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Impact of student-teacher relationship quality on classroom behavioral engagement for young students on the autism spectrum

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ABSTRACT

Background: Student academic behavioral engagement (BE) contributes to learning and school success. Student-teacher relationships (STRs) may promote BE, although previous findings regarding how these constructs are associated over time are mixed. For young autistic students who face barriers to early school success, a high-quality STR may serve as a key protective factor to promote classroom engagement.

Methods: The present study investigated connections between teacher-rated STR quality and student BE over two school years for 146 young autistic children (grade PK-2) using cross-lagged structural equation modeling. A full model with cross-lagged paths from BE to STR quality *and* from STR quality to BE was first examined. Potential confounding variables (i.e., externalizing behaviors, cognitive skills, and language skills) were included. The model was then trimmed by removing all non-significant paths. It was hypothesized that the final model would highlight the unidirectional influence of STR quality on BE.

Results: Results supported the unidirectional influence of STR quality on BE across one school year. STR quality at the beginning of the first school year predicted behavioral engagement at the end of the year (β =.26, p<.01) BE outcomes persisted into the following school year (β =.45, p<.001).

Conclusions: Findings suggest that STR quality significantly contributes to engagement for young autistic students, potentially serving as a critical protective factor for classroom success. This highlights the importance of developing quality STRs with high levels of closeness and low levels of conflict for students on the spectrum in early schooling.

Classroom behavioral engagement, or children's observed participation in the classroom (e.g., attention, effort, response to directions), is one of many important classroom skills that promotes learning (Fredricks & McColskey, 2012; Fredricks et al., 2004; Reeve, 2013; Robinson & Mueller, 2014; Roorda et al., 2017). Unfortunately, young autistic students in early schooling (PK −2) often face barriers to school functioning and success, including behavioral engagement (Ashburner et al., 2010; Blacher et al., 2014; Jahromi et al., 2013; Matson & Nebel-Schwalm, 2007; Sparapani et al., 2016; Zaidman-Zait et al., 2021). The social communication demands (e.g., working with peers, following verbal directions, joint attention) and behavioral expectations (e.g., transitions between activities) of classroom settings can be a mismatch for the social communication characteristics and restricted and repetitive behaviors (RRBs) in autism (American Psychiatric Association, 2013; Lindsay et al., 2013). During these early school years, positive, high-quality

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student-teacher relationships (STRs) may serve as key protective factors for students' classroom functioning and success, including their engagement with the learning environment (Baker, 2006; Silver et al., 2005). However, there is a dearth of research examining the influence of STR quality on behavioral engagement, specifically, for autistic students in early schooling.

1. Behavioral engagement

Behavioral engagement is critical for student learning and is often a focus in school assessment, intervention, and progress-monitoring, as it involves observable indicators that can be operationally defined and objectively measured (Shapiro, 2011). Higher levels of student behavioral engagement result in more opportunities to learn, which can in turn lead to more positive student outcomes (Fantuzzo et al., 2007; Ponitz et al., 2009). Research indicates that students who are more engaged in the classroom tend to achieve at higher levels than less engaged peers (Finn & Zimmer, 2012; Lei et al., 2018; Rowe & Rowe, 1992). For example, in a nationally representative study of 12,462 kindergarteners, Robinson and Mueller (2014) found that kindergarten students with higher levels of behavioral engagement demonstrated more growth in math achievement over the course of the kindergarten year. Further, student engagement may play a critical mediating role between child background factors and characteristics (e.g., family socioeconomic status (SES), IQ) and early school outcomes (Reyes et al., 2012; Walker et al., 1994).

