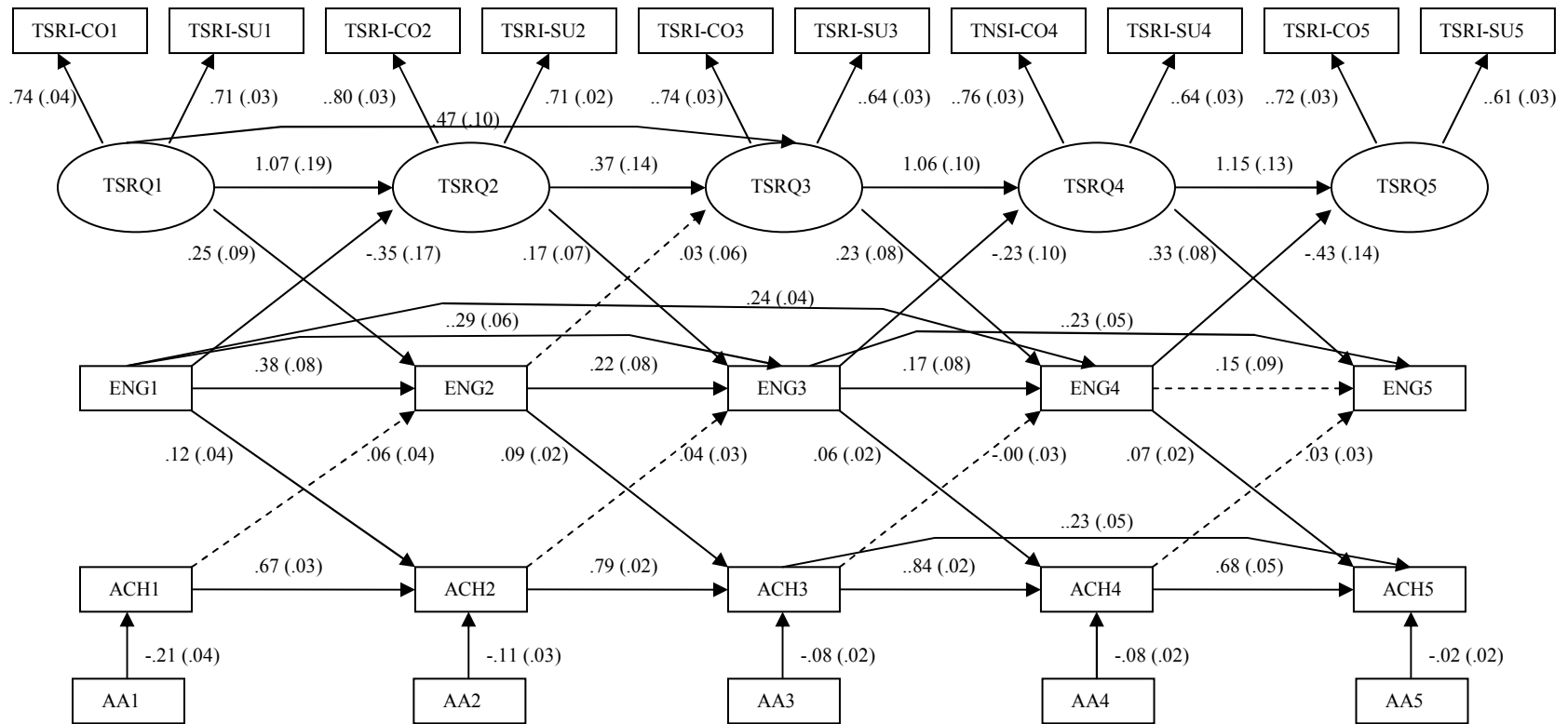
Figure 3. Model of reading achievement. Values are unstandardized parameter estimates, with standardized estimates in parentheses. Paths with dashed lines are not significant at p = .05. . TSRI-CON = teacher perception of teacher-student relationship low conflict; TSRI-SU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement; ACH = Woodcock-Johnson Broad Reading W score; AA = African American Ethnicity.
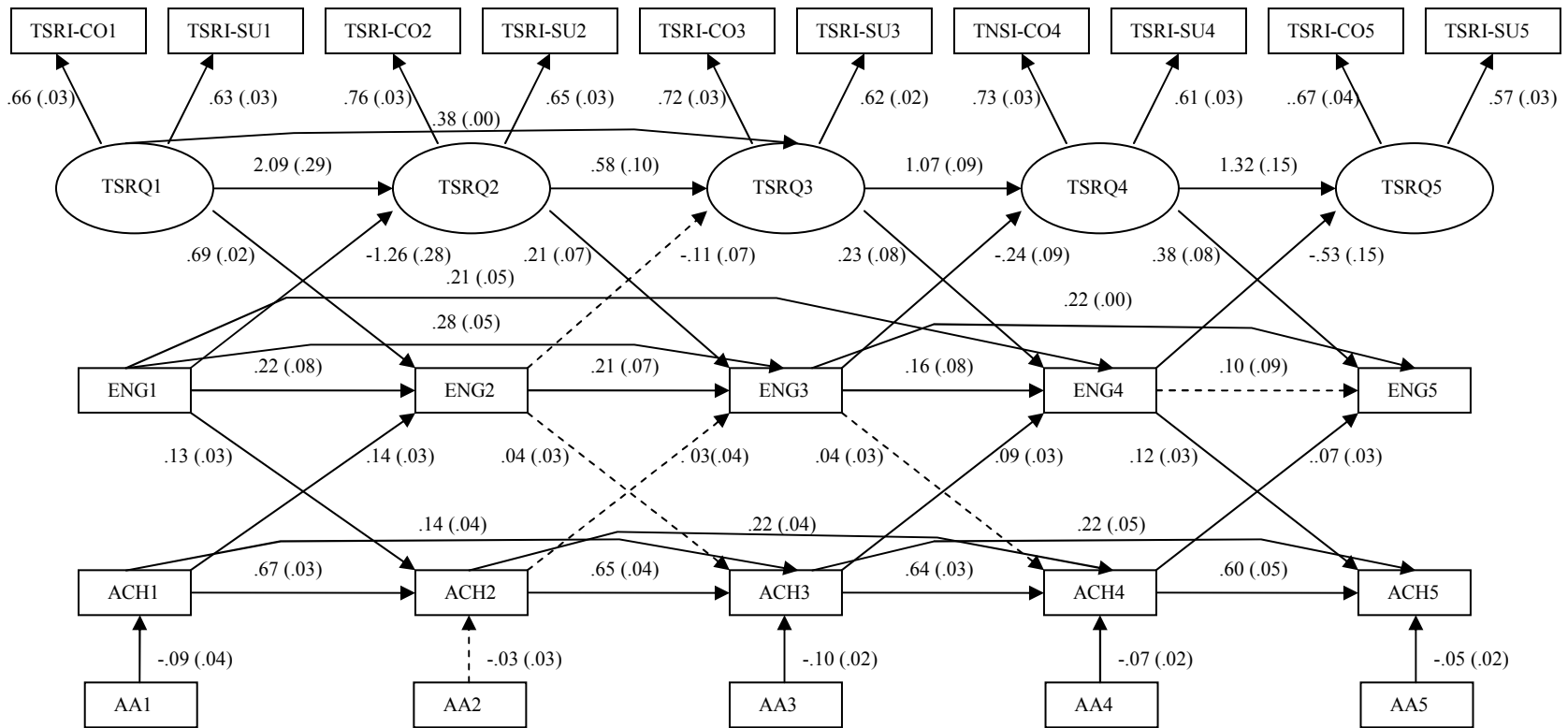
Figure 4. Model of math achievement. Values are unstandardized parameter estimates, with standardized estimates in parentheses. Paths with dashed lines are not significant at p = .05. TSRI-CON = teacher perception of teacher-student relationship low conflict; TSRI-SU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement; ACH = Woodcock-Johnson Broad Math W score; AA = African American Ethnicity.

