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Student Perceptions of Teacher-Student Relationships in General and Special Education

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ABSTRACT OF THE THESIS

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Teacher-student relationships (TSRs) have largely been found to significantly impact student performance and achievement (Roorda, Koomen, Spilt, & Oort, 2011). The purpose of this investigation was to identify differences between the TSRs experienced by students in special education (SPED) and their typically developing peers, and analyze how these differences impacted academics (i.e., math achievement). Secondary analysis of data from the Measures of Effective Teaching (MET) project indicated no statistical or practical differences between the TSRs reported by SPED students and their peers in general education. Furthermore, teacher caring was found to predict math achievement for non-SPED students. However, student-perceived TSRs were not found to be related to math achievement for SPED students. Implications of these findings are discussed.

Keywords: teacher-student relationships, math, special education

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Students with disabilities often struggle academically in comparison to their typically developing peers, with achievement gaps noted in reading, mathematics, science, and social studies (Wagner, Newman, Cameto, & Levine, 2006). Recent data from the National Center for Education Statistics (2019) demonstrate differences in the academic performance of students with and without disabilities, particularly in the content area of math. In 2019, 50% of 4th grade students identified as having a disability scored within the "Below Basic" range on national assessments of mathematics, while only 14% of the students without disabilities obtained similar scores (NCES, 2019).

Empirical research concerning rates of growth further indicate poor math achievement by students with disabilities. Shin, Davison, Long, Chan, and Heistad (2013) employed growth curve modeling using math and reading assessment scores across three years (Grades 4 to 7) to examine the achievement gaps between students receiving various services (i.e., SPED, free and reduced lunch, language) and students enrolled in regular education classes only. Analyses suggested a decreasing achievement gap in the content area of reading over time but indicated an increasing math achievement gap over time. Students enrolled in special education consistently earn lower math (and reading) achievement levels in comparison to non-SPED students (Shin et al., 2013). Similar results from Schulte and Stevens (2015) indicate that students with disabilities persistently had lower achievement and less growth in math than their typically developing peers throughout Grades 3 and 7.

Several publications have addressed the low math performance of SPED students by examining and advocating for the implementation of evidence-based practices (e.g.,

Okilwa & Shelby, 2010; Powell, 2015). Multiple strategies have been found to positively impact the math performance of students with learning disabilities, including explicit instruction and instructor feedback (Geresten, Chard, Jayanthi, Baker, Morphy, & Flojo, 2009). In addition to these strategies, an additional factor that may influence math achievement is the quality of a teacher-student relationship.

Teacher-Students Relationships

Teacher-student relationships, or TSRs, have been conceptualized as consisting of varying combinations of teacher and student perspectives, with a few consistent and notable elements considered from the perspective of both teachers and students: caring, conflict, expectations, respect, and warmth (Brinkworth, McIntyre, Juraschek, & Gehlbach, 2018). Specific studies have examined each of these elements for differing purposes and with differing methods.

Drawing on three studies utilizing both quantitative and qualitative methods, Muller, Katz, and Dance (1999) examined caring and expectations in TSRs for students in middle and high school and how these impact academic outcomes. The authors reported that teachers largely based their expectations on student test scores, which in turn were found to impact teacher-student interactions and teaching (Muller et al., 1999). Students, on the other hand, assigned great importance to teacher caring, reporting teacher fairness and understanding as crucial factors of the teacher-student relationship.

Teven and McCroskey (1997) examined TSRs in college-age students by analyzing student-perceived teacher caring in association with student evaluations of teachers. Participating college students were asked to rate their professors' caring (i.e.,

teacher empathy, understanding, and responsiveness) as well as complete measures pertaining to their attitudes towards and likelihood of taking another course with the teachers (Teven & McCroskey, 1997). Results indicated that teacher caring, as perceived by students, played a significant role in the student's evaluation of the teachers (Teven & McCroskey, 1997).

In a similar vein, Yu, Johnson, Deutsch, and Varga (2018) sought to determine key factors that positively influence adolescent views of TSRs and found teacher noticing and teacher investment to be of significance. Teacher noticing refers to acknowledgement of individual students and their unique needs from the teacher (i.e., calling students by name in class, interacting with students outside the classroom) (Yu et al., 2018). Teacher investment includes teachers making substantial efforts to bond and interact with students. Within the context of this study, students reported teacher caring and listening as teacher investment (Yu et al., 2018). The results of this study indicate that, from the perspective of students, positive TSRs are characterized by teacher noticing and involvement, and contributed to the level of closeness, respect, and trust students felt towards their teachers (Yu et al., 2018).

