THE ROLE OF RELATIONSHIP QUALITY AND RELATEDNESS TO TEACHERS IN ENGAGEMENT AND ACHIEVEMENT IN ELEMENTARY AND MIDDLE SCHOOL: A LONGITUDINAL STUDY

By

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ABSTRACT

THE ROLE OF RELATIONSHIP QUALITY AND RELATEDNESS TO TEACHERS IN ENGAGEMENT AND ACHIEVEMENT IN ELEMENTARY AND MIDDLE SCHOOL: A LONGITUDINAL STUDY

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Previous research suggests a connection between teacher-student relationship quality, relatedness and student engagement and achievement. However, methodological limitations present in extant research reduce the confidence we can place in the results from previous studies. Specifically, these limitations include single raters of relationship quality which leads to possible shared methods variance, cross-sectional data gathering, and failing to account for the nested nature of classroom data. This study addressed these concerns by gathering data from 2nd through 6th grade students and their teachers across two school years while using multi-level modeling to control for classroom differences and student change across time. The purpose of this study is to use these more conservative methods to examine the unique contributions of relationship quality and relatedness for student engagement and achievement. We also extend previous research by including the sex of teacher as a covariate of relationship quality, engagement and achievement. As expected we found that variables of relationship quality predicted student engagement. Importantly, these associations remained significant even when teacher and student reports were compared. Teacher-rated engagement also predicted achievement. Unexpectedly, there was little support for a connection between relational quality variables and achievement or for student rated engagement and student achievement. Overall, findings indicate support for theories that posit a connection between relationship quality and student engagement but our results indicate that the connection between relationship quality, engagement and achievement may not be as

strong as previous research has reported. This highlights the value of using more conservative analytical methods to determine the confidence we can place in the correlations between teacher-student relationship quality, relatedness to teacher, student engagement and student achievement.

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Chapter 1: Introduction and Review of Literature

All teachers want their students to be engaged in classroom activities. Engaged students are those who work hard, complete assignments, find academic tasks to be useful, and in general are motivated to learn (Appleton, Christenson & Furlong, 2008; Brophy, 2004). One aspect of the school environment that has received growing attention in the field of motivation and engagement is the quality of students' relationships with peers and teachers (Furrer & Skinner, 2003; Hamre & Pianta, 2001; Hughes & Kwok, 2006; Wentzel, 1999).

Relationships are thought to influence engagement in school in at least two ways. First, interactions within a relationship provide instruction, correction, modeling and support for students, forming the basis of *teacher-student relationship quality* (TSRQ; Pianta, 1998). TSRQ is generally reported by teachers (see e.g., Hughes & Kwok, 2006; Pianta, 1992). Second, a student's perception of a positive relationship with a teacher provides security and increases willingness to engage in the school environment (Baumeister & Leary, 1995; Deci & Ryan, 1985). Students' perceptions are generally self-reported and are described as students' *sense of relatedness* (Furrer & Skinner, 2003; Skinner & Belmont, 1993).

Research demonstrates that engaged students tend to have academic and social success in school (Fredericks, Blumenfeld, & Paris, 2004; Furlong & Christenson, 2008; Martin, Malmberb, & Liem, 2010). Researchers also consistently find positive associations between TSRQ and engagement (Juvonen, 2006; Roorda, Koomen, Split & Oort, 2011; Wentzel 1999) and between student relatedness and engagement (Furrer & Skinner, 2003; Ryan, Stiller & Lynch, 1994; Skinner, Furrer, Marchand & Kindermann, 2008), suggesting that both relationship quality and student relatedness act as influential moderators or facilitators of engagement in school (Juvonen & Wentzel, 1996; Skinner, Kinderman, Connell & Wellborn, 2009).

What is not clear from the teacher-student relationship and engagement literatures is how TSRQ and student relatedness may interact with each other, as no previous study has examined both constructs at the same time. The current study addresses this void and, so doing, helps to specify the conditions under which TSRQ, student's sense of relatedness to teachers, or both constructs interactively influence student engagement and achievement (Juvonen, 2006). The basic premise of this study is that TSRQ, sense of relatedness to teacher, engagement and achievement should all be associated. (Juvonen, 2006; Roorda et al., 2011). This positionis often assumed in the field but has not been tested empirically.

A second purpose of this study is to examine covariation between teacher and student characteristics and longitudinal change in teacher-student relationships and student engagement. Adding teacher and student characteristics to the basic premise of the study allows a more precise examination of the conditions under which teacher-student relationship quality and student relatedness to teacher are associated with engagement and achievement. Of particular importance in this study is the consideration of teacher sex, as this characteristic is rarely included in analyses because of the lack of male teachers in elementary schools (Split, Koomen & Jak, 2012). The current study's sample of male teachers is also small (n = 9, or 25% of total teachers), but nonetheless permits an initial investigation of this issue.

The third and final goal of this study is to address three methodological limitations in extant work on TSRQ, relatedness to teacher, and engagement. The first limitation is that the vast majority of the research has only gathered data from teachers or students (Decker, Dona & Christenson, 2007; Hughes, Luo, Kwok & Loyd, 2008), even as a full understanding of the TSRQ-engagement correlation requires information from both members of the teacher-student dyad (Pianta, 1998). The second limitation is a lack of longitudinal data on the associations

between teacher-rated TSRQ, student-rated relatedness to teacher, and engagement and achievement (Roorda et al., 2011; Wentzel, 2009). The third limitation is a lack of multilevel models examining the interrelations of TSRQ, relatedness to teacher, engagement and achievement. Students are nested in classrooms, yet very few studies take this lack of independence into account. Taken together, these limitations highlight the fact that much of what we know about connections between TSRQ, relatedness, engagement and achievement comes from results that could be inflated or spurious.

The need to address these three limitations has been recently noted in a significant meta-analysis of research on relationship quality and engagement. Roorda et al. (2011) conclude that meta-analysis saying:

> The use of multiple informants and methods is recommended for future research. Most studies on the influence of affective TSRs are cross-sectional, and it would be interesting for future studies to focus on students' growth trajectories across different school years and to investigate how the relationships with different teachers create deflections (either positive or negative) from students' average growth trajectories for engagement and achievement (p. 519).

By collecting both teacher- and student-rated data over two consecutive years (4 waves of data collection) and using hierarchical models to account for classroom dependencies, the current study addresses this call for research.

The following review of literature defines key terms, details the theoretical frameworks that guide the study, and highlights limitations in extant research.

Relationship Quality and Engagement

Definitions. *Engagement* is defined as an observable manifestation of student motivation to learn (Connell & Wellborn, 1991; Fredericks et al., 2004). While the importance of engagement has not been questioned, the field has not settled on a single, coherent description of the construct (Appleton et al., 2008). The most common view is that it can be broken down into some combination of emotional, behavioral and cognitive engagement (Fredericks et al., 2004). This study focuses on emotional and behavioral engagement, where e*motional engagement* is defined as the affective actions, attitudes and feelings that indicate interest and enjoyment of school, and *behavioral engagement* is defined as working hard, persisting in academic tasks, following instructions and turning in work.

A *relationship* is built through a history of meaningful interactions between at least two people (Hinde, 1979; Pianta, 1998). In a school setting, interactions between a teacher and student provide the environment where the quality of the relationship is created. Relationships are dynamic in that they can change in their duration, quality and purpose (Berschied, 1999). Thus, the quality of a relationship can move from close and supportive to bitter and conflictual based on the interactions and perceptions between individuals. This principle of dynamic change in relationships may hold especially true in schools where students generally have only one year with each of their teachers (Pianta, 1998).

The influence of relationship quality between teacher and student has usually been seen as affecting socio-emotional outcomes in the school environment. Therefore, some may assume that they have little importance for academic success. However, researchers have argued that the ideal learning environment is when teachers focus on relational as well as cognitive growth in students. For example, research shows that students whose teachers attend to both social and instructional needs tend to have higher levels of math growth, demonstrate more positive

changes in behavior, and are more likely to meet academic standards in math and reading (Perry, Donahue & Weinstein, 2007).

In general, relationships in elementary and middle school have been characterized as either close or conflictual (Birch & Ladd, 1997; Hughes, 2011; Pianta, 1992; Pianta and Stuhlman, 2004). *Close relationships* are those that are viewed as positive, supportive, warm and secure. Both theory and empirical research indicate that close relationships are significantly associated with many beneficial academic outcomes including: greater engagement and academic achievement (Decker et al., 2007; Hughes & Kwok, 2007; O'Conner & McCartney, 2007) more interest and persistence in school (Van Ryzin, Gravely & Roseth, 2009; Wentzel, 1999) and higher self-esteem (Wentzel, Battle, Russell, Looney, 2010). Close relationships may also act as a buffer when risk for failure is high. For example, teacher reported close relationships with students predict reading gains but only for students whose parents reported less progressive parenting attitudes (Burchinal, Peisner-Feinberg, Pianta & Howes, 2002).

Conflictual relationships between teachers and students are characterized by impatience, aggression, frustration, arguing and tension (Birch & Ladd, 1997; Goodenow, 1993; Hughes & Kwok, 2007; Pianta, 1998). Students having conflictual relationships with teachers are more likely to have poor relationships later in their education (Pianta & Stuhlman, 2004), greater likelihood of not finishing school (Finn, 1989), disaffection with school, (Decker et al. 2007; Pianta, Steinberg & Rollins, 1995) and lower achievement (Hughes & Kwok, 2006; Hughes et al., 2008). Associations between negative outcomes and conflictual relationships in elementary school tend to be more robust then the associations between close relationships and positive outcomes (Jerome, Hamre, & Pianta, 2009; Roorda et al., 2011).

Attachment theory. The connection between TSRQ and engagement is most often based on attachment theory (Pianta, 1998; Wu, Hughes & Kwok, 2010). The central theme of attachment theory is that humans have an innate desire to connect with others and that emotional security results from a positive relationship with a caregiver (Bowlby, 1969). The perception that one is cared about by others is posited to provide a safe environment for learning and exploring the world (Baumeister & Leary, 1995; Ainsworth, 1989). Research on TSRQ works within an extended attachment framework (Roorda et al., 2011) suggesting that a similar "secure base" occurs between caring and supportive teachers and students (Birch & Ladd, 1997; Pianta, 1998; Saft & Pianta, 2001). This feeling of safety or security promotes internal working models or schemata of how relationships work, helping to promote positive relationships in the future (Ainsworth, 1989). For example, children in school who experience positive relationships tend to see school as a safe place and are more likely to engage in the environment. According to theories of engagement and motivation, this increased engagement should lead to enhanced learning opportunities and success in academic outcomes (Appleton et al., 2008; Pianta, 1998; Skinner, Wellborn & Connell, 1990) as well as positive reciprocal effects on teacher student interactions where teachers provide more support for engaged students (Skinner & Belmont, 1993). In this way, positive relationships facilitate and provide affordances for learning.

Attachment theory predicts the opposite result for children without secure relationships. When interactions with others include anger, fear, distrust, conflict and disappointment there is no feeling of safety that encourages exploration and engagement in the environment (Bowlby, 1969). These children are also less likely to trust others, leading to impoverished relationships in the future (Birch & Ladd, 1997). In schools, students without a positive relationship with teachers would be less likely to engage in learning tasks. Thus, poor relationship quality

constrains interactions in the environment which is associated with decreased engagement and lower school performance (Hamre & Pianta, 2005).

Relatedness and Engagement

Definitions. A *sense of relatedness* has been described as a feeling of belonging or connectedness to others (Baumeister & Leary, 1995), or the perception of having support from others (Furrer & Skinner, 2003; Vansteenkiste, Lens & Deci, 2006; Wentzel, 1997). While relatedness is a construct that is often used interchangeably with relationship quality (see e.g., Roseth, Saltarelli & Glass, 2011), there are both theoretical and practical differences between the two that should be addressed empirically. Specifically, a more precise view highlights the fact that a sense of relatedness is conceptualized as existing *within* an individual while the quality of the relationship exists *between* people (Juvonen, 2006). In the current study, we assessed relationship quality by surveying teachers about the quality of their interactions with individual students thus highlighting what was occurring between teacher and student. In contrast, we assessed relatedness by asking students to report how they felt when they were with their teacher, thus focusing on the internal perceptions of the students. More detailed descriptions of the scales used in the current study are included in the methods section of the paper. The importance of relatedness in the field of engagement and motivation is based on Self-determination theory (Deci & Ryan, 1985).

Self determination theory. Deci and Ryan's *Self Determination Theory* (SDT) (Ryan & Deci, 2000; Ryan et al., 1994) posits that relatedness is one of three innate needs that when fulfilled are causal of motivational outcomes such as self-regulation, engagement, intrinsic motivation and self-esteem. Specifically, any environment that provides sufficient support for relatedness, autonomy (perception of being in control of one's actions), and competence

(perception of achievement and the ability to succeed) will lead to increased motivation. According to SDT, these needs tend to be intertwined but also can have unique effects. For example, a student who feels competent in schoolwork is also more likely to feel in control of their success in school and to perceive that his or her relatedness needs are being fulfilled. However, there are situations where these basic needs could be in conflict. For example, if a student feels that they must give up autonomy in order to have a positive relationship with their teacher then SDT would predict a drop in motivation even though relatedness needs could be considered fulfilled (Vansteenkiste et al., 2006). Following the precedent of Ryan et al., (1994) the current study focuses on the unique role of relatedness for student engagement even as we recognize that SDT suggests that autonomy support and competence are also important variables in understanding student engagement.

A sense of relatedness has consistently shown associations with important academic outcomes. For example, students who perceive that they have a supportive, close relationship with their teacher are more likely to approach the teacher for help in times of confusion (Marchand & Skinner 2007), feel a sense of security at school, have higher self-esteem (Ryan et al., 1994), and are more behaviorally and emotionally engaged in school (Furrer & Skinner, 2003). A sense of relatedness is posited to buffer students against the negative effects of hardship, stress and even failure in school and thus facilitate academic achievement, retention and school adjustment both concurrently and in the future (Furrer & Skinner, 2003; Pianta, 1998). One of the ways that relatedness is posited to influence student engagement is through an increased desire in students (and all people) to assimilate practices and values from people that show us care and warmth (Deci & Ryan, 2000). In a school setting, this would suggest that students who feel a sense of relatedness with their teacher are more likely to act according to established

standards of conduct, give more effort and have higher engagement (Deci & Ryan, 2009). Thus, according to SDT, a sense of relatedness can energize individuals toward teacher desired behaviors and tasks even when the tasks may not be considered interesting or intrinsically motivating to students (Deci, Vallerand, Pelletier & Ryan, 1991).

Student Achievement

In general previous research has shown positive associations between TSRQ and achievement as well as between student engagement and achievement. However, the strength of these associations is inconsistent. For example, Hamre and Pianta (2001) and Baker, (2006) found no significant correlation between teacher rated closeness and student achievement on standardized tests of math and reading. However, both studies found a significant negative relationship with teacher rated conflict and standardized test scores with *r's* ranging from -.29 to -.21. Furrer and Skinner, (2003) found a correlation $r = .16$ between student rated relatedness to teacher and student grades. In terms of engagement, Wu, Hughes and Kwok, (2010) found correlations between teacher rated engagement and student achievement on a standardized test with *r's* ranging from .23-.41. Furrer and Skinner, (2003) reported a correlation of $r = .59$ between teacher rated engagement and teacher generated grades. One reason for the differences in strength of correlation between these constructs could be the diverse methods of measuring student achievement. Previous studies have used standardized achievement measures (Hughes, Luo, Kwok & Loyd, 2008; Wu, Hughes & Kwok, 2010) teacher generated grades (Furrer & Skinner, 2003) or a combination of both (Baker, 2006; Decker, Dona & Christenson, 2007; Hamre & Pianta, 2001). Because of shared methods we would expect correlations to be higher when teachers control reports of academic achievement ratings (i.e. grades) as well as reports of TSRQ and engagement.