For students on the autism spectrum, classrooms can present environmental challenges to behavioral engagement. Traditional classroom instruction involves a heavy communication load (e.g., responding to instructions, choral responding, requesting assistance as needed) and often incorporates group or partner activities, making it challenging for students on the spectrum who may have unconventional social communication styles, to engage with their academic environments without additional support (Carnahan et al., 2009; Green & Dixon, 1994; Lindsay et al., 2013; Matson & Nebel-Schwalm, 2007). In inclusive settings, particularly, the mode of instruction is less likely to be modified or individualized based on the needs or interests of individual students, which can be unsupportive of autistic students who often have interests and behavioral characteristics that do not fit with non-autistic classroom expectations or that are deemed problematic, particularly by those with a lack of understanding or exposure to autism (Barned et al., 2011; Mavropoulou & Sideridis, 2014). Few accessible evidence-based resources exist for general education teachers in facilitating the inclusion of students on the spectrum, thus teachers may not know how to identify and build upon autistic students' strengths rather than focusing on their differences (Lindsay et al., 2013). Indeed, Jahromi et al. (2013) found autistic students to be less behaviorally engaged in school than non-autistic peers for a sample of $n = 40$ young students (mean age = 4.5 years) matched on age and expressive language skills. In a sample of $N = 196$ autistic students in early elementary (grade K-2), Sparapani et al. (2016) found that observed active engagement in the classroom (e.g., participation) was positively correlated with communication skills and negatively correlated with externalizing behavior. Overall, the social communication and behavioral demands, and lack of individualization in many classrooms can present challenges to autistic students' academic engagement.

2. Student-Teacher relationships and student engagement

STR quality is one key classroom feature that is consistently linked to student engagement (Cadima et al., 2015; Doumen et al., 2012; Roorda et al., 2017; Wu et al., 2010). In conceptualizing classrooms as complex, multicomponent systems, Pianta et al. (2012) theorized that STRs impact student outcomes indirectly through child and teacher classroom behaviors, including student engagement. Positive STRs are generally conceptualized as being high in closeness (i.e., feelings of warmth, openness, and liking) and low in conflict (i.e., feelings of hostility or discord; Birch & Ladd, 1997; Sabol & Pianta, 2012). From an attachment perspective, developing relationships with teachers that feel safe and supportive allows students to feel more comfortable and perhaps more integrated in the classroom community, which then enables students to learn without heightened anxiety or avoidance of stressful or novel situations (Bergin & Bergin, 2009; Riley, 2009). This comfort and support in the learning environment is likely reflected in student behaviors, including behavioral engagement, which then contributes to students' learning and growth over time (e.g., better academic performance). Several studies with non-autistic students in early schooling (K-3) support this pathway by which STR quality drives students' levels of behavioral engagement, which in turn impact student outcomes (Roorda et al., 2017). Doumen et al. (2012) found that, for a sample of 148 non-autistic kindergarteners, higher levels of STR closeness and lower levels of STR conflict (i.e., higher-quality STRs) predicted behavioral engagement (i.e., teacher-rated independent and cooperative participation) in the classroom. O'Connor and McCartney (2007) found that the effect of STR quality on academic achievement was mediated by direct observational ratings of behavioral engagement for 880 third grade students, such that better quality STRs led to greater levels of behavioral engagement, which in turn promoted better academic achievement outcomes.

The unidirectional influence of STR quality on engagement for early elementary students is further supported by previous studies that explored the potential for a reciprocal, dynamic relation between STR quality and engagement in which they influence one another over time (Archambault et al., 2013; Engels et al., 2016). Archambault et al. (2013) examined transactional associations between STR quality and behavioral engagement (e.g., following directions, participating in class) from first to fourth grade in a sample of 1145 non-autistic students. Their results suggested that STR quality in first grade significantly predicted fourth grade behavioral engagement, but that first grade engagement did not significantly predict fourth grade STR. Similarly, in an older sample (grades 7–11) of $N = 1116$ non-autistic students exploring reciprocal influences between STR quality and behavioral engagement, Engels et al. (2016) found that STR quality unidirectionally influenced engagement. Notably, one study found reciprocal effects between STR quality and engagement, such that STR quality in first grade impacted engagement in second grade, which then impacted STR quality in third grade ($N = 671$ non-autistic students; Hughes et al., 2008). Taken together, although some research with transactional models over time has suggested a reciprocal relationship between STR quality and behavioral engagement over time (e.

g., Hughes et al., 2008), more work has supported the key role of STR quality in driving levels of engagement (Archambault et al., 2013; Engels et al., 2016).

