Teacher student relationship quality type in elementary grades: Effects on trajectories for achievement and engagement

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Abstract

Teacher, peer, and student reports of the quality of the teacher-student relationship were obtained for an ethnically diverse and academically at-risk sample of 706 second and third grade students. Cluster analysis identified four types of relationships based on the consistency of child reports of support and conflict in the relationship with reports of others: Congruent positive, Congruent Negative, Incongruent Child Negative and Incongruent Child Positive. The cluster solution evidenced good internal consistency and construct validity. Cluster membership predicted growth trajectories for teacher-rated engagement and standardized achievement scores over the following three years, above prior performance. The predictive associations between child reports of teacher support and conflict and outcomes depended on whether child reports were consistent or inconsistent with reports of others. Study findings have implications for theory development, assessment of teacher-student relationships, and teacher professional development.

Students whose relationships with their teachers are characterized by high levels of support and low levels of conflict obtain higher scores on measures of academics, and behavioral adjustment than do students whose relationships with teachers are less positive (for review see Hamre & Pianta, 2006). Prospective studies find that a more positive teacher-student relationship is associated with a greater sense of school belonging (Furrer & Skinner, 2003), lower levels of externalizing behaviors (Birch & Ladd, 1997; Hughes, Cavell, & Jackson, 1999; Meehan, Hughes, & Cavell, 2003; Silver, Measelle, Armstrong, & Essex, 2005), improved peer relationships (Hughes, Cavell, & Willson, 2001; Hughes & Kwok, 2006; Taylor & Trickett, 1989), and higher achievement (Crosnoe, Johnson, & Elder, 2004; Hamre & Pianta, 2001; Ladd, Birch, & Buhs, 1999; Skinner, Zimmer-Gembeck, & Connell, 1998) Furthermore, longitudinal meditational analyses find that the effect of a supportive teacher-student relationship on achievement is due to the direct effect of teacher-student relationship quality on students' engagement in the classroom (Hughes, Luo, Kwok, & Loyd, 2008; O'Connor & McCartney, 2007).

A supportive relationship with one's teacher benefits children from preschool and kindergarten (Ladd et al., 1999; Howes, Hamilton, & Matheson, 1994) through middle and high school (Crosnoe et al., 2004; Ryan, Stiller, & Lynch, 1994; Wentzel, 1999). Drawing from research on attachment theory, which posits that children construct mental representations of relationships with adult care-givers that they carry forward to future relationships (Bretherton, & Munholland, 1999; Cassidy, Kirsh, Scolton, & Parke, 1996) and on research on the long-term consequences of early risk and protective processes (Dodge, Greenberg, Malone, & Conduct Problems Prevention Research Group, 2008), one might expect relationships in the elementary grades to be particularly important to students' long-term school adjustment. Indeed, Hamre and Pianta (2001) found an effect for teacher-student relationship conflict assessed in first grade on achievement seven years later, controlling for relevant baseline child characteristics such as verbal intelligence and problem behaviors.

A positive relationship with one's teacher may be especially important to the school adjustment of students at higher risk for school failure due to family background variables (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; Gruman, Harachi, Abbott, Catalano, & Fleming, 2008) or academic or behavioral problems (Baker, 2006; Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008). For example, in a study of first grade students, children's level of regulatory control moderated the association between teacher-student support and gains in reading, such that a supportive relationship buffered students with poor regulatory control from low reading achievement (Liew, Chen, & Hughes, *in press*).

Different Perspectives on TSRQ

Most of what is known about the effects of teacher student relationship quality (TSRQ) on adjustment in the elementary grades is based on teacher report of TSRQ (Hamre & Pianta, 2001; Hughes et al., 2008; Ladd et al., 1999). Researchers investigating the validity of teacher reports of TSRQ report good correspondence with both direct observations of the teacher-student relationship (Doumen, Verschueren, Koomen, & Buyse, 2008) and peer ratings of teacher-student support (Hughes, 2009). Teacher ratings also demonstrate good test-retest reliability over periods of 3 to 4 months (Doumen et al., 2008).

Much less is known about relationship between students' perceptions of TSRQ and academic, social, and behavioral adjustment. Most studies employing child reports of TSRQ have used cross-sectional research designs (Decker, Dona, & Christenson, 2007; Henricsson & Rydell, 2004; Mantzicopoulos & Neuharth-Pritchett, 2003; Murray, Murray, & Waas, 2008; Rey, Smith, Yoon, Somers, & Barnett, 2007), which provide a poor basis for inferring causality. These cross-sectional studies find that child reports are more highly correlated with other child-report measures of adjustment than with teacher or peer reports of adjustment or with objective measures such as scores on standardized measures of achievement. The associations between child report of TSRQ and child reports of school adjustment may be due to source effects, or a reporting bias, rather than to an effect of children's perceptions of TSRQ on adjustment. Child reports of TSRQ show low to moderate correspondence with both teachers' reports of relationship quality (Henricsson & Rydell, 2004; Hughes, 2009; Hughes et al., 1999; Mantzicopoulos and Neuharth-Pritchett, 2003; Murray et al., 2008; Rey et al., 2007) and peer reports of teacher support (Hughes, 2009). The low correspondence between children perceived TSRQ and others' perceptions of TSRQ raises questions about the meaning or significance of child perceptions of the relationship for the child's adjustment.

Significance of Child Report of Teacher-Student Relationship

Social motivational theories (Connell & Wellborn, 1991; Harter, 1986) posit that individuals have a basic psychological need for relatedness, autonomy, and competence. According to this view, a child's perception of his or her relationship with teachers as being close and supportive, irrespective of the congruence with others' perceptions of the relationship, may promote a child's sense of belonging to school and general perceived competence. In turn, these self views may motivate the child to work hard to meet classroom academic and behavioral expectations (Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Furrer & Skinner, 2003; Pajares, 1996). Additionally, children who perceive teachers as being supportive and available may also be more likely to approach teachers for learning assistance (Marchand & Skinner, 2007). Consistent with this protective view of perceived teacher support are findings that a positive view of social acceptance, even when inaccurate, predicts more positive adjustment among adolescents (McElhaney, Antonishak, & Allen, 2008). The majority of published research on the effects of students' perceptions of teacher support on school adjustment is based on social motivational theories (Furrer & Skinnner; 2003; Ryan et al., 1994; Skinner, Furrer, Marchand, & Kindermann, 2008).

A second view is that the developmental consequences of a child's report of TSRQ is contingent on its agreement with others' reports (i.e., teacher, peers, or observers). Child perceptions of social support from others that are discrepant with others' reports of the provision of social support to the child have been referred to as positively or negatively biased (Hoza, Pelham, Dobbs, Owens, & Pillow, 2002; Hughes, Cavell, & Grossman, 1997; Gresham, Lane, MacMillan, Bocian, & Ward, 2000) or simply as discrepant in either a positive or negative direction (Decker et al., 2007; Diamantopoulou, Rydell, & Henricsson, 2008; Edens, Cavell, & Hughes, 1999). According to psychodynamic and attachment perspectives (Bowlby, 1980; Bretherton & Munholland, 1999), positive perceptions of relatedness that are discrepant with others' reports may reflect a defensive coping style or poor social awareness (Heath & Glen, 2005; Ohan & Johnston, 2002). Empirical support for this premise comes from research on youths' perceptions of their social acceptance. This research has focused on children's concordant or discrepant perceptions of both peer support (e.g., Hughes, Cavell, & Prasad-Gaur, 2001; Zakriski & Coie, 1996; Hoza et al., 2002) and teacher support (Decker et al., 2007; Hughes et al.,1997; Prasad-Gaur, Hughes, & Cavell, 2001). This research has established that high but discrepant perceptions of social support from others may increase risk for a number of adjustment difficulties, including aggression (Hughes et al., 1997; Salmivalli, Ojanen, Haanpää, & Peets, 2005; Zakriski & Coie, 1996), peer rejection (Hughes, Cavell, & Prasad-Gaur, 2001), and low academic competence (Gresham, Lane, MacMillan, Bocian, & Ward, 2000). Conversely, incongruent but low perceptions of social relatedness have been associated with internalizing behaviors (Kistner, David-Ferdon, Repper, & Joiner, 2006; Pardini, Barry, Barth, Lochman, & Wells, 2006). Low views of one's acceptance, in the context of others' positive views, may indicate a more general negative cognitive style that is characteristic of depressed individuals (Beck, 2002).

These two perspectives lead to different predictions as to the meaning and developmental consequences of students' perceptions of TSRQ. According to the first perspective, student perceptions of a positive relationship are expected to make an additional, incremental contribution to adjustment, above other sources of information on the relationship. According to the second view, student perceptions of TSRQ will be positively associated with adjustment only when the student's perceptions are consistent with other sources.