Other important factors from the standpoints of students include feelings toward teachers, time spent with teachers, and interest in teacher-led activities as reported by Minuchin and Shapiro (1938; as cited in Pianta & Nimetz,1991). Although the role of student-perceived teacher caring has been well established as a TSR indicator, a variety of TSR conceptualizations, including those from teacher perspectives, have been used to gauge the impact TSRs have on student performance and achievement.

Impact of TSRs

Despite the varying conceptualizations of teacher-student relationships presented within the literature, TSRs have largely been found to significantly impact student performance and achievement (Roorda, Koomen, Spilt, & Oort, 2011). In a meta-analytic examination of TSRs, Roorda et al. (2011) compared the influence of positive TSRs and negative TSRs on student academic engagement and achievement. Teacher-student closeness (i.e., warmth and openness) served as the defining feature of positive TSRs and demonstrated positive associations with the outcome variables. Conflict between instructors and their pupils indicated negative TSRs and was shown to have detrimental effects on student engagement and achievement, especially for primary school students (Roorda et al., 2011). These results indicate the relevance of both teacher-student closeness and conflict within classrooms (Roorda et al., 2011).

Roorda et al. (2011) additionally suggested that TSRs share stronger correlations with student engagement than achievement, regardless of the nature of the relationship. Findings from an investigation by Klem and Connell (2004) which explored the influence of student-perceived teacher support (i.e., teacher involvement, expectations, facilitation of autonomy) on student achievement and engagement provides a plausible explanation for such results (Klem and Connell, 2004). An analysis of longitudinal data taken from elementary schools indicated an indirect association between teacher support and achievement via teacher-reported student engagement (Klem & Connell, 2004). That is, student reports of teacher caring relate to higher levels of student engagement, which in turn predict better attendance and test scores. Higher attendance rates and examination

results are strong indicators of school completion and continuation (i.e. achievement; Klem & Connell, 2004). Positive TSRs have been found to play integral roles in student engagement and achievement. Further research provides evidence for the influence positive teacher-student relationships have on shaping student behavior.

As found in a study examining the impact of student-teacher relationships on risky behavior, students are less likely to engage in risky behaviors (e.g. smoking, drinking) when they share positive relationships characterized by closeness with their teachers (Rudasill, Reio, Stipanovic, & Taylor, 2010). Furthermore, conflict-heavy TSRs were found to increase the occurrence of risky behavior in adolescents (Rudasill et al., 2010). Taken together with the previously mentioned studies, these results suggest that positive TSRs produce good behavioral outcomes while also increasing academic engagement and achievement. The advantages of teacher closeness and warmth are not limited to general achievement but can also be seen within individual subject areas.

Subject specific achievement. TSRs with a focus on student variables (i.e., student participation, achievement, motivation) and learning are considered "learner-centered" (Cornelius-White, 2007). Learner-centered teacher-student relationships have been found to produce achievement in several academic domains (Cornelius-White, 2007). Results obtained via meta-analytic methods indicate that learner-centered TSRs share significant positive associations with grades, math achievement, verbal achievement, and perceived achievement (Cornelius-White, 2007).

An analysis by Hughes and Kwok (2007) corroborated the notion that TSRs have an indirect yet important impact on achievement. In regard to literacy, quality teacher-

student relationships from the teacher's perspective yielded higher levels of student engagement and eventually reading achievement, as measured by teacher report and a standardized test of academic achievement respectively (Hughes & Kwok, 2007). Similar findings were not obtained for math, also measured by a standardized assessment, likely due to the heavy emphasis and attention given to reading during first grade (Hughes & Kwok, 2007). However, there is substantial evidence from individual studies in support of a positive relationship between TSRs and math achievement.

Math achievement. A longitudinal investigation of the impact of teacher-student relationships on students' academic achievement and motivation found and highlighted the indirect benefits of TSRs for math achievement (Hughes, Wu, Kwok, Villarreal, & Johnson, 2012). Specifically, the results indicated that student-perceived teacher warmth influenced student math competence beliefs, thereby affecting achievement on a standardized assessment of math. Although competence and achievement were considered for both math and reading, teacher conflict and warmth had considerably stronger effects on mathematics (Hughes et al., 2012). The authors ascribe this to the large proportion of instructional time geared towards math in Grades 3 to 5.