Limitations

While past research has been useful in detailing the associations between TSRQ, a sense of relatedness, engagement and achievement, limitations associated with teacher sex differences, shared method variance, a lack of longitudinal data and a lack of accounting for the nested nature of classrooms reduce the confidence we can have in the inferences drawn from the results. These limitations will each be discussed in turn.

Limitation one: Teacher sex differences. It is not clear either theoretically or empirically whether the benefits of TSRQ and relatedness for engagement and achievement differ depending on the sex of the teacher. The sex of students is included as a covariate in virtually all of the analyses of the seminal work regarding change across time in student engagement and motivation (Anderman & Anderman, 1999; Eccles et al., 1984; Eccles, Adler & Meece, 1984; Eccles et al. 1993; Midgley, Feldlaufer & Eccles, 1989) as well as research in teacher student relationships (Saft & Pianta, 2001; Furrer & Skinner, 2003; Wu et al, 2010). Taken together, these studies suggest that, on average, boys are seen by teachers as less engaged in the classroom and tend to have less close and more conflictual relationships with teachers (Goodenow, 1993; Hamre & Pianta, 2001; Hughes, 2011). What is not examined in these studies is the potential for systematic differences between teachers giving the reports. For example, most studies do not report the sex of the teacher at all (Split et al., 2012). This is surprising given that according to the American Psychological Association, (2001) because of potential sex differences and/or biases, the sex of the rater or observer is posited to be as important as the sex of participants in reporting empirical research.

Attachment theory posits that positive interactions lead to secure relationships and according to teacher reports, this happens more often for girls than boys in the classroom. This

could explain why girls tend to be more engaged in school. An alternative explanation is that girls could have more secure relationships because they are more likely to match the gender of their teacher (Gold & Reis, 1982; Roorda et al., 2011). This possibility has resulted in calls for more male elementary school teachers as a way to increase the engagement and success of male students (Cho, 2012; Mazjub & Rais, 2010). However, this assumption has been based on intuition rather than empirical testing (Split et al., 2012). The current study, with a sample size of 9 male teachers out of 27 total teachers, is well suited to explore this issue.

Limitation two: Single rater bias. The results from the work on TSRQ and engagement have helped bring the importance of relationships for school functioning to the attention of educators. Conclusions are limited, however, because variables of relationship quality and engagement and achievement were nearly always reported by a single rater (Furrer & Skinner, 2003; Hughes & Kwok, 2006; Hamre & Pianta, 2001; Wentzel, 1997, 1998). This can lead to shared method variance. This measurement bias can result in artificially high intercorrelations between variables (Campbell & Fiske, 1959). The concern is that if a single rater gives their response regarding distinct but related variables, those variables will tend to be associated with each other. Thus, the correlation could be the result of similarities in response patterns within the individual rather than actual associations between the variables. This affects Type I and Type II error and can therefore decrease the validity of the results of previous work (Campbell & Fiske, 1959).

To date, only three studies were found that explored TSRQ and student engagement with multiple raters. Wu et al., (2010) examined in a longitudinal study of at risk, early elementary students whether a student's positive perception of relationship quality in and of itself would provide the benefits of close relationships even when teachers did not perceive the relationship to

be close. They found that predictive associations between relatedness and later engagement depended on the congruency of reports of relatedness. In other words, when both teacher and child reported low or high relatedness, the students in each group were more likely to be disengaged or engaged in school three years later. This suggests that having both teacher and student reports of relatedness and engagement provided a more precise measure of which students are most likely to be affected by their relationship with their teacher.

A second article (Hughes, 2011) using the same dataset as Wu et al., (2010), showed that student and teacher reports of TSRQ had low correspondence. Each of the constructs uniquely predicted outcomes. For example, teacher ratings of relationship quality predicted behavioral engagement and academic competence, while student ratings of TSRQ predicted school belonging, academic competence and math achievement. The author suggests that teacher and student reports of TSRQ assess largely different constructs and therefore data from both raters is most appropriate. While these studies have many laudable qualities, they were limited in dealing only with young, at-risk students. Also, TSRQ and relatedness were only measured at one point in time (3rd grade), while engagement and school performance were measured longitudinally.

In a cross-sectional design, Decker et al. (2007) also gathered data on TSRQ, relatedness and engagement from teachers, students and peers. Their cross-sectional sample included forty-six K-6th grade African-American students who were at risk for school failure. Their results were similar to Wu et al, (2010) in that the congruence of student and teacher reports showed a more robust association with student engagement. While both of these studies moved the field forward methodologically, the focus on at-risk students limits the generalizability of both studies and, in the case of Decker et al. (2007), the design was cross-sectional with a limited sample size. The current study addresses these issues by working with a larger and more representative

sample of both students and teachers to measure TSRQ, relatedness and engagement from the student and teacher perspectives. Importantly, this study also includes achievement data from standardized end of level tests and DIBELS. Not only does this afford examination of the motivation-achievement link, but it also avoids shared methods concerns associated with the teacher providing both the achievement measure (e.g. grades) and ratings of relationship quality or engagement.

Limitation three: Lack of longitudinal data on teacher-student relationships. Relationship quality is not established in a day (Pianta, 1998). Relationships must develop over time and are dynamic in that they can shift in quality, purpose, and importance (Berscheid, 1999). As Reis (2007, p. 5) states: "Relationships are intrinsically longitudinal: they have beginnings, middles, ends, and aftermaths; they may differ, often substantially so, depending on their current stage; and what happens at one time is almost always influenced by what has happened earlier." Thus, the dynamic and temporal nature of relationships in school suggests that relationships are not solely the product of current teacher-student interactions but are also cyclical in that past relationships influence what each member of the dyad expects to occur in the current relationship. These expectations or schemata then guide future behavior (Hughes; 2011; Pianta, 1998). Thus, a history of interactions over time is posited to have a cumulative influence on current interactions and student perceptions of relatedness (Hamre & Pianta 2001; Pianta, Belsky, Vandergrift, Houts & Morrison, 2008).

This understanding of relationships changing over time suggests the importance of longitudinal data collection. However, a review of the literature suggests that with few exceptions (e.g. Wu et al., 2010) our understanding of a sense of relatedness and student engagement is based on cross-sectional data. For example, in a meta-analysis report, it was

determined that out of 99 studies of relationships and engagement, only nine collected longitudinal data and of these only five continued beyond one year (Roorda et al., 2011). One oft-cited study of relationships that did employ a longitudinal design found that teacher-reported relationship quality in kindergarten predicted academic and behavioral outcomes in eighth grade. Relationship quality was a stronger predictor of behavioral as opposed to academic outcomes (Hamre & Pianta, 2001). However, this study only measured relationship quality once (kindergarten) and only from the teacher's perspective. Again we see the limitation of a single rater and a lack of true longitudinal data on how relationship quality changes over time.

Understanding the nature of relationships underscores the necessity and potential benefits of studying TSRQ, student's sense of relatedness and student engagement with longitudinal data from both teachers and students. To our knowledge there are no studies that fully fit this description. The current study addressed this concern by gathering data from students and teachers over the course of two school years with four data points.

Limitation four: Hierarchical nature of students' relationships. Data gathered from individuals in an educational setting are always nested. Every classroom is a unique context with teachers and students creating a shared environment that influences the learning and development of individual students. The importance of the context is recognized in ecological models of learning and development which posit that developmental growth occurs through the interaction between an individual and the context in which they are embedded (Bronfenbrenner & Morris, 1998). While this position is well accepted, it has not always been easy to account statistically for the nested nature of educational data. For example, in order to control for nested data, one study of TSRQ and school functioning took longitudinal data from multiple classrooms and randomly selected one school year for each student to be used in a cross-sectional analysis

(Baker, 2006). This type of analysis results in the loss of valuable data and a weaker cross-sectional design. Recent methodological advances in multilevel analysis or hierarchical linear modeling (HLM) have provided a tool that allows researchers to analyze hierarchical data in a multilevel framework and thus make better use of longitudinal and nested data (Burchinal et al., 2002; Lau & Nie, 2008; Raudenbush, 1995).

The statistical rationale for hierarchical or multi-level models for classroom data is that because of shared experiences, individuals within classrooms tend to be more similar when compared with other classrooms (O'Connell & McCoach, 2008). Failing to account for the similarity within a classroom can lead to lower variance estimates and thus increase the likelihood of Type I error (Martin et al., 2010). For example, results detailed in the current review of literature consistently suggest a significant association between TSRQ and engagement (Connell & Wellborn, 1991; Furrer & Skinner, 2003; Hughes, 2011; Wentzel, 1999). However, the magnitude of these correlations could be lower than reported if within group similarities werented for. When associations are inflated the results of these analyses can lead to inaccurate conclusions and inferences (Ma, Ma & Bradley, 2008). The same analyses conducted using HLM would be more conservative and appropriate in analyzing the data regarding relationship quality, engagement and achievement. This allows for greater confidence in the statistical validity of the analyses and the inferences that follow (O'Connell & McCoach, 2008). Multi-level models not only help control for this statistical concern, they also allow researchers to explore the influence that context has on individual outcomes. For example, in looking for change in student's engagement over time, a new school year involves several changes in context including a new teacher, new classroom, new peers and possibly a new school (Eccles, Wigfield,

Harold, & Blumenfeld, 1993). By failing to account for these *changes in context*, changes in engagement may be inaccurately ascribed to *changes within the individual* (Ma et al., 2008).

Hierarchical models are also appropriate when analyzing longitudinal data. Individual responses to the same measure at different times are not independent. For example, in the current study, student engagement at time one should be significantly associated with student engagement at later data collection points. In HLM, the responses of each student can be treated as a "cluster" which controls for the lack of independence. If this were not done than the analysis would violate the assumption of independence of observations that is required for most analytic procedures including multiple regression (Bryk & Raudenbush, 1988).

To date only two studies of TSRQ or relatedness and student engagement were found that accounted for the nested nature of the data in the study of relationship quality in school and only one used HLM. Burchinal et al., (2002) employed HLM to examine whether teacher-rated closeness predicted academic growth trajectories of at-risk students from preschool through second grade. Results showed that closeness to their teacher moderated the impact of authoritarian parents on reading and vocabulary acquisition, but only for African-American students. This study showed that the benefits of a close relationship were dependent on individual student, family and classroom characteristics. This study was limited in only using closeness as a measure of relationship quality, and in only using a teacher-reported measure of relationship quality.

In a second study of classroom characteristics Wentzel et al. (2010) found that the social support from teachers was differentially related to motivational outcomes depending on the teacher and the classroom. Specifically, social support (i.e. student perceptions of receiving help, safety and emotional nurturing) in and of itself was not necessarily associated with greater

motivation, but given certain contextual conditions (e.g. peer social goal pursuit, grade level and classroom goal structure) the association was significant. This highlights the utility of recognizing and accounting for the multiple levels and covariates present in a classroom environment that interact to influence engagement and motivation to learn. It should be noted that while this study was stronger for applying multi-level models, it was limited by having only one rater of relationship quality (student) and they did not have longitudinal data.

The current study extends the work in the fields of relationships and engagement by using HLM to account for individual differences in classrooms as well as accounting for the lack of independence in student and teacher repeated measures for TSRQ, relatedness and student engagement over four data points.

The Current Study

In summary, theory and empirical research suggest the quality of teacher-student relationships and students' sense of relatedness are important factors in promoting the engagement of students. These constructs have been studied separately but less is known about the contribution of both TSRQ and relatedness and their relative influence in shaping the engagement of students over time.

Understanding in the field of elementary teacher relationship quality and student engagement is also limited because previous work is based almost solely on the reports of female teachers (Split et al., 2012). It is possible that male teachers may create a different classroom environment that is more or less conducive and responsive to relationship quality (Nurmi, 2012). For example, Wentzel (2010) specifically states in a review article regarding the influence of teacher relationships in the elementary school environment, "the teachers who participate in these studies are female; it is unknown if male teachers would yield similar findings" (p.

312). The current study explores this issue by including teacher and student sex as covariates in the proposed model.

Current knowledge about connections between relationships and engagement in school are also limited due to single rater bias (Hughes, 2011; Wentzel, 2009). The current study analyzes data from both teachers and students. This design increases the statistical validity of the work, and allows us to have greater confidence in the results of the study. This is a benefit to the field because it will either support past results or move the field forward in recognizing inaccuracies and providing new directions for future research.

Relationships are inherently longitudinal in nature (Reis, 2007) and yet there are no studies that have measured the stability of TSRQ *and* relatedness across grade levels. Some research suggests that previous relationship quality is predictive of later academic and behavioral outcomes (Hamre & Pianta, 2001) but other research suggests that changing teachers, grade levels and/or schools can all change student perceptions of relationship quality (Eccles et al., 1993a). The current study seeks to clarify these issues by examining the relationship between initial levels of TSRQ and relatedness and later levels of TSRQ and relatedness. We examine these relationships at each data point, thus examining the functional form of change in TSRQ and relatedness. It is possible that the changes will be linear either in remaining fairly stable such as decreasing with age or the form could be quadratic or cubic with a mixed pattern of growth and decline based on the time of year or a new teacher. For example, Furrer and Skinner (2003) found that in general student relatedness decreased over a school year, but that overall relatedness was higher in 4^{th} and 5^{th} grade when compared to 3^{rd} grade students. This study used cross-sectional data, again highlighting the limitation of previous work and the value in

following students individually over a longer period of time to determine if the same patterns occur.

Accounting for the nested nature educational data using HLM is the final purpose of the current study. This analytic technique accounts for more of the error variance in the data thus allowing us to have greater confidence in the associations between TSRQ, relatedness and student engagement. We expect that some of the associations reported in past research between these variables are inflated because the nested nature of the data was not controlled for. Therefore, we examine whether the relationship between TSRQ and relatedness varies across classrooms and whether the associations are similar to past results after controlling for the nested nature of the data.

The current study contributes to theory in three ways. First, by testing assumptions that are often assumed in the field but have not received sufficient empirical support. Second, by including less readily available demographic information such as teacher sex as a covariate in the HLM model (Split et al., 2011) we are able to examine more closely the conditions under which TSRQ and relatedness interact with student engagement and achievement. Third, by addressing methodological concerns that have characterized past research we can compare current results with previous studies. If previous results are supported, then our results will allow for increased confidence in the associations between TSRQ, relatedness, student engagement and academic achievement. On the other hand if previous results are not supported, then this will provide needed clarification and direction for future research.

There are also practical implications for education in more fully explicating the roles of teachers and students in fulfilling students' need for relatedness and thus influencing student engagement and achievement. By better understanding the role of relationships in school and the

classroom climate, teachers, administrators, school psychologists and parents can take steps to promote conditions that help relationships enhance rather than obstruct student engagement and achievement.

Chapter 2: Method

Participants

This study was conducted at three elementary schools from a rural school district comprised of mostly middle and working-class families in the western United States. Eligibility criteria included student assent (see Appendix A) and parental consent (Appendix B) of students in second through sixth grade. Exclusion criteria included the inability to read and write in English and unwillingness to follow procedural directions. Participants were recruited by contacting school principals and teachers and, pending approval, inviting students to participate by sending a letter home to parents (see Appendix C). Participants received a mechanical pencil for participation. In all, 77% ($N = 401$) of recruited students agreed to participate in the study. Approximately 91% of the participants were Caucasian, 5% were Hispanic, and the remaining 4% were African American, Asian, mixed race or other. Procedures associated with the study were reviewed and approved by the sponsoring university's institutional review board (IRB no. 10-331).

Procedures

Students completed self-report questionnaires administered by the lead investigator in four 30-45 minute sessions. The lead investigator read the survey protocol (see Appendix D) followed by reading the questions aloud with second and third grade students, while all other students read the survey questions by themselves and asked questions as needed (see Appendix E for the complete survey). Classroom teachers left the room during the administration of the survey so that students were not influenced by their presence. Teachers completed their surveys (Appendix F) on their own time and were completed within four weeks of the students taking the

survey. Questionnaires were administered in the fall (October) and in the spring (March) over two consecutive years.

Students' reported on their sense of relatedness to teachers and their engagement versus disaffection in school. Teachers reported on their relationship quality with each student and on their perceptions of the engagement versus disaffection of each student. Teachers only reported for those students in their class who participated in the study.