Person-Centered Approach to Conceptualizing and Measuring TSRQ

Previous studies that examine the association between teacher and child reports of TSRQ or their shared and unique contributions to adjustment exemplify a variable-centered approach (Henricsson & Rydell, 2004; Hughes, 2009; Hughes et al., 1999; Mantzicopoulos and Neuharth-Pritchett, 2003; Murray et al., 2008; Rey et al., 2007). In contrast, the current study takes a person-centered approach (Bergman & Magnusson, 1997) to understanding multiple perspectives of TSRQ. Consistent with organizational approaches to understanding developmental processes (Cicchetti & Richters, 1997; Lerner, 1989), person-centered approaches are concerned with the pattern, or organization of factors. According to this view, the meaning of a given factor is dependent or conditional on other factors. Identification of types of students based on such a configural approach has a long and productive history in child and educational psychology (Haapasalo, Trembly, Boulerice, & Vitaro, 2000; McKinney & Speece, 1986; Kim, Kamphaus, & Baker, 2006; Youngman, 1978). For example, in a sample of 13 year old girls and boys, Magnusson and Bergman (1990) identified specific patterns of behavior based on six variables (aggressiveness, motor restlessness, lack of concentration, low school motivation, under achievement in school, and poor peer relations) that predicted adult criminality and alcohol abuse. Importantly, some variables were only predictive of these outcomes in the context of other variables. Specifically, a lack of concentration, low school motivation, and poor peer relations were

predictive of negative adult outcomes only when they co-occurred with hyperactivity and aggression. Similarly, child positive or negative perceptions of TSRQ may be predictive of certain adjustment outcomes only when these perceptions co-occur with others' reports.

Gender and racial/ethnic differences in reports of TSRQ

Across grades, boys experience less support and more conflict in their relationships with teachers than do girls, according to both teacher reports (Baker, 2006; Hughes & Kwok, 2007; Ryan et al., 1994) and student reports (Mantzicopoulos & Neuharth-Pritchett,2003; Murray & Greenberg, 20006 ;). These sex differences have been explained in terms of the higher prevalence of conduct problems in boys relative to girls (Hamre, Pianta, Downer, & Mashburn, 2008).

Teachers report higher levels of conflict with African-American children than with Caucasian and Hispanic students (Hughes & Kwok, 2007; Ladd & Burgess, 2001; Murray, Murray, &Waas, 2008; Saft & Pianta, 2001), although this effect is moderated by the ethnic match of teachers and students; levels of conflict between African-American students and their teachers are not higher when described by African-American teachers (Murray et al., 2008; Saft & Pianta, 2001). There is a paucity of research on racial or ethnic differences in students' reports of TSRQ. Murray et al. (2008) found that although teachers rated relationships with African American students as less positive than relationships with Hispanic and Caucasian groups, no race/ethnic differences were found for child reports. Studies investigating racial/ethnic differences in perceptions of social competence have documented that compared to Euro-American students, African American students' self ratings of how much peers like hem are more positive than the ratings of liking they received from others (Dunkel, Kistner, & David-Ferdon, 2009; Zakriski & Coie, 1996). Based on these sex and racial/ethnic differences, it is important to examine associations between sex and race and sources student and others' reports of TSRQ.

Study Purpose and Hypotheses

The overall purpose of this study was to investigate the developmental consequences of second- and third-grade students' reports of TSRQ. Because we expected the associations between child report and adjustment to be contingent on congruence with others' reports, we employed cluster analysis, a person-centered approach, to conceptualizing and measuring TSRQ. Cluster analysis is a classification technique for forming homogenous groups across a set of variables. Although a number of different statistical clustering methods exist, essentially a clustering method "is a multivariate statistical procedure that starts with a data set containing information about a sample of entities and attempts to reorganize these entities into relatively homogenous groups" (Aldenderfer & Blashfield, 1984, p. 7). The study had two specific aims.

Aim 1: Identification and Validation of TSRQ types

Identification of types—Based on previous research identifying subtypes of students whose perceptions of social support are either congruent or discrepant with others' reports, (Edens et al., 1999; Kistner et al., 2006), we expected that cluster analysis would identify four theoretically meaningful types of teacher-student relationships based on teacher and child reports of support and conflict and peer reports of support. Specifically, we expected a *Congruent Positive* group, characterized by consensually high ratings of teacher-student support and low levels of conflict. We also expected a *Congruent Negative* group, characterized by consensually low ratings of teacher support and high levels of conflict. We also expected two incongruent groups: a group characterized by low ratings of support and high ratings of conflict by others yet average to high ratings of support and low ratings of

conflict by students (*Incongruent Child Positive*) and a group characterized by average to high ratings of support and average to low ratings of conflict by others yet low levels of child-perceived support from others (*Incongruent Child Negative*).

Cluster validation—Validity of the four TSRQ types was evaluated by testing group differences on demographic and adjustment variables that are theoretically or empirically related to each type. First, based on research summarized above on racial/ethnic differences in teacher reports of TSRQ, we expected African American students to be underrepresented in the Congruent Positive group. Based on studies summarized above finding that African American students' reports of others' liking for them are higher than others' reports, we also expected African American students to be over-represented among the Incongruent Child Positive group. Second, based on research summarized above documenting sex differences in child and teacher reports of TSRQ, we expected boys to be over-represented in the Congruent Negative group and girls to be over-represented in the Congruent Positive group.

With respect to adjustment variables, we predicted that the Congruent Positive group would obtain better scores on all adjustment variables relative to the Congruent Negative group. Of greater interest were differences between groups that differed only on child report of TSRQ (i.e., Congruent Negative versus Incongruent Child Positive and Congruent Positive versus Incongruent Child Negative). First, we predicted no differences between the Congruent Negative and Incongruent Child Positive groups on teacher- or peer-rated problems or on achievement (i.e., all variables that are associated with teacher reports of TSRQ); we did predict differences between the groups on child reports of competence. We expected the Incongruent Child Positive Group would report more positive levels of global self worth and math and reading competence relative to reports of Congruent Negatives. This expectation is based on the reasoning that students tend to generalize a positive bias in self-ratings of support relative to other self perceptions (Prasad-Gaur, Hughes, & Cavell, 2001).

Based on similar reasoning, we expected the Incongruent Child Negative group to report lower levels of global self-worth and math and reading competence beliefs, despite equivalent performance in reading and math, compared to the Congruent Positive group. Furthermore, based on the association between negative self-evaluation schema and internalizing symptoms (Beck, 2002), we expected the Incongruent Child Negative group to be rated by teachers as having more emotional symptoms than the Congruent Positive group. Similarly, based on prior findings of an association between internalizing symptoms and lower peer acceptance (Ladd, Kochenderfer, & Coleman, 1996), we expected Incongruent Child Negatives would experience lower levels of peer acceptance, relative to Congruent Positives.

Aim 2: Implications of TSRQ Cluster Membership for Future Engagement and Achievement

Using structural equation modeling (SEM), we also determined the implications of teacher-student relationship group membership for students' behavioral engagement and achievement trajectories over three years, above prior levels of engagement and achievement. Behavioral engagement refers to students' effortful and cooperative involvement in the classroom (i.e., working hard, persisting in the face of failure, and/or complying with classroom rules) (Hughes & Kwok, 2006). Based on previous research demonstrating the positive effect of teacher reports of TSRQ on engagement and achievement, we expected that the two groups characterized by high teacher-reported relationship quality (Congruent Positive and Incongruent Child Negative) would outperform the two groups characterized by low levels of teacher-reported relationship quality (Congruent Negative and Incongruent Child Positive). Based on research suggesting that a positive view of relationship support that is discrepant with others' reports is not a

developmental asset (Hughes et al., 1997; Salmivalli et al., 2005), we expected the Congruent Negative and Incongruent Child Positive groups would not differ from each other on trajectories for engagement and achievement. With respect to trajectory differences between Congruent Positives and Incongruent Child Negatives, we expected students who under-report the level of teacher support, relative to other reports, would exhibit lower levels of engagement and achievement. This expectation is based on the reasoning that the effect of teacher support on children's engagement is mediated in part by its direct effect on students' sense of school belonging and positive identity as a student (Skinner et al., 2008)

Method

Overview

The 706 participants in the current study were recruited into a longitudinal study when they were in first grade (see *Participants*). Data on TSRQ were collected from teachers (questionnaires), classmates (peer sociometric interviews), and children (individual interviews) during Year 3, when 526 students were in 3rd grade and 174 were in 2nd grade (i.e., had been previously retained in grade) with 6 cases of missing grade information. Teacher-rated behavioral engagement and performance on a standardized measure of reading and math achievement were the study outcomes. These measures were collected in Year 2 (baseline performance) and in Years 4, 5, and 6 (years used to assess individual growth trajectories). Demographic variables (sex, race/ethnicity) and IQ were assessed in Year 1. Cluster validation variables (teacher-rated conduct problems, emotional symptoms, and behavior engagement; peer nomination aggression and social preference; child perceived global self worth and math and reading competence and reading and math achievement) were assessed in Year 3. Teachers received compensation for completing and returning the questionnaires. Research staff individually administered tests of reading and math achievement and interviewed students each year, with the constraint that each assessment was separated by at least 8 months. Sociometric interviews and teacher questionnaires were administered in the spring of each year.

