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Correlates of Change in Elementary Students' Perceptions of Interactions with their Teacher

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Abstract

Students' perceptions of interactions with their teacher lay the stage for future interactions, ultimately influencing students' success in school. While prior work has elucidated what individual and contextual factors contribute to the development of middle and high school students' perceptions, less is known about elementary students' perceptions. As such, the present study leveraged a racially/ethnically diverse sample of third and fourth grade students and teachers in a large, urban district to investigate whether stable student and teacher characteristics (e.g., sex) and observed quality of classroom interactions influenced change in students' perceptions of interactions with their teacher. Results indicated that students rated their teacher more positively from Time 1 to Time 2 when female and in classrooms characterized by positive teacher-student interactions. Unexpectedly, students in classrooms characterized by high Instructional Support rated their teachers less positively over time. Implications for teacher-student relationships and students' academic and social-emotional achievement are discussed.

Correlates of Change in Elementary Students' Perceptions of Interactions with their

Teacher

Teacher-student relationships are foundational to students' success in school. Relationships characterized by warmth, connection, and trust help to bolster students' academic achievement (O'Connor & McCartney, 2007) and social-emotional development (Pianta & Stuhlman, 2004), particularly among academically and behaviorally at-risk students (Crosnoe et al., 2010; Hamre & Pianta, 2001). The benefits of such high-quality relationships may play a unique role in supporting middle grade elementary students as the focus of instruction becomes more academically rigorous and they begin engaging with high stakes testing. Critical to the development of these relationships are the interactions that undergird them, which have themselves been shown to positively influence students' ability to thrive in school (Hamre & Pianta, 2005). Unlike relationships, however, teacher-student interactions are most often studied at the classroom-level (Cadima, Leal, & Burchinal, 2010; Cameron-Ponitz, Rimm-Kaufman, Grimm, & Curby, 2009; Curby et al., 2011; Jennings et al., 2017) rather than dyadically, which has resulted in a vague empirical understanding of how individual students perceive interactions with their teacher.

According to developmental systems theory (DST; Lerner, 1998), these interactions are best understood from multiple perspectives (e.g., students). While there is some evidence to support the link between elementary school students' perceptions of interactions with their teacher and academic (Schenke, 2018) and social-emotional development (Rucinski, Brown, & Downer, 2016), what work exists probing factors that may contribute to students' perceptions has largely been conducted using samples of middle and high school students (Erstevåg & Havik, 2019; Ruzek & Schenke, 2019; Schenke, Ruzek, Lam, Karabenick, & Eccles, 2018) –

samples developmentally distinct from younger students in elementary school. Better understanding what influences the development of younger students' perceptions of interactions with their teacher is important because students ascribe meaning to these perceptions that outline expectations for future interactions (Clark & Lemay, 2010) and have implications for the development of teacher-student relationships (Pianta, 1999). The present study addresses this gap by investigating what student and teacher characteristics are associated with third and fourth grade students' perceptions of interactions with their teacher.

DST also posits that teacher-student interactions be understood within the classroom context in which they most often occur (Pianta & Allen, 2008). While extant research shows that classrooms characterized by emotionally, organizationally, and instructionally supportive interactions support students' academic and social-emotional development (Curby, Brock, & Hamre, 2013), emerging research provides evidence suggesting that simply being in these classrooms is not enough – students must perceive this support themselves to experience the positive effects (Brock, Nishida, Chiong, Grimm, & Rimm-Kaufman, 2008; Ruzek, Hafen, Allen, Gregory, Mikami, & Pianta, 2016; Schenke, 2018). As such, the second aim of this study is to investigate whether observed classroom quality was related to individual students' perceptions of interactions with their teacher.

Theoretical Perspectives on Teacher-Student Interactions

According to developmental systems theory (DST; Lerner, 1998), students' development can be understood as the result of myriad systems (e.g., relationships) that interact within and across different levels (e.g., individual, classroom) that are more (e.g., biological) or less (e.g., social policies) proximal to the individual (Pianta, Hamre, & Stuhlman, 2003). From this perspective, teacher-student relationships, and the social, emotional, and academic interactions

that undergird them (Pianta, 1999), are one of many systems that define the contextual landscape that support or inhibit students' academic and social-emotional development. In this paper, we investigated how stable student and teacher characteristics and observed classroom quality contributed to change in elementary-aged students' perceptions of interactions with their teacher. The following sections summarize research relevant to these research aims, which we situate within DST.

Students' Perceptions of Interactions with Their Teacher

Like all systems, teacher-student relationships are made up of component parts (Pianta et al., 2003); foundational among these are the interactions that take place over time (Pianta, 1999). Each interaction, and impressions of interactions over time, are dynamically defined. How a student or teacher makes meaning of an interaction is largely dependent on individual perceptions that shape memories of past and expectations for future interactions (Clark & Lemay, 2010), all of which may result in more or less stable perceptions over time. These perceptions are influenced by, among other things, the stable (e.g., sex, race/ethnicity) and variable (e.g., beliefs, values) characteristics of teachers and students (Pianta et al., 2003). For example, female teachers may interact differently with male and female students, dependent on understanding of and expectations for different gendered roles (Spilt, Koomen, & Jak, 2012). Thus, interactions are most robustly understood when considered from multiple perspectives.

Increasingly, late elementary through high school-aged students are being asked to report on the supportive, organizational, and instructional qualities of interactions with their teacher that support or inhibit learning in the classroom (Chaplin, Gill, Thompkins, & Miller, 2014; Ross et al., 2017). These perceptions are most often leveraged to describe the classroom as opposed to any individual student's experience within it (Lüdtke, Robitzsch, Trautwein, & Kutner, 2009).

For example, middle school teachers had higher value-added scores when students in their classroom reported them to be more organized around classroom management (e.g., effective use of instructional time; Wallace, Kelsey, & Ruzek, 2016), and reading and math achievement among fourth and fifth grade students increased in classrooms where students reported their teachers to be more academically challenging (e.g., "My teacher pushes everybody to work hard"; Sandilos, Rimm-Kaufman, & Cohen, 2017).

Most measures of students' perceptions of interactions with their teacher, including the one used in both the Wallace et al. (2016) and Sandilos et al. (2018) studies, indicate that the vast majority of variation resides between students, not classrooms (Downer, Stuhlman, Schweig, Martinez, & Ruzek, 2014; Fauth, Decristan, Rieser, Klieme, & Büttner, 2014). This means that students in the same classroom are experiencing it differently from one another, and these differences have been found to influence students' academic and social-emotional development. For example, elementary students who reported feeling academically encouraged by their teacher had higher math achievement at the end of the year compared to students who felt less encouraged (Schenke, 2018). Another study found that elementary students reported lower levels of depression when they perceived interactions with their teacher to be characterized by warmth and support (Rucinski et al., 2016).