Measures

Composite scores were determined by adding the individual items to yield a total score. Where necessary, negative items were reverse coded so that all items could be scored similarly. Student and teacher ratings of scale items ranged from 1 (*low*) to 5 (*high*). As reported in Table 2, reliability estimates were acceptable for all variables with *Cronbach alphas* ranging from .71 to .80. The one exception to this was student-reported relatedness to teacher where alphas ranged from .56 to .74.

Relatedness: Student-report. Students completed 4 self-report items considering their sense of relatedness to teachers using the Sense of Relatedness questionnaire (Furrer & Skinner, 2003). The stem for each item was: "When I'm with my teacher,…" The four times included: "I feel accepted," "I feel like someone special," "I feel ignored" (reverse coded), and "I feel unimportant" (reverse coded).

Relationship Quality: Teacher-report. Teachers completed 15 items considering their perceptions of their relationship with individual students from the Student-teacher Relationship Scale (STRS, Pianta, 1992). The STRS is a widely used measure of teacher-student relationship quality and has shown validity with regard to predicting academic and social functioning in pre-k through middle school (e.g., Davidson, Gest & Welsh, 2010; Hamre & Pianta, 2001; Pianta, La

Paro, Payne, Cox, & Bradley, 2000). This scale yields *closeness* and *conflict* relationship quality scores.

Engagement versus disaffection: Student-reports. Students completed 19 items considering their perceptions of their engagement in school from the Engagement vs. Disaffection with Learning Scale (Connell & Wellborn, 1991). The *behavioral engagement* scale tapped student's effort and persistence when beginning and completing tasks in school and sample items include, "When we work on something in class, I get involved," and "I pay attention in class." The *emotional engagement* scale tapped student's emotional feelings toward schoolwork and sample items include "When I'm in class, I feel good," and "I enjoy learning new things in class."

The disaffection in school items tapped students' feelings of detachment, boredom, and maladaptive attitudes toward schoolwork. *Behavioral disaffection* items include "I don't try very hard at school," and "When I'm in class, my mind wanders." *Emotional disaffection* items include "When we work on something in class, I feel bored," and "Class is not all that fun for me." Disaffection items were reverse coded during scoring and averaged with engagement items in order to obtain a single aggregate score for engagement in school. The behavioral and emotional engagement and disaffection scores were combined to yield a total student-rated engagement score.

Engagement versus disaffection: Teacher-report. Teachers also completed 20 items considering their perceptions of student's engagement in school using the Engagement vs. Disaffection with Learning Scale (Connell & Wellborn, 1991). This form is similar to the student form described above. *Behavioral engagement* items include "In my class, this student works as hard as he/she can," and "In my class, this student does more than required." *Emotional*

engagement items include "When we start something new in class, this student is enthusiastic," and "When working on classwork in my class, this student seems to feel good." *Behavioral disaffection* items include "When we start something new in class, this student doesn't pay attention," and "In my class, this student does just enough to get by." *Emotional disaffection* items include "When I explain new material, this student doesn't seem to care," "In my class, this student is angry." Disaffection items were reverse coded during scoring and averaged with engagement items in order to obtain a single aggregate score for engagement in school. As with the student-rated measure, behavioral and emotional engagement and disaffection scores were combined to yield a total teacher-rated engagement score.

Academic Achievement

DIBELS. The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) test is a widely used standardized reading assessment measuring student fluency, accuracy and retelling abilities. Over multiple assessments, composite DIBELS scores have been shown to predict the level of support a student needs in reading interventions (Dewey, Latimer, Kaminski, & Good, 2012). DIBELS composite scores were only reported for second- through fifth-grade students and only for the first year (i.e., Waves 1 and 2) of the study.

Levels. In the state this sample is drawn from, all students in third-grade and above take standardized tests at the end of each school year to assess their proficiency – or "Level" – in math and language arts. Scores from these tests are reported as scaled scores that are normed at the state office of education. Levels composite scores were only reported for third- through sixth-grade students and only at the end of Year 1 (i.e., Wave 2) of the study.

Data Analysis

The data for each dependent measure was analyzed in two steps. First, Pearson-product correlations were computed to examine associations within measures as well as concurrent correlations between dependent measures. Second, longitudinal change and covariation in engagement and academic achievement were examined using two forms of regression: Linear Mixed Models (LMMs) and, for Levels only, hierarchical multiple regression. The next section provides a general introduction to using LMMs for longitudinal data analysis.

Linear mixed models (LMMs) for multi-level longitudinal data. This study's multi-level data may be conceptualized as clustered repeated measures, with students (the unit of analysis) nested within classrooms, and repeated measures collected on students on four occasions (i.e., waves). Accordingly, a series of linear mixed models (LMMs; Fitzmaurice, Laird, & Ware, 2004; West, Welch, & Galecki, 2007) were used to examine change over time in engagement and achievement while accounting for the clustered structure of the data and the correlated error terms associated with repeated measures. Assuming an ignorable missing data mechanism (e.g., missing completely at random, or MCAR), LMMs allow for missing data (Liang & Zeger, 1986) and can be viewed as hierarchical linear models (HLMs) with individual- and cluster-level equations (Raudenbush & Bryk, 2002; Singer, 1998). For example, this study's data has three levels, with Level 3 representing the classrooms, Level 2 the students, and Level 1 the repeated measures. LMMs are typically expressed as a single equation that is computed by substituting the higher-order HLM equations into the Level 1 equation.

A "top-down" strategy was used for model building (West et al., 2007, Ch. 2; Verbeke & Molenberghs, 2000, Ch. 9), including fixed effects for all covariates in the first model (including interactions), then selecting a covariance structure for the residuals, and finally using hypothesis tests to determine whether some fixed effects may be removed from the model and chi-square

difference tests to compare nested models. Parameters and test statistics were estimated using the restricted maximum likelihood method (REML), the Kenward and Roger (1997) method for degrees of freedom, and significance level of $\alpha = .05$ in the PROC MIXED procedure of SAS 9.2. For all models, the covariance structure of the Level 1 residuals, $\mathbf{R}_i$, was defined as $\sigma^2\mathbf{I}$, where σ^2 is the individual-level measurement error variance assumed to be constant across time and individuals and **I** is a *T* by *T* identity matrix. Normal probability plots were used throughout the model-building process to screen residuals for violations of assumptions (e.g., normality and constant variance) and outliers.

The design of the current study is not focused on causal claims. Rather, we sought to find the unique contribution of each of the independent variables in predicting change in the criterion variables (i.e. engagement and achievement). Thus, for each criterion variable we compared three models using hierarchical regression.

Control model. The control model examines mean change over time. This model treats all participants in the sample as one group and models the mean trajectories of change over time in engagement and achievement. This is the model that is most often tested in the literature. It simply tests for associations between relational variables and engagement and achievement. We also examine in this model whether the mean changes in this first step of the model testing are conditional on static or fixed characteristics of students and teachers such as sex.

Student model. The second level of our model tests for the unique contribution of student characteristics that are dynamic. This involves examining longitudinal covariation between TSRQ, relatedness and engagement while controlling for linear trends over time as well as the static characteristics of teachers and students. The variables added in the

student model are termed “dynamic” because both the outcome and predictor variables are fluid and are expected to change over time.

Teacher model. The third step in our model testing is identical conceptually to the student model but adds dynamic variables as reported by the classroom teachers into the hierarchical regression.

Chapter 3: Results

Results are organized in three parts. Part 1 summarizes participant flow over the study's two years of data collection. Part 2 reports descriptive statistics, including a detailed examination of intercorrelations among variables. Part 3 reports the results of the longitudinal data analysis.

Participant Flow

Over the two years, $j = 50$ classrooms and $N = 401$ students (53% female) participated in the study. The classrooms included 36 different teachers (25% male), with 14 teachers participating during both years of the study. Table 1 summarizes the final sample at both the classroom- and student-level of analysis. We provide this information because participant flow is more complex in longitudinal models with multiple units of analysis. Issues of missing data, power and effect sizes are all impacted based on the flow of participants. This information also allows for more precise comparisons of results and possible replications of this work (Ferron et al., 2008).

Approximately 98% of students participated over multiple waves, with $n = 255$ (63.6%) with four data points, $n = 39$ (9.7%) with three data points, $n = 97$ (24.2%) with two data points, and $n = 10$ (2.5%) with one data point. Organized by wave, this corresponded to $n = 384$ (28.6%) participants at Wave 1, $n = 394$ (29.4%) at Wave 2, $n = 279$ (20.8%) at Wave 3, and $n = 284$ (21.2%) at Wave 4, for a total of 1341 data points across the two years. Supporting the assumption that missing data may be classified as missing completely at random (MCAR), Little's MCAR test (Little & Rubin, 2002) was not statistically significant for repeated measures of teacher-rated engagement, $\chi^2 = 38.87$, $df = 28$, $p = .08$, student-rated engagement, $\chi^2 = 20.70$, $df = 28$, $p = .83$, and DIBELS, $\chi^2 = 4.64$, $df = 2$, $p = .09$.

Descriptive Statistics

Table 2 reports descriptive statistics for each variable by wave of data collection. Interestingly, average scores on teacher-rated variables were above the midpoint, as teachers reported low amounts of conflict, high levels of closeness, and high levels of engagement for the majority of students. Student-rated scores were also all above average, as students reported high levels of relatedness to teacher and high levels of engagement.

Table 3 reports intercorrelations between teacher-rated engagement, closeness, and achievement measures. It should be noted that these intercorrelations do not yet address many of the limitations that have been detailed in earlier sections. Therefore, these results should be considered mainly for comparison to extant research.

For all repeated measures, within-variable correlations were significantly positively correlated and, in general, decreased in magnitude as the time between waves increases (e.g., Wave 1: Wave 4). This pattern of positive correlations provides evidence of test-retest reliability across time.

As expected and across all waves, teacher-rated engagement was significantly positively correlated with closeness, *r*s = .13 to .53, $p < .05$, and significantly negatively correlated with conflict, *r*s = -.29 to -.64, $p < .01$. This indicates that above average teacher-rated engagement was associated with above-average closeness and *below*-average conflict. Also as expected, closeness and conflict were significantly negatively correlated, with same-wave correlations ranging from $r = -.20$ to -.40, $p < .01$, and indicating that above-average closeness was associated with below-average conflict. Surprisingly, only Wave 3 and 4 closeness were significantly correlated with Wave 1 and 2 DIBELS, *r*s = -.18 to -.21, $p < .05$, and the negative direction indicated that above-average closeness was associated *below*-average DIBELS. Conflict was not

significantly correlated to DIBELS, but was significantly positively correlated with Wave 2 Levels, *r*s = -.18 to -.26, $p < .05$. This indicates that below-average conflict was associated with above-average Levels.

Table 4 reports intercorrelations across four waves of data between student-rated relatedness to teacher and teacher-reported closeness and conflict. Surprisingly, results indicate that in general student perceptions of relatedness were not significantly related to teacher-rated closeness. The exception to this was at wave 2 with $r = .17$, $p < .01$. This was unexpected because the two constructs are theoretically similar. On the other hand and as expected, student-rated relatedness was significantly, negatively associated with teacher rated conflict *r*s = -.14 to -.30, $p < .01$.

Table 5 reports intercorrelations between student and teacher rated engagement across four waves of data collection. As expected these constructs were significantly, positively associated across time with *r*s = .15 to .33, $p < .01$. The only exceptions to this were non-significant associations between student engagement at wave 1 and teacher rated engagement at wave 3 and between student rated engagement at wave 2 and teacher rated engagement at wave 4.

Table 6 reports intercorrelations between student-rated engagement, relatedness to teacher, and achievement measures. Once again, within-variable correlations were significantly positively associated for all repeated measures, following the pattern of decreasing magnitude from Wave 1 to Wave 4 and providing evidence of test-retest reliability. Also as expected and across all waves, student-rated engagement was significantly positively correlated with relatedness to teacher, *r*s = .21 to .57, $p < .01$. This indicates that above-average student-rated engagement was associated with above-average relatedness to teacher. Surprisingly, student-rated engagement was not significantly correlated with DIBELS, but Wave 4 student-rated

engagement was significantly positively correlated with Wave 2 Levels. As expected, relatedness to teacher was significantly positively correlated with Waves 1 and 2 DIBELS, *r*s = .17 to .21, $p < .01$, indicating that above-average relatedness was associated with above-average DIBELS.

Teacher-rated Engagement

Next, longitudinal analyses were performed to examine change over time in engagement and covariation between teacher-rated engagement and student-rated relatedness and teacher-rated closeness and conflict. The results are organized by the three nested models used to analyze the data. Results are shown in Table 7.

Control model. The control model was used to examine the nature of change over time in teacher-rated engagement and to determine whether change was conditional on student sex and teacher sex. It was hypothesized that teacher-rated engagement would show a mean decrease over time, and that female students would tend to have a higher average engagement score than male students across time. There was no specific hypothesis for teacher sex. The specific control model was:

$$Y_{tij} = \beta_0 + \beta_1 t_{ij} + \beta_2 Student_{ij} + \beta_3 Teacher_j + \mu_{0j} + \mu_{0i|j} + \varepsilon_{tij},$$

(Eq. 1)

where Y_{tij} is the teacher-rated engagement score at time *t* (*t* = 1 to 4, corresponding to Waves 1-4) of the *i*th student nested within classroom *j*, and β_1 and β_2 are the intercept and linear rate of change (i.e., slope), respectively. By using the values 0 = male and 1 = female for $Student_{ij}$ and $Teacher_j$, β_2 and β_3 represent the difference between female and male students and between female and male teachers, respectively. The u_{0j} and $u_{0i|j}$ terms represent the random classroom-

and student-level effects associated with the intercept, and the term, ε_{ij} is the level-one residual. All teacher-rated engagement models also included the terms, u_{1j} and u_{11j}, representing the classroom-level random effects associated with linear rate of change (slope) and the intercept-linear covariance, respectively.

As shown in Table 7 and contrary to the hypothesis, results revealed a non-significant linear trend, $\beta_1 = -0.26$, $p < .05$. To confirm that the linear variable should be removed from the model, an intercept-only model (not presented) was fit and compared to the control model using a likelihood (i.e., -2LL) ratio test. The change in deviance statistic, $\Delta D = 13.6$, was found to be statistically significant when compared to the critical value of χ^2 with 3 degrees of freedom, corresponding to the 1 fixed effect + 2 random effects = 3 parameters omitted from the linear model. This indicated that the more complex linear model fit the data better than the intercept-only model and, as a result, the linear variable (i.e., the 1 fixed effect and 2 random effects) remained in subsequent models.

Results also revealed significant intercept differences associated with student sex, $\beta_2 = 2.28$, $p < .001$, and teacher sex, $\beta_3 = 4.26$, $p < .001$. These sex differences are displayed in Figure 1 and indicate that, *regardless of teacher sex,* female students tended to have a higher teacher-rated engagement average than male students across time. However, compared to male teachers, female teachers tended to report higher average engagement scores across time for *both* female and male students.

Student-rated relatedness to teacher. The student-rated relatedness model was used to examine covariation between teacher-rated engagement and student-rated relatedness to teacher

while controlling for linear trend and teacher and student sex. Specifically, $\beta_4 Relatedness_{ij}$ was added to the control model, where β_4 represents dynamic covariation between teacher-rated engagement and student-rated relatedness to teacher for the *i*th student nested in classroom *j*. It was hypothesized that change over time in teacher-rated engagement would be positively associated with change over time in relatedness to teacher.

As expected, results revealed significant covariation with relatedness to teacher, $\beta_4 = 0.27$, $p < .001$, indicating that an increase over time in teacher-rated engagement was associated with an increase over time in relatedness to teacher. Figure 2a displays this finding, showing how increasing relatedness to teacher (e.g., ratings in quartile 4) was associated with increased teacher-rated engagement.