Participants

Participants were drawn from a larger sample of 784 children participating in a longitudinal study. Participants for the longitudinal study were recruited from three school districts in Texas (one urban and two small cities) across two sequential cohorts in first grade during the fall of 2001 and 2002. The racial/ethnic composition of the urban school was 25% African American, 36% Hispanic, and 39% White. The racial/ethnic composition for one small city school was 29% African American, 28% Hispanic, and 38% White; for the second small city school, the racial/ethnic composition was 12% African American, 11% Hispanic, and 68% White. Children were eligible to participate in the larger longitudinal study if they scored below the median score for their school district on a state-approved, district-administered measure of literacy. Because each of the three districts selected a different measure of literacy from the list of tests approved by the state education agency, scores were standardized within each district. Students who scored below the median for their district were eligible to participate. Additional eligibility criteria were spoken either English or Spanish, were not receiving special education services, and had not been previously retained in first grade (i.e., were in first grade for the first time in Year 1). No evidence of selective consent for participation in the larger longitudinal study was found.

Of the 784 recruited children, 706 (90.05 %) met the following criteria for the current study: (a) at least one data entry on any of the five clustering variables at Year 3, and (b) at least one data point on engagement or achievement at Year 4, 5, or 6. No evidence of selective attrition was found based on demographic variables including IQ (assessed with the

Universal Nonverbal Achievement Test; Bracken & McCallum, 1998) gender, ethnicity, and eligibility for free or reduced lunch (based on school records in first grade). The 706 participants (53.5 % male) were nested in 317 classrooms in Year 3 (of which 526 students were in 3rd grade and 174 were in 2nd grade with 6 cases of missing grade information). The ethnic composition was 23% African American, 38% Hispanic (of which 15.7% were in bilingual classrooms), 34% Caucasian, and 5% others. Fifty-nine percent of participants were eligible for free or reduced lunch. The mean broad reading and math age-standardized achievement scores on the Woodcock-Johnson Test of Achievement were 95.5 (SD=14.2) and 100.6 (SD=12.4), respectively. Of these 706 participants, 480 had complete information on the five clustering variables. Participants with and without complete data did not differ on the five clustering variables at Year 3, nor on reading and math achievement and behavioral engagement scores at Years 2, 4, 5, and 6 after alpha adjustment for multiple tests. The overall rate of missingness for all 12 analysis variables was 16.2%. Normality of study variables was examined. Skewness and kurtosis values were within ± 3, suggesting the distribution of the data was appropriate for the analytic methods employed. Based on the equal pattern of the participants with and without complete data on all demographic and study variables, and to maintain the same sample across outcomes, missing data for the 706 participants were imputed using an Estimation-Maximization (EM) algorithm estimation method in conjunction with MCMC augmentation method within the PROC MI procedure in SAS 9.2.

Measures

Determination of Language for Testing

If children were enrolled in bilingual classrooms, identified by the school as Limited English Proficient, or if children or their parents spoke any Spanish according to parent or teacher report, children were administered the *Woodcock-Muñoz Language Test* (Woodcock & Muñoz-Sandoval, 1993) by a Spanish-English bilingual examiner to determine the child's language proficiency in English and Spanish. This test was administered each year or until the child was assessed as more proficient in English for two consecutive years. All child interviews and measures of achievement were administered in the child's dominant language.

Measures of Teacher-Student Relationship Used in Cluster Analysis

Child ratings of teacher-student relationship—The *Network of Relationships Inventory* (NRI; Furman & Buhrmester, 1985) is a child-report measure of relationship quality informed by Robert Weiss's (1974) theory of the provision of social support. Items on the NRI assess six forms of social support (affection, admiration, intimacy, satisfaction, nurturance, and reliable alliance) and conflict in the teacher-student relationship. In individual interviews, children were asked to indicate on a 5-point Likert-type scale the level of support (16 items) or conflict (6 items) in their relationships with their teacher. An exploratory factor analysis on half (392) of third-grade participants randomly selected from the larger study revealed three factors: Warmth (10 items), Intimacy (6 items), and Conflict (6 items). Results of confirmatory factor analysis on the other half (392) of participants found that the three-factor model provided an adequate fit for the data, χ^2 (202) = 306.502, *p* < .001, comparative fit index (CFI) = .949, root-mean-square error of approximation (RMSEA) = .040, standardized root mean square residual (SRMR) = .057. Only the Warmth (α =.87) and Conflict (α = .79) scales were used for the current study. The Warmth scale was selected as the measure of relationship support as it best captures teacher provision of social support and is more consistently predictive of adjustment than the Intimacy scale (Hughes & Villarreal, 2008). Examples of items on the Warmth scale include "How much does your teacher like or love you?" and "How much does your teacher treat you like you're admired

and respected"? Examples of items on the Conflict scale include "How much does this teacher punish you?" and "How much do you and your teacher disagree and quarrel?

Teacher ratings of teacher-student relationship—The 22 items on the child version of the NRI were rephrased so that teachers reported on a 5-point Likert-type scale their provision of support to the student and level of conflict in their relationship. For example, an item on the child version asks "How much does your teacher treat you like you're admired and respected?' The comparable item on the teacher version is "This child gives me many opportunities to praise him/her." The exploratory and confirmatory factor analysis by Hughes et al. (2008) with the larger longitudinal sample identified three factors: Warmth (13 items), Intimacy (3 items) and Conflict (6 items). The difference in factor structure between the children and teacher versions is due to the fact that three items from the Nurturance subscale of the NRI load on the Intimacy factor of the Child version and on the Warmth factor of the Teacher version. The Warmth ($\alpha = .96$) and Conflict scales ($\alpha = .91$) were used. Examples of items on the Warmth scale include "I enjoy being with this child." and "This child gives me many opportunities to praise him/her." Examples of items on the Conflict scale include "This child and I often argue or get upset with each other." and "I often need to discipline this child."

Peer nominations for teacher-student support—Peer perceptions of teacher-student relationship support were assessed using well-established peer-nomination procedures (Realmuto, August, Sieler, & Pessoa-Brandao, 1997). Consent for participation in the peer-nomination procedure was requested from parents of all children in classrooms in which study participants were enrolled. Only children with consent to participate provided peer nominations; however, all children in the class were eligible to be nominated. To ensure reliability, peer-nomination interviews were conducted only in classrooms in which at least 40% of students provided nominations (Terry, 2000). An average of 13 students (SD = 3.08) provided nominations in each classroom. The mean classroom percentage of students participating in the peer-nomination procedures was 70% (range = 40% to 100%).

For this procedure, students were asked to name as few or as many classmates as they wished who best fit the following description: "These children get along well with their teachers. They like to talk to their teachers, and their teachers enjoy spending time with them. What kids in your class are like this?" The number of nominations a child received was standardized within classrooms. Previous research has demonstrated that peer nomination scores for children's social behaviors such as aggression, cooperation, and leadership are moderately correlated with teacher ratings of similar constructs yet make unique contributions to the prediction of children's future social and behavioral adjustment (Kendall, 1982; Nelson & Dishion, 2004; Terry & Coie, 1991). An advantage of peer nominations is that scores reflect the perspectives of multiple members of a peer group versus a single rater.

Cluster Validation Measures

Teacher-rated conduct problem and emotional symptoms—Teachers completed the *Strengths and Difficulties Questionnaire* (SDQ; Goodman, 1997), a 25-item screening measure for psychopathology that has been translated into 67 languages and used throughout the world (Youth in Mind, 2010). Each item is rated on a scale from 0 (not true) to 2 (certainly true). The SDQ includes five scales comprised of 5 items each. Only the Conduct Problems and Emotional Symptoms scales were used in the current study ($\alpha = .84$ and .74, respectively). Conduct Problem items include "often fights with other children or bullies them" and "generally well behaved, usually does what adults request" (reverse scored). Emotional Symptoms items include "often complains of headaches, stomach-aches, or

sickness" and "nervous or clingy in new situations, easily loses confidence." The teacher SDQ has demonstrated good construct and criterion-related validity (Hill & Hughes, 2007).

Children's perceived competence in math and reading—Children's perceived reading and math competencies were assessed with the Competence Beliefs and Subjective Task Values Questionnaire (Wigfield et al., 1997). The math and reading scales consist of 5 items each. Children were asked how good they are in reading/math, how good they are relative to other things they do, how good they are relative to other children, how well they expect to do in the future in reading/math, and how good they would be at learning something new in reading/math. Scores on reading and math scales are significantly correlated with actual achievement (Wigfield et al., 1997). We followed Eccles, Wigfield, Harold, and Blumenfield's (1993) recommendation to provide graphic representation of the response scale for younger children. Specifically, children were asked to respond by pointing on a thermometer numbered 0 to 30. The end point and midpoint of each scale were also labeled with a verbal descriptor of the meaning of that scale point, e.g., the number 1 was labeled with the words "not at all good, or one of the worst," the number 15 was labeled with the words "OK," and the number 30 was labeled with the words "very good, or one of the best." The internal consistency for the reading and math scales were .82 and .83, respectively, for our sample.

Global self-worth—Children's self-worth was measured with the six-item Global Self-Worth scale of the *Self-Perception Profile for Children* (Harter, 1985). This measure has demonstrated good internal consistency and test-retest reliability, and scores are moderately correlated with child-reported anxiety and depression and with other-reported internalizing and externalizing behaviors (Muris, Meesters, & Figen, 2003). An example item is "This statement reads, 'some kids usually do the *right* thing', BUT this statement reads, 'some kids usually don't do the *right* thing'. Which one are you more like?" After the child makes his or her selection, the examiner points to two boxes under the appropriate statement and asks, "Is this true of you or is this sort of true for you?" Based on both responses, the child receives a score of 1-4 for each item. The alpha was .68 for our sample.