McCormick, O'Connor, Cappella, and McClowry (2013) examined the impact of teacher-reported TSRs on math and reading achievement scores for students transitioning from kindergarten to first grade. Similar to Hughes et al. (2012), positive TSRs were found to have a beneficial impact on math achievement (McCormick et al., 2013)**.** That is, quality teacher-student relationships in kindergarten predicted achievement on a standardized math measure taken in first grade. Such results were not duplicated for

reading. One posited explanation for this phenomenon is that student growth in the area of reading may stem from the high amount of time spent on literacy within these grades as well as the increased use of research-based instructional practices for reading (McCormick et al., 2013). Teacher-student relationships may have negligible effects on reading in comparison to the constant delivery of literacy lessons (McCormick et al., 2013).

Support for the importance of TSRs in math achievement for at-risk students comes from an analysis of student reports of teacher-student relationship quality (TSRQ). According to Richardson (2007) from The Education and Economic Development Coordinating Council, any student requiring interim or long-term intervention for academic success and positive life outcomes is considered at-risk for prematurely leaving school. Results from Hughes (2011) suggest that math achievement can be predicted by student perceptions of TSRs. Similarly, a longitudinal study found that teacher caring (e.g. praise, listening, expectations) plays an especially prominent role in math achievement for students who are at risk of leaving school (Muller, 2001). For these students who are at-risk, teacher caring may provide social capital and a greater connection to the academic activities of the classroom (Muller, 2001).

As suggested by the aforementioned investigations, the impact of TSRs is likely significant for math achievement and potentially invaluable for at-risk students. Additional research has explored TSRs in association with various at-risk populations, including students enrolled in special education (SPED). These studies examine the

quality of TSRs often experienced by SPED students and the potential benefits of quality TSRs for this population.

TSRs for Students with and Without Learning or Behavioral Problems

Studies examining the quality of teacher-student relationships experienced by students with learning or behavioral problems and their typically developing peers have reported differences across the two groups (Baker, 2006; Blacher, Baker, & Eisenhower, 2009). In a comparison of the TSR patterns for children with and without intellectual disabilities (ID), Blacher et al. (2009) used standardized assessments of intelligence and parent-completed adaptive behavior scales to establish disability status, while teacher responses on a classroom climate survey provided information about the classes (i.e., special versus general education) each individual with ID participated in. To determine the degree to which student behavior and social skills deficits influenced TSRs, the participating teachers also completed various measures meant to assess perceptions of TSR quality (i.e., conflict, closeness), student behavior problems, and student social skills repertoire (Blacher et al., 2009). Data were longitudinally collected over three years, starting when the children were age six and occurring once a year thereafter. Results indicated that TSR quality was less stable for the children with intellectual disability (ID). That is, students with ID participate in progressively less close and more conflictual relationships with their teachers during their early schooling years (Blacher et al., 2009). Social skills demonstrated a significant role in teacher closeness, while behavior problems were predictive of conflict (Blacher et al., 2009). Overall, children with ID

were found to have poorer TSRs than their typically developing peers at all stages of the study (Blacher et al., 2009).

Whereas Blacher et al. (2009) investigated TSRs for children with ID, Baker (2006) focused on all students and found important results regarding students with behavioral or learning problems. With the main purpose of examining the impact teacher-perceived positive TSRs have on behavioral, social, and academic outcomes, additional data on specific student characteristics were collected in hopes of identifying moderators (Baker, 2006). Behavioral and social data was obtained via teacher completion of a standardized behavioral scale and teacher assignment of social development to students. Academic achievement was measured using school records, which included language arts report card grades and standardized reading assessment results. Grade level, gender, and behavioral problems were considered as potential moderators.

Results from Baker (2006) indicate TSRs influence academic, behavioral, and social outcomes similarly for students across grade levels and gender. However, compared to typically developing peers, students with behavioral or learning issues demonstrate poor school outcomes and experience fewer benefits from positive TSRs. Interestingly, a difference was noted between students with behavioral problems experiencing TSRs characterized by closeness and children of the same population without positive TSRs. The close TSRs had a protective effect on the students with behavioral problems, meaning these students performed better in reading than children with behavioral problems and poor TSRs.