There is ample evidence that elementary-aged students report experiencing different interactions with their teacher (Downer et al., 2014; Fauth et al., 2014; Wallace et al., 2016), and that these perceptions of interactions contribute to a host of other student outcomes (Sandilos et al., 2017). What remains virtually unknown is what factors relate to change in elementary school students' perceptions of interactions with their teacher (for findings related to middle and high school students, see Summers, Davis, & Hoy, 2017; Ruzek & Schenke, 2019), and there are

developmental reasons to investigate this specifically among younger students. Compared to middle and high school students, elementary-aged students spend the majority of each school day with one teacher, resulting in more time over which interactions with their teacher occur, but also increasing the influence that those interactions are likely to have for students (Hughes & Cao, 2018). That there is more time over which interactions might exert influence is important context, given that elementary students rely more on co-regulation to effectively regulate their behaviors and emotions, which means they depend more heavily on their teacher to support their positive experience in the classroom (Baker, Grant, & Morlock, 2008; Zee & de Bree, 2015). Further, elementary school students have less well-developed cognitive skills (e.g., working memory, abstract reasoning; Eisenberg et al., 1989; Luna, Garver, Urban, Lazar, & Sweeney, 2004) than older students, placing constraints on what (e.g., one's own experience versus inferences or judgements of what others experience) and how (e.g., complexity of Likert-scale response options) they are able to report on their experiences. Given these developmental differences between elementary and middle or high school students, investments in understanding elementary students' perceptions of interactions is warranted.

Because interactions are interdependent and dynamically defined, how one interaction is perceived holds implications for the next, and stable characteristics of individuals are theorized to influence those perceptions (Pianta et al., 2003). For example, a recent meta-analysis showed that girls attained higher grades than boys (Voyer & Voyer, 2014). This could be an indicator that teachers are interacting differently with boys and girls in the classroom, which may become more apparent and salient related to students' perceptions as those interactions unfold throughout the school year. Alternatively, it could be that achievement, as measured by grades, influences other behaviors in the classroom (e.g., engagement, acting out), which may create patterns of

teacher-student interactions that iteratively influence students' perceptions. Regardless, individuals' stable characteristics (e.g., sex) help to define perceptions of and expectations for interactions that take place over time. With this in mind, this study leverages students' perceptions of positive interactions with their teacher at two time points to explore whether stable (i.e., demographic) student and teacher characteristics are associated with change in perceptions of interactions over time.

The Classroom as Context for Teacher-Student Interactions

One central tenet of DST is that systems themselves interact in interdependent ways; that smaller systems (e.g., interactions) are best understood in relation to the larger systems (e.g., classrooms) in which they function (Pianta et al., 2003). Following from this, characteristics of the classroom (e.g., how well the teacher is able to manage students' behavior) provide important context for understanding the teacher-student interactions that take place within it – a particularly important point since elementary students spend the majority of their time at school within one classroom.

The observed quality of classroom interactions has emerged as integral for students' success. For example, classrooms characterized by emotionally (e.g., warm, caring) and instructionally (e.g., cognitively stimulating) supportive interactions mitigated low achievement for first grade students identified as at risk (Hamre & Pianta, 2005). Similarly, students entering pre-kindergarten with low math skills showed significant improvement when in classrooms with strong behavior management and effective use of instructional time (Cadima, et al., 2010). It could be, however, that what is observed for the classroom generally is not what individual students experience.

In fact, recent work has provided evidence that classroom quality operates through elementary students' perceptions to influence outcomes (Brock et al., 2008; Schenke, 2018). Thus, it is not enough for students to be exposed to a warm, organized, and instructionally rigorous classroom – they must experience it as such to reap the benefits. Observed classroom quality has been shown to be stable over an academic year (Casabianca, Lockwood, & McCaffrey, 2015). Curby, Rimm-Kaufmann, and Abry (2013) found that observed mean scores (standard deviations in parentheses) for third and fourth grade classrooms rated on a 7-point scale ranged from 5.03 (0.53) - 5.19 (0.57), 5.74 (0.52) - 5.89 (0.54), and 2.74 (0.69) – 2.88 (0.76) across five time points for emotional support, classroom organization, and instructional support, respectively. Given the relative stability, it is likely that students' perceptions of the quality of classroom interactions become reinforced the longer they are exposed to it – students continuously exposed to a warm and supportive environment may more strongly perceive it as such as the year progresses. Some work has linked observed classroom quality to classroom-level teacher-student interactions, as perceived by elementary students (Downer et al., 2014; Schenke, 2018), but no study that we are aware of has investigated the association between observed classroom quality and individual elementary-aged students' perceptions of interactions with their teacher over time. The present study adds to this growing evidence base by investigating the association between observed classroom interactions and change in individual elementary students' perceptions of positive interactions with their teacher.

The Present Study

Using a diverse sample of third and fourth grade students and teachers in urban schools, the present study explored the associations between student (i.e., age, sex, poverty, and race/ethnicity) and teacher (i.e., sex, race/ethnicity, and years of teaching experience)

demographic characteristics, observed classroom quality, and students' perceptions of positive

interactions with their teacher. Due to the lack of prior research investigating student and teacher

factors related to elementary students' perceptions of interactions, we viewed this work as

exploratory and had no specific hypotheses. Regarding observed classroom quality, we

hypothesized that classrooms characterized by emotionally, organizationally, and instructionally

supportive interactions would be positively associated with change in students' perceptions of

positive interactions with their teacher.

Method

Data and Participants

Data for this study come from cohort one (2015-2016) of a two cohort large-scale cluster

randomized controlled efficacy trial[1] of a social-emotional learning (SEL) and literacy

intervention (Reading, Writing, Respect, and Resolution; 4Rs) paired with an intensive teacher

coaching model designed to improve curricular effectiveness (MyTeachingPartner™; MTP). The

4Rs+MTP program integrates these two well-validated interventions to support teachers'

knowledge and use of effective practices, as well as students' social-emotional learning in the

classroom. The 4Rs component of the program is a universal, school-based intervention that

centers content on conflict resolution and intergroup relations, while integrating social-emotional

learning into the language arts curriculum for students in grades K-5 (Jones, Brown, & Aber,

2011). MTP is an innovative approach to professional development that leverages two modes

through which teachers receive feedback about their practice – shared viewing of enacted

classroom practice with a coach, and written feedback and questions from their coach intended to

prompt teachers' self-reflection on practice successes and challenges (Allen, Pianta, Gregory,

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[1] In this design, schools were considered clusters and randomized within each cohort to treatment or control conditions.

Mikami, & Lun, 2011). The study was conducted in third and fourth grade classrooms in a large, urban city located in the northeastern United States. Program implementation occurred over the course of one academic year.