Social preference—In individual interviews, children were asked to nominate as few or as many classmates as they wished whom they "liked the most." Children were also asked to indicate their liking for each child in the classroom on a five-point rating scale. Specifically, the interviewer named each child in the classroom and asked the child to point to one of five faces ranging from sad (1= don't like at all) to happy (5= like very much). A child's mean liking score was the average rating received by classmates. Following Coie, Dodge, and Coppotelli (1982), we computed social preference scores as the standardized liked-most nomination score minus the standardized liked-least scores. To avoid asking children to nominate disliked children, a rating of "1"on the rating scale was considered equivalent to a "liked least" nomination score (Asher & Dodge, 1986).

Peer evaluated aggression—Using the peer nomination procedure described above for social preference, children were asked to nominate as few or as many classmates as they wanted who fit a behavioral description of aggression: These kids start fights, say mean things, or hit others. The number of nominations a child received was standardized within classroom.

Measures of Outcomes

Academic achievement—The *Woodcock-Johnson Tests of Achievement III* (Woodcock, McGrew, & Mather, 2001) is an individually-administered measure of academic achievement for individuals ages 2 to adulthood. The WJ-III Broad Reading scores (Letter-

Word Identification, Reading Fluency, and Passage Comprehension subtests) and the WJ-III Broad Math scores (Calculations, Math Fluency, and Math Calculation Skills subtests) were used. Extensive research documents the reliability and construct validity of the WJ-III (Woodcock et al. 2001). Analyses were conducted with Rasch-based "W" scores, which are especially well-suited to assessing longitudinal change in achievement. Children tested as more proficient in Spanish than English (above) were administered the *Bateria III* (Muñoz-Sandoval, Woodcock, McGrew, & Mather, 2005), which yields W scores for Reading and Math that are comparable to those of the WJ-III.

Teacher-rated student behavioral engagement—Teachers rated students' classroom behavioral engagement with an 11-item questionnaire. Items were adapted from the both the teacher and the student versions of the *Student Engagement Questionnaire* (Skinner, Zimmer-Gembeck, & Connell, 1998). Example items include "tries hard to do well in school," "concentrates on doing work," and "participates in class discussion." Teachers were asked to indicate the extent to which each statement was true of their student on a 1 (not true at all) to 4 (very true) scale. A mean item score was calculated (α =.93 for our sample). Scores on this measure are correlated with students' reports of their behavioral engagement and with objective measures of achievement (Skinner et al., 1998; Skinner et al., 2008).

Covariates and Baseline Performance Measures

Children's IQ was entered as a covariate in the regression analyses based on its association with engagement and achievement (Luo, Hughes, Liew, & Kwok, 2009). IQ was assessed in first grade using the abbreviated *Universal Nonverbal Intelligence Test* (UNIT; Bracken & McCallum, 1998). The UNIT abbreviated IQ score correlates .91 with the full battery IQ score, which has demonstrated good reliability and construct validity (Hooper, 2003; Bracken & McCallum 1998). Year 2 measures of reading and math achievement were assessed with the WJ-III or Bateriá. Baseline behavioral engagement was assessed with a 10-item teacher rating scale assessing teacher perceptions of child effort and persistence that has demonstrated good criterion-related validity (Hughes et al., 2008) and has been equated to the 11-item teacher-rated behavior engagement scale used as an outcome measure (see description above).

Analyses Overview

K-means clustering algorithm—Cluster analysis was used for classifying individuals into meaningful TSRQ groups. We selected *K*-means iterative partitioning method because it does not assume clusters are hierarchical, can handle significantly larger datasets than the hierarchical methods, goes through the data in a recursive process, and adjusts for a poor initial partition of the data (Aldenderfer & Blashfield, 1984).

The FASTCLUS procedure in SAS 9.2 was used to perform the k-means clustering analysis with the five Year 3 clustering variables (i.e., child-rated warmth, child-rated conflict, teacher-rated warmth, teacher-rated conflict, and peer nominations related to teacher-student support) to classify participants. Because the algorithm used by FASTCLUS places more influence on variables with larger variance, all variables were standardized before performing the cluster analyses. Different numbers of cluster solutions were tested, and maximum iteration was set to ensure that the cluster analysis reached convergence. To prevent the problem of suboptimal solutions caused by ill-selected initial cluster seeds, random option was used for reordering the data randomly and re-running the analysis recursively to obtain a stable cluster solution (SAS Institute, 2008).

Latent Growth Curve Model (LGCM)—To determine the association between the types of the teacher-student relationship and the growth trajectories of both behavioral

engagement and academic achievements over time, latent growth curve modeling investigated the growth pattern of both achievement (math and reading) and behavioral engagement. We then regressed the latent growth factors (i.e., intercept and slope factors) on the types of teacher-student relationship based on the class solutions from the cluster analysis. Three LGC models for the outcome variables (reading and math achievement and behavioral engagement) were analyzed with data from Years 4, 5, and 6 (see Figure 1.). The first factor (labeled as "I") represented the intercept with all the factor loadings from this factor constrained to one. The mean of the intercept factor was equivalent to the average score of the outcome variable at the first time point (Year 4), which was adjusted by Year 2 performance on that measure. The second factor (labeled as "S") was the slope factor, and the magnitude of the loadings to this factor defined the shape of the growth trajectory. For example, a factor loading pattern {0, 1, 2} from the three observed indicators to the slope factor represents a linear growth trajectory in which the mean of the slope factor is the average linear growth rate. In this study, the loading between the slope factor and the Year 6 indicator (i.e. λ_3) was freely estimated to test the linear/nonlinear growth trajectory (Bollen & Curran, 2006;Kwok, Luo & West, in press;Meredith & Tisak, 1990). After the growth trajectory for each outcome variable was confirmed, both intercept and slope factors of each outcome variable were then regressed on the teacher-student relationship (TSRQ) types, controlling for the effect of the students' IQ. Contrast and dummy coding variables were created to represent different TSRQ types.

The LGCMs were estimated using Mplus V5.2 (Muthén & Muthén, 2007). The data were assumed to be missing at random, and the missing data were imputed with the PROC MI routine in SAS 9.2. Ten imputed data sets were then analyzed using the IMPUTATION feature of Mplus, where the parameter estimates and the standard errors were averaged over the ten sets of analyses. Furthermore, Type=COMPLEX routine in Mplus was used to take into account the dependency among observations (children) who were nested within clusters (classrooms).

Results

Descriptive and Correlational Results

Descriptive statistics and correlations among variables are shown in Table 1. Child reports of warmth are only modestly and negatively correlated to child reports of conflict (−.14). Child reports of conflict are modestly and negatively related to teacher reports of warmth (−.25) and peer nominations of teacher-student support (−.18), but moderately and positively related to teacher report of conflict (.43). Teacher reports of warmth are negatively and moderately correlated to teacher reports of conflict (−.56), but positively and modestly correlated to peer nominations of teacher-student support (.29). Peer nominations of teacher-student support are also modestly and negatively correlated to the teacher reports of conflict (−.27). All clustering variables were correlated in the expected direction with baseline and outcome variables.

Identification of TSRQ types

The k-means cluster analysis resulted in a four-cluster solution in which four different types of teacher-student relationships were found in our data. To determine the optimal number of clusters, three-, four-, five-, and six-cluster models were tested with SAS FASTCLUS procedure. Pseudo F statistic (Calinski and Harabasz, 1974), approximate expected overall R-squared (SAS Institute, 2008), and cubic clustering criterion (CCC; Sarle, 1983) are commonly used to determine the optimal number of clusters that is empirically and theoretically reasonable. The cluster solution with highest pseudo F statistic and peak CCC value are considered the best (Milligan & Cooper, 1985).

The four-cluster solution had the highest pseudo F statistic and CCC, while the three-cluster solution had slightly lower values of pseudo F and CCC. Moreover, the four-cluster solution had much higher approximate expected overall R-squared and smaller maximum within-cluster distance between observations and cluster centroids than those for the three-cluster solution. Thus, the four-cluster solution was considered the optimal cluster solution. Table 2 presents the frequencies and mean values of the five clustering variables for each of the four clusters. The chart in Figure 2 shows the mean differences across the four groups on the five variables used for the cluster analysis.

Additionally, the bootstrap method (Efron & Tibshirani, 1993) was used to prevent the local optimality problem and to verify the internal replicability of the cluster solution at Year 3 (Huberty & Wisenbaker, 1992; Thompson, 1994). The bootstrap validation method iteratively re-sampled the original data with replacement. A total of 500 copies of bootstrapped samples were generated. The re-sampled datasets were analyzed with the k-mean clustering algorithm. As the result, the averaged cluster solution validated the cluster solution of the original dataset and confirmed the internal replicability of the four-cluster solution at Year 3.

The four derived clusters are consistent with the study's hypotheses. Cluster 1 (Congruent Positive) had the highest scores on child-rated and teacher-rated warmth, and peer nominations for teacher-student relationship quality (TSRQ), and the lowest score on the child-rated and teacher-rated conflict scores. In general, students in this group were viewed by all reporters as having a positive relationship with their teachers. Compared with the children in cluster 1, children in cluster 2 (Congruent Negative) scored in an opposite direction. They had the highest child-rated and teacher-rated conflict scores and scored the second lowest on child-rated and teacher-rated warmth, and peer nominations of support.