Both Baker (2006) and Blacher et al. (2009) highlight the difference in TSR quality experienced by students with and without behavioral or learning problems. The importance of TSRs for students with behavioral problems was also reported (Baker, 2006), with additional support for this notion coming from studies exclusively investigating TSRs in relation to at-risk students.

TSRs and At-Risk Students

In an investigation of the quality and impact of TSRs experienced by African-American students at-risk for special education referral due to behavioral issues, Decker, Dona, and Christenson (2007) obtained both student and teacher perspectives of the relationship, student engagement, and student social skills. Teachers also completed a short behavioral survey about students' disciplinary history. Academic performance was assessed using standardized measures and teacher judgement (Decker et al., 2007). Results indicated higher student and teacher ratings of TSRs were associated with better academic, engagement, behavioral, and social outcomes for students (Decker et al, 2007). These findings provide evidence for the beneficial influence TSRs can have on at-risk students.

Robertson, Chamberlin, and Kasari (2003) examined TSRs between students with autism and their general education teachers, but also studied the role the children's' behavior played in shaping the relationship. Information about the teacher-student relationships and student maladaptive behavior was collected via teacher-completed scales, while students were asked a series of questions to determine the level of social inclusion in their classrooms (Robertson et al., 2003). According to the teachers, students

with autism generally experienced positive TSRs. Further results indicated that higher levels of child problem behaviors predict weaker TSRs and teacher-perceived positive TSRs were associated with fewer behavioral problems and more social inclusion for the students with autism (Robertson et al., 2003).

Taken together, the aforementioned studies highlight the strong connection between TSRs and student behavior and performance. Similar findings were obtained by Baker, Grant, and Morlock (2008) in their attempt to identify contexts under which students with behavior problems may positively adapt to school. An analysis of school records (for academic achievement measures) and teacher-completed behavior scales, TSR scales, social development evaluations, and classroom adjustment surveys indicated that warmth, trust, and low levels of conflict are needed for positive outcomes in this population (Baker et al., 2008).

Current Study

Students in SPED struggle academically and have lower levels of math achievement than non-SPED students (Wagner et al., 2006). Teacher-student relationships, despite having various definitions across the literature, have been associated with improved student performance and achievement in various subjects, including mathematics. Research on TSRs provides evidence to support a relationship between positive teacher-student interactions and better outcomes for students with learning or behavioral problems (Baker et al., 2008; Decker et al., 2007). Given the difficulties SPED students have in math and the noted benefits of positive TSRs, the present study looks to add to the existing literature underscoring the importance of

teacher-student relationships, with a focus on students enrolled in special education and math achievement. The conceptualization of TSRs used is from the student perspective and is related to teacher caring. The purpose of this investigation was to identify whether differences were observable between the TSRs experienced by students in SPED and their typically developing peers, and to analyze how these differences impacted student math achievement.

Method

Secondary analyses of data obtained from the Measure of Effective Teaching Longitudinal Database (MET LBD) were conducted. The MET LBD, funded by the Bill and Melinda Gates Foundation, includes district administrative data, teacher survey responses, student test scores, student survey data, and observational data. Data collection took place across the 2009-2010 (Year 1) and 2010-2012 (Year 2) academic years in six districts across the nation (White, Rowan, Alter & Greene, 2014). Opportunity sampling across schools receiving Gates Foundation funding resulted in 2,741 participating teachers from 317 schools in Year 1, with 2,086 of these teachers contributing to the Year 2 core study sample. Several teachers were subject matter generalists, teaching math and language arts to students in Grades 4-6. Subject matter specialists lead single-subject classes in math, language arts, and science for Grades 4-9 (White et al., 2014). Specialist teachers within the schools nominated classrooms for participation. Year 1 data were collected across 4,497 class sections and a subset (n = 1,909) of these class sections participated in Year 2 (White et al., 2014).

Sample

Across both years, approximately 67% of the students in the full sample identified as Black or Hispanic, while 24% identified as White. Thirteen percent of all participating students classified as English Language Learners and 8% were enrolled in special education. Many students (57%) qualified for free or reduced-price lunch (White et al., 2014).

The current study focused on Year 1 data from students in Grades 4 and 5, as these elementary students typically received instruction from one teacher and therefore had only one TSR to consider. The subsample consisted of a total of 6,859 students, with 587 of these students receiving special education services. The remaining 6,272 students were enrolled in general education classes.