The total analytic sample for the current study included 2,047 third and fourth grade students taught by 145 teachers (synonymous with classrooms) in 27 schools (see Table 1 for sample counts by treatment status). The sample was evenly distributed across third (49%) and fourth (45.5%) grade classrooms, with a small proportion of mixed grade classrooms (5.5%). Just over half of the students were female (54%) with an average age of 9 years ($SD = .81$). There was a high rate of economic disadvantage, with 85% of students eligible for free or reduced price lunch (FRPL). Just over one quarter of students (28%) were identified as having special education (SPED) status (19 classrooms consisted of 100% students identified as having an Individualized Education Program [IEP]), and 15% were identified as English Language Learners (ELL). The majority of students were identified as Hispanic or Latino (65%) with the remaining identified as Black (26%), White (5%), or Other (4%).

The majority of teachers were female (93%) and reported an average of 11 years of teaching experience ($SD = 7.52$). This was a highly qualified sample of teachers with the majority (93%) holding a master's degree. Teachers were racially/ethnically diverse; approximately 34% identified themselves as White, 25% as Hispanic or Latino, 30% as Black or African American, 6.5% as Multiracial, 3.5% as Asian, and 1% as Other. The average class size was 22 students ($SD = 5.48$; Range $= 8 - 33$).

Procedures

All full-time third and fourth grade teachers in participating treatment and control schools were eligible for the study. Out of all eligible teachers ($n = 177$), 153 (86.4%) consented to

participate (90.5% of teachers who returned a consent form). Seven of these teachers later withdrew their consent, either because they no longer wanted to participate or because they had personal or health reasons that prevented them from continuing to participate. Active parental consent was obtained through permission forms that research study staff distributed to classrooms of students between September and December. Out of all eligible students ($n =$ 3,356), 2,364 (70.4%) received parental permission to participate in the study (82.3% of students who returned a parent permission form). One parent later withdrew consent to have their child participate.

The majority of participating teachers (93%) reported on their demographic characteristics via a self-report survey administered in the summer (August) prior to the start of the academic year. A small number of teachers ($n = 10$) completed the self-report survey between August and December. Students reported on their perceptions of interactions with their teacher via a self-report survey administered in the winter (January - April). The majority of students (85%) completed the survey by March. Summer and winter data are subsequently referred to as Time 1. All participating students also reported on their perceptions of interactions with their teacher at the end of the academic year (May), which will be referred to as Time 2. In order to account for the wide Time 1 data collection window in relation to Time 2 data collection, a time lag variable was created and included in all predictive models. This variable is described in detail in the analytic plan. Following is a detailed description of procedures related to student survey administration and classroom observations.

Procedures for student survey administration. The student self-report survey was administered at Time 1 and 2 to students in each participating teacher's classroom who had received active parental consent to participate in the study. Two trained field researchers visited

each classroom and administered the survey to students as a group during one class period (approximately 45 minutes). One field researcher read each survey item aloud while the other walked around the classroom to answer questions and assist students as needed. Before administering the survey, each student was asked to provide written assent indicating whether they agreed to participate in the study and complete the survey. At Time 1, 133 consented students (6%) refused assent and did not complete the survey. At Time 2, 184 consented students (10%) refused assent and did not complete the survey.

For students whose primary language was Spanish, survey administration was conducted in Spanish ($n = 40$ or 2% of students at Time 1; $n = 34$ or 2% of students at Time 2), either with individual students or in small groups, usually at the back of the classroom. When one or more students in a classroom were absent on the initial survey administration day, at least one attempt was made to return to the classroom at a later date to administer the survey to those students. These make-up sessions were conducted individually or in small groups, usually at the back of the classroom.

Procedures for classroom observations. A live classroom observation was conducted in each participating teacher's classroom at Time 1 and 2. Because only Time 1 classroom observations were included in analyses, all following information pertains to those in particular. A team of 18 classroom observers who were trained to reliability and certified on the Classroom Assessment Scoring System-Upper Elementary (CLASS-UE; Pianta, Hamre, & Mintz, 2012) conducted the observations between January and May, with 85% having been completed by April. Reliability certification required scoring within one scale point of the master-coded score on 80% of the dimension scores and scoring within one scale point of the master-coded score on at least two out of five codes within each dimension. With the exception of classrooms that were

double-coded (see Measures section for more detail), each classroom observation was conducted by one observer and included four 20-minute cycles, with each cycle followed by a ten-minute coding period. The vast majority of observations were completed in a single two-hour session, but a small number had to be split across two or three sessions, either on one day or across two different days ($n = 5$ classrooms at Time 1).

Classroom observers were blind to the 4Rs+MTP random assignment status of the schools in which they conducted observations. At each time point, CLASS scores were averaged across all four cycles to create 11 dimension scores, which were the data points used to specify exploratory structural equation models (ESEM) that yielded superordinate domains used in this study (described in more detail under Measures).

Measures

Students' perceptions of positive interactions with their teacher. Students' perceptions of positive interactions with their teacher were measured using 30 items from the Learning about Teacher-Student Interactions survey (LATSI; Downer et al., 2014). In order to create a measure of students' perceptions of positive interactions with their teacher, only items that oriented the students to their teacher were retained. For example, the item "My teacher helps me to solve this problem" was retained, whereas the item "I feel comfortable in this class," which requires the student to consider the classroom as a whole, was not. Students responded to these 21 items using a 5-point Likert scale ranging from 1-*Almost Never* to 5-*Almost Always*. LATSI has shown construct validity (Downer et al., 2014) and predictive validity using a smaller subset of items (Rucinski et al., 2018).

LATSI was developed to align with the Teaching Through Interactions (Hamre & Pianta, 2007) framework, such that items represented three conceptual domains: Emotional Support,

Classroom Organization, and Instructional Support. Downer et al. (2014) provided empirical

evidence that a larger set of LATSI items organized into three latent factors represented these

domains. Considering the present sample, confirmatory factor analysis (CFA) showed identical

fit between a one- and three-factor solution[2] (CFI = .92, TLI = .91, RMSEA = .04, SRMR = .04).

The latent factors defined in the three factor solution were highly correlated (between r = .88 and

r = .95) suggestive of a single underlying construct. As such, we proceeded with the one-factor

solution. The single LATSI factor showed metric (ΔCFI = .00) and partial scalar invariance

between Time 1 and Time 2 (ΔCFI = .004; Cheung & Rensvold, 2002). With evidence that the

LATSI measures the same underlying construct across time, we opted to utilize mean scores in

place of factor scores or a latent variable, such that results could be interpreted on the scale used

by students to respond to LATSI items (e.g., point increases or decreases on the 1-5 scale). As

such, the mean of these 21 LATSI items was used to represent students' perceptions of positive

interactions with their teacher oriented toward emotional, organizational, and instructional

support. In the current sample, LATSI items showed acceptable internal consistency at both

Time 1 (α = .88) and Time 2 (α = .90). While the sample means (see Table 2 univariate statistics

for all key study variables) did not differ substantially from Time 1 (M = 3.69, SD = .71) to Time

2 (M = 3.73, SD = .75), students' perceptions were moderately positively correlated (r = .62, p <

.001; see Table 3 for bivariate correlations among all study variables) indicating that some

students' perceptions became more or less positive between time points.