Children in cluster 3 (Incongruent Child Negative) had low teacher-rated and child-rated conflict scores. Children in this group reported the lowest warmth scores, but their teachers and peers reported average to positive warmth scores

Children in cluster 4 (Incongruent Child Positive) received high teacher-rated conflict scores and low teacher-rated and peer-nominations of support scores. Cluster 4 children, however, reported warmth and conflict scores that were average.

Cluster Validation

Demographic variables—Table 3 presents the demographic profile for each of the four clusters. As expected, the Congruent Positive group included more female [χ^2 (3) = 54.1, $p \le .0001$] and Hispanic students [χ^2 (15) = 41.8, $p \le .0001$]; the Congruent Negative group contained more male and African-American students; and the Incongruent Child Positive group contained more African American students. Although not expected, males were also over-represented in the Incongruent Child Positive group

Adjustment variables—The validity of the four clusters at Year 3 was tested using ten cluster validation measures: teacher-rated conduct problem, emotional symptoms, and engagement; peer social preference and peer nomination as aggressive; child-perceived global self-worth and math and reading competence beliefs, and WJ-III math and reading achievement scores. Ten separate one-way analyses of variance (ANOVAs) were conducted; the results are presented in Table 4. The four clusters exhibited a differential effect on all cluster validation variables. Differences were generally consistent with expectations.

With respect to teacher-rated conduct problems [$F_{(3,540)}=138.571$, p<.001], the Congruent Negative and Incongruent Child Positive groups had the highest scores, followed by

Congruent Positive and Incongruent Child Negative groups, which did not differ from each other. As for teacher-rated emotional symptoms $[F_{(3,540)}=9.539, p<.001]$, the expectation that the Incongruent Child Negative group would be rated as having more emotional symptoms than Congruent Positive group was not supported; both had fewer emotional symptoms than the Congruent Negative and Incongruent Child Positive groups. Regarding social preference $[F_{(3,615)}=17.185, p<.001]$, as expected, the Congruent Positive group enjoyed higher levels of social preference than did the Incongruent Child Negative group; both groups were better accepted than the Congruent Negative and Incongruent Child Positive groups, which did not differ from each other. For the teacher-rated behavioral engagement scores $[F_{(3,540)}=98.79, p<.001]$, the Congruent Positive group received the highest engagement scores and Incongruent Child Negative group the second highest, whereas the Congruent Negative and Incongruent Child Positive groups were rated as the lowest and were not statistically different from each other.

As expected, the Incongruent Child Negative group reported lower global self-worth $[F_{(3,665)}=13.343, p<.001]$ and lower reading $[F_{(3,665)}=5.579, p = .001]$ and math competence beliefs $[F_{(3,665)}=6.988, p<.001]$ than did the Congruent Positive groups. Also as expected, the Incongruent Child Positive group reported higher global self-worth and reading and math competence beliefs than did the Congruent Negative group. Indeed, the Incongruent Child Positive group reported levels of global self-worth similar to the Incongruent Child Negative group and levels of reading and math competence beliefs higher than the Incongruent Child Negative and similar to the Congruent Positive groups.

With respect to achievement, the Congruent Positive and Incongruent Child Negative groups scored higher on reading achievement $[F_{(3,702)}=6.455, p<.001]$ than did the Incongruent Child Positive and Congruent Negative groups. In addition, the Congruent Positive group had the highest math achievement scores $[F_{(3,702)}=9.509, p<.001]$, followed by the Incongruent Child Positive and Congruent Negative groups. The Incongruent Child Negative was not different from the Congruent Positive or Incongruent Child Positive in math achievement.

Difference in Growth Trajectories among Clusters

Modeling growth trajectories—Both linear ($\lambda_3 = 2$) and nonlinear (λ_3 is freely estimated) latent growth models were tested. Significant chi-square differences revealed nonlinear trajectories in the repeated outcome measures. For reading achievement, the factor loading estimate of Year 6 reading was 1.087, which indicated the reading growth pattern was nonlinear over time. The mean intercept ($\bar{I}_{Reading} = 386.4, p <.001$) and mean slope ($\bar{S}_{Reading} = 96.3, p <.001$) were statistically significant for reading achievement, holding IQ constant. For math achievement, the statistically significant factor loading estimate of Year 6 math was 1.060, which suggested the math growth pattern was also nonlinear over time. The mean intercept ($\bar{I}_{Math} = 385.1, p <.001$) and mean slope ($\bar{S}_{Math} = 107, p <.001$) were significant, controlling for IQ. With respect to engagement scores, the factor loading estimate of Year 6 engagement was .940, again indicating the engagement growth pattern was not linear over time. The mean intercept ($\bar{I}_{Engagement} = 2.0, p <.001$) and mean slope ($\bar{S}_{Engagement} = .502, p <.001$) for engagement were significant, controlling for IQ.

Cluster differences—Three orthogonal contrasts were created to investigate the growth trajectories among the four clusters. The first contrast compared the difference in the growth trajectory between the two groups in which others (teachers and peers) report a positive relationship (combination of Congruent Positive and Incongruent Child Negative) with the two groups in which others reported a negative relationship (Congruent Negative and Incongruent Child Positive). This first contrast was denoted as $C_{others\ positive/others\ negative}$.

The second contrast compared the Congruent Positive with the Incongruent Child Negative ($C_{CP/IN}$), and the third contrast compared the Congruent Negative with the Incongruent Child Positive ($C_{CN/IP}$).

Table 5 presents the parameter estimates of the latent growth curve model under the coding scheme. The contrast coded variable $C_{others\ positive/others\ negative}$ had statistically significant path estimates in all intercept factors ($\widehat{\beta}_{C\,other\ positive/other\ negative} \rightarrow$ I, Reading=2.76, p <.001; $\widehat{\beta}_{C\,other\ positive/other\ negative} \rightarrow$ I, Math=1.57, p <.001; $\widehat{\beta}_{C\,other\ positive/other\ negative} \rightarrow$ I, Engagement=.174, p <.001), meaning that the latent intercept (predicted average score of the outcome variable at Year 4) of the Congruent Positives/ Incongruent Child Negative combined groups was significantly higher than that of the Congruent Negative/Incongruent Child Positive groups across the three outcome variables. The $C_{others\ positive/others\ negative}$ also had significant path estimates on the slope factors of reading, math and engagement, which indicated the growth rates of Congruent Positive/ Incongruent Child Negative in reading, math and engagement were greater than those of Congruent Negative/Incongruent Child Positive. No additional statistically significant path estimate was found with respect to the other contrast coding variables, except for $C_{IP/CN}$ in predicting the initial status of mathematics achievement, which shows that the Incongruent Child Positive group had significantly higher average starting point at Year-4 math achievement score than the Congruent Negative group.

The reading, math, and engagement scores growth trajectories of four clusters are depicted in Figure 3. As seen in Figure 3, growth patterns for the four clusters in both reading and math are parallel, and the trajectories of the Congruent Positive and Incongruent Child Negative clusters are almost overlapping. As expected, the Congruent Negative and Incongruent Child Positive groups had lower baseline achievement levels (Year 2), and thus lower values of predicted achievement than the other two groups in Years 4, 5, and 6. The four growth trajectories for engagement displayed similar non-linear patterns as for achievement. The Congruent Positive and Incongruent Child Negative groups had significantly higher baseline levels and faster growth rates than the other two groups.

Gender and ethnic analyses—To test whether the pattern of relationships between clusters and growth trajectories was similar for boys and girls and for different ethnic groups (African American, Hispanic, and Caucasian), multi-group comparisons were conducted. Chi-square difference tests were used to compare models in which parameters were constrained to be the same across gender or ethnicity to models in which parameters were free to vary. The chi-square test results were not significant, revealing that neither gender nor ethnicity moderated the fit of the models.

Discussion

Cluster Identification and Validation

The first aim of this study was to identify and validate theoretically meaningful types of teacher-student relationships based on teacher and child reports of support and conflict and peer reports of support. Cluster analysis yielded four expected TSRQ types. Specifically, two congruent groups were identified, one in which both children and others reported high support and low conflict (Congruent Positive) and one in which children and others reported low support and high conflict (Congruent Negative). A third group, Incongruent Child Negative, is characterized by average to good reports of TSRQ by others but low child-reported warmth. The fourth group, Incongruent Child Positive, is characterized by poor

TSRQ as rated by others but average child reports. Bootstrapping methods confirmed the reliability of the cluster solution.

Demographic differences among clusters—As expected, there was an association between cluster membership and racial/ethnic status. African Americans were over-represented in the Congruent Negative and Incongruent Child Positive groups. Hispanics were somewhat over-represented in Congruent Positive and Incongruent Child Negative groups and under-represented in the Congruent Negative and Incongruent Child Positive groups, a finding consistent with literature suggesting the Latino culture places a high value on respectful interactions with adults and compliance with rules set by authority figures (Garcia, 1992). The expected gender differences were also found. Specifically girls were over-represented in Congruent Positive group and under-represented in each other group.