Measures

District administrative data. Administrative data were obtained from each participating district. School level data provided information regarding the enrollment size for each grade, grade configuration, and general student demographics (White et al., 2014). District data also encompassed details regarding teacher gender, ethnicity, educational attainment, and years of experience. Data on individual demographics, free/reduced-price lunch status, program enrollment, and state achievement test scores were available at the student level. The current study focused on student-level data, specifically program participation status, to identify students receiving special education services (White et al., 2014).

The Student Perceptions (TRIPOD) Survey. Students within participating classrooms were administered the Student Perceptions (TRIPOD) Survey as a measure of

student perceptions regarding classroom instruction (White et al., 2014). The TRIPOD was designed to measure seven dimensions of classroom instruction: Care, Control, Clarify, Challenge, Captivate, Confer, and Consolidate. Referred to as the "Seven Cs" (7Cs), these aspects of teaching were measured by 36 items on the TRIPOD. Although the survey used in the MET project included over 75 total items, only the items related to the 7Cs were considered in the evaluation of the psychometric properties of the TRIPOD (White et al., 2014). Analyses conducted by the MET researchers indicated indices for the seven core constructs demonstrated acceptable reliability, with correlations of 0.80 and above (Bill & Melinda Gates Foundation, 2010). The predictive validity of the TRIPOD was demonstrated using comparisons between students' answers on the survey and student achievement gains over time as measured by state assessments. Student responses for each item were recorded using a 5-point Likert scale (i.e., 1 = *No, never/Totally untrue*; 5 = *Yes, always/Totally true*; Bill & Melinda Gates Foundation, 2012). Student TRIPOD responses related solely to math instruction were selected for analysis instead of responses concerning math and language arts instruction to create a more homogeneous subsample. That is, because students may hold different perceptions of the interactions shared with teachers during math and language arts lessons, TRIPOD results may vary across subjects. Due to the focus on TSRs and math achievement in the current study, only TRIPOD data concerning math instruction were considered, while responses related to language arts teaching were excluded.

As discussed previously, student-perceived teacher caring is a commonly noted indicator of quality TSRs (Teven & McCroskey, 1997; Yu, Johnson, Deutsch, & Varga,

2018). Given this information, items relevant to teacher caring about math learning and general caring were selected for analysis across the Care, Confer, and Consolidate dimensions. The Care items relate student perceptions of safety within the classroom, while the Confer items require students to identify how teachers adjust to student input during instruction. Items within the Consolidate grouping have students rate the degree to which teachers promote the integration and understanding of various topics. Four items were selected for the general caring construct, while four additional items comprised the caring about math learning variable (see Appendix A).

Balanced Assessment in Mathematics (BAM). The Balanced Assessment in Mathematics (BAM) was used as a measure of student math achievement (White et al., 2014). Administered to students in Grades 4-8 in their math classes, the BAM measures students' ability to conceptualize problems, manipulate math facts, make inferences, and explain math concepts. Completion of the BAM requires higher order reasoning skills and is cognitively demanding. Students were given one of three forms of the BAM to complete (White et al., 2014). Students achievement scores were transformed into Z-scores by the MET researchers, allowing for combined analyses for Grades 4 and 5.

Analyses

Before the two constructs of general caring and caring about math learning were compared between SPED and non-SPED students, invariance testing within a confirmatory factor analysis framework was carried out (French & Finch, 2006; Jöreskog, 1971; Sörbom, 1974). This procedure to test measurement invariance is aligned with other applications in school psychology (e.g., Kim, Kim, & Kamphaus, 2010;

Pendergast, von der Embse, Kilgus, & Eklund, 2017; Wang, Willett, & Eccles, 2011) which compares models with additional constraints with models with fewer constraints. This well-established procedure starts with the least restrictive model (dimensional invariance model), where the groups have the same number of factors. In our first model, we tested whether the same number of items measure each factor across SPED and non-SPED groups. Subsequent models included additional restriction of equal factor loadings across the SPED and non-SPED groups (metric invariance model); equal item intercepts across the SPED and non-SPED groups (strong invariance model); and equal residual variance across the SPED and non-SPED groups (strict invariance model). This procedure allowed for testing partial invariance where loadings or thresholds for particular items are freed rather than constrained (Bryne, Shavelson, & Muthén, 1989; Putnick & Bornstein, 2016).