Next, a likelihood ratio test was used to compare model fit, and the results revealed that the likelihood ratio test statistic, 7379.3 - 6778.6 = 600.7, was statistically significant when compared to the critical value of $\chi^2(1)$. This indicated that the student-rated relatedness to teacher model fit the data better than the control model. The student-level proportional R^2, or proportional reduction of prediction error (Snijders & Bosker, 1994, 1999) resulting from the use of the student-rated relatedness to teacher model compared to the control model was .07. This indicated that the student-rated relatedness to teacher model accounted for approximately 7% more variation in teacher-rated engagement than the control model.

Teacher-rated closeness and conflict model. The teacher-rated closeness and conflict model was used to examine covariation between teacher-rated engagement and teacher-rated closeness and conflict while controlling for student-rated relatedness to teacher, teacher sex, and student sex. Specifically, $\beta_5 Closeness_{ij}$, and $\beta_6 Conflict_{ij}$, were added to the student-rated

relatedness model, where β_5 and β_6 represent dynamic covariation between teacher-rated engagement and teacher-rated closeness and conflict for the *i*th student nested in classroom *j*. It was hypothesized that change over time in teacher-rated engagement would be positively associated with change over time in closeness and negatively associated with change over time in conflict.

As expected, results revealed significant covariation with closeness, $\beta_5 = 0.37$, $p < .001$, and conflict, $\beta_6 = -0.27$, $p < .01$. This indicates that an increase over time in teacher-rated engagement was associated with an increase in closeness and a *decrease* in conflict. Unexpectedly, results also revealed a significant negative interaction between student-rated relatedness to teacher and teacher-rated conflict, $\beta_7 = -0.01$, $p < .01$, indicating that above-average relatedness buffered negative covariation between teacher-rated engagement and conflict. For the first time, the results also revealed a significant linear trend, $\beta_1 = -0.70$, $p < .001$, supporting the original hypothesis that teacher-rated engagement decreased across time.

Importantly, the results of the teacher-rated model also highlight the independent contributions of the different variables in accounting for variation in teacher-rated engagement. Specifically, the results of the teacher-rated model revealed patterns of dynamic covariation between teacher-rated engagement and relatedness to teacher, closeness, and conflict, even after controlling for the intercept differences associated with student sex, $\beta_2 = 0.75$, $p < .05$, and teacher sex, $\beta_3 = 1.80$, $p < .01$.

Comparing model fit, the likelihood ratio test statistic, 6778.6 – 6119.0 = 659.6, was statistically significant when compared to the critical value of $\chi^2(4)$. This indicated that the

teacher-rated closeness and conflict model fit the data better than the student-rated relatedness to teacher model. The student-level proportional R^2 statistic was .56, indicating that the teacher-rated closeness and conflict model accounted for approximately 56% more variation in teacher-rated engagement than the student-rated relatedness to teacher model.

Student-rated Engagement

To examine change over time in student-rated engagement, the same three nested models detailed above were used to determine the unique contribution of control variables (e.g., linear trend, student sex, teacher sex), student-rated variables, and teacher-rated variables. The results are again organized by the three models and Table 8 shows the results.

Control model. The same control model used for teacher-rated engagement (i.e., Eq. 1) was used to examine the nature of change over time in student-rated engagement and to determine whether change was conditional on student sex and teacher sex. It was hypothesized that student-rated engagement would show a mean decrease over time, and that female students would tend to have a higher average engagement score than male students across time. There was no specific hypothesis for teacher sex.

As expected, results revealed a significant intercept difference associated with student sex, $\beta_2 = 2.28$, $p < .001$, and a marginally significant intercept difference associated with teacher sex, $\beta_3 = 1.08$, $p = .06$. Results also revealed a significant interaction between linear trend and student sex, $\beta_4 = -0.79$, $p < .01$. As displayed in Figure 3, this interaction indicated that even as female students tended to report higher average engagement scores than male students across time, their scores also decreased at a higher rate than male students. By Wave 4, in fact, this higher rate of

decrease corresponded to no notable difference between female and male students' predicted means (predicted means = 36.40 and 36.34, respectively).

Student-rated relatedness to teacher. The same student-rated relatedness model was used to examine covariation between student-rated engagement and student-rated relatedness to teacher while controlling for linear trend, teacher sex, and student sex. It was hypothesized that change over time in student-rated engagement would be positively associated with change over time in relatedness to teacher.

As expected, results revealed significant covariation with relatedness to teacher, $\beta_5 = 0.95$, $p < .001$, indicating that an increase over time in student-rated engagement was associated with an increase over time in relatedness to teacher. Figure 2b displays this finding, showing how increasing relatedness to teacher was associated with increased student-rated engagement. Comparing Figures 2a and 2b also illustrates how the magnitude of covariation differs between teacher- and student-rated engagement, with student-rated relatedness to teacher corresponding to a larger difference in student-rated engagement compared to teacher-rated engagement.

Comparing model fit, the likelihood ratio test statistic, 7139.5 – 6725.8 = 413.7, was statistically significant when compared to the critical value of $\chi^2(1)$. This indicated that the student-rated relatedness to teacher model fit the data better than the control model. The student-level proportional R^2 statistic was .57, indicating that the student-rated relatedness to teacher model accounted for approximately 57% more variation in student-rated engagement than the control model.

Teacher-rated closeness and conflict. The same teacher-rated closeness and conflict model was used to examine covariation between student-rated engagement and teacher-rated

closeness and conflict while controlling for student-rated relatedness to teacher, teacher sex, and student sex. It was hypothesized that change over time in student-rated engagement would be positively associated with change over time in closeness and negatively associated with change over time in conflict.

As expected, results revealed significant covariation with closeness, $\beta_6 = 0.09$, $p < .01$, and conflict, $\beta_7 = 0.08$, $p < .05$. For closeness, this indicated that an increase over time in student-rated engagement was associated with an increase in closeness. However, the result for conflict was moderated by a significant negative interaction with linear trend, $\beta_8 = -0.05$, $p < .05$, indicating that increasing conflict was associated with steeper *decline* in student-rated engagement.

Importantly, the results of the teacher-rated model also highlight the independent contributions of the different variables in accounting for variation in student-rated engagement. Specifically, the results of the teacher-rated model revealed patterns of dynamic covariation between student-rated engagement and relatedness to teacher, closeness, and conflict even after controlling for the intercept differences associated with student sex, $\beta_2 = 1.25$, $p = .01$, and the negative interaction between linear trend and student sex, $\beta_4 = -0.55$, $p = .05$.

Comparing model fit, the likelihood ratio test statistic, 6778.6 – 6119.0 = 659.6, was statistically significant when compared to the critical value of $\chi^2(4)$. This indicated that the teacher-rated closeness and conflict model fit the data better than the student-rated relatedness to teacher model. The student-level proportional R^2 statistic was .09, indicating that the teacher-

rated closeness and conflict model accounted for approximately 9% more variation in teacher-rated engagement than the student-rated relatedness to teacher model.

DIBELS

To examine change over time in Dynamic Indicators of Basic Early Literacy Skills (DIBELS), the same three nested models detailed above were used to determine the unique contribution of control variables, student-rated variables, and teacher-rated variables. Note that DIBELS analyses only examined change during Year 1 and only among second- through fifth-grade students. Note also that the results of preliminary analyses (not presented) revealed that neither student nor teacher sex were significantly related to DIBELS trajectories. Instead, $Experience_j$ (i.e., teacher's years of experience in classroom *j*) $Grade_j$ (i.e., the grade level of classroom *j*) were significantly related. Accordingly, student and teacher sex were replaced by teacher experience and student grade level for all three models. An additional change was the addition of both teacher-rated and student-rated $Engagement_{ij}$ variables (i.e., engagement of the *i*th student in classroom *j*) to account for achievement variation dependent on changes in engagement. The results are again organized by the three models and Table 9 shows the results.

Control model. The control model was used to test the hypotheses that DIBELS would vary as function of student grade level and show a mean increase over time. There was no specific hypothesis for teacher experience.

As expected, results revealed a significant positive linear trend, $\beta_1 = 93.88$, $p = .001$, indicating that DIBELS increased during Year 1. Results also revealed a significant intercept difference associated with teacher experience, $\beta_2 = -2.27$, $p < .01$, and student grade level, $\beta_3 =$

65.21, $p < .001$. This indicated that DIBELS tended to *decrease* as teacher experience increased and, in contrast, increase as student grade level increased.

Student-rated relatedness to teacher and engagement. The student-rated relatedness to teacher and engagement model was used to examine covariation between DIBELS, relatedness to teacher, and student-rated engagement while controlling for linear trend and teacher sex and student sex. It was hypothesized that change over time in DIBELS would be positively associated with change over time in relatedness to teacher and student-rated engagement. Contrary to the hypotheses, however, results revealed that neither relatedness to teacher, $\beta_4 = 1.69$, $p = .18$, nor student-rated engagement, $\beta_5 = 0.48$, $p = .46$, covaried significantly with DIBELS.

Comparing model fit, the likelihood ratio test statistic, 6269.8 – 5383.1 = 886.7, was statistically significant when compared to the critical value of $\chi^2(2)$. This indicated that the student-rated relatedness and engagement model fit the data better than the control model. The student-level proportional R^2 statistic was .04, indicating that the student-rated relatedness and engagement model accounted for approximately 4% more variation in DIBELS than the control model.

Teacher-rated closeness, conflict, and engagement. The teacher-rated closeness, conflict, and engagement model was used to examine covariation between DIBELS, closeness, conflict, and teacher-rated engagement while controlling for linear trend and teacher sex and student sex. It was hypothesized that change over time in DIBELS would be positively associated with student-rated engagement would be positively associated with change over time

in closeness and teacher-rated engagement, and negatively associated with change over time in conflict.

As expected, results revealed significant covariation with teacher-rated engagement, $\beta_8 = 5.08$, $p < .001$, indicating that increasing DIBELS was associated with increasing teacher-rated engagement. Results also revealed significant interactions between closeness and (a) linear trend, $\beta_9 = -3.47$, $p < .01$, (b) teacher experience, $\beta_{10} = 0.34$, $p < .01$, and (c) relatedness to teacher, $\beta_{11} = -0.72$, $p < .01$. For teacher experience, the positive interaction indicated that covariation between DIBELS and closeness was associated with increasing teacher experience. In contrast, the *negative* interactions for linear trend and relatedness to teacher indicated that covariation between DIBELS and closeness was associated with *decreased* linear trend and *decreased* relatedness to teacher. Put differently, these findings suggest that increasing closeness was associated with a lower rate of increase in DIBELS and decreasing covariation between DIBELS and relatedness to teacher. Less unexpected was the significant negative interaction between conflict and relatedness to teacher, $\beta_{12} = -0.45$, $p < .01$, indicating that covariation between DIBELS and relatedness to teacher was associated with *decreasing* conflict.

Comparing model fit, the likelihood ratio test statistic, 5383.1 – 4699.4 = 683.7, was statistically significant when compared to the critical value of $\chi^2(7)$. This indicated that the teacher-rated closeness, conflict, and engagement model fit the data better than the student-rated relatedness and engagement model. The student-level proportional R^2 statistic was .17, indicating that the teacher-rated closeness, conflict, and engagement model accounted for approximately 17% more variation in DIBELS than the student-rated relatedness and engagement model.

End-of-level State Standardized Tests (Levels)

Because Levels were only assessed once during the spring of Year 1 (i.e., Wave 2), hierarchical multiple regression was used to determine the amount of variation in Levels that was uniquely associated with different static and dynamic variables. Note also that Levels were only assessed among 3rd- through 5th-graders.

To determine the amount of variation in Levels that was uniquely associated with control variables (e.g., student grade level, student sex, teacher sex, and teacher experience) were entered at Step 1, followed by student-rated relatedness to teacher and engagement at Step 2, and then teacher-rated closeness, conflict, and engagement at Step 3. As in the previous longitudinal analyses, it was hypothesized that Levels would be associated with above-average scores in all variables, save conflict where it was hypothesized that Levels would associated with below-average conflict. Results are shown in Table 10.

Results revealed that only the teacher-rated closeness, conflict, and engagement model accounted for significant variation in Levels. Results revealed that teacher experience was significantly associated with Levels, $\beta = 0.82$, $p < .05$, indicating that above-average teacher experience was associated with above-average Levels. Results also revealed that Wave 2 closeness ($\beta = -1.52$, $p < .01$) and Wave 2 conflict ($\beta = 1.15$, $p < .01$) were significantly associated with Levels, but in the opposite direction predicted. This indicated that above-average closeness was associated with *below*-average Levels, and above-average conflict associated with *above*-average Levels. Consistent with hypotheses, results also revealed that both Wave 1 and 2 teacher-rated engagement were positively associated with Levels (Wave 1: $\beta = 2.02$, $p < .001$; Wave 2: $\beta = 1.70$, $p < .001$), indicating that above-average teacher-rated engagement was associated with above-average Levels. Finally, results also revealed that $\Delta R^2 = .46$, indicating

that the teacher-rated closeness, conflict, and engagement model accounted for 46% more variation in Levels than the student-rated relatedness and engagement model.

Taken together, the DIBELS and Levels results highlight the independent contribution of different variables in accounting for variation in student achievement. Specifically, the DIBELS results highlight divergent patterns of covariation with relatedness to teacher, teacher-student relationship qualities (i.e., closeness, conflict), and teacher- and student-rated engagement, with only teacher-rated engagement (not student-rated engagement) covarying significantly over time with DIBELS, and *both* student-rated (i.e., relatedness to teacher) and teacher-rated (i.e., closeness and conflict) variables covarying significantly over time with DIBELS. This pattern was only partially replicated by the Levels results, as only teacher-rated engagement (not student-rated engagement) was significantly associated with Levels. Also different were the findings that teacher-rated closeness and conflict (not student-rated relatedness to teacher) were significantly associated with Levels, and in both cases in the opposite direction (negative for closeness, positive for conflict) from the DIBELS results.

Chapter 4: Discussion

This study examined the relationship between TSRQ (closeness, conflict), student relatedness to teacher, engagement, and achievement. The basic premise was that teacher-student relationship quality serves to facilitate or undermine students' sense of relatedness to teacher and, in turn, student engagement and achievement. The study's results provided strong support for the position that TSRQ and relatedness to teacher are connected significantly with student engagement but only mixed support for the idea that, ultimately, TSRQ, relatedness to teacher and engagement are predictive of greater achievement.

The discussion is organized in three parts. In Part 1, intercorrelations between variables of relationship quality, relatedness to teacher, engagement and achievement are considered. While the statistical validity of these results is limited because they do not control for classroom differences, they do provide a comparison to previous research that was also limited by ignoring the nested quality of student in classroom. In Part 2, the results from the longitudinal analyses are discussed, including a detailed comparison of the way student-rated and teacher-rated variables differentially account for variation in student- and teacher-rated engagement. Finally, Part 3 considers study's limitations and implications for theory and practice.

Intercorrelations between TSRQ, Relatedness to Teacher, and Achievement

Closeness. As predicted, results showed that teacher-rated closeness was positively associated with teacher-rated engagement and negatively associated with teacher-rated conflict. These findings are consistent with many previous studies (e.g., Birch & Ladd, 1997; Hamre & Pianta, 2005) and suggest that, for teachers, perceptions of closeness and conflict with students are important predictors of their sense of student engagement in school.

Closeness was not significantly associated with any concurrent achievement measures (i.e., DIBELS, Levels). This finding is *in*consistent with previous research (e.g. Furrer and Skinner (2003) report a correlation of r =.59, and Roeser, Midgley and Urdan report a correlation r= .19); and fails to support the idea that positive student-teacher relationships and interactions are connected to positive achievement outcomes. It may be that social desirability led teachers to inflate their ratings of closeness, as the average score was well above the midpoint (28.52 > 17.5). If this were the case then the measure may not sufficiently distinguish the spectrum of teacher-student relationship possibilities. This same measurement issue has been reported in other research using the TSRQ measure of closeness (e.g., Rudasill, 2010; Saft & Pianta, 2001) as well as alternative measures (e.g., Wu et al., 2010). In summary, it is difficult to determine whether relationship scores above the midpoint are reflective of reality or a measurement issue., This highlights the need for more objective methods of measuring closeness between teachers and students. Future research should consider collecting observational data of closeness and conflict, even as it would be very time consuming and expensive to do so.