Cluster differences on cluster validation variables—Not surprisingly, the Congruent Positive group outperformed the Congruent Negative group on all measures of school adjustment. The performance of the two groups in which children's reports were incongruent with those of teachers and peers, however, is of particular theoretical and applied significance. The incongruent groups tell us whether the predictive meaning of child reports of TSRQ depends on whether they are congruent or not with others' reports. Children in the Incongruent Child Negative group were similar to children in the Congruent Positive group on measures of conduct problems and emotional symptoms but lower on teacher-rated engagement, child-reported self-concept (global self-worth and child perceived reading and math competence), and peer sociometric ratings. It appears that children in the Incongruent Child Negative tend to hold negative views of their competence. Contrary to expectations, children in the Incongruent Child Negative group were not rated by teachers as having more internalizing problems. This finding may reflect a tendency for teachers to under-report internalizing behaviors, relative to child reports (Loeber, Green, & Lahey, 1990), although the current study is not well designed to investigate this possibility. As expected, the Incongruent Child Negative group scored lower on peer sociometric and engagement ratings than did the Congruent Positives. Children whose reports of teacher support are incongruent with those of teachers and peers may lack confidence in social and academic areas and, therefore, be less likely to participate in the classroom and persist in the face of failure.

As expected, the Incongruent Child Positive group was similar to the Congruent Negative group on all teacher and peer-rated variables. The Incongruent Child Positive group reported higher global self-worth and perceived math and reading competence beliefs than did the Congruent Negative group. Indeed, their level of reported global self-worth was similar to that of the Incongruent Child Negative group, even though these two groups differed on teacher-rated internalizing and externalizing behaviors and peer sociometric ratings. Children in the Incongruent Child Positive group may adopt a boastful or assertive presentation style that impedes teachers' abilities to provide social and emotional support, as teachers reported the lowest level of support for the Incongruent Child Positive group. However, future research is necessary to test if this is the case. The finding that the Incongruent Child Positive group performed better than Congruent Negative group on math achievement provides some support for the view that an inaccurate but positive view of relatedness with one's teacher may promote math achievement. It is not clear why this benefit did not extend to reading. Perhaps differences in the nature of math and reading instruction in the elementary grades accounts for this difference. For example, because math instruction involves more individual work than reading instruction (Blanton, Wood, & Taylor, 2007; Rasinski & Hoffman, 2003), an individual's competence may be a stronger predictor of effort, and thus achievement in math than in reading.

Contrary to expectation, children in the Incongruent Child Positive group were not rated by teachers as being more aggressive than the Congruent Negative group. One explanation is that this sample was not selected for aggression. Previous research that has found that inflated perceptions of relatedness are associated with higher levels of aggression have been conducted with behaviorally at-risk samples (Hughes et al., 1997; Pardini et al., 2006).

Differences Among Clusters on Engagement and Achievement Trajectories

Consistent with our predictions, cluster membership predicted trajectories for each of the three outcomes, engagement and reading and math achievement. First, the two groups defined by positive other ratings of TSRQ outperformed the two groups defined by negative other ratings of TSRQ on intercept and slope for all variables. When teachers and peers viewed TSRQ as average to good, children were more engaged and had higher achievement over the next three years compared to children whose TSRQ was rated low by others. The standardized effect sizes of the differences in growth rate were large for math (.63) and medium for reading (.36) and engagement (.30) (Raudenbush & Liu, 2001).

Second, the Congruent Positive and Incongruent Child Negative groups did not differ on intercept or slope for any of the three outcomes. Apparently, as long as teachers and peers view the teacher-student relationship as average in support, the child is likely to improve in engagement and achievement. That is, average to good levels of other-perceived teacher support are "good enough" to promote positive trajectories for engagement and learning, regardless of whether the child shares others' perceptions of the teacher-student relationship as supportive. Finally, the Incongruent Child Positive group, relative to the Congruent Negative group, did not differ in intercept or slope for engagement or reading achievement; however, this group had a higher intercept, but not slope, for math achievement. This finding parallels the finding of group differences for math achievement in Year 3. Thus, this study provides no evidence that a positive but incongruent view is a risk factor for future adjustment, and some evidence it may be a protective factor, at least for math achievement. Relative to the Congruent Positive group, however, the Incongruent Child Positive group had a more negative trajectory for each outcome. That is, a positive view of relationship differentially predicted trajectories based on its concordance with others' ratings of relationship quality.

Implications of Findings for Social Motivation Theories

The relationship between TSRQ and engagement and achievement has been explained in terms of the effect of TSRQ on students' self-views, including self-concept (Hughes et al., 2008; Marchand & Skinner, 2007) and sense of belonging to school (Furrer & Skinner, 2003). Among the students in this study who were rated by teachers and peers as having a positive teacher-student relationship, those with congruent versus incongruent views of the TRSQ did not differ in trajectories for engagement and achievement. This finding suggests that mechanisms other than child self-views may account for an effect of TSRQ on engagement and achievement, at least for some students. There may be multiple mechanisms, or pathways, from TSRQ to engagement and achievement, and different learner characteristics may determine the operative mechanism. For example, for students in the Incongruent Child Negative group, teacher support may affect engagement and achievement because teachers provide more responsive instruction to students with whom they feel close (Itskowitz, Navon, & Strauss, 1988). A child's positive view of the TSRQ offers little protection for children rated by others as having low levels of support and high conflict in their relationships with teachers. Although a child's positive view of TSRQ is associated with concurrent academic competence and general self-worth, it is not associated with future engagement or reading achievement.

Implications for Educational Policy and Practice

The study provides strong support that TSRQ is important to children's academic growth. Not only did TSRQ cluster membership predict change in level (intercept) for each outcome, controlling for prior performance, it also predicted slope over the next three years. These findings add to an accumulating body of evidence that teacher-student relationship quality is an academic resource. Teachers differ in their ability to establish supportive and low-conflict relationships with students (Pianta et al., 2007). Increasing the availability of effective pre-service and in-service professional development efforts in this area is a high priority. Although the current empirical base for improving TSRQ is limited, recent research suggests that professional development efforts that are sustained over time, embedded in teachers' classrooms, and provide mentors or coaches who provide context-embedded feedback and emotional support can improve teachers' abilities to provide a positive and emotionally supportive context for students (Landry, Anthony, Swank, & Monseque-Bailey, 2009; Pianta, Mashburn, Downer, Hamre, & Justice, 2008). Teachers may find it especially difficult to provide social and emotional support to children who present an overly confident sense of self. Teachers are likely to attribute children's misbehavior to malicious intent and to respond with harshness (Poulou & Norwich, 2000). Helping teachers perceive such children as attempting to bolster a fragile sense of perceived competence and self-worth may enable teachers to provide these students more support and positive involvement.

It is important to note that teachers' reports of TSRQ and student behaviors influence each other in a reciprocal manner (Hughes et al., 2008). Thus interventions to improve TSRQ need to address both student and teacher influences on the relationship. Programs such as the Power Coping program (Lochman & Wells, 2004) have been found to reduce student problem behaviors that contribute to teacher-student conflict (Lochman & Wells, 2004). The impact of such interventions on teacher-student relationships, however, has not yet been investigated.

Study results support the inclusion of measures of teacher-student relationships in child assessments conducted by school psychologists. Including assessment of relationship supports as perceived by both the teacher and the student is consistent with ecological models of assessment concerned with aspects of the learning context that may promote or hinder student learning. Specifically, study results suggest that a reliance only on student report of relationship support may lead to erroneous conclusions concerning the child's level of relational risk.

Limitations and Future Directions

Study results need to be interpreted in the context of several limitations. First, the current study assigned students to clusters based on Year 3 ratings of TSRQ. Based on findings that teacher and student ratings of TSRQ are only moderately stable across years (Hughes, 2009; Pianta & Stuhlman, 2004), it is likely that students' cluster membership also changes from year to year. Instability in cluster membership would likely minimize the effect of cluster membership on long-term achievement. The fact that in the current study, cluster membership was more strongly and consistently predictive of intercept than of slope on outcome measures may be due to instability in cluster membership across years. Future research should address factors that predict change in membership as well as implications of changes in membership for children's trajectories.

Second, the characteristics of our sample (academically at-risk students) limit generalization of our findings to higher-achieving students. Our sample was selected based on scoring below the 50th percentile in first grade on a district-administered measure of literacy in first grade. Despite this selection criterion, the sample's mean performance on the Woodcock-

Johnson Broad Reading (M=95.5, SD=14.2) and Broad math (M=100.6, SD=12.4) at year 3 was in the average range with no evidence of restricted range. Previous research has found that teacher-student relationship quality has a stronger effect on student adjustment for students who are at-risk for behavioral or academic school adjustment difficulties (Baker, 2006; Buyse et al., 2008).

Previous research has found that racial/ethnic match moderates the association between African American status and TSRQ, such that racial differences in TSRQ are not present when African American students are paired with African American teachers (Murrary et al., 2008; Saft & Pianta,2001). Unfortunately, the current study had insufficient numbers of African American teachers to investigate the effect of racial matching on cluster membership. Of the 706 students, 163 (23.1%) students were African American. Of the 163 African American students, 3 (1.8%) had teachers of the same race/ethnicity. Conversely, of the 241 Caucasian students, 170 (70.5%) had teachers of the same race/ethnicity. The paucity of African American students with same-race teachers in the current sample may have contributed to the finding that African American students were over-represented in the Congruent Negative and Incongruent Child Positive groups.