A variety of common fit indexes were compared (Bentler & Bonnet, 1980; Hu & Bentler, 1999) including the Akaike information criterion (AIC; Akaike, 1998), the Bayesian information criterion (BIC, Schwartz, 1978), root-mean-square error of approximation (RMSEA; Steiger, 1990), the Tucker-Lewis index (TLI; Tucker & Lewis, 1973), and comparative fit index (CFI; Bentler, 1990). Models with CFI and TLI values of at least .95, and RMSEA values of no more than .06 reflected good fit to the data (Hu & Bentler, 1999). Models with relatively lower AIC and BIC values were also considered a good fit. Chi-square values for nested structural models determined the relative fit of the models.

After evidence of comparability across the groups for both constructs was established, Wald test statistics were calculated to compare factor means and variances across SPED and non-SPED students and regression analyses were carried out to explore the consistency of the relationship between the constructs and math achievement.

Results

There were no statistical or practical differences in student responses by item (Table 1). For example, student responses for an item related to perceptions of their teachers caring about mathematics learning, ("My teacher wants me to explain my answers -why I think what I think"), was similar for non-SPED students ($M = 4.23$, $SD = 0.93$) and SPED students ($M = 4.21$, $SD = 0.97$), $t(6{,}857) = 0.74$, $p = .46$. Similarly, responses for an item related to student perceptions of teacher general caring ("My teacher seems to know if something is really bothering me") indicated a lack of statistically significant and practical differences across SPED students ($M = 3.73$, $SD = 1.20$) and non-SPED students ($M = 3.74$, $SD = 1.22$), $t(6{,}857) = -0.20$, $p = .84$.

When considering the four items for each factor, results such as non-significant χ^2 values and low RMSEA values suggest adequate fit of the one-factor models for student perceptions of their teachers' caring about mathematics learning and general caring (Hu & Bentler, 1999; Kline, 2016) (Table 2). In other words, evidence supports the assertion that the four items measuring caring about math learning relate to a single latent construct, and that the four items measuring general caring relate to a single latent construct.

There is evidence of dimensional invariance across the two groups of students (SPED and non-SPED) for the caring about mathematics learning factor and general caring factor (Table 3). The nonsignificant change in chi-square values when comparing the different models provides evidence of metric invariance (constraining the factor loadings to be equal across the two groups of students), $\Delta\chi^2 = 2.17$, $p = .54$, and strong invariance (constraining the factor loadings and item intercepts to be equal across the two groups), $\Delta\chi^2 = 7.86$, $p = .64$, for the caring about mathematics factor. Similarly, there is evidence of metric invariance, $\Delta\chi^2 = 9.63$, $p = .21$, and strong invariance, $\Delta\chi^2 = 2.59$, $p = .99$, for the general caring factor. While there was no evidence for strict invariance (constraining the item residual variances to be equal) for the caring about mathematics learning factor, $\Delta\chi^2 = 32.76$, $p < .001$, modification indexes suggested freeing the residual variances for two items on the caring about mathematics learning factor ("My teacher is nice to me when I ask questions" and "I like the way my teacher treats me when I need help") improved the model fit, $\Delta\chi^2 = 5.38$, $p = .15$. Similarly, there was no evidence for strict invariance for the general caring factor, $\Delta\chi^2 = 14.86$, $p < .001$, but freeing the residual variance for two items ("My teacher seems to know if something is really bothering me" and "The teacher in this class encourages me to do my best") improved model fit, $\Delta\chi^2 = 7.45$, $p = .06$. With evidence to support partial strict invariance, SPED and non-SPED students had similar interpretations on the two factors.

Given evidence for partial strict invariance, we compared the factor means and variances between SPED and non-SPED students. Across these two groups, there were similar factor means on the caring about math learning factor (factor mean for non-SPED

= 3.81; factor mean for SPED = 3.80) and the general caring factor (factor mean for non-SPED = 4.30; factor mean for SPED = 4.31). There were also similar factor variances for the caring about math learning factor (factor variance for non-SPED = 0.81; factor variance for SPED = 0.41; Wald(1) = 0.50, p = .48) and the general caring factor (factor variance for non-SPED = 0.57; factor variance for SPED = 0.49; Wald(1) = 0.07, p = .78). There was no evidence for statistical or practical differences between SPED students and non-SPED students in terms of their perceptions of their teachers' caring about their math learning or perceptions of their teachers' general caring about them.