Table 1
Means and Standard Deviations of Analysis Variables

| Scale	Total (N=684) M	Total (N=684) SD	Females (n = 321) M	Females (n = 321) SD	Males (n = 363) M	Males (n = 363) SD	AA (n = 157) M	AA (n = 157) SD	Non-AA (n = 527) M	Non-AA (n = 527) SD
1. TCO1	4.10	.96	4.34	.81	3.89	1.03	3.72	1.07	4.22	.89
2. TSU1	4.00	.78	4.14	.75	3.88	.79	3.77	.86	4.07	.74
3. ENG1	3.23	1.05	3.48	1.02	3.01	1.02	2.98	1.00	3.31	1.05
4. READ1	434.15	26.29	435.71	27.01	432.78	25.59	422.22	21.44	437.71	26.57
5. MATH1	462.67	13.58	461.88	13.20	463.37	13.88	458.14	11.75	464.02	13.80
6. TCO2	4.11	.98	4.30	.85	3.94	1.05	3.64	1.16	4.25	.87
7. TSU2	3.90	.83	4.02	.77	3.78	.86	3.70	.97	3.96	.77
8. ENG2	3.34	1.04	3.56	1.01	3.15	1.02	3.04	1.05	3.43	1.02
9. READ2	461.82	22.40	463.29	21.78	460.52	22.89	450.14	20.81	465.30	21.69
10. MATH2	475.86	11.17	474.89	10.61	476.71	11.59	472.07	10.08	476.98	11.24
11. TCO3	4.11	.92	4.39	.78	3.87	.96	3.56	1.06	4.28	.80
12. TSU3	3.86	.85	4.00	.82	3.74	.86	3.54	.95	3.96	.79
13. ENG3	3.37	.79	3.54	.74	3.23	.80	3.05	.83	3.47	.75
14. READ3	477.12	20.01	479.39	18.17	475.11	21.33	465.65	20.12	480.54	18.68
15. MATH3	486.69	11.53	486.22	11.61	487.11	11.46	481.65	10.33	488.19	11.45
16. TCO4	4.18	.87	4.42	.69	3.98	.95	3.77	.98	4.31	.79
17. TSU4	3.86	.84	4.03	.76	3.70	.88	3.67	.90	3.91	.81
18. ENG4	2.75	.67	2.89	.65	2.63	.66	2.53	.69	2.82	.64
19. READ4	488.45	18.59	490.25	18.00	486.86	18.98	476.74	18.00	491.94	17.31
20. MATH4	496.18	10.80	496.05	10.74	496.29	10.87	490.66	9.88	497.82	10.52
21. TCO5	4.22	.87	4.44	.73	4.02	.93	3.80	1.09	4.35	.74
22. TSU5	3.79	.84	3.90	.80	3.69	.86	3.55	.85	3.86	.83
23. ENG5	2.74	.69	2.86	.68	2.63	.67	2.44	.67	2.83	.67
24. READ5	499.03	19.03	500.71	18.21	497.55	19.63	487.13	17.89	502.58	17.91
25. MATH5	504.42	10.73	504.17	10.59	504.63	10.87	498.80	9.51	506.09	10.52