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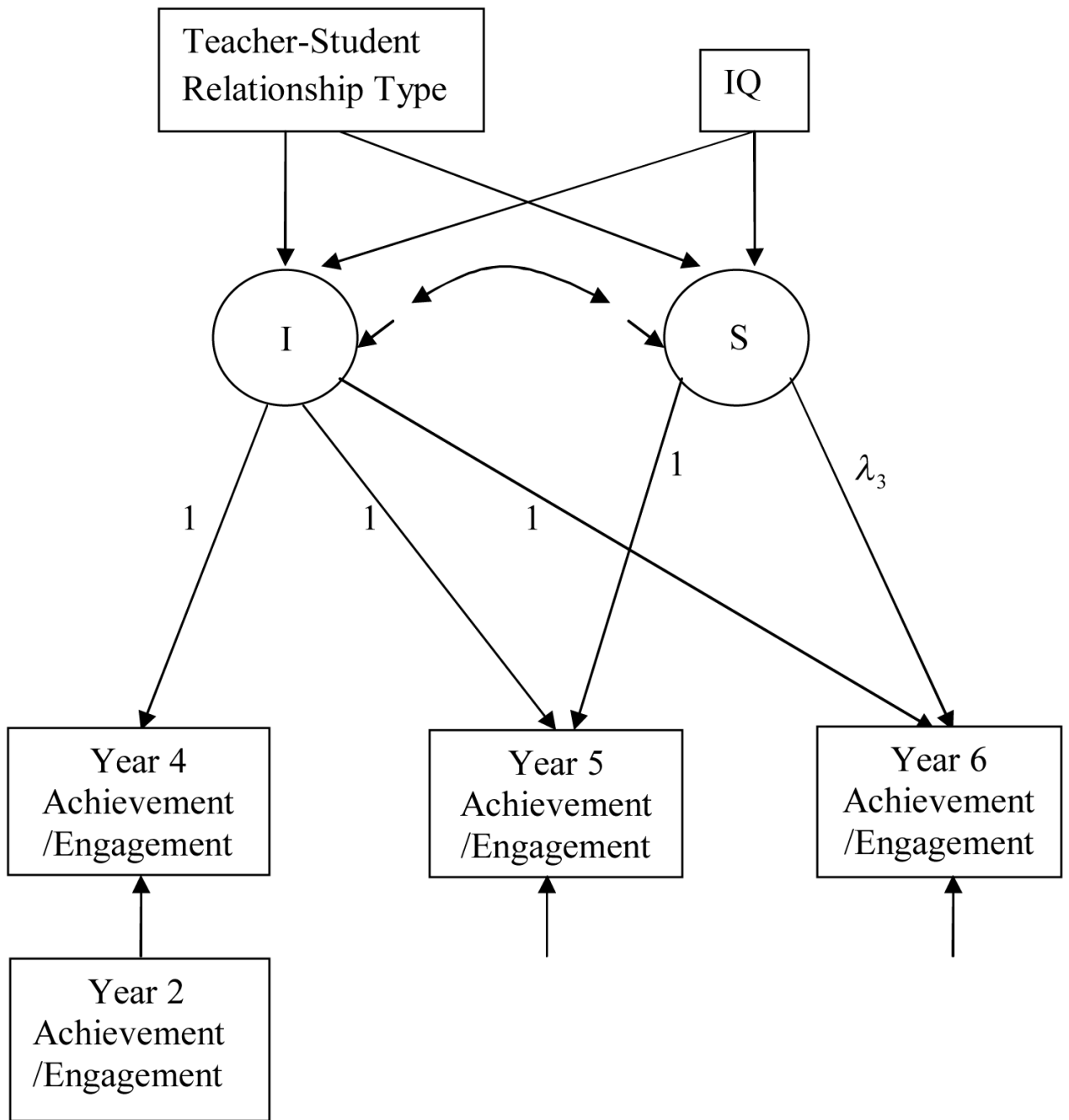
Figure 1.
Latent growth model with year 2 achievement and Teacher-Student relationship (TSRQ) variables as covariates.
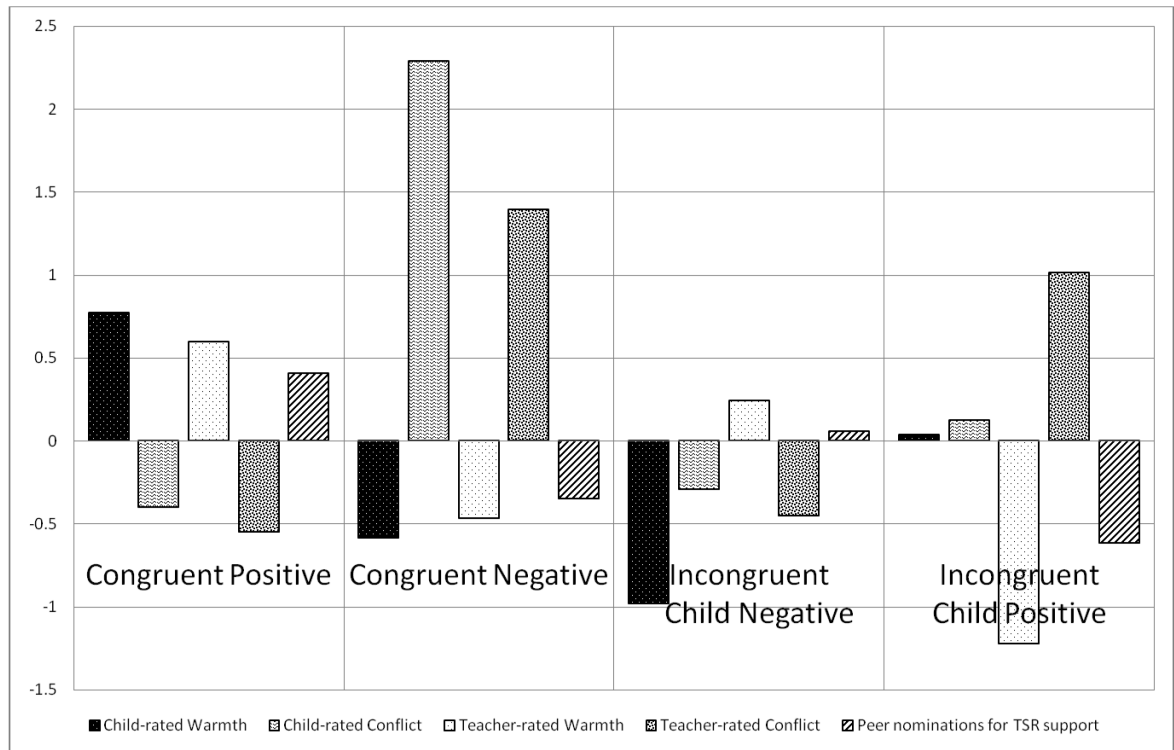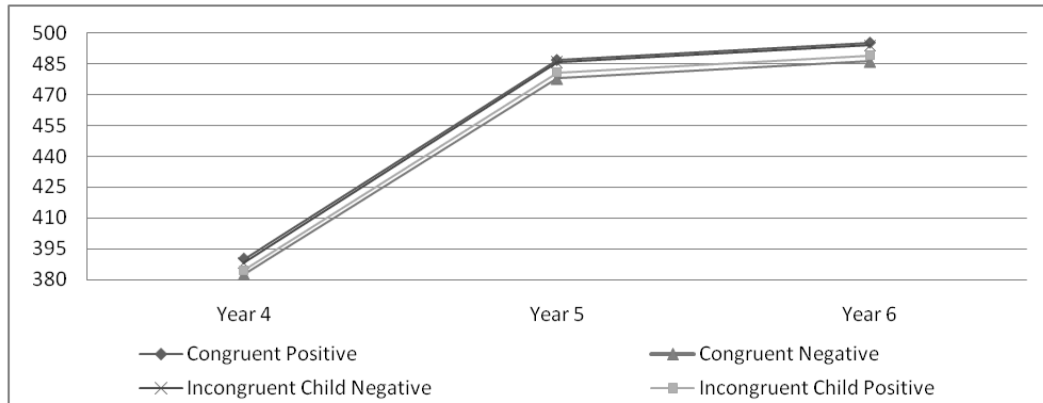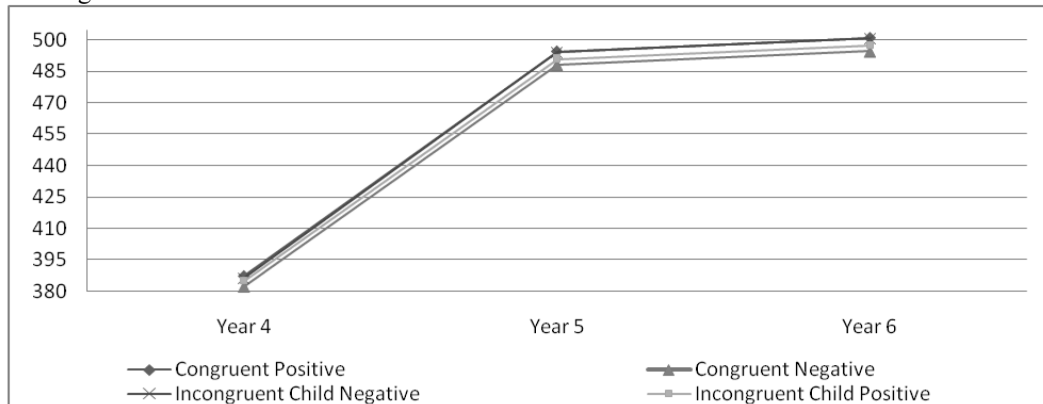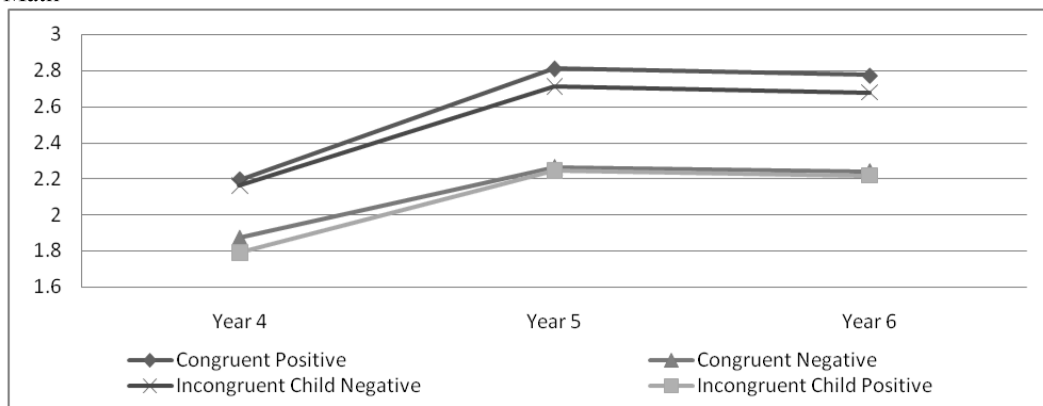
Figure 2.
Mean values of five clustering variables across four clusters at Year 3