STRs may be even more impactful (i.e., protective) on school functioning for students with existing risk for negative school adjustment and experiences, such as students with high levels of behavior problems (Baker, 2006; Elledge et al., 2016; Hamre & Pianta, 2001). Young students on the autism spectrum are one such group of students, as they face barriers to both classroom engagement and developing positive STRs. Previous research suggests that students on the spectrum are at risk for poorer quality STRs than other groups of students (Blacher et al., 2014; Longobardi et al., 2012). Autistic students with more externalizing behaviors (i.e., behaviors that manifest outwardly towards others or the environment such as aggression and impulsivity) and autism characteristics (e.g., social reciprocity challenges), and lower cognitive and language skills are at the greatest risk for poor-quality STRs (Blacher et al., 2014; Caplan et al., 2016; Robertson et al., 2003). Teachers may have difficulty creating supportive, positive interactions with students who display more externalizing behaviors or RRBs (Barned et al., 2011; Roberts & Simpson, 2016). On the other hand, teachers may find it easier to interact positively with students who have relatively higher social communication (e.g., spoken language) and cognitive skills (i.e., IQ). Thus, for students on the autism spectrum specifically, externalizing behaviors, autism characteristics, cognitive skills, and language skills may be important factors contributing to STR quality. Importantly, STRs for young children, including children with developmental disabilities, have been found to be quite stable, persisting across different school years and teachers (Blacher et al., 2009; Jerome et al., 2009; Pianta & Stuhlman, 2004), underscoring the critical role of STR quality in the early school years, specifically.

3. Present study

Collectively, young students on the autism spectrum may be at compounded risk for negative classroom experiences and outcomes due to barriers to (1) classroom engagement and (2) developing positive STRs. These barriers to engaging in the classroom and developing positive STRs can include unique behavioral (e.g., externalizing behavior problems) and social communication (e.g., lower spoken language skills, more ASD-related social characteristics) needs that are often a mismatch for classroom environments and demands (Caplan et al., 2016; Sparapani et al., 2016). The stability of early STRs and engagement indicates that this risk may persist across school years and teachers. However, it is unclear how these two factors (i.e., student behavioral engagement and STR quality) may impact one another over time among this population of students. Although several previous studies suggest that STR quality unidirectionally promotes behavioral engagement (e.g., Archambault et al., 2013; Engels et al., 2016), some work supports reciprocal effects between STR quality and engagement over time (Hughes et al., 2008). Notably, none of the aforementioned studies were conducted with autistic students. Considering the important influence that behavioral engagement and STRs have on student outcomes across populations, it is critical that we better understand how these two constructs affect one another over time so we can identify key, proactive intervention targets to best support students on the spectrum.

The present study aimed to examine how STR quality and behavioral engagement interact over time for young autistic students through exploration of a cross-lagged SEM path model. There is reason to believe that STR quality plays an important role for young autistic children; for certain groups of students, including students who are predisposed to poor school adjustment and achievement outcomes, STR quality may have a stronger positive influence on outcomes over time, serving as a protective factor (Baker, 2006; Elledge et al., 2016; Hamre & Pianta, 2001; Silver et al., 2005). Previous research suggests that, for students with developmental vulnerabilities (e.g., externalizing behavior problems), positive STRs may buffer negative effects on school functioning (e.g., behavioral engagement; Baker, 2006; Elledge et al., 2016; Hamre & Pianta, 2001; Silver et al., 2005). Together with empirical findings supporting the influence of STR quality on engagement for non-autistic samples (Archambault et al., 2013, Doumen et al., 2012; Engels et al., 2016; Hughes et al., 2008; O'Connor & McCartney, 2007; Roorda et al., 2017), it was hypothesized that analysis of a cross-lagged model would support STR quality as driving levels of student behavioral engagement over time rather than STR quality and engagement reciprocally influencing one another, taking into consideration other potential contributing factors to STR quality and engagement (i.e., externalizing behaviors, autism-related characteristics, cognitive functioning, and spoken language skills), for these young students on the spectrum.