Observed classroom interactions. Observations of the general quality of teacher-student

interactions in the classroom was measured using the CLASS-UE (Pianta et al., 2012). The

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[2] There were a total of 23 LATSI items that prompted students to explicitly reflect on their teacher. However, two of these items (one positive climate and one negative climate) were found to function poorly. As such, both items were removed from all measurement models and from the construction of mean scores. Results did not vary dependent upon their inclusion.

CLASS-UE consists of three domains under which lie 11 dimensions (listed in parentheses) that align with the Teaching Through Interactions framework (Hamre & Pianta, 2007): *Emotional Support (positive climate, negative climate, teacher sensitivity, regard for student perspectives)*, which describes the affective quality of teacher-student interactions, how attuned the teacher is to the individual needs of students, and how effective the teacher is at facilitating and supporting students' autonomy in the classroom; *Classroom Organization (behavior management, productivity, instructional learning formats)*, which measures how well the teacher is able to manage student behavior, effective use of instructional time, and the extent to which the teacher is able to organize materials and activities to engage students; and *Instructional Support (content understanding, analysis and inquiry, quality of feedback, instructional dialogue)*, which describes the teachers' use of cognitively stimulating instruction, targeted feedback, and facilitated discussion to increase students' learning.

Observers rated each CLASS-UE dimension (1 – *very low* to 7 – *very high)*. Interrater reliability (IRR) was calculated using the 38 observations (13%) that were double-coded across the data collection year. IRR was calculated using a one-way random intraclass correlation (ICC), which captures rater consistency across two measured constructs (Shrout & Fleiss, 1979). The ICC is a conservative measure of interrater reliability, as it includes both the variability within and across observers. ICCs can range from -1 to +1, with values less than .5 indicating poor reliability, values between .50 and .75 indicating moderate reliability, values between .75 and .90 indicating good reliability, and values greater than .90 indicating excellent reliability (Koo & Li, 2016). In the current study, ICCs were 0.62 for the Emotional Support domain, 0.20 for the Classroom Organization domain, and 0.54 for the Instructional Support domain. The low ICC for Classroom Organization reflects the fact that there was limited variability in the double-

coded scores and not that there was low agreement among observers. Indeed, agreement was relatively high for Classroom Organization, with 81% of double-coded scores for the domain falling within one scale point of each other.

In order to attain a measure of global quality of classroom interactions, bifactor exploratory structural equation modeling (Bi-ESEM) was used to define a global latent factor in addition to the three conceptual domains described. This approach was taken for two reasons. First, defining generally positive classroom interactions aligned with the student perception measure, which allowed for the examination of the extent to which students exposed to generally positive classroom interactions perceived generally positive interactions with their teacher, over and above other types of classroom interactions. Second, an examination of the three factor CFA (e.g., Emotional Support, Classroom Organization, and Instructional Support) showed poor fit to the data (CFI = .81, RMSEA = .16, SRMR = .11) and a traditional bifactor solution failed to converge. Unlike confirmatory approaches, Bi-ESEM models cross-loadings of indicators such that an indicator could appreciably load onto more than one latent factor (Morin, Arens, & Marsh, 2016). The benefit of this method is that it uses all available data to define latent factors instead of constraining the factor loadings of indicators onto their non-dominant latent factor to zero. This is appropriate when applied to the CLASS-UE because, for example, it is reasonable to think that the dimension of Positive Climate (i.e., warm and respectful teacher-student interactions and relationships) would significantly contribute variation to more than just the domain of Emotional Support.

The Bi-ESEM model showed acceptable fit to the data (CFI = .99, TLI = .98, RMSEA = .05, SRMR = .01). With the exception of negative climate (factor loading = .23) and analysis and inquiry (factor loading = .36), all CLASS dimension factor loadings ranged from .51 to .72 (see

Table 4 for all factor loadings) indicating that (1) these dimensions contributed substantial

variation to the global factor and (2) the underlying global factor was not disproportionately

defined by some smaller subset of dimensions. As such, we interpret the global factor as Global

Quality of Classroom Interactions, though we limit our discussion of characteristics related to

negative climate and analysis and inquiry due to the comparatively small amount of variance

each contributed. The pattern of factor loadings across the three sub-factors supported

interpreting them as Emotional Support, Classroom Organization[3], and Instructional Support.

Further, the factor determinacy scores for each latent factor ranged from .82 - .93, suggesting the

estimated factor scores were reliable representations of the underlying factors. As such, factor

scores[4] from the four Bi-ESEM latent factors were exported and used in all predictive models.

Student and teacher demographics. Student demographic data including age, sex, and

race/ethnicity were collected via school records provided by the local Department of Education.

Teachers reported on their years of experience and race/ethnicity via a survey administered at

Time 1. In order to investigate between-group differences in changes in students' perceptions of

positive interactions with their teacher that may stem from racial/ethnic group identification,

initial attempts were made to include the following racial/ethnic categories for students and

teachers in all models: Black, Hispanic or Latino, White, and Other. Unfortunately, multiple

imputation models constructed to include these racial/ethnic categories for students, teachers, or

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[3] Two dimensions conceptualized to define the domain of Instructional Support significantly crossloaded onto Classroom Organization. The size of the crossloadings were small (< .30), which means that each was contributing a relatively small amount of variance to the sub-factor. In addition, the largest factor loadings for this sub-factor belonged to dimensions conceptualized to define Classroom Organization, supporting our interpretation of that sub-factor as such.

[4] Mean scores for Global Quality of Classroom Interactions, Emotional Support, Classroom Organization, and Instructional Support could not be used because a bifactor model allows all items to first load onto a global factor after which remaining variance is used to model subfactors. It would not be a synonymous approach, nor methodologically justifiable to use the same item-level variance to generate mean scores for each of these domains.

both failed to converge. As such, the decision was made to dichotomize student and teacher race

to represent Non-white (vs. White).

Analytic Plan

Results from an unconditional two-level model[5] indicated that 16% of the variance in

students' perceptions was attributable to classrooms, indicating multilevel modeling to be the

appropriate methodological approach (Raudenbush & Bryk, 2002). To interpret the intercept as

Time 2 students' perception of positive interactions with their teacher in a classroom at its

average perception, all continuous level-1 variables were group-mean centered (e.g., centered on

each classroom's average; Hoffman & Gavin, 1998). Level-1 covariates themselves might have a

nested structure (i.e., the ICC of Time 1 student perceptions was .10 indicating that 10% of the

variance existed between classrooms) resulting in a unique association with the level-1 and level-

2 variance in the outcome (i.e., Time 2 student perceptions; Hoffman, 2015). As such, all

continuous level-1 covariates were modeled at level-1, and included as covariates (i.e.,

aggregated to the classroom-level) predicting the random intercept at level-2. The equations

below represent those specified to examine correlates of change in students' perceptions of

positive interactions with their teacher:

Level-1 Equation (student-level):

$$Y_{ij} = \beta_{0j} + \beta_1 Covariates_{ij} + r_{ij}$$

Level-2 Equation (classroom-level):

$$\beta_{0j} = \gamma_{00} + \gamma_{0p} StAggCov_j + \gamma_{0q} L2Covariates_j + \gamma_{0r} CLASS_j + u_{0j}$$

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[5] Because the study design randomized treatment at the school-level, a three-level unconditional model was initially investigated. Results indicated there to be virtually no (ICC = .004) between school variation in students' perceptions of positive interactions with their teacher. As such, we proceeded with a two-level model, including treatment status as a covariate at level-two.