Note. The numbers in the row headings refer to the timing of assessment. TCO = teacher perception of teacher-student relationship low conflict (reverse coded); TSU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement; READ = Woodcock-Johnson Broad Reading W score; MATH = Woodcock-Johnson Broad Math W score.

Table 2
Correlations for All Continuous Analysis Variables

Scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. TCO1	-																								
2. TSU1	.63	-																							
3. ENG1	.51	.57	-																						
4. READ1	.09	.12	.33	-																					
5. MATH1	*.07*	.08	.15	.40	-																				
6. TCO2	.57	.44	.38	.15	.11	-																			
7. TSU2	.34	.41	.31	.13	.19	.66	-																		
8. ENG2	.36	.39	.56	.27	.26	.51	.58	-																	
9. READ2	.15	.15	.38	.73	.25	.14	.09	.27	-																
10. MATH2	.17	.08	.29	.31	.70	.18	.20	.28	.45	-															
11. TCO3	.51	.39	.39	.21	.13	.55	.37	.39	.10	.14	-														
12. TSU3	.31	.29	.35	.16	.14	.37	.35	.38	*.05*	.10	.56	-													
13. ENG3	.36	.33	.48	.22	.18	.35	.33	.55	.19	.22	.51	.57	-												
14. READ3	.15	.15	.38	.65	.28	.15	.13	.32	.84	.41	.15	.09	.27	-											
15. MATH3	.17	.15	.29	.35	.62	.20	.17	.27	.45	.78	.17	.09	.22	.51	-										
16. TCO4	.45	.31	.33	.14	.10	.54	.40	.34	.09	.10	.56	.40	.36	.13	.13	-									
17. TSU4	.26	.22	.31	.11	*.06*	.30	.26	.29	*.00*	*.05*	.34	.28	.36	.08	*.04*	.58	-								
18. ENG4	.29	.28	.46	.20	.23	.30	.33	.44	.15	.26	.32	.33	.49	.23	.23	.53	.62	-							
19. READ4	.15	.13	.38	.60	.29	.17	.15	.35	.79	.43	.17	.11	.29	.88	.50	.16	.09	.24	-						
20. MATH4	.16	.15	.36	.44	.56	.17	.17	.30	.52	.73	.17	.14	.21	.56	.83	.14	.11	.30	.59	-					
21. TCO5	.46	.30	.33	.19	*.04*	.51	.30	.37	.19	.12	.53	.36	.39	.22	.13	.51	.37	.31	.22	.12	-				
22. TSU5	.29	.29	.32	.14	*.05*	.27	.20	.32	.13	.09	.31	.33	.38	.14	*.04*	.27	.31	.36	.17	.08	.56	-			
23. ENG5	.37	.32	.44	.23	.15	.37	.29	.47	.22	.19	.40	.41	.54	.24	.18	.36	.40	.57	.26	.24	.60	.68	-		
24. READ5	.15	.12	.38	.56	.35	.16	.14	.34	.75	.46	.14	.12	.28	.85	.52	.15	.10	.29	.90	.60	.19	.12	.26	-	
25. MATH5	.16	.14	.36	.39	.51	.18	.19	.39	.48	.69	.18	.18	.28	.56	.76	.16	.10	.37	.60	.83	.19	.14	.31	.63	-

Note. Correlations in italics are not significant at p = .05. The numbers in the row headings refer to the timing of assessment. TCO = teacher perception of teacher-student relationship low conflict; TSU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement; READ = Woodcock-Johnson Broad Reading W score; MATH = Woodcock-Johnson Broad Math W score.