These factors are highly correlated with each other for both non-SPED (coefficient= 0.67, SE = .31, $p < .001$) and SPED students (coefficient = .65, SE = .05), $p < .001$) which suggests that while conceptually these are different concepts, statistically, there is great overlap. There were differences in the relationship between these factors to math achievement scores. The caring about math learning factor was related to math achievement for non-SPED students, estimate = 0.06 (SE = .01), $p < .001$ but not related to math achievement for SPED students, estimate = 0.02 (SE = .07), p = .71. Similarly, the general caring factor was related to math achievement for non-SPED students, estimate = .04 (SE = .01), $p < .001$ but not related to math achievement for SPED students, estimate = .06 (SE = .05), p = .29.

Discussion

In this study, we examined the differences between the TSRs experienced by students in SPED and their typically developing peers. Student perceptions of TSRs was measured using the TRIPOD survey. Invariance testing indicated partial strict invariance

across groups for the general caring and caring about math learning factors. This measurement invariance indicates SPED and non-SPED students completed the selected TRIPOD items similarly, suggesting that the survey was practical to use with participants regardless of their special education status and that responses could be compared across groups. Furthermore, the invariance indicated the survey items may be used to predict math achievement for and across groups.

Comparison of the responses obtained on the TRIPOD indicated no statistical or practical differences between the TSRs experienced by SPED and non-SPED students. That is, students enrolled in special education and general education hold similar perceptions of their relationships with their teachers. These results differ from those obtained by prior comparisons of the TSRs experienced by individuals with and without learning or behavioral problems. As previously discussed, Blacher et al. (2009) noted less positive TSRs and more conflictual student-teacher interactions for students with intellectual disability than for their typically developing peers. This discrepancy between findings may be attributable to the methods used for data collection. Whereas our secondary analysis of the MET data focused on student perceptions of TSRs as measured via the TRIPOD, Blacher et al. (2009) assessed TSRs from the perspective of teachers by administering The Student-Teacher Relationship Scale (STRS). Results from Decker et al. (2007) suggested discrepancies between student and teacher views on their shared relationships. Students at-risk for special education referrals generally rated the TSRs positively, while teachers held more negative perspectives of their interactions with students (Decker et al., 2007). The lack of congruity across student and teacher

perspectives of TSRs provides support to the proposed notion that the results of this study differ from previous investigations due to the measurement of TSRs from the student perspective. Future research should examine TSRs from the viewpoints of both teachers and students and explore the impact of any discord between perspectives on various measurement methods and outcomes.

Although students reported participating in comparable TSRs, differences were seen in the impact TSRs had on math achievement for both groups. Caring about math learning and general caring were related to math achievement for non-SPED students, but not for SPED students. Both caring factors predicted math achievement for students in general education, but do not play a significant role in math achievement for student in special education, indicating that alternative factors may be stronger predictors of math achievement for SPED students. For example, student skill and performance deficits may impede achievement and therefore limit the influence of teacher caring. Students in SPED need additional supports, such as explicit instruction or intensive intervention, beyond teacher caring for success in mathematics. Similar conclusions have been made by previous investigations of TSRs. Baker (2006) discussed the need for targeted supports and positive TSRs for students with academic problems. Although students with learning difficulties experienced less advantages from warm interactions with their teachers than the typically developing comparison group, Baker (2006) highlighted the importance of maintaining constructive relationships with such students as positive TSRs can still offer benefits in social, behavioral, and other non-academic contexts.

The limitations of this study should be acknowledged. The findings regarding the similarities between the TSRs reported by both subgroups (i.e., SPED and non-SPED) and the influence of TSRs on math achievement are based on information from a subsample for the MET project. Analyses were completed using data only from students in Grades 4 and 5. Furthermore, the analyses were restricted to Year 1 data. Subsequent empirical investigations should expand of the noted results by looking at students in various grades and across time.

The current study provides evidence towards the potential positive impact that TSRs may have on the math difficulties of non-SPED students. Although SPED students need additional supports for academic success, positive TSRs can benefit other areas of performance for this group (Baker, 2006). Given this information, school psychologists may consider the potential positive outcomes of facilitating warm teacher-student relationships while working to lessen conflict within the classroom. Consultation and coaching sessions between mental health professionals and teachers have been shown to improve teachers' relationships with students (Capella et al., 2012). With a majority of school psychology programs providing training and coursework in consultation (Anton-LaHart & Rosenfield, 2004), school-based practitioners are well-suited to guide teachers and promote positive TSRs to benefit students in a variety of ways.