Where Y_{ij} is the perception of positive interactions with the teacher for student i in classroom j, β_{0j} is the average students' perception for classroom j, β_1 is the effect of level-1 (i.e., Time 1 student perceptions; students' age, sex, poverty status, and race/ethnicity; and time lag for survey completion), and r_{ij} is the deviation from the classroom mean perception for student i in classroom j, holding constant the vector of covariates. At level-2, the intercept from level-1 (β_{0j}) becomes the outcome, γ_{00} is the grand mean of students' perceptions, γ_{0p} are the effects of covariates that have been aggregated from level-1 (i.e., classroom mean student perceptions and age), γ_{0q} are the effects of other level-2 covariates (i.e., treatment status, teacher race/ethnicity, teacher's years of experience), γ_{0r} are the effects of CLASS-UE domains, and u_{0j} is classroom j's deviation from the grand mean of students' perceptions holding constant the vector of covariates.

As previously mentioned, the Time 1 and Time 2 data collection windows spanned three months and one month, respectively. As such, some students had a longer lag between Time 1 and Time 2 self-reports than others. To account for this, we controlled for the number of days between Time 1 and Time 2 student survey completion dates. This lag variable (subsequently referred to as time lag) was included in all predictive models.

Missing data, the prevalence of which ranged from less than 1% to 22.5%, was dealt with using multilevel multiple imputation. Applied to these data, this approach allows imputed values to vary as a function of classroom-specific slopes resulting in more precise estimation (Keller & Enders, 2017). Twenty imputed datasets were created using Blimp (Keller & Enders, 2017) and analyzed in Mplus version 7 to estimate the associations between student and teacher demographic characteristics, observed classroom interactions, and change in students' perceptions of positive interactions with their teacher. Two models were estimated. Model 1

investigated individual students' age, sex, race/ethnicity, and poverty status; teacher sex, race/ethnicity, and years of experience; classroom-level time 1 student perceptions and student age related to Time 2 students' perception of positive interactions with their teacher, controlling for Time 1. Because the intervention itself might have had a unique influence on students' perceptions of positive interactions with their teachers, treatment status[6] was also controlled for at level 2. Model 2 added observed classroom quality (Global Quality of Classroom Interactions, Emotional Support, Classroom Organization, Instructional Support) to Model 1. As previously noted, the time lag variable was included in both models to control for the timing of data collection.

Several statistics were used to contextualize model fit and explanatory power. First, the within and between residual variance components were used to calculate the proportion of variance explained by all independent variables and covariates in each model, which we refer to as R_1^2 in tables and text (Snijders & Bosker, 2012). Second, the percent change in variance (PCV; Merli, Yang, Chaix, Lynch, & Råstam, 2005) was calculated for the within and between levels, respectively. More specifically, PCV values represent the amount of level-1 or level-2 variance explained that is attributable to specific independent variables and/or covariates included at either level. Finally, Cohen's f^2 was calculated as a measure of local effect size for statistically significant independent variables (Cohen, 1988; Selya, Rose, Dierker, Hedeker, & Mermelstein, 2012). In line with convention, values of .02, .15, and .35 indicate a small, medium, and large

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[6] A sensitivity analysis was conducted in which all models were examined for treatment and control groups, respectively. Most results were not sensitive to treatment status. However, students' sex (i.e., female) and instructional support were not significantly associated with change in students' perceptions of positive interactions with their teacher among students in treatment group schools. The effect size for both sex ($f^2 = .00$) and instructional support ($f^2 = .01$) related to the outcome were small in the full sample. It is unlikely we were able to detect such effects with smaller samples ($N_{treatment} = 861, N_{control} = 1,186, N_{full} = 2,047$).

effect. The present study's sample ($N = 2,053$) is able to detect with 80% power effect sizes of .01 or higher.

Results

Associations between Student and Teacher Demographics and Students' Perceptions of Interactions with Their Teacher

Model 1 results indicate that student sex (female) was significantly positively associated with Time 2 student perceptions, controlling for Time 1 perceptions ($b = .07$, $p < .05$, $f^2 = .00$; see Table 5 for Model 1 and 2 results). This means that female students rated interactions with their teachers .07 units more positively from Time 1 to Time 2 than male students in their same classroom. Despite being statistically significant, the effect size was small. No other student or teacher demographic characteristics were significantly associated with change in students' perceptions. All covariates in Model 1 explained 40% of the variance in Time 2 students' perceptions of positive interactions with their teacher. The level-1 PCV was .35 indicating that 35% of the variation in Time 2 students' perceptions of positive interactions with their teacher was attributable to level-1 covariates. The level-2 PCV showed that 67% of the between classroom variation in students' perceptions was attributable to level-2 covariates (see Table 5 for a list of all level-1 and level-2 covariates).

Associations between Observed Classroom Interactions and Students' Perceptions of Interactions with Their Teacher

Model 2 results indicated global quality of classroom interactions to be significantly positively associated with Time 2 student perceptions, controlling for Time 1 perceptions ($b = .08$, $p < .001$, $f^2 = .01$). This means that each unit increase in global quality of classroom interactions was associated with a .08 point increase in students' perceptions of positive

interactions with their teacher from Time 1 to Time 2. In contrast, Instructional Support was significantly negatively associated with Time 2 student perceptions, controlling for Time 1 (b = -.07, $p < .05$, f^2 = .01). This indicates that a one unit increase in observed Instructional Support was associated with a .07 point decrease in students' perception of positive interactions with their teacher from Time 1 to Time 2. The effect size for both of these associations was small (f^2 = .01). The domains of Emotional Support and Classroom Organization were not significantly associated with students' perceptions of positive interactions with their teacher. All covariates in Model 2 explained 41% of the variance in Time 2 students' perceptions of positive interactions with their teacher. The level-2 PCV showed that 74% of the between classroom variation in students' perceptions was attributable to level-2 covariates.