4. Methods

4.1. Participants

Participants were children on the autism spectrum ($N = 146$), their primary caregivers, and their teachers who enrolled in a larger multisite (i.e., greater Boston and Southern California regions), longitudinal study exploring the transition into early schooling for young autistic students. Families were recruited for the larger study on an individual basis (rather than schoolwide; i.e., students were not nested in classrooms or schools) through online and print flyers distributed at local school districts, autism resource centers, intervention agencies, autism-related conferences, parent support groups, and through clinicians. Students' primary teacher of record (i.e., the teacher with whom they spent the most time during the school day) was invited to participate. All aspects of the study were approved by the Institutional Review Board (IRB) and all participants provided informed consent. Eligibility criteria included the following: (a) between the ages of 4 and 7 years and enrolled in school (grades Pre-K to 2nd Grade), (b) IQ $\geq$ 50, assessed using a short form of the Wechsler Preschool and Primary Scales of Intelligence-3 (WPPSI-III; Wechsler, 2002), (c) diagnosed with ASD by clinical evaluation or receiving special education services under the Individuals with Disabilities Education Improvement Act (IDEA, 2004) classification of autism (if only classified through the school, the ADI-R was also administered; Lord et al., 1994), and (d) confirmed

ASD diagnosis with the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) at the time of the initial eligibility visit. To be included in the present substudy, teachers had to complete the two key study measures (i.e., the Student-Teacher Relationship Scale (STRS; Pianta, 2001) and the Academic Engagement Scale (AES; Skinner et al., 2009)).

Parents completed intake inventories upon study entry that included questions about their child's date of birth, sex, ethnicity identity, grade, and IEP status, and about their own education level. Teachers completed a separate intake inventory upon study entry that included questions about their gender identity, ethnicity identity, and how much time the target student spends in general education. Participant background information is reported in Table 1. Notably, the majority of students were male whereas the majority of teachers were female, reflecting the current prevalence rates of autism and broader makeup of the teaching field, respectively. A large majority of students in the sample were in grades below second (91.4 % in grades PK-1), depicting a group of very young students. Although 87.2 % of students had an Individualized Education Program (IEP), more than half (53.2 %) of the students spent at least half the school day in a general education classroom setting and nearly half of students were in a general education setting for 75–100 % of the day. Notably, 5.7 % of children were not found eligible for special education services following a school evaluation (i.e., children's autism characteristics were not found to impact educational performance; IDEA, 2004) and 7.1 % of children had not received a school evaluation. Thus, this sample reflects a group of autistic children with diverse educational needs and placements, including children who did not receive any special education services (i.e., did not have an IEP and spent 100 % of the school day in a general education setting).

4.2. Measures

4.2.1. Teacher measures

Behavioral Engagement. The Behavioral Engagement subscale (BES) of the *Academic Engagement Scale* (AES; Skinner et al., 2009) was used to measure behavioral aspects of students' academic engagement. The AES is an eight-item measure completed by teachers to assess student academic engagement. Teachers rate each item on a four-point Likert scale (1 = not at all true, 4 = very true), and a composite score for Behavioral Engagement (4 items) is generated. The AES also generates a composite score for Emotional Engagement (4 items), but for the present study we were interested in the Behavioral Engagement subscale as an observable indicator of the child's engagement (e.g., attention, enthusiasm, participation). Example items include "When we start something new in class, this student participates in discussions or activities," and "When we start something new in class, this student pays attention." In its pilot sample of 1018 students in grades 3–6, the teacher-rated AES demonstrated strong convergent validity with teacher-rated student involvement and behavioral observations of on-task behaviors, as well as satisfactory internal consistency and high cross-time stability (Skinner et al., 2009). Further, its short length makes it a feasible and socially valid measure for completion by teachers. In this sample, internal consistency of the four-item BES as measured using Cronbach's alpha was acceptable at each time point (T1: α=.77; T2: α=.81; T3: α=.72).