Reading

Math

Engagement

Figure 3.
Reading, Math, and Engagement growth trajectories of four TSRQ clusters

Table 1

Descriptive Statistics and Zero-Order Correlation of Analysis Variables

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	CWA3	--																	
2	CCO3	-.14	--																
3	TWA3	.08	-.25	--															
4	TCO3	-.09	.43	-.56	--														
5	TSUP3	.09	-.18	.29	-.27	--													
6	READ4	-.01	-.23	.15	-.18	.09	--												
7	READ5	-.04	-.21	.15	-.15	.04	.90	--											
8	READ6	-.02	-.25	.17	-.20	.07	.87	.90	--										
9	MATH4	-.02	-.24	.15	-.17	.05	.58	.59	.63	--									
10	MATH5	-.07	-.25	.20	-.19	.01	.58	.62	.62	.82	--								
11	MATH6	.00	-.26	.19	-.22	.08	.62	.63	.69	.81	.83	--							
12	TENG4	.01	-.28	.39	-.43	.29	.23	.26	.26	.30	.34	.38	--						
13	TENG5	.09	-.31	.47	-.47	.31	.28	.26	.28	.26	.32	.34	.54	--					
14	TENG6	.05	-.27	.37	-.38	.30	.34	.33	.37	.33	.33	.41	.54	.60	--				
15	IQ1	-.10	-.12	.12	-.16	-.04	.28	.28	.29	.33	.35	.38	.18	.17	.14	--			
16	READ2	-.01	-.15	.07	-.11	.02	.76	.72	.66	.50	.46	.50	.14	.23	.28	.23	--		
17	MATH2	-.07	-.20	.13	-.15	-.02	.39	.43	.49	.70	.67	.65	.27	.17	.23	.29	.34	--	
18	TENG2	-.02	-.23	.35	-.37	.28	.33	.29	.31	.28	.34	.34	.45	.43	.38	.18	.28	.26	--
	Mean	3.6	1.8	3.9	1.8	-.2	488	498	507	496	504	510	2.8	2.8	2.8	92.9	461	475	3.4
	S.D.	.87	.77	.85	.95	.83	18.6	18.8	20.9	10.5	10.6	10.9	.68	.70	.67	14.6	22.6	11.1	1.06

Note. CWA =Child-rated Warmth; CCO=Child-rated Conflict; TWA=Teacher-rated Warmth; TCO=Teacher-rated Conflict; TSUP=Peer nominations for teacher-student support; READ =WJ-III Reading; MATH= WJ-III Math; TENG=Teacher-rated Behavioral engagement.

[a] The number following the variable name indicates the year of assessment (e.g. READ2 is the baseline measure of WJ-III reading at year 2, and READ4 is the respective outcome measure at year 4)

Table 2

Mean Values of the Clustering Variables across Clusters at Year 3

Clustering Variables	Congruent Positive n=279 (39.3%)	Congruent Negative n=70 (9.9%)	Incongruent Child Negative n=195 (27.5%)	Incongruent Child Positive n=165 (23.3%)	F	P
Child-rated Warmth	0.77 a	−0.58 c	−0.98 d	0.04 b	251.1	<.0001
Child-rated Conflict	−0.40 c	2.29 a	−0.29 c	0.12 b	291.6	<.0001
Teacher-rated Warmth	0.60 a	−0.47 c	0.25 b	−1.22 d	185.7	<.0001
Teacher-rated Conflict	−0.55 c	1.40 a	−0.45 c	1.01 b	253.3	<.0001
Peer nominations for teacher-student support	0.41 a	−0.35 c	0.06 b	−0.62 c	42.2	<.0001

Note. Cluster means in the same row that do not share subscripts (e.g. a, b, c, and d) differ at $p<.05$ in Fisher least Significant Difference Test

Table 3

Demographic Profiles across Clusters at Year 3

Categories	Congruent Positive (n=279)		Congruent Negative (n=70)		Incongruent Child Negative (n=195)		Incongruent Child Positive (n=165)	
	Actual	Expected	Actual	Expected	Actual	Expected	Actual	Expected
Gender: [a]								
Female	174	130.3	19	32.7	86	91	52	77
Male	105	148.7	51	37.3	109	104	113	88
Ethnicity: [a]								
African-American	54	64.1	28	16.1	26	44.8	55	37.9
Hispanic	117	106.2	22	26.7	81	74.3	50	62.8
Caucasian	93	94.8	19	23.8	75	66.3	54	56.1
Other	15	13.7	1	3.5	13	9.7	6	8.1

[a] *Note.* indicate Pearson χ^2 is statistically significant at $p < 0.001$

Table 4

Mean Values of the Cluster Validation Variables across Clusters at Year 3

Clustering Variables	Congruent Positive (n=279)	Congruent Negative (n=70)	Incongruent Child Negative (n=195)	Incongruent Child Positive (n=165)	F	P
Peer nominations Aggression	−.21 b	.73 a	−.07 b	.57 a	29.9	<.001
Teacher-rated conduct problem	.14 b	.84 a	.14 b	.79 a	138.6	<.001
Teacher-rated Emotional Symptoms	.29 b	.44 a	.27 b	.49 a	9.5	<.001
Teacher-rated Engagement	3.17 a	2.28 c	2.96 b	2.19 c	98.7	<.001
Social Preference	.11 a	−.61 c	−.07 b	−.48 c	17.2	<.001
Global Self-Worth	3.4 a	2.9 c	3.2 b	3.2 b	13.3	<.001
Math Competence Beliefs	23.2 a	20.4 b	21.4 b	20.4 a	7.0	<.001
Reading Competence Beliefs	22.9 a	20.8 b	20.9 b	22.9 a	5.6	.001
Math Achievement	488 a	480.5 c	487.4 ab	485.4 b	9.5	<.001
Reading Achievement	479.5 a	469.5 b	478.6 a	474.1 b	6.5	<.001

Note. Cluster means in the same row that do not share subscripts (e.g. a, b, c, and d) differ at *p*<.05 in Fisher least Significant Difference Test

Table 5

Parameter Estimates of the Latent Growth Curve Model

	Contrast coding		
	Reading	**Math**	**Engagement**
λ_3	1.087***	1.060***	.940***
IQ→I	.132***	.102***	.003***
IQ→S	.031**	.021	−.001
$C_{\text{others positive/others negative}}$→I	2.762***	1.566***	.174***
$C_{\text{CP/IN}}$→I	.991	.518	.015
$C_{\text{IP/CN}}$→I	.926	1.423***	−.042
$C_{\text{others positive/others negative}}$→S	.713**	.770***	.079***
$C_{\text{CP/IN}}$→S	−.222	−.373	.034
$C_{\text{IP/CN}}$→S	.368	.001	.031
Mean of intercept	386.354***	385.099***	2.005***
Mean of slope	96.329***	106.975***	.502***
Variance of slope	73.041***	13.644***	.048**

Note. The path coefficients are unstandardized.

Contrast coding variables: $C_{\text{others positive/others negative}}$ contrasts the combination of Congruent Positives and Incongruent Child Negative to the combination of Congruent Negatives and Incongruent Child Positives; $C_{\text{CP/IN}}$ contrasts Congruent Positives with Incongruent Child Negative; $C_{\text{CN/IP}}$ contrast Congruent Negatives to Incongruent Child Positives.

***
$p<.01$

**
$p<.05$