Conflict. As predicted, results indicated that teacher-rated conflict was significantly negatively associated with teacher-rated engagement. Results also revealed a significant negative association between conflict and end of level test scores, suggesting that teachers tended to have more conflict with students who did less well on state standardized tests. Interestingly, teacher-rated conflict from waves 1, 3 and 4 were also significantly associated with test scores at wave 2. This suggests that there may be a reciprocal relationships between conflict and future achievement (Pianta, 1998), with teacher-rated conflict predicting lower scores on end of level tests and, in turn, end of level test predicting conflict up to one year later. By implication, this

also suggests that students who may be most in need of the benefits of a positive relationship with their teacher are more often the least likely to have a positive relationship.

Student relatedness to teacher. As expected, student-rated relatedness to teacher was positively associated with student-rated engagement, Wave 2 DIBELS, and Wave 4 Levels.

Student relatedness, closeness and conflict across time. As predicted there was a negative association between the level of conflict reported by teachers and the student's perception of relatedness. Few studies have gathered data from both teachers and students regarding relationship quality but our results are consistent with those of Wu et al (2010) and Decker et al. (2007). This suggests some level of consistency between the way that student's and teachers see their relationships. However, the magnitude of this correlation both in the current study as well as previous work is small and therefore should be interpreted with caution. Also, it should be noted that we found no significant association between student rated relatedness and teacher rated closeness. This was inconsistent with Decker et al. (2007) and is surprising because intuitively it seems that the nature of relatedness and closeness are very similar. However, Hughes, (2011) has contended that while both constructs and perspectives are valuable, the students and teachers reports of relationship quality are measuring "largely different constructs."

Summary. In general, the correlational results were consistent with theory and prior research, providing additional evidence that TSRQ predicts engagement and relatedness to teacher predicts engagement. The results were mixed, however, for linking these variables to achievement. This is unsurprising given that previous researchers have also found mixed results especially between relational variables and student achievmement (Furrer & Skinner, 2003; Hamre & Pianta, 2001). Importantly, the results are also limited in failing to account for the nested quality of students in classrooms, and failing to document the nature of longitudinal

change in engagement and achievement. Using longitudinal data analysis for multi-level data, the next set of results addressed these limitations.

Teacher-rated Engagement

Control model. Unexpectedly, teacher sex predicted teacher-ratings of student engagement and indicated that, on average, male teachers rated both male and female students as less engaged than did female teachers (see Figure 1). This result is inconsistent with gender schema theory that posits that individuals are more likely to identify positively with someone of the same gender (Bem, 1981). If this were true then gender match between teacher and student should facilitate more positive interactions leading to higher ratings of relationship quality and, according to attachment theory, greater engagement. Our results support this view for *females* but this was not the case for *males*. To our knowledge this issue has never been raised in the engagement literature. However, a similar measurement difference has been explicitly tested for relationship quality to determine if boys have better relationships with male teachers than with female teachers (Split et al., 2012). The results showed that rather than seeing an increase in relationship quality when boys were matched with a male teacher, boys compared to girls were ranked lower in closeness and higher in conflict by male teachers than boys were with female teachers. The results of the current study showed a similar pattern for teacher-rated engagement. This result is surprising given the common call in academia and the popular press for a greater representation of males in the field of education as an intervention in helping struggling male students (Cho, 2012; Cushman, 2005).

The issue of gender measurement difference has also been raised in the field of aggression. For example, Pellegrini et al. (2011) found that among trained raters of preschool students, male coders consistently coded more aggression in male students when compared to

female coders. The authors suggest that this difference could be the result of extant sex schemata within the male raters that boys are more aggressive than girls. It is possible that the same sex schemata could be present for male teachers in the context of student engagement.

This gender difference issue in engagement and motivation is analogous to the recent complaint of researchers who have questioned the generalizability of nearly all psychological research. This is because most studies in psychology have been conducted using American college students (a convenience sample) as if they were representative of all human beings (Henrich, Heine & Norenzayan, 2010). This same concern needs to be examined in the fields of relationships and engagement in elementary school since what we "know" is based almost entirely on female teacher's reports (Pianta, 1998; Wentzel, 2009). In terms of practical implications for teachers, potential gender difference may also lead teachers and students into a cycle of self-fulfilling prophecies (McKown & Weinstein, 2008). For example, if male teachers expect boys to be less engaged, that schema could then be at least partially supported because it was expected in the first place (Rosenthal & Jacobs, 1968).

Absent additional evidence, it remains an empirical question whether relationships between *male* teachers and students are qualitatively different from relationships between female teachers and students. The absence of data on this issue also raises concerns that extant theory and knowledge about relationship quality predicting engagement may also depend to an unknown extent on teacher gender. As a starting point, future research on TSRQ and engagement should report the sex of the rater, and where possible, potential measurement differences should be controlled for statistically (Split et al., 2012). Future research should also continue to explore whether male teacher difference leads to actual declines in positive student teacher interactions. It may be that male teachers simply report lower student engagement because they differ from

female teacher in their perceptions of engagement. If this is the case then male and female teachers may treat students similarly even though male teachers rate students as less engaged. An alternative explanation is that male teachers may be especially careful *not* to discriminate against female students because previous research has suggested that, compared to girls, boys tend to be given more attention and approval (Eccles, 1987; Marsh, Martin & Cheng, 2008; Meece, Wigfield & Eccles, 1990). Clearly, the expectation and hope for all teachers is that they treat their students with equity, fairness and high expectations for success.

Student model. . Student-rated relatedness to teacher was a significant positive predictor of teacher-rated student engagement, even after controlling for the linear trend and static covariates. This is important because it shows the unique contribution of relatedness to engagement without relying on shared methods for the association. This finding also supports self-determination theory's (SDT's) proposition that increasing relatedness should result in increased engagement in the environment.

Teacher-model. . Teacher-rated closeness and conflict were both significant predictors of teacher-rated engagement. This indicates that when teachers feel a close relationship with a student, they also rate the student as more highly engaged in school. The same pattern is seen in reverse with conflict. These findings suggest that teacher's perceptions of a close relationship with their student predicts above-average student engagement. In contrast, teacher's perceptions of a conflictual relationship with their student were associated with below-average engagement. These patterns are consistent with attachment theory which posits that positive interactions and the perception of closeness in a relationship will lead to great engagement in the environment (Anderman & Anderman 1999; Goodenow, 1993; Hamre & Pianta, 2001; Birch & Ladd, 1997; Pianta, 1998). However, it should be noted that past research was limited because of shared

methods and failing to control for nested data. Thus, the current study strengthens previous research by controlling for classroom dependence. That being said, it should still be noted that this study's results for TSRQ predicting teacher-rated engagement are still limited by shared methods since teachers rated both TSRQ and engagement.

Student-rated Engagement

Control model. On average, girls reported significantly higher levels of engagement than boys in the initial year of the study but, over time, also showed a mean decrease in engagement whereas boys stayed more consistent. The drop in girl's engagement was significant enough that by the last point of data collection, there was virtually no difference between girls' and boys' engagement scores. The mean difference favoring girls over boys is consistent with previous research showing that girls tend to be more engaged than boys in school (e.g. Goodenow, 1993). However, previous research does not suggest that this gap closes for boys and girls as they age. Rather, boys tend to be less engaged than girls throughout the later elementary and middle school years (Eccles et al.,1984). This is also consistent with teacher reports of engagement in the current study where teachers rated boys as less engaged than girls across all four waves of the study.

It is not clear from the current study why girls' self-reported engagement levels declined more than boys. Future work should include replication of the current study with more diverse samples and ages to determine whether these results are found consistently. This finding also underscores the value of examining the characteristics of the students in the sample as opposed to simply looking at the mean trends. Specifically, in this case, it helped to clarify that decline in student engagement over time was due mainly to the girls in the sample.

Teacher model. Results indicated that conflict was a significant negative predictor of student-rated engagement. This suggests that increased conflict with teacher over time was systematically associated with a drop in student engagement. While this is consistent with previous research, it should be noted that the association was less robust than predicted. The magnitude of the association indicates little practical significance. Previous research has almost universally found robust negative associations between conflict and engagement (Birch & Ladd, 1997; Goodenow, 1993; Hamre & Pianta, 2001; Hughes & Kwok, 2007; Pianta, 1998). However, in our sample, it bears note that we are testing the association between teacher-rated conflict and *student-rated engagement*. Very few researchers have compared teacher ratings of conflict with student ratings of engagement (see Wu et al., (2010) for an exception). Our results indicate that the associations previously reported in the literature may be inflated because of shared methods variance or because of a lack of controlling for the nested nature of the classrooms where data were gathered (Goodenow, 1993; Hamre & Pianta, 2001; Jerome et al., 2009). Our results also suggest that teacher-rated conflict in the classroom is more likely to influence outcomes and perceptions that are in the *teacher's* control such as teacher expectations for individual students and other teacher generated academic measures of success in the classroom.

The hopeful side of these results is that students show some resilience to teacher's perceptions of a conflictual relationship. This suggests that teachers need not assume that every instance of conflict (i.e. frustration, arguments, disagreements) will necessarily damage student engagement, at least from the student's perspective. However, it may also be that conflict shows so called "sleeper" effects where earlier conflict predicts later academic concerns. Hamre and Pianta (2005) show some evidence of this sleeper effect in showing that conflict in preschool

significantly predicted behavioral and academic outcomes in 8th grade. Once again, however, these analyses were limited by failing to control for the nested nature of the data.

The results from the current study provide important direction for future research in understanding the role that conflict plays in a student's perceptions of engagement. Specifically, it would be helpful to continue to study these issues longitudinally from an individual (as opposed to variable) perspective to examine whether conflict is indeed shaping, influencing and giving direction to future relationship quality and engagement of students.

Student model. We found that students with higher ratings of relatedness to their teacher were more likely to report higher engagement as well. This suggests there is an important connection within student's perceptions regarding these two aspects of school. These results also support SDT (Deci & Ryan, 2000), which posits that a sense of relatedness should lead to higher engagement in the environment. Here again, however, these results are characterized to some degree with shared methods since students reported both relatedness and engagement. Relative to previous studies, however, the results are strengthened by controlling for the nesting nature of the data. Results are also strengthened by showing a significant association between teacher-rated closeness and student-rated engagement. Thus, through two methodological advancements (multiple raters and HLM), this study's results provide more robust support for SDT's proposition that student relatedness to teachers significantly influences student engagement.

DIBELS

Control model. The DIBELS composite score is derived from multiple reading assessments within the DIBELS battery including current and past scores of words read correctly per minute, early phonemic awareness skills and oral retell. Within the DIBELS literature, this score is posited to provide the best overall estimate of a student's reading proficiency (Dewey et

al., 2012). The composite score continues to get higher as reading skills improve across the year and across grades. Therefore, we expected to see clear differences between grade levels and results supported our prediction.

Unexpectedly, the results also revealed a significant negative association between teacher experience and the composite score. This indicates that teachers with more experience had students who, on average, were *lower* in their reading scores. There was also a significant positive interaction between teacher-rated closeness, teacher experience and the composite DIBELS score. This suggests that closeness between teacher and student is more predictive of higher DIBELS scores for more experienced teachers. While there are many possible reasons for the differences associated with teacher experience, the very, very small magnitude of this correlation may be the more substantive issue. Put simply, this *statistically* significant result seems to hold little *practical* significance as it accounts for a mere 1% change in DIBELS.

Teacher-rated closeness, conflict, and teacher-rated engagement. Teacher-rated closeness and conflict were both significantly predictive of DIBELS scores. However, the size of the change was so small (i.e. less than 3 points movement from a mean of 359) that it would be inappropriate to make any substantive inferences. In practical terms these results indicate that closeness and conflict are not significant predictors of DIBELS scores. No studies were found in the DIBELS literature examining the role of teacher student relationships and DIBELS scores.

Teacher-rated engagement was a significant positive predictor of DIBELS scores. This suggests that when DIBELS scores rose, so did teacher-ratings of engagement. There was also a significant interaction between teacher sex and teacher-rated engagement, suggesting that students who were rated as less engaged by male teachers scored lower on the DIBELS assessment than students who were rated as less engaged in a female teacher's classroom. These

results are consistent with previous research, which suggests that engagement should predict achievement. The interaction between teacher sex and teacher engagement suggests that this connection between engagement and DIBELS achievement is even more predictive for male teachers.

One final note of interest was the fact that teacher-rated TSRQ and engagement variables were more predictive of DIBELS scores than they were of Levels test scores. The DIBELS assessment is intriguing regarding relationships because the assessment is administered one-on-one, often with the classroom teacher. Therefore, this measure of reading achievement may be more sensitive to teacher ratings of engagement and relationship quality because the teacher is actually interacting personally with students. This is not the case with the state's end-of-level tests. It may be that the DIBELS assessment provides an opportunity for students and teachers to interact more individually than usual in an assessment. This interaction may give teachers a more salient experience to judge student's engagement. A positive interaction between teacher and student during an assessment like DIBELS may help to promote close relationships. The current manual for DIBELS administration does not include any reference to how a teacher should interact with the student during the assessment. However, it would be an interesting area of research to see whether the quality of the interaction during the assessment impacts the success of students in their reading proficiency over time.

End-of-level Scores (Levels)

Results indicated that TSRQ, relatedness and student rated engagement were not strong predictors of success on the state tests. Indeed, only teacher-reported variables accounted for any significant variance. Specifically, teacher-rated engagement was a significant positive predictor of test scores. This suggests that teacher's view students who do better on state testing as more

engaged than those who do less well. This result is consistent with previous research, which suggests that student engagement is an important aspect of academic success in school (Pianta, 1998). This result is also supportive of attachment theory and SDT both of which suggest that increased engagement should provide the conditions that would increase student achievement. However, it should be noted that the magnitude of this association is quite small. Therefore, it would be inappropriate to draw substantive conclusions from these results. The size of the correlation is also consistent with previous research in motivation and engagement, which has shown small to medium effect sizes (Hughes, 2011; Nurmi, 2011).

Counter to our predictions, there was a significant negative association between teacher-rated closeness and Levels and a significant positive association between conflict and Levels. This was surprising given that both attachment theory and SDT would predict the opposite result. Once again, however, the magnitude of these associations are small and suggest that, in practical terms, teacher's perceptions of relationship quality had little connection to student success on end of level tests. This could be taken to suggest that attachment theory and SDT have overstated the importance of relationships for measures of student achievement. However, it should also be remembered that in these theories relationships are not posited to always have immediate, direct effects on student achievement. Rather, a more long term influence is predicted with relationships acting as a guiding or directing mechanism where interactions between teachers and students will influence student engagement, which should then influence achievement in a cyclical pattern (Juvonen, 2006; Pianta, 1998; Roorda et al., 2011). This long-term view is supported by research which found a significant though small association ($r = -.22$, $p < .05$, for boys only) between conflict in kindergarten at early ages and later achievement on math and

language arts test scores. There was no association between closeness and later achievement (Burchinal, 2002).

One of the purposes of the current study was to compare the results of our multi-level analysis to similar work that did not account for the nested nature of the data. It is important therefore to note that neither student-rated relatedness to teacher or student-rated engagement significantly predicted any achievement measure. This suggests that student ratings showed little connection to the academic success of students, at least as measured in this study. This is inconsistent with previous research in the fields of relatedness and engagement, which has found consistent, albeit small, associations between these constructs and achievement (Connell & Wellborn, 1991; Furrer & Skinner, 2003). For example, a recent meta-analysis found a correlation of $r = .29$, $p < .01$ between engagement and achievement and $r = .16$, $p < .01$ between positive relationships and achievement (Roorda et al., 2011). Once again, however, the magnitude of these results is suspect in that the primary studies failed to control for the nested nature of student data. It should also be noted that there are many factors that influence student achievement. For example, more stable family and student characteristics such as socio-economic status (SES), general cognitive ability and prior performance on tests account for a large amount of the variance in student achievement (Hughes, 2011; Roorda et al., 2011). Therefore it is possible that the impact of relationships and engagement get lost in these main effects, especially given the statistical noise that is inherent in educational research.