Student-Teacher Relationship Quality. The Student-Teacher Relationship Scale (STRS; Pianta, 2001) is a well-established 28-item measure of teachers' perceptions of their relationships with an individual student used with pre-K through 3rd grade teachers. Teachers rate each item on a 5-point Likert scale (1 = definitely does not apply, 5 = definitely applies). Ratings result in scores for three subscales: (a) Conflict (12 items; e.g., "This child and I always seem to be struggling with each other"), (b) Closeness (11 items; e.g., "I share an affectionate, warm relationship with this child"), and (c) Dependency (5 items; "This child expresses hurt or jealousy when I

Table 1
Participant characteristics.

	Mean (Standard Deviation) or Percentage of Total Sample
Child (at T1; *n* = 146)	
Age	5.5 years (1.0 year)
Sex	84.4 % Male; 15.6 % Female
Race or Ethnicity	55.3 % White; 19.9 % Bi/Multiracial; 10.6 % Latinx; 4.3 % Asian or Asian American; 2.8 % Black or African American; 5.7 % Other (1.4 % missing)
Parent Education	8.5 % HS diploma or less; 26.2 % some college; 35.5 % college degree (e.g., B.A., B.S.); 29.8 % Master's degree or higher
School Setting	70.9 % Public Elementary or Preschool; 9.9 % Private or Parochial Preschool; 14.2 % Other (0.7 % missing)
% Time in General Education Setting (Teacher Reported)	53.2 % spend > 50 % of time (3.5 % missing)
Has Individualized Education Program (IEP)	87.2 % Yes (1.7 % no response)
Teacher (at T1-T2; *n* = 146)	
Gender	87.9 % Female; 11.3 % Male (0.7 % missing)
Race or Ethnicity	70.2 % White; 14.2 % Latinx; 5.0 % Asian or Asian American; 2.8 % Black or African American, 0.7 % Native American/Alaskan; 5.7 % Other (1.4 % missing)
Classroom Setting (Select All)	53.4 % General Education; 50.0 % Special Education; 0.7 % Resource Room; 1.4 % Other (3.4 % missing)
Teacher (at T3; *n* = 102)	
Gender	63.8 % Female; 7.8 % Male (28.4 % missing)
Race or Ethnicity	55.3 % White; 9.2 % Latinx; 2.8 % Asian or Asian American; 2.1 % Black or African American; 0.7 % Native American/Alaskan; 0.7 % Other (29.1 % missing)
Classroom Setting (Select All)	41.1 % General Education; 32.9 % Special Education; 3.4 % Resource Room; 0.7 % Other (29.5 % missing)
Had Student Previous Year	8.5 % Yes

spend time with other children"), in addition to a Total Relationship Quality Score (range 28–140, with higher scores indicating a better STR). In this study, we examined the Total Relationship Quality score as a general indicator of overall STR quality. The STRS has demonstrated adequate reliability and validity (Pianta, 2001), and has been used with both TD and autistic student populations (e.g., Blacher et al., 2014). For this sample, internal consistency for the STRS Total Relationship Quality score as measured by Cronbach's alpha was acceptable at each time point (T1: α=.79; T2: α=.81; T3: α=.81).