Discussion

The present study investigated stable demographic characteristics of students and teachers and quality of observed classroom interactions related to change in elementary students' perceptions of positive interactions with their teacher. We examined this in a historically racially/ethnically minoritized sample of third and fourth grade students – a population at particular risk of developing relationships characterized by more conflictual interactions over time (Spilt, Hughes, Wu, & Kwok, 2012). While student sex (female), global quality of classroom interactions, and Instructional Support emerged as significant predictors, the effect sizes for all were small. Both Model 1 and Model 2 explained approximately 40% of the variation in Time 2 student perceptions, controlling for Time 1. Further, level-1 covariates explained about one third (35%) of the variation between students and level-2 covariates explained between 67%-74% of between classroom variance. These represent some of the first empirical findings of what does and does not contribute to the development of elementary school

students' perceptions of interactions with their teacher, helping to contextualize the teacher-student relational system that supports students' development (O'Connor & McCartney, 2007; Pianta & Stuhlman, 2004). The following sections empirically and practically situate these findings in the broader study of teacher-student relationships, highlight avenues for future research stemming from this work, and discuss limitations to consider.

Student and Teacher Demographic Characteristics Related to Students' Perceptions of Interactions with Their Teacher

The present study is among the first to empirically investigate what student and teacher demographic characteristics influence upper elementary school students' perceptions of interactions with their teacher within an academic year. While developmental systems theory applied to teacher-student relationships posits that such characteristics help students make meaning of interactions (Pianta, et al., 2003), the present study found little evidence to support this related to changes in perceptions over time. The only student or teacher demographic characteristic to emerge as significantly associated with change in students' perceptions was student sex, such that female students rated interactions with their teachers more positively over time compared to male students. This finding aligns with extant work showing that teachers report more relational conflict and less closeness with male students (Jerome, Hamre, & Pianta, 2009; Koomen & Jellesma, 2015; Madill, Gest, & Rodkin, 2014). However, the small effect size ($f^2 = .00$) – indicating limited practical applicability – aligns with work that has shown no difference between boys and girls with regard to teacher-student relational quality (Murray & Murray, 2004). While students' age was not significantly associated with change in students' perceptions of positive interactions with their teacher, it is important to note that age in the present study was group (e.g., classroom) mean centered. Findings from this study suggest that

variation in students' age *within* a classroom is unrelated to change in students' perceptions of interactions over time. Future work would benefit from other methodological approaches, like grand mean centering, to determine if there exist systematic differences in how younger versus older students in a sample perceive interactions with their teacher. Extant research has found a high-declining trajectory to be normative across elementary teachers reporting relational closeness with students in grades 1-5 (Spilt et al., 2012), and that students themselves report declining quality of relationships with their teachers as they transition to and through middle school (Hughes & Cao, 2018). Whether synonymous longitudinal trends exist from elementary students' perspective remains an open question. Alternatively, it could be that stable individual characteristics like sex help students make meaning out of specific interactions, but are less salient related to meaning-making of interactions over time.

Though Model 1 (only student and teacher demographics) explained 40% of the overall variation in students' perceptions at Time 2, this was largely driven by Time 1 student perceptions, which explained the vast majority (97%) of the 35% of variance explained at level-1. That prior experiences of interactions would have such a large influence on later ones is in line with DST (Pianta et al., 2003; Pianta, 1999). How one makes meaning of an interaction informs how subsequent interactions are approached (Clark & Lemay, 2010; Hinde, 1987), leading to patterns of interactions that characterize relationships over time (O'Connor, 2010; Reis, Collins, & Berscheid, 2000; Spilt et al., 2012). This suggests that early impressions matter, and highlights the potential utility in supporting teachers and students to engage in positive interactions early in the school year. Promoting positive interactions early on is likely to set the expectation for future interactions – an especially important point considering the amount of time that elementary students spend with their teacher. Further, because third and fourth grade students are still fairly

dependent on their teacher to support their positive behavior in the classroom (Baker et al., 2008; Zee & de Bree, 2015), students who perceive positive interactions with their teacher early on may be more likely to rely on them to co-regulate, putting in motion a positive feedback loop between teacher-student relationships and student behavior that ultimately supports students' success. Evidence from a randomized controlled trial of a school-wide intervention intended to support the development and maintenance of positive teacher-student relationships revealed that the intervention led to a significant decrease in fourth and fifth grade students' observed disruptive behavior (Cook et al., 2018), highlighting the potential power of such feedback loops. Teachers' perceptions of relational quality may operate through students' perceptions to influence outcomes including student behavior. As such, the field would benefit from utilizing both teacher and student reports of interactional or relational quality in future intervention efforts. It is worth noting that the present study measured students' perceptions of interactions with their teacher mid-year and thus this study cannot speak to what proportion of variance perceptions at the start of year might explain related to those at the end of the year. However, the ICC (i.e., between classroom variability) for students' perceptions of interactions with their teacher increased from Time 1 to Time 2, indicating that perceptions of students within classrooms converged over time. It is reasonable to think that the convergence observed was more persistent from earlier in the school year than the present study observed.

While most stable characteristics of students and teachers were not found to influence change in students' perceptions of positive interactions with their teacher, present findings should not be viewed conclusively. It is worth noting, for example, that the present study's student sample was 95% non-white. Extant research provides evidence that students of color often have different relationships with their teachers compared to their white peers from pre-

kindergarten and beyond (Garner & Mahatmya, 2015; Hughes & Kwok., 2007; Jerome, 2009; 2007; Spilt et al., 2012). It could be that such differences may be reflected in student reports of interactions with their teacher in more racially/ethnically diverse samples, though it could also be that between racial/ethnic group differences did exist, but we were unable to detect them having grouped students identified as Black, Hispanic, and Other into one category. Relatedly, more measurement work needs to be done to confirm whether or not this student perception measure, and others like it, measure the same underlying construct(s) among students of different races/ethnicities. While the confirmatory measurement model fit our data well, we did not have the sample size to test multigroup models by race/ethnicity. Alternatively, it may be that these stable characteristics interact to influence changes in students' perceptions. For example, a growing literature on student-teacher race-match suggests pre-kindergarten and elementary school teachers perceive and interact differently with students dependent upon whether or not the students' race matches their own (Downer, Goble, Myers, & Pianta, 2016; Rasheed, Brown, Doyle, & Jennings, 2019; Saft & Pianta, 2001). Future work would benefit from replication in other samples, as well as investigations of interactive effects of student and teacher stable characteristics related to students' perceptions of interactions with their teacher.

In addition to stable demographics, DST postulates that variable characteristics (e.g., beliefs, psychological states) contribute to how students and teachers make meaning of and develop expectations for future interactions (Pianta et al., 2003, Clark & Lemay, 2010). While not a focus of the present study, this seems a fruitful avenue for future work. For example, there is a growing literature indicating that teachers experiencing higher levels of stress, depression, or burnout interact with students in less emotionally, organizationally, and instructionally supportive ways (Jennings et al., 2017; Sandilos, Goble, Rimm-Kaufman, & Pianta, 2018).

Whether or not students perceive these differences related to how their teacher interacts with them is an open question. Abstract reasoning and perspective-taking skills are still developing among third and fourth grade students (Eisenberg et al., 1987; Selman, 1974). As such, teacher states, like burnout, may only be perceived by elementary-aged students if they translate into concrete behaviors that influence interactions.