We also cannot tell from the current study whether the predicted pattern of student perceptions predicting engagement is happening for some students and not for others. Researchers working within the SDT framework could strengthen the theory by examining more particularly the conditions that are present when students do show the expected pattern. This has

been done more often in SDT for autonomy support and competence (see e.g., Vansteenkiste et al., 2006), but the conditions and effects of relatedness are less well understood (Ryan et al., 1994). The results of the current study suggest that this would be an appropriate time in the fields of relationships and engagement to re-examine positions on achievement and conduct further research with more appropriate study designs.

Limitations

Participation. The participation rate of students was lower than desired in the current study. This is a common concern with studies in schools where only students who bring back a permission form can participate. This led to a participation rate of approximately 77%, which is comparable to similar peer reviewed publications (e.g. Murray, Waas & Murray, 2008; Wentzel et al., 2010). The concern is that there is no way to determine whether the students who did not participate were significantly different from the participating students. It is possible that students who were responsible enough to bring back a permission form may be more likely to be the type of students who have characteristics that facilitate positive teacher student relationships. These students may also have parents that are more responsible or responsive to school tasks, which may equate to more secure home environments. If this were the case, it could lead to inflated ratings of engagement and relationship quality from the students in this sample. Indeed, it is possible that the students that would be most useful to study in terms of relationship quality did not participate in the study. This would make it more difficult in the analyses of these data to capture the variation between students that likely exists in teacher student relationship quality and student engagement.

Homogeneity. This student sample was characterized by ethnic homogeneity, with 91% of the participants self-reporting as Caucasian. This reflects the demographic norm for this area

of the United States, but it limits the generalizability of this data to other ethnic groups and to more diverse schools. We are mindful of the fact that the same patterns discussed in this paper may change in more diverse populations or in different educational contexts. Therefore, before drawing any definitive conclusions in the fields of relationships and engagement, it will be important to document trends in more diverse samples and contexts.

Social desirability. The general lack of significance for student reported variables could be the result of social desirability. As has been noted previously in this sample as well as other published articles (Furrer & Skinner, 2003) most students tend to report themselves as highly engaged, yet student reports are less likely than teacher reports to correlate with independent observers reports of student engagement (Hughes, 2011; Wu et al., 2010). It could be that teachers are more reliable and objective than students in reporting student engagement. This is a validity issue that has often been raised when working with young students (Wigfield et al., 1997); it is harder to be sure that the students, especially second and third graders, truly understand what the questions on the survey mean even when they are read to them and questions can be asked. There may also be less concern with social desirability in teacher's responses when compared with students reporting engagement though we see evidence of skewed data from both informants. For the current study this suggests that teacher reports of engagement are more predictive measures of student engagement at least when we are using academic outcomes. The fact that this was true of both measures of student achievement strengthens this position. However, further research is needed that clarifies the longitudinal utility of student reports of engagement. It may be that the best prediction of academic outcomes can be found when teacher, student and observer accounts show agreement. Research of this kind

would help to clarify the conditions under which measures of engagement and relationship quality are more predictive of student achievement.

Alternative analyses. While using multilevel models to analyze the data for the current study represents an improvement over previous designs, there are other advanced statistical methods that would allow other issues to be examined. First, Pianta (1998) describes relationships in school as part of a dynamic system of student development. Analyzing the cyclical and bidirectional nature of these variables would be interesting and appropriate. Using this method of analysis would be enhanced through extended longitudinal analyses. This is the case because social influences are more likely to have a distal rather than proximal effect on student academic outcomes (Graham, 1996) and thus are difficult to capture in cross-sectional data. Second, structural equation modeling and path analysis would allow us to simultaneously test the influence of each part model of relationship quality, relatedness, engagement and achievement. Third, an individual- as opposed to variable-centered analysis would allow us to more fully answer questions regarding the conditions that predict longitudinal changes in individuals as opposed to trends for large groups of students.

Implications for Theory

Despite these limitations, this study contributes to the literature in several important ways. First, the study's findings have strong validity, as the use of multiple raters and multilevel analyses serve to address methodological limitations that have abounded in previous work on TSRQ, relatedness and engagement. These advancements provide greater confidence in making inferences about the importance of these constructs and how they can be applied appropriately.

For theory, the results of this study generally support the positions of both attachment theory and SDT regarding the importance of TSRQ in predicting student engagement and

brought to light the importance of examining both static and dynamic covariates in addition to general trends. For example, our results suggest significant differences in the way that male and female teachers rate engagement and relationships. Yet the measures for these variables do not take these differences into account. Given our results, it would be appropriate to adjust, or extend the positions of these theories in order to address sex differences in the way that relationships and relatedness affect student engagement and achievement.

Second, using more conservative and appropriate methods for analyses, we found little practical support for the position that relationship quality predicts achievement on any of the measures. More research is needed, especially regarding the long term, cumulative effects of relationships on academic outcomes, but it may be that theories of relationships, which have been based on limited methods, have overstated the case for relationships predicting academic achievement. An important area for future research would be the development of alternative measures of teacher child relationships that are less prone to social desirability and measurement bias. One intriguing possibility would be to measure teacher perceptions of students more implicitly in a manner similar to the implicit association test (Greenwald, McGhee & Schwartz, 1998). A measure of this style would not allow teachers to have time to think about how they "should" see their students and may more appropriately capture teacher perceptions.

In terms of engagement, teacher ratings were more predictive than students in finding associations with academic outcomes. Student ratings of engagement were not predictive of any measure of achievement in the study. This suggests that caution is merited whenever elementary age students report their engagement. Measures with stronger construct validity of student rated engagement would be a great benefit to the field of engagement and motivation.

Implications for Practice

Practical implications for this study emphasize the importance of relationships in promoting student engagement. While we cannot prove a causal relationship, it is clear that the two constructs are connected. This was true for both teachers and students. Therefore, teachers should continue to be careful to promote positive interactions with all students, especially those who may be hardest to have a positive relationship with. Our results suggest concurrent benefits for positive relationships and student engagement and we are hopeful that future research will indicate that whether the results are seen immediately or years later, there are positive consequences for teacher efforts at promoting positive relationships.

Regarding teacher sex we found several interesting results indicating classroom differences between male and female teachers. First, rather than finding positive effects for a gender match between males, our results indicate that male teachers rate boys as less engaged than female teachers do. It should be noted that analysis of this issue was exploratory in nature and therefore replication is needed to support our results. However, teachers, administrators and parents should not expect that gender match between a male teacher and boy student will naturally lead to increased relational or academic gains. There may be other benefits to a gender match that are valuable; this is a question that is worth further examination.

APPENDICES

Appendix A: Tables and Figures

Table 1

Teacher Experience and Student Age by Student Grade-level, Sex, and Teacher Sex

Level / Variable	Grade	Male teacher			Female teacher		
Level 3 – Classrooms		*j*	*M*	*SD*	*j*	*M*	*SD*
Teacher experience	2	1	33.00	-	5	15.98	6.68
	3	4	19.75	13.57	7	13.06	12.54
	4	2	8.50	0.70	8	12.62	5.56
	5	2	21.00	1.41	8	16.93	8.45
	6	4	13.91	11.77	9	18.01	9.85
Level 2 – Male students		*i*	*M*	*SD*	*i*	*M*	*SD*
Student age	2	11	7.31	0.33	36	7.40	0.35
	3	28	8.44	0.31	56	8.38	0.42
	4	16	9.56	0.40	59	9.32	0.39
	5	20	10.47	0.44	60	10.33	0.36
	6	18	11.38	0.40	12	11.58	0.35
Level 2 – Female students		*i*	*M*	*SD*	*i*	*M*	*SD*
Student age	2	14	7.39	0.40	43	7.30	0.42
	3	20	8.30	0.29	54	8.27	0.40
	4	11	9.36	0.39	70	9.25	0.33
	5	22	10.31	0.36	82	10.28	0.31
	6	27	11.38	0.42	29	11.34	0.33

Note. Both teacher experience and student age reported in years.

Table 2
Descriptive Statistics

	Wave	α	*n*	*M*	*SD*
Student-rated					
Engagement	1	0.71	347	37.79	6.01
	2	0.73	317	36.67	5.90
	3	0.78	233	37.61	5.60
	4	0.80	245	36.96	6.35
Relatedness to	1	0.56	360	15.96	2.95
teacher	2	0.71	338	16.07	3.28
	3	0.67	254	16.60	2.86
	4	0.74	262	16.32	3.10
Teacher-rated					
Engagement	1	0.89	355	26.87	6.87
	2	0.88	328	26.49	6.96
	3	0.88	261	27.63	6.51
	4	0.88	255	27.18	6.42
Closeness	1	0.90	366	28.82	4.58
	2	0.87	341	29.65	4.39
	3	0.87	270	28.89	4.61
	4	0.88	267	29.33	4.46
Conflict	1	0.90	365	13.39	6.09
	2	0.93	339	11.85	6.33
	3	0.93	273	10.45	5.58
	4	0.93	264	11.48	6.05
Achievement					
DIBELS[a]	1		242	297.82	117.93
	2		359	386.67	123.86
Levels test[b]	2		193	510.73	23.89

[a] Second through fifth grades only.

[b] Third through sixth grades only.

Table 3

Intercorrelations between Teacher-rated Engagement, Closeness, Conflict, and Achievement

		Wave	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	Engagement	1	.72**	.48**	.49**	.45**	.31**	.20**	.17**	-.64**	-.51**	-.44**	-.43**	.30**	.31**	.48**
2.		2		.48**	.49**	.33**	.49**	.22**	.21**	-.46**	-.59**	-.41**	-.46**	.17*	.23**	.35**
3.		3			.80**	.13*	.15*	.53**	.44**	-.28**	-.33**	-.59**	-.50**	.16*	.06	.50**
4.		4				.26**	.19**	.45**	.50**	-.33**	-.29**	-.55**	-.60**	.20**	.09	.55**
5.	Closeness	1					.59**	.30**	.33**	-.40**	-.21**	-.13*	-.14*	-.12	-.02	-.05
6.		2						.35**	.32**	-.25**	-.31**	-.13*	-.19**	-.03	.01	-.12
7.		3							.68**	-.06	-.07	-.27**	-.16*	-.18*	-.22**	.08
8.		4								-.01	-.07	-.17**	-.20**	-.18*	-.21**	.06
9.	Conflict	1									.71**	.54**	.51**	-.10	-.06	-.18*
10.		2										.57**	.54**	.01	-.02	-.10
11.		3											.79**	-.09	.03	-.26*
12.		4												-.21*	.02	-.23*
13.	DIBELS[a]	1													.89**	.65**
14.		2														.58**
15.	Levels[b]	2														

[a] Second through fifth grades only.

[b] Third through sixth grades only.

*$p < .05$, **$p < .01$.

Table 4

Intercorrelations Between Teacher-rated Closeness and Conflict and Student-rated Relatedness

		Wave	2	3	4	5	6	7	8	9	10	11	12
1.	S_Relatedness	1	.46**	.35**	.24**	.11*	.04	-.10	-.07	-.16**	-.14**	-.02	-.11
2.		2		.47**	.32**	.05	.17**	-.04	-.01	-.22**	-.30**	-.08	-.10
3.		3			.51**	.08	.05	.03	.10*	-.19**	-.19**	-.17**	-.19**
4.		4				.11	.13*	.09*	.18**	-.12	-.23**	-.27**	-.30**
5.	T_Close	1					.66**	.28**	.34**	-.36**	-.23**	-.12*	-.13*
6.		2						.34**	.35**	-.24**	-.32**	-.14*	-.20**
7.		3							.70**	-.03	-.06	-.26**	-.18*
8.		4								.01	-.06	-.15**	-.20**
9.	T_Conflict	1									.69**	.53**	.52**
10.		2										.58**	.55**
11.		3											.76**
12.		4											

*$p < .05$, **$p < .01$.

Table 5

Intercorrelations Between Student-rated Engagement and Teacher-rated Engagement

	Wave	2	3	4	5	6	7	8
1. S_Engagement	1	.47**	.47**	.36**	.19**	.15**	.07	.16**
2.	2		.56**	.49**	.17**	.16**	.05**	.11
3.	3			.64**	.24**	.24**	.23**	.20**
4.	4				.27**	.33**	.25**	.26**
5. T_Engagement	1					.73**	.48**	.49**
6.	2						.47**	.49**
7.	3							.80**
8.	4							

** $p < .01$.

Table 6

Intercorrelations between Student-rated Engagement, Relatedness, and Achievement

		Wave	2	3	4	5	6	7	8	9	10	11
1.	Engagement	1	.46**	.45**	.36**	.50**	.33**	.29**	.22**	.09	.12*	.04
2.		2		.58**	.51**	.32**	.57**	.38**	.31**	.13	.08	-.05
3.		3			.65**	.25**	.45**	.53**	.37**	.07	.06	.12
4.		4				.21**	.42**	.48**	.56**	-.01	.01	.18*
5.	Relatedness	1					.44**	.33**	.27**	.21**	.21**	.02
6.		2						.47**	.37**	.16*	.17**	.07
7.		3							.54**	.19*	.12	.10
8.		4								.11	.06	.10
9.	DIBELS[a]	1									.89**	.65**
10.		2										.58**
11.	Levels[b]	2										

[a] Second through fifth grades only.

[b] Third through sixth grades only.

* $p < .05$, ** $p < .01$.

Table 7

Teacher-rated Engagement: REML Parameter Estimates

Effects	Parameters	Control	Student-rated	Teacher-rated
Fixed effects				
	Intercept, β_0	22.94*** (0.85)	18.54*** (1.16)	16.34*** (1.93)
	Linear, β_1	-0.26 (0.21)	-0.14 (0.21)	-0.65** (0.22)
	Student sex, β_2	2.28*** (0.44)	2.22*** (0.44)	0.65† (0.36)
	Teacher sex, β_3	4.26*** (0.92)	4.20*** (0.90)	1.92** (0.79)
Student-rated				
	Relatedness, β_4		0.27*** (0.05)	0.30*** (0.09)
Teacher-rated				
	Closeness, β_5			0.37*** (0.03)
	Conflict, β_6			-0.24** (0.09)
	Relatedness*Conflict, β_7			-0.01** (0.01)
Random effects				
	Classroom-level			
	Intercept, μ_{0j}	3.38* (1.78)	3.36* (1.80)	2.40* (1.29)
	Linear, μ_{1j}	0.79* (0.43)	0.55† (0.39)	0.83** (0.39)
	Intercept*Linear, (μ_{0j}, μ_{1j})	-0.02 (0.58)	-0.05 (0.56)	-0.33 (0.55)
	Student-level	25.36*** (1.83)	23.65*** (1.84)	12.94*** (1.12)
	Residual[a]	10.23*** (0.66)	10.44*** (0.72)	7.66*** (0.55)
Fit statistics				
	-2LL	7379.3	6778.6	6119.0
	AIC	7389.3	6788.6	6129.0
	BIC	7398.8	6798.2	6138.6
Proportional R^2			.07	.56

Note. The intercept, β_0, is the grand mean teacher-rated engagement; β_2 is the difference between male students (coded 0) and female students (coded 1); β_3 is the difference between male teachers (coded 0) and female teachers (coded 1); standard errors (SE) follow parameter estimates in parentheses; -2LL = -2 log likelihood; AIC = Akaike's Information Criterion; BIC = Bayes Information Criterion; proportional R^2 is the student-level proportional reduction in prediction error.

[a] For all models, residual variance (i.e., the $\mathbf{R}_{ij}$ matrix) was specified $\sigma^2\mathbf{I}_2$.