National assessment data indicate that students with disabilities achieve lower scores on assessments of math in comparison to students without disabilities (NCES, 2019). Numerous strategies and factors have been investigated to improve SPED students' academic performance, including teacher-student relationships. Using data from

The Bill and Melinda Gates Foundation, the current study found no differences in the TSRs experienced by SPED and non-SPED students. Additional analyses indicated a relationship between student-perceived TSRs and math achievement for non-SPED students, while previous studies highlight the importance of TSRs for SPED students in other contexts. School psychologists can use consultation help improve outcomes for students by fostering positive TSRs within schools.

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Table 1

Descriptive Statistics

	Not Special Education (n = 6,272)		*Special Education (n = 587)*	
	M	*SD*	*M*	*SD*
Caring about Math Learning				
When my teacher marks my work, he/she writes on my papers to help me understand how to do better	3.79	1.23	3.91	1.21
My teacher wants me to explain my answers – why I think what I think	4.23	0.93	4.21	0.97
My teacher is nice to me when I ask questions	4.38	0.89	4.39	0.91
I like the way my teacher treats me when I need help	4.42	0.90	4.39	0.92
General Caring				
My teacher in this class makes me feel that he/she really cares about me	4.30	1.01	4.32	1.00
My teacher seems to know if something is really bothering me	3.73	1.20	3.74	1.22
If I am sad or angry, my teacher helps me feel better	3.79	1.30	3.82	1.29
The teacher in this class encourages me to do my best	4.57	0.82	4.53	0.80

Table 2

Model Fit Statistics

Competing Models	*CFI*	*TLI*	*RMSEA*	*90% CI RMSEA*	*AIC*	*BIC*	*ABIC*
Caring about Math Learning							
1. Dimensional invariance	0.94	0.82	0.13	0.12, 0.15	72989.37	73153.37	73077.11
2. Metric invariance	0.94	0.90	0.10	0.09, 0.11	72986.09	73129.59	73062.85
3. Strong invariance	0.94	0.93	0.08	0.08, 0.09	72987.95	73110.95	73053.75
4. Strict invariance	0.93	0.94	0.08	0.07, 0.08	73012.71	73108.37	73063.88
5. Partial strict invariance	0.94	0.94	0.08	0.07, 0.09	72989.13	73098.46	73047.62
General Caring							
1. Dimensional invariance	0.97	0.92	0.12	0.10, 0.13	74889.27	75053.27	74977.01
2. Metric invariance	0.97	0.95	0.09	0.08, 0.10	74892.91	75036.41	74969.68
3. Strong invariance	0.97	0.97	0.07	0.07, 0.08	74889.49	75012.49	74955.29
4. Strict invariance	0.97	0.97	0.07	0.06, 0.07	74896.35	74992.02	74947.53
5. Partial strict invariance	0.97	0.97	0.07	0.06, 0.08	74892.94	75002.28	74951.43

Note. CFI = comparative fit index; RMSEA = root mean square error of approximation, CI = confidence interval; TLI = Tucker-Lewis Index; AIC = Akaike; BIC = Bayesian; ABIC = Adjusted BIC.

Table 3

Invariance Testing

Competing Models	χ^2	*Df*	*Reference Model*	$\Delta\chi^2$	Δdf
Caring about Math Learning					
1. Dimensional invariance	238.60	4			
2. Metric invariance	241.31	7	1	2.71	3
3. Strong invariance	249.17	10	2	7.86	3
4. Strict invariance	281.93	14	3	32.76*	4
5. Partial strict invariance	254.55	12	3	5.38	2
General Caring					
1. Dimensional invariance	186.89	4			
2. Metric invariance	196.52	7	1	9.63	3
3. Strong invariance	199.11	10	2	2.59	3
4. Strict invariance	213.97	14	3	14.86*	4
5. Partial strict invariance	206.56	12	3	7.45	2

*$p < .001$.

APPENDIX A

TRIPOD Items for Caring About Math Learning and General Caring

Factor	TRIPOD Item
Caring About Math Learning	When my teacher marks my work, he/she writes on my papers to help me understand how to do better
	My teacher wants me to explain my answers –why I think what I think
	My teacher is nice to me when I ask questions
	I like the way my teacher treats me when I need help
General Caring	My teacher in this class makes me feel that he/she really cares about me
	My teacher seems to know if something is really bothering me
	If I am sad or angry, my teacher helps me feel better
	The teacher in this class encourages me to do my best