However, in this study only 16% of the variation in students' perceptions of positive interactions with their teacher was attributable to classrooms, and relatively little (33%) of that remained unexplained. While future work would certainly benefit from investigating things like teachers' wellbeing related to students' perceptions, there is more explanatory power to be leveraged in explaining differential perceptions *between* students in the same classroom. The majority (84%) of the variation in students' perceptions existed between students, and our models only explained about a third (35%) of that, even having controlled for time 1 student perceptions. As such, investigations focusing on variable characteristics of students is warranted. For example, one study found more disagreement between students reporting on their teacher's emotional support in classrooms observed to be unfair (Schenke et al., 2018). It is possible that students who experience unfairness or injustice directed toward them might perceive their teachers less positively compared to those who did not. This finding, however, was among a sample of middle schoolers – students who have more advanced perspective-taking (Choudhury, Blakemore, & Charman, 2006) and abstract reasoning skills (Eisenberg et al., 1987) than elementary students. Perceptions of fairness may only influence student perceptions of interactions with their teacher once these cognitive skills – which facilitate students' ability to make complex inferences about the circumstances of a peer whom they might compare themselves to – have developed, though this is an empirical question that merits testing. Student

behavior may also contribute to changes in students' perceptions of interactions. Extant work provides evidence that elementary students displaying externalizing behaviors tend to have more conflictual relationships as reported by teachers (Murray & Murray, 2004; Skalická, Stenseng, & Wichstrøm, 2015), which may translate into less positive interactions as perceived by students (see Erstevåg & Havik, 2019 for an example of how proactively aggressive fifth through tenth grade students differentially perceive interactions with teachers). Given that most of the variation in elementary students' perceptions of interactions with their teacher exists between students in the same classroom, the field would benefit from examining what student beliefs, values, classroom experiences, and psychological states influence how these perceptions change over time.

Observed Classroom Quality Related to Students' Perceptions of Interactions with Their Teacher

As hypothesized, global quality of classroom interactions was positively associated with change in elementary students' perceptions of positive interactions with their teacher. More specifically, students perceived interactions with their teacher more positively when their teacher created a warm and supportive environment, effectively managed student behavior, implemented routines to maximize learning time, and facilitated discussions to increase learning. This finding aligns with prior work that showed classroom quality to operate through elementary school students' perceptions to influence outcomes (Brock et al., 2008; Schenke, 2018). Though the effect size was small ($f^2 = .01$), global quality explained 5% of the 74% of total variance explained at level-2 – not an inconsequential amount given that Time 1 student perceptions accounted for almost half (45%) of the variance. Extant research has shown observed classroom interactions to be particularly important for academically and behaviorally at-risk students

(Cadima et al., 2009; Curby, Rudasill, Edwards, & Pérez-Edgar, 2011; Hamre & Pianta, 2005; Wilson, Pianta, & Stuhlman, 2007). As such, investigations of populations of elementary students for whom high quality global classroom interactions may be particularly beneficial is warranted related to students' perceptions of positive interactions with their teacher. For example, the association between global quality of classroom interactions and students' perceptions of positive interactions with their teacher may be dependent upon students' psychological state – perceptions of students experiencing depression or anxiety may become more positive when in a high quality classroom compared to students that are not. Future work would benefit from investigations of conditional benefits of classroom interactions.

Counter to our hypothesis, Instructional Support was negatively associated with students' perceptions of positive interactions with their teacher. This means that teachers who provided cognitively stimulating instruction, opportunities to engage with open-ended tasks, and structured dialogue to support students' learning were viewed less positively by their students compared to teachers who did not. The present study operationalized Instructional Support using a bifactor exploratory structural equation model, which means that instructional support must be understood as what variance relevant dimensions have left to contribute after having defined the global factor (Morin et al., 2016). It may be that what variance is shared between Instructional Support, Emotional Support, and Classroom Organization comprises more affective interactional qualities, leaving variance related to Instructional Support that might be interpreted as "cognitive press" or how effective teachers are at delivering content to students (Hamre, Hatfield, Pianta, & Jamil, 2014).

Though unexpected, Schenke (2018) observed a negative association between observed Instructional Support and upper elementary students' perceptions of instructional support,

indicating this to be a robust finding. It could be that instructionally rigorous teaching practices create discomfort for students, especially net of global quality, emotional support, and classroom organization. For example, Instructional Support includes the extent to which the teachers attend to and correct students' misconceptions and opportunities provided for students to explain their thoughts, self-evaluate, and reflect (Pianta et al., 2012). Students who misunderstand a concept and are corrected might feel disappointment in having gotten the answer wrong or embarrassment in having done so in front of the class. Similarly, having to share and revise your thoughts can be a vulnerable process during which students might feel anxious or insecure. Given that this negative association has now been found in two studies, future work would benefit from investigating specific classroom practices associated with Instructional Support related to students' perceptions of interactions with their teacher.

Limitations

The present study contributes to understanding how students' perceptions of positive interactions with their teacher change within an academic year. However, findings must be contextualized by several limitations. Because the majority of students first reported on positive interactions with their teacher between January and March, several months of the school year had passed during which students' perceptions of interactions had the opportunity to develop. While it is notable that significant associations emerged related to change in students' perceptions over such a condensed period of time – raising questions about when in the academic year interventions might be effective – it is possible that stronger or different associations might have arisen had change in students' perceptions across a wider span of the academic year been investigated.

Measurement error in student reports of positive interactions with their teacher is included in the mean scores created for both Time 1 and Time 2, which may be biasing results. Though this is an important first glance into how elementary students' perceptions of interactions with their teacher change over time, future work should consider leveraging structural equation methodologies (e.g., latent change scores) to probe this topic with more precision. Issues of generalizability also need to be considered. Because the student sample leveraged for the present study included a high proportion of historically racially/ethnically minoritized students in an urban area, findings cannot be assumed to generalize to more racially/ethnically homogeneous student samples or those living in rural or suburban areas. Further, issues regarding multiple imputation model convergence constrained the number of student and teacher racial/ethnic categories that we were able to investigate in predictive models. It is possible that between racial/ethnic group differences in change in students' perceptions of positive interactions with their teacher existed that we were unable to observe due to this limitation.

Finally, while the present study provides insight into between student differences in how perceptions of teacher-student interactions change over time, the methodology employed does not investigate within person fluctuations over time (Hoffman, 2015). Recent work leveraging a sample of middle and high school students showed a different pattern of results between students' mastery goal orientation and their perceptions of academic press dependent on whether between- or within- student changes were modeled (Ruzek & Schenke, 2019). Future work would benefit from similar approaches in younger student populations to determine whether rank order of perceptions (i.e., where a student's perceptions fall in comparison to other students) or an individual student's deviation from their own mean level of perceptions are stronger predictors of how their perceptions change over time.