Table 3

Correlations between Covariates and Study Variables

Covariate	Gender	African American Ethnicity	Cognitive Ability
TCON1	-.23	-.22	.16
TSU1	-.17	-.17	.09
ENG1	-.22	-.13	.20
READ1	*-.06*	-.25	.22
MATH1	*.06*	-.18	.36
TCO2	-.18	-.27	.15
TSU2	-.15	-.13	*.06*
ENG2	-.19	-.16	.22
READ2	*-.06*	-.29	.23
MATH2	.08	-.19	.30
TCO3	-.28	-.33	.15
TSU3	-.15	-.21	.12
ENG3	-.20	-.22	.15
READ3	-.11	-.31	.26
MATH3	*.04*	-.24	.36
TCO4	-.25	-.26	.12
TSU4	-.19	-.12	.09
ENG4	-.20	-.19	.19
READ4	-.09	-.34	.28
MATH4	*.01*	-.28	.39
TCO5	-.24	-.27	.13
TSU5	-.12	-.16	.09
ENG5	-.16	-.24	.17
READ5	-.08	-.34	.30
MATH5	*.02*	-.29	.37

Note. Correlations in italics are not significant at p = .05. The numbers in the row headings refer to the timing of assessment. TCO = teacher perception of teacher-student relationship low conflict; TSU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement; READ = Woodcock-Johnson Broad Reading W score; MATH = Woodcock-Johnson Broad Math W score.

Table 4

Parameter Estimates of Covariance in the Model Presented in Figure 3

Parameter	Unstandardized Estimate	Standardized Estimate
TSRQ1 with TENG1	.72	.04
TSRQ2 with TENG2	.75	.18
TSRQ3 with TENG3	.75	.07
TSRQ4 with TENG4	.96	.12
TSRQ5 with TENG5	1.19	.24
TNRICO1 with TNRISU1	.19	.04
TNRICO2 with TNRISU2	.20	.04
TNRICO3 with TNRISU3	.17	.04
TNRICO4 with TNRISU4	.18	.04
TNRICO5 with TNRISU5	.16	.04

Note. TSRI-CON = teacher perception of teacher-student relationship low conflict; TSRI-SU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement.

Table 5

Parameter Estimates of Covariates in the Model Presented in Figure 3

Parameter	Unstandardized Estimate	Standardized Estimate
TSRQ1 on GENDER	-.32	.04
TSRQ1 on AA	-.24	.05
TSRQ1 on CA	.13	.04
ENG1 on GENDER	-.25	.04
ENG1 on AA	-.09	.04
ENG1 on CA	.19	.04
ACH1 on GENDER	*-.07*	*.03*
ACH1 on CA	-.21	.04

Note. Paths in italics are not significant at p = .05. TSRQ = latent variable composed of TSRI low conflict and support scales; ENG = teacher perception of child academic engagement; ACH = Woodcock-Johnson Broad Math W score; AA = African American Ethnicity; CA = cognitive ability as measured by the UNIT.

Table 6

Parameter Estimates of Covariates in the Model Presented in Figure 4

Parameter	Unstandardized Estimate	Standardized Estimate
TSRQ1 with TENG1	.83	.03
TSRQ3 with TENG3	.86	.09
TSRQ4 with TENG4	1.02	.16
TSRQ5 with TENG5	*2.07*	*.96*
TNRICO1 with TNRISU1	.27	.04
TNRICO2 with TNRISU2	.29	.03
TNRICO3 with TNRISU3	.27	.03
TNRICO4 with TNRISU4	.28	.03
TNRICO5 with TNRISU5	.25	.03

Note. Paths in italics are not significant at p = .05. TSRI-CON = teacher perception of teacher-student relationship low conflict; TSRI-SU = teacher perception of teacher-student relationship support; ENG = teacher perception of child academic engagement.

Table 7

Parameter Estimates of Covariates in the Model Presented in Figure 4

Parameter	Unstandardized Estimate	Standardized Estimate
TSRQ1 on GENDER	-.29	.04
TSRQ1 on AA	-.22	.04
TSRQ1 on CA	.16	.04
ENG1 on GENDER	-.26	.04
ENG1 on AA	.19	.04
ENG1 on CA	-.09	.04
ACH1 on GENDER	.04	.04
ACH1 on CA	.33	.04

Note. TSRQ = latent variable composed of TSRI low conflict and support scales; ENG = teacher perception of child academic engagement; ACH = Woodcock-Johnson Broad Math W score; AA = African American Ethnicity; CA = cognitive ability as measured by the UNIT.

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