†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 8

Student-rated Engagement: REML Parameter Estimates

Effects	Parameters	Control	Student-rated	Teacher-rated
Fixed effects				
	Intercept, β_0	35.96*** (0.63)	21.80*** (0.93)	18.27*** (1.63)
	Linear, β_1	-0.08 (0.24)	-0.28 (0.22)	0.31 (0.38)
	Student sex, β_2	2.28*** (0.59)	1.26*** (0.50)	1.25*** (0.52)
	Teacher sex, β_3	1.08† (0.57)	0.11 (0.50)	-0.04 (0.51)
	Linear*Student sex, β_4	-0.79** (0.31)	-0.51* (0.27)	-0.55* (0.28)
Student-rated				
	Relatedness, β_5		0.95*** (0.05)	0.94*** (0.05)
Teacher-rated				
	Closeness, β_6			0.09** (0.03)
	Conflict, β_7			0.08* (0.04)
	Linear*Conflict, β_8			-0.05* (0.02)
Random effects				
	Classroom-level	0.87† (0.64)	0.81* (0.49)	0.74† (0.48)
	Student-level	18.27*** (1.71)	9.95*** (1.27)	9.00*** (1.26)
	Residual[a]	16.31*** (1.04)	14.84*** (0.98)	14.87*** (1.03)
Fit statistics				
	-2LL	7139.5	6725.8	6255.8
	AIC	7145.5	6731.8	6261.8
	BIC	7151.2	6737.5	6267.6
Proportional R^2			.57	.09

Note. The intercept, β_0, is the grand mean student-rated engagement; β_2 is the difference between male students (coded 0) and female students (coded 1); β_3 is the difference between male teachers (coded 0) and female teachers (coded 1); standard errors (SE) follow parameter estimates in parentheses; -2LL = -2 log likelihood; AIC = Akaike's Information Criterion; BIC = Bayes Information Criterion; proportional R^2 is the student-level proportional reduction in prediction error.

[a] For all models, residual variance (i.e., the $\mathbf{R}_{ij}$ matrix) was specified $\sigma^2\mathbf{I}_2$.

†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 9

DIBELS: REML Parameter Estimates

Effects	Parameters	Control	Student-rated	Teacher-rated
Fixed effects				
	Intercept, β_0	93.88*** (25.48)	45.93 (35.73)	-372.54** (144.72)
	Linear, β_1	101.03*** (3.89)	100.12*** (4.61)	218.12*** (37.89)
	Teacher experience, β_2	-2.27** (0.76)	-1.64** (0.82)	-11.25** (3.64)
	Grade level, β_3	65.21*** (5.69)	64.15*** (6.02)	63.34*** (6.28)
Student-rated				
	Relatedness, β_4		1.69 (1.26)	28.97*** (8.36)
	Engagement, β_5		0.48 (0.65)	0.36 (0.69)
Teacher-rated				
	Closeness, β_6			4.89 (4.18)
	Conflict, β_7			9.91*** (2.91)
	Engagement, β_8			5.08*** (0.74)
	Closeness*Linear, β_9			-3.47** (1.23)
	Closeness*Teacher experience, β_{10}			0.34** (0.12)
	Closeness*Relatedness, β_{11}			-0.72** (0.23)
	Conflict*Relatedness, β_{12}			-0.45** (0.18)
Random effects				
	Classroom-level	378.15*** (288.16)	455.26† (326.74)	583.78† (380.23)
	Student-level	7247.83** (652.11)	6884.90** (675.30)	5462.66** (621.45)
	Residual[c]	1460.54** (150.91)	1524.13** (182.48)	1527.66** (215.71)
Fit statistics				
	-2LL	6269.8	5383.1	4699.4
	AIC	6275.8	5389.1	4705.4
	BIC	6278.9	5392.2	4708.6
Proportional R^2			.03	.17

Note. The intercept, β_0, is the grand mean DIBELS score; β_3 is the difference between male teachers (coded 0) and female teachers (coded 1); standard errors (SE) follow parameter estimates in parentheses; -2LL = -2 log likelihood; AIC = Akaike's Information Criterion; BIC = Bayes Information Criterion; proportional R^2 is the student-level proportional reduction in prediction error.

[a] For all models, residual variance (i.e., the $\mathbf{R}_{ij}$ matrix) was specified $\sigma^2\mathbf{I}_2$.

†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 10

Levels: Hierarchical Multiple Regression Results

Model Parameters	Control β (*SE*)	Student-rated β (*SE*)	Teacher-rated β (*SE*)
Step 1 – Static covariates			
$F(4, 109) = 0.39$, $p = .80$			
Teacher experience	0.44 (0.41)	0.53 (0.42)	0.82* (0.34)
Grade level	-2.29 (5.86)	-5.24 (6.23)	4.86 (4.98)
Student sex	-1.97 (4.79)	-2.74 (5.09)	-4.76 (3.88)
Teacher sex	2.78 (5.67)	3.41 (5.73)	-6.45 (5.08)
Step 2 – Student-rated			
$F(8, 105) = 0.60$, $p = .80$			
Relatedness – Wave 1		0.93 (1.19	0.59 (0.93)
Relatedness – Wave 2		1.33 (1.18)	1.00 (0.92
Engagement – Wave 1		-0.19 (0.61)	-0.25 (0.47)
Engagement – Wave 2		-0.62 (0.55)	-0.56 (0.42)
Step 3 – Teacher-rated			
$F(14, 99) = 7.28$, $p < .001$			
Closeness[b] – Wave 1			-0.77 (0.49)
Closeness[b] – Wave 2			-1.52** (0.54)
Conflict[b] – Wave 1			0.05 (0.48)
Conflict[b] – Wave 2			1.15** (0.54)
Engagement – Wave 1			2.02*** (0.49)
Engagement – Wave 2			1.70*** (0.48)
ΔR^2		.02	.46***
Total R^2	.01	.04	.50***

Note. Standard errors (SE) follow parameter estimates in parentheses.
* $p < .05$, ** $p < .01$, *** $p < .001$.

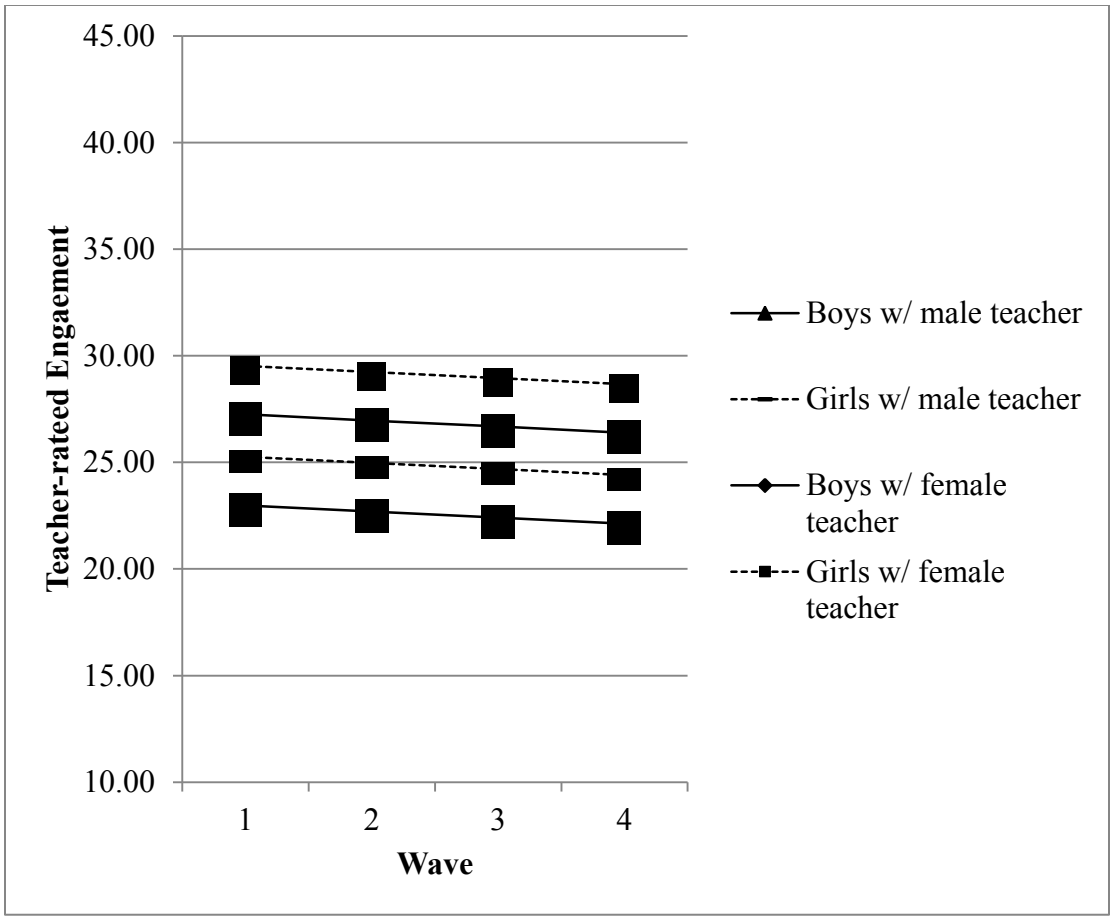

Figure 1

Teacher-rated Engagement Trajectories by Student and Teacher Sex

Figure 1. Predicted mean trajectories comparing male students' (boys) and female students' (girls) average teacher-rated engagement scores by teacher sex. Across time, girls tended to have a higher average than male students for both male and female teachers. However, compared to male teachers, female teachers tended to report higher average engagement scores for both female and male students.

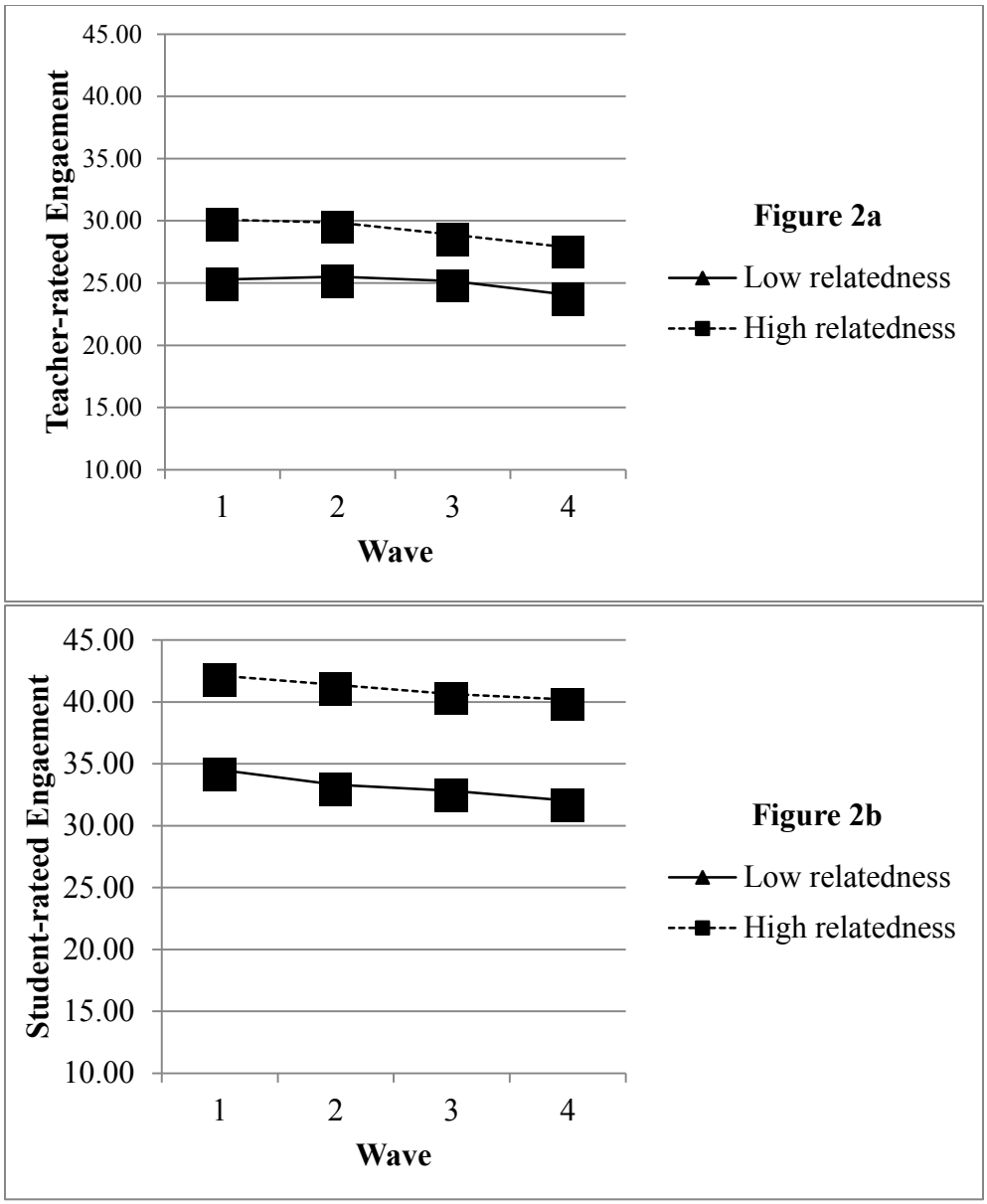

Figure 2

Dynamic Covariation between Teacher- and Student-rated Engagement Trajectories and Students' Sense of Relatedness to Teachers

Figure 2. Predicted mean trajectories for teacher-rated (Figure 2a) and student-rated (Figure 2b) engagement scores by teacher relatedness. Q1 = *low* (quartile 1) teacher relatedness scores; Q4 = *high* (quartile 4) teacher relatedness scores. Comparing Figures 2a and 2b illustrates how the magnitude of covariation differs between teacher- and student-rated engagement, with teacher relatedness corresponding with larger differences between Q1 and Q4 trajectories in student-rated engagement (Figure 2b) compared to teacher-rated engagement (Figure 2a).

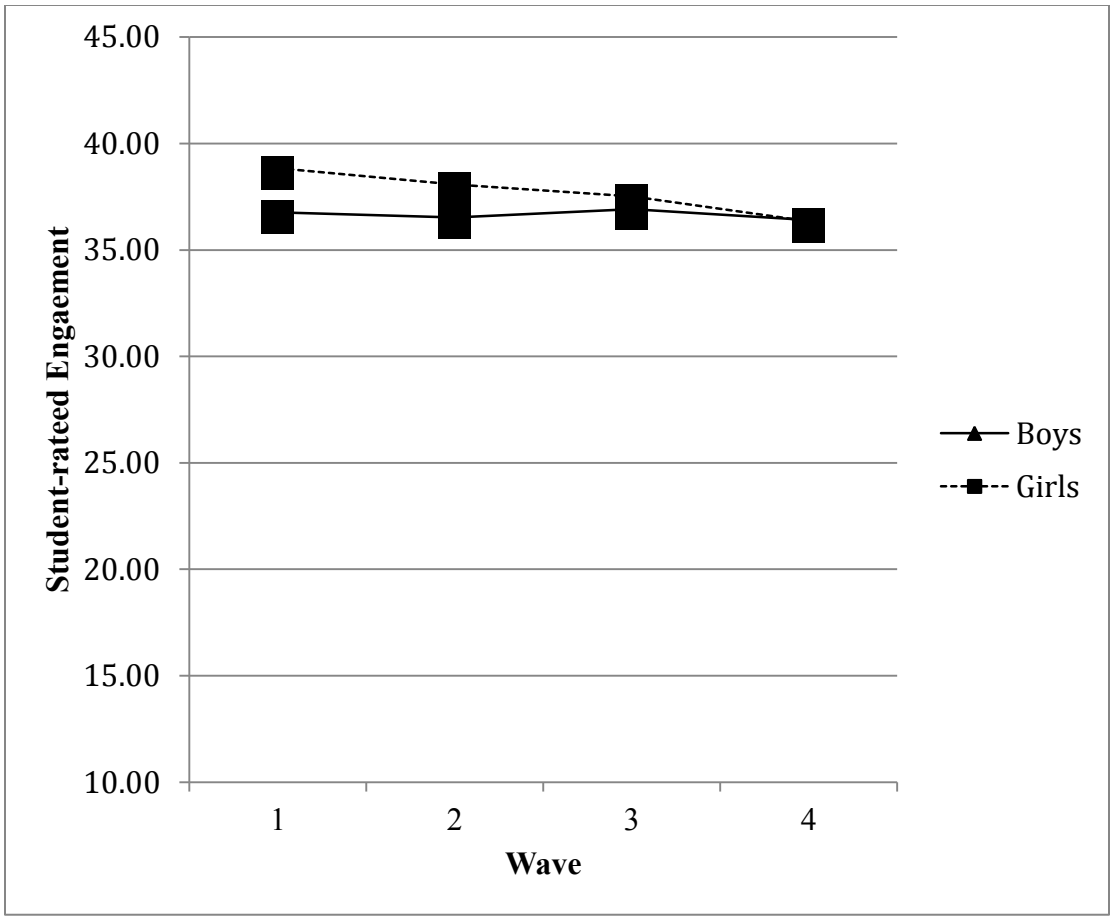

Figure 3

Student-rated Engagement Trajectories by Student Sex

Figure 3. Predicted mean trajectories comparing male students' (boys) and female students' (girls) average student-rated engagement scores. Across time, girls tended to report higher average engagement than male students. However, this difference was effectively non-existent by Wave 4, as girls' average engagement also declined over time at a higher rate than boys.