Conclusion

Students' perceptions of interactions with their teacher are foundational for future interactions (Clark & Lemay, 2010), influencing the quality of teacher-student relationships (Brock et al., 2008) and ultimately students' success in school (Jamil et al., 2008). A growing base of evidence has developed providing insight into how perceptions of teacher-student interactions fluctuate among middle and high school students (Erstevåg & Havik, 2019; Ruzek & Schenke, 2019; Schenke et al., 2018). Adding to this, the present study contributes a better understanding related to change in elementary students' perceptions of interactions with their teacher, providing critical insight to the teacher-student relational system that might be leveraged to support teachers and students to thrive.

Acknowledgements

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Table 1.
Analytic sample counts by treatment status.

	Treatment	Control	Total Sample
Students	861	1,186	2,047
Teachers/Classrooms	66	79	145
Schools	14	13	27

Table 2.
Univariate statistics for key study variables.

	Mean	SD	Min	Max
T1 St. Perc.	3.69	0.71	1.00	5.00
T2 St. Perc.	3.73	0.75	1.00	5.00
CLASS-GL	0.00	0.92	-2.68	1.82
CLASS-ES	0.01	0.81	-3.79	2.25
CLASS-CO	0.01	0.85	-2.21	1.89
CLASS-IS	0.01	0.81	-1.73	2.44

Note. SD = standard deviation, T1 = time 1, T2 = time 2, St. Perc. = students'
perceptions of interactions with their teacher, CLASS-GL= CLASS global factor
scores, CLASS-ES = CLASS emotional support factor scores, CLASS-CO = CLASS
classroom organization factor scores, CLASS-IS = CLASS instructional support factor
scores.

Table 3.
Bivariate correlations for all study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. T2 St. Perc.	1														
2. T1 St. Perc.	.62***	1													
3. St. Age	.01	.06**	1												
4. St. Female	.10***	.10***	-.08***	1											
5. St. Poverty	.05*	.07**	.06**	.01	1										
6. St. Non-White	.03	.05*	.05*	-.02	.30***	1									
7. Time Lag	.03	.05*	-.07**	-.01	.01	.01	1								
8. TX	.04	.01	.03	.02	.17***	.10***	-.03	1							
9. Tch. Yrs. Exp.	.07**	.03	.03	.02	.05**	.05*	-.10***	.19***	1						
10. Tch. Female	.04	.02	-.04	.01	.02	.01	.01	.08***	.11***	1					
11. Tch. Non-White	.09**	.05	-.05*	.00	.17***	.18***	-.08**	.12***	.24***	.09***	1				
12. CLASS-GL	.11***	.06**	.04	-.02	-.07**	-.06*	.01	-.22***	-.07**	-.07**	-.04	1			
13. CLASS-ES	.05	.02	-.02	.02	-.06**	.00	.06*	.08***	.02	-.09***	.00	.13***	1		
14. CLASS-CO	.07**	.06**	-.02	.02	.00	.01	-.15***	.06**	.07**	.00	-.03	.11***	-.00	1	
16. CLASS-IS	-.08**	-.03	.02	-.02	-.07**	.10***	.04	-.19***	-.09***	-.08***	-.03	.15***	-.16***	-.17	1

Note. $N_{classrooms}$ = 145. Bivariate correlations were conducted prior to imputation. T1 = time 1, T2 = time 2, St. Perc. = students' perceptions of interactions with their teacher; St. = student, Time Lag = time lag in days between Time 1 and Time 2 survey completion, TX = treatment status (1=treatment), Tch Yrs. Exp. = teacher's years of experience, Tch. = teacher, CLASS-GL= CLASS global factor scores, CLASS-ES = CLASS emotional support factor scores, CLASS-CO = CLASS classroom organization factor scores, CLASS-IS = CLASS instructional support factor scores.
*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table 4.
Factor loadings resulting from the Classroom Assessment Scoring System – Upper Elementary Bifactor Exploratory Structural Equation measurement model.

	CLASS-G	CLASS-ES	CLASS-CO	CLASS-IS
Positive Climate	.67***	.53***	.13	-.07
Teacher Sensitivity	.68***	.38***	.11	-.12
Regard for Student Perspectives	.51***	.34*	-.22	.25
Negative Climate	.23***	.36***	.07	-.02
Behavior Management	.53***	.15	.58***	-.10
Productivity	.51***	.01	.59***	.00
Instructional Learning Formats	.69***	-.05	.08	.08
Content Understanding	.72***	-.21	-.07	.37**
Analysis and Inquiry	.36**	-.03	-.08	.66***
Quality of Feedback	.58***	.07	-.26**	.29
Instructional Dialogue	.67***	.14	-.23***	.52***
Factor Determinacy Score	.94	.82	.86	.82

Note. Standardized factor scores are reported. CLASS-GL= CLASS global, CLASS-ES = CLASS emotional support, CLASS-CO = CLASS classroom organization, CLASS-IS = CLASS instructional.
*** $p \leq .001$. ** $p \leq .01$. * $p \leq .05$.

Table 5.
Results for multilevel models examining the associations between student and teacher demographics, observed quality of classroom interactions, and change in students' perceptions of interactions with their teacher.

	Model 1			Model 2		
	Estimate	(S.E)	f^2	Estimate	(S.E.)	f^2
Level-1						
Time 1 St. Perc.	.61***	(.02)	.63[7]	.61***	(.02)	.61
St. Age	-.04	(.03)		-.04	(.03)	
St. Female	.07*	(.03)	.00	.07*	(.03)	.00
St. Poverty	.01	(.04)		.01	(.04)	
St. Non-White	-.03	(.08)		-.04	(.08)	
Time Lag	.00	(.00)		.00	(.00)	
Level-2						
CL Time 1 St. Perc.	.87***	(.08)		.82***	(.08)	
CL St. Age	-.02	(.03)		-.02	(.03)	
Treatment	.02	(.05)		.04	(.04)	
Tch. Non-White	.05	(.05)		.05	(.05)	
Tch. Female	.04	(.08)		.05	(.08)	
Tch. Yrs. Exp.	.00	(.00)		.00	(.00)	
CLASS-G	-			.08***	(.02)	.01
CLASS-ES	-			-.02	(.03)	
CLASS-CO	-			.00	(.02)	
CLASS-IS	-			-.07**	(.02)	.01
R_1^2		.40			.41	

Note. All estimates are unstandardized. Local effect sizes (f^2) are reported for significant associations. Models were estimated across 20 imputation datasets. S.E. = standard error; St. Perc. = students' positive perceptions of interactions with their teachers; St. = student; CL = classroom-level; Tch. = teacher; CLASS-G = CLASS global; CLASS-ES = CLASS emotional support; CLASS-CO = CLASS classroom organization; CLASS-IS = CLASS instructional support.
*** $p \le .001$. ** $p \le .01$. * $p \le .05$.

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[7] The local effect sizes reported for Time 1 student perceptions represents the effect of that variable at both level-1 and 2.