Appendix B

Student Assent Form

Student Assent Form

You are being asked to participate in a research study about school. Your parent(s) and teacher have said it is okay for you to answer these questions but I also need your permission to answer the questions. Researchers are required to provide an assent form to inform you about the study, to convey that participation is voluntary, to explain risks and benefits of participation, and to empower you to make an informed decision. You should feel free to ask the researchers any questions you may have.

Study Title:	The Role of Peer and Teacher Relatedness in Children's Motivation
Researcher and Title:	Cary J. Roseth, PhD
Department and Institution:	CEPSE, College of Education
Address and Contact Information:	513C Erickson Hall Michigan State University East Lansing, MI 48824-1034 (e) croseth@msu.edu (p) 517-432-0454

1. PURPOSE OF RESEARCH:

You are being asked to participate in a research study. We are trying to learn about:

- Motivation in school
- How you feel toward your peers and teacher
- What changes show up when comparing 2nd through 8th graders
- There are 3 other schools doing this study
- About 700 other students will answer these same questions
- This will take about 30-45 minutes

2. WHAT YOU WILL DO:

- Listen to questions read out loud/or read questions to yourself about how you feel about school, your teacher and peers
- Mark your answers on the paper we provide/or on the computer version click on your answer
- Your teacher will also fill out a survey about your motivation in school
- We will also look at your End of Level Test scores

3. POTENTIAL BENEFITS:

- Opportunity to describe your relationship with your teacher and peers.
- Participate in a real scientific study
- Provide information that could help your teacher and improve schools

4. POTENTIAL RISKS:

- We do not anticipate any risks for participating in this study as you are only answering questions about how you feel in school.

5. PRIVACY AND CONFIDENTIALITY:

- Once I get back to Michigan you will be given a secret code so that your name is not connected to your answers but only to your secret code.
- We will lock your answers in a filing cabinet at Dr. Roseth's MSU office for 3 years
- Dr. Roseth, his researchers and MSU's IRB (Institutional Review Board) can see the data

6. YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW

- This is a volunteer project, you do not have to participate unless you want to
- If you do participate, you may change your mind later and stop at any time
- If you want, you may also skip any question that you don't want to answer
- There is no punishment for saying 'No, I don't want to participate.'
- There is also no punishment for changing your mind later.

7. COSTS AND COMPENSATION FOR BEING IN THE STUDY:

- As a way of saying thanks for taking our survey, you will receive a small gift (e.g., pencil).
- You will still receive a small gift if you change your mind and decide not to participate.

8. CONTACT INFORMATION FOR QUESTIONS AND CONCERNS

- If you have any questions, you may ask me today.
- You and/or your parents may also talk to Dr. Cary J. Roseth at 517-432-0454
- You and/or your parents may also talk to Michigan State University's Human Research Protection Program at 517-355-2180

9. DOCUMENTATION OF INFORMED CONSENT.

Your signature below means that you voluntarily agree to participate in this study.

_____ Yes, I agree to participate in the study and answer the survey questions.

_____ No, I do not want to participate in the study.

_____
Name

Appendix C

Parental Consent Form

Parental Information and Consent Form

Your child is being asked to participate in the research study, "The Role of Peer and Teacher Relatedness in Children's Motivation: A Longitudinal Study." Researchers are required to provide a consent form to inform you about the study, to convey that your consent and your child's participation is voluntary, to explain risks and benefits of participation, and to empower you to make an informed decision. You should feel free to ask the researchers any questions you may have.

Study Title:	The Role of Peer and Teacher Relatedness in Children's Motivation: A Longitudinal Study
Researcher and Title:	Cary J. Roseth, PhD
Department and Institution:	CEPSE, College of Education
Address and Contact Information:	513C Erickson Hall, Michigan State University East Lansing, MI 48824-1034 (e) croseth@msu.edu (p) 517-432-0454

1. PURPOSE OF RESEARCH:

Your child is being asked to participate in a research study examining the role of peer and teacher relatedness (i.e., relationships) on children's academic motivation. Your child is being asked to participate because he/she is in the 2nd through 8th-grade in one of the schools listed below. From this study, we hope to learn whether the importance of peer and teacher relatedness changes with age, and whether these changes are associated with differences in academic motivation and achievement. In the entire study, 800 students from 3 different schools are being asked to participate. Participating schools include Parowan Elementary School, Cedar South Elementary School, Canyon View Middle School, or Cedar Middle School. Your child's participation in this study will take about 20-45 minutes of classroom time each time they take the survey.

2. WHAT YOUR CHILD WILL DO:

In this study, researchers will twice (fall and spring) administer a survey regarding parent, teacher and student relatedness in your child's classroom. Questions will be read aloud by the researcher for 2nd-3rd grade students, and 4th-8th grade students will read the survey to themselves. The researcher will be available to answer students' questions throughout the survey. If you choose to not have your child participate, then your child's teacher will provide and supervise an alternative activity. Students' teachers will also twice complete a brief survey regarding their relatedness to students and their perceptions of students' peer relatedness. Researchers will examine how the results of these surveys relate to your child's end-of-level test scores. The study's results will be made available to participating schools and interested teachers and parents.

3. POTENTIAL BENEFITS:

The potential benefits to your child for taking part in this study include validation of your child's thoughts and feelings regarding teacher and student relatedness. More generally, your child's

participation will also advance the world's knowledge about the role of teacher, parent and peer relatedness in children's academic motivation and achievement, potentially informing educational practice and teacher preparation programs.

4. POTENTIAL RISKS:

The potential risks of participating in this study are minimal, as survey questions refer only to teacher and student relatedness and do not require disclosure of sensitive personal details.

5. PRIVACY AND CONFIDENTIALITY:

Information related to your child's participation will be kept confidential to the maximum extent allowable by law. Specifically, students' identities will be coded and a key maintained separately in the locked files of the Principal Investigator (Dr. Roseth) for at least three years after project closes. The results of this study may be published or presented at professional meetings, but the identities of all research participants will remain anonymous. Only the Principal Investigator (Dr. Roseth), graduate student research associates and MSU's IRB (Institutional Review Board) will have access to the data.

6. YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW

Your child's participation in this research project is completely voluntary, as is your consent for your child's participation. You or your child may change your mind and withdraw from the study at any time. Your child may also choose not to answer specific questions or to stop participating at any time, in which case your child's teacher will provide and supervise an alternative activity. Choosing not to participate or withdrawing from this study will not make any difference in the quality of your child's experience at school, nor will it involve any loss of benefits to which your child is otherwise entitled. You will be told of any significant findings that develop during the course of the study that may influence your willingness to consent to your child's participation in this research.

7. COSTS AND COMPENSATION FOR BEING IN THE STUDY:

After completing the survey, students will receive a small gift for their participation (e.g., pencil).

8. CONTACT INFORMATION FOR QUESTIONS AND CONCERNS

If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher (Dr. Cary J. Roseth, at 517-432-0454, Fax 517-353-6393, or email croseth@msu.edu, or regular mail at 513C Erickson Hall, College of Education, MSU, East Lansing, MI 48824-1034.).

If you have questions or concerns about your child's role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, MSU, East Lansing, MI 48824.

9. DOCUMENTATION OF INFORMED CONSENT.

_____ Yes, I voluntarily consent to my child's participation in the study.

_____ No, I do not voluntarily consent to my child's participation in the study.

_____
Student Name

_____ _____
Parent/Guardian Signature Date

****Please return this form to your child's teacher.**

Appendix D

Letter Home to Parents (Name of School Removed)

August 14, 2011

Dear Elementary Parent,

My name is Ammon Wilcken. I taught at Elementary for six years and now am working on a graduate degree in educational psychology at Michigan State University. I loved working with students as an elementary teacher and I am excited to learn more about how to help students succeed throughout their education.

I am writing you about a study of academic motivation involving the Elementary. My advisor, Dr. Cary Roseth, a professor of educational psychology at MSU is supervising the project. In our study, students will respond to survey questions about their perceptions of support from their teacher and peers. They will also respond to questions about their own engagement in school. Both the County School District and the MSU Institutional Review Board have approved this procedure.

Please consider allowing your child to participate in this important study by returning a signed copy of the enclosed signature page (the blue sheet).

Thank you in advance and please don't hesitate to contact me or Dr. Roseth if you have any questions or concerns.

Sincerely yours,

Ammon J. Wilcken

Cary J. Roseth, PhD.

Appendix E

Survey Protocol

Student Assent Process

The Role of Peer and Teacher Relatedness in Children's Motivation: A Longitudinal Study

Protocol

Student Identification and Greeting In Classrooms

In classroom, RA works with teacher(s) to bring class to order. RA then reads from script below.

Hello everyone. My name is_____, and I am a student at Michigan State University. I'm here today because I am learning to be a scientist that studies schools and I need your help. Today, you can help me learn about schools by answering some questions. These questions are not a test and, in fact, each of you will be given a secret code number so that once I get back to Michigan, your name will not be connected to your answers. Answering these questions will take about 30-45 minutes and then, when we finish, I have some pencils for each of you as a way to say 'thank you' for helping me to learn about schools.

Student Assent

RA begins to read from the Student Assent Form.

[Following Student Assent Form: "You are being asked to participate in a research study about school. Your parent(s) and teacher have said it is okay for you to answer these questions for me but I also need your permission to answer some questions for me..."]

RA continues to read Student Assent Form, pausing after each section to ask students whether they have any questions.

At section "DOCUMENTATION OF INFORMED CONSENT," RA stops reading from the Student Assent Form, continuing from the script below.

We are now ready for you to decide whether you want to answer some survey questions about your relationship with your teacher and classmates. Please write your name on the bottom of the sheet where it says 'Name.'

Next, if you want to participate in the study, please put a checkmark by the word 'Yes'. Or, if you do not want to participate in the study, please put a checkmark by the word 'No'.

Classroom teacher circulates the room confirming that students have given assent. Any student refusing to participate will be taken by the teacher to an alternative room.

Administer Questionnaire

Great, thank you for agreeing to participate in our study. We will now get started on the survey.

RA passes out questionnaire booklet and begins reading questionnaire.

APPENDIX F

Student Questionnaire (Adapted from Connell & Wellborn, 1991; Furrer & Skinner, 2003)

Demographic Section:

1. Please enter your first name:
2. Please enter your last name:
3. Please enter today's date (for example 09/15/2010):
4. Please enter your age:
5. Please enter your teacher's name (for example, Mrs. Keys):
6. Please mark your gender: Female or Male

Student Survey Items:

Each question was followed with a five point Likert scale with three anchors ranging from never--sometimes--always.

7. When I'm with my Teacher, I feel accepted.
8. When I'm with my Teacher, I feel unimportant.
9. When I'm with my Teacher, I feel like someone special.
10. When I'm with my Teacher, I feel ignored.
11. When I'm with my Classmates, I feel accepted.
12. When I'm with my Classmates, I feel unimportant.
13. When I'm with my Classmates, I feel like someone special.
14. When I'm with my Classmates, I feel ignored.
15. When I'm with my Friends, I feel accepted.
16. When I'm with my Friends, I feel unimportant.
17. When I'm with my Friends, I feel like someone special.
18. When I'm with my Friends, I feel ignored.
19. I feel that my teacher provides me choices and options.
20. My teacher believes in my ability to do well in this class.
21. I feel confident in my ability to learn in this class.
22. I am able to achieve my goals in this class.
23. My teacher encourages me to ask questions.
24. If I decide to learn something hard, I can.
25. My teacher tries to understand how I see things before suggesting a new way to do things.
26. I can do well in school if I want to.
27. If I don't do well in school, it's because I didn't work hard enough.
28. I feel able to meet the challenge of performing well in this class.
29. For me to do well in school, all I have to do is work hard.
30. I can't do well in school, even if I want to.
31. I feel understood by my teacher.

32. I am capable of learning in this class.
33. My teacher listens to how I would like to do things.
34. If I don't do well on my schoolwork, it's because I didn't try hard enough.
35. If I want to do well on my schoolwork, I just need to try hard.
36. I can't stop myself from doing poorly in school.
37. I try hard to do well in school.
38. In class, I work as hard as I can.
39. When I'm in class, I participate in class discussions.
40. I pay attention in class.
41. When I'm in class, I listen very carefully.
42. When I'm in class, I think about other things.
43. When I'm in class, my mind wanders.
44. When I'm in class, I feel good.
45. When we work on something in class, I feel interested.
46. Class is fun.
47. I enjoy learning new things in class.
48. When we work on something in class, I get involved.
49. When we work on something in class, I feel bored.
50. When I'm in class, I feel worried.
51. When we work on something in class, I feel discouraged.
52. When I'm in class, I feel bad.

Appendix G

Teacher Questionnaire (Adapted from Connell & Wellborn, 1991; Pianta, 1992; Used with permission. This questionnaire should not be used without Robert Pianta's consent).

Teacher-Student Relationship Survey

Demographic information

1. Please enter your name.
2. Please enter the first and last name of the STUDENT for this survey.
3. Please enter the STUDENT's gender.
4. Please report the STUDENT's ethnicity.
    a. White
    b. African-American
    c. Hispanic, Latino or Spanish origin
    d. American Indian
    e. Asian-American
    f. Other

Teacher Survey Items

First Section: Closeness and Conflict.

All items were followed by a 5 point Likert scale with markers of: Definitely does not apply, Not really, Neutral, Applies somewhat, and Definitely applies.

5. I share a warm, positive relationship with this student.
6. This student and I always seem to be struggling with each other.
7. If upset, this student will seek comfort from me.
8. This student values his/her relationship with me.
9. When I praise this student, he/she beams with pride.
10. This student spontaneously shares information about himself/herself.
11. This student easily becomes angry with me.
12. It is easy to be in tune with what this student is feeling.
13. This student remains angry or is resistant after being disciplined.
14. Dealing with this student drains my energy.
15. When this student is in a bad mood, I know we're in for a long and difficult day.
16. This student's feelings toward me can be unpredictable or can change suddenly.
17. This student is sneaky or manipulative with me.
18. This student openly shares his/her feelings and experiences with me.

Second Section: Student Engagement vs. Dissaffection

All items were followed by a 5 point Likert scale with markers of: Never, Sometimes and Always.

19. When we start something new in class, this student participates in discussions.
20. In my class, this student works as hard as he/she can.
21. When I explain new material, this a student listens carefully.
22. In my class, this student does more than required.
23. When we start something new in class, this student doesn't pay attention.
24. When we start something new in class, this student thinks about other things.
25. In my class, this student does just enough to get by.
26. In my class, this student comes unprepared.
27. When we start something new in class, this student is enthusiastic.
28. When working on classwork in my class, this student appears involved.
29. In my class, this student seems interested.
30. In my class, this student seems unhappy.
31. When I explain new material, this student doesn't seem to care.
32. In my class, this student is angry.
33. When working on classwork in my class, this student appears frustrated.
34. When we start something new in class, this student seems restless.
35. When working on classwork in my class, this student seems uninterested.

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