4.2.2. Child eligibility measures

Cognitive Performance. The Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III; Wechsler, 2002) is a standardized test of cognitive abilities for children ages 2:6–7:3. It is individually administered and results in a full-scale IQ (FSIQ) score with a normative mean of 100 and standard deviation of 15. In a test review of the WPPSI-III, Gordon (2004) reported reliability evidence including excellent internal consistency across composites and subtests, high interrater reliability, and stability of scores, and validity evidence including exploratory and confirmatory factor analytic evidence for the three-factor structure (for the older age band relevant in the present study) and convergence with other measures of preschool intelligence (e.g., Differential Ability Scales, Bayley Scales of Infant and Toddler Development). To screen participants for eligibility for this study (i.e., $\geq$ 50), an abbreviated version was administered that consisted of three subtests, Vocabulary (measures word knowledge and verbal concept formation), Matrix Reasoning (involves visuo-spatial abilities, understanding of part-whole relationships, perceptual organization, fluid intelligence), and Picture Completion (measures visual perception, concentration/attending, and recognition of essential object details), which were summed to estimate FSIQ using Sattler's conversion tables (Sattler, 2008). Short forms of the WPPSI can be appropriate for screening or research purposes (Dixon, Belisle, & Stanley, 2018; Sattler & Dumont, 2004) and have been found to be correlated with the FSIQ generated from the full administration (Dixon et al., 2018; Sattler & Dumont, 2004; Sattler, 2008). Minshew, Turner, and Goldstein (2005) found short forms of the Wechsler scales to have good predictive accuracy for scores on full test administration for a sample of autistic individuals (N = 215; ages 8–55). The WPPSI and other Wechsler scales of intelligence are widely used with both non-autistic and autistic populations (e.g., Mayes et al., 2009). Previous work from this longitudinal project has found the WPPSI-III to be associated with STR quality for young autistic students (e.g., Caplan et al., 2016).

Autism Characteristics. The Autism Diagnostic Observation Schedule (ADOS and ADOS-2; Lord et al., 2000; Lord et al., 2012) is widely considered to be one of the gold-standard assessments of ASD. It is a semi-structured, standardized assessment of social communication, play, and restricted and repetitive behaviors that has demonstrated adequate sensitivity, specificity, interrater reliability, internal consistency, and test-retest reliability on item, domain, and classification levels (Lord et al., 2000). The revised research algorithms from the ADOS-2 (Lord et al., 2012) were used for screening. Some examples of observable behaviors rated on the ADOS include social overtures, social responses, shared enjoyment in the interaction, and directed facial expressions.

4.2.3. Child background characteristics

Externalizing Behaviors. The Teacher Report Form (TRF; Achenbach & Rescorla, 2001; Achenbach & Rescorla, 2000) was completed by teachers as a standardized measure of behavior challenges at school. Teachers of children ages 5 and younger completed the preschool form (99 items) and teachers of children ages 6 and older completed the school-aged form (112 items). Teachers are presented with statements and respond on a 3-point Likert scale (0 = not true, 2 = very/often true). The Externalizing Problems scale, which summarizes scores from the Attention and Aggression subscales for the preschool-aged form and for Aggression and Rule-Breaking subscale for the school-aged form, was used as an indicator of externalizing behavior levels. Example items include "has temper tantrums" and "argues a lot." The TRF is widely used and has demonstrated validity (e.g., discriminative validity) and reliability (e.g., test-retest reliability) with both non-autistic (e.g., Kendall et al., 2007) and autistic samples (e.g., Pandolfi, Magyar, & Dill, 2009; Pandolfi, Magyar, & Dill, 2012). Previous work has found externalizing behaviors measured by the TRF to be negatively correlated with STR quality and classroom engagement for students on the spectrum (e.g., Sparapani et al., 2016).

Level of Autism Characteristics. The Social Responsiveness Scale (SRS; Constantino, 2002) was completed by parents as a standardized measure of ASD-related characteristics, with the total T score used here as an index of ASD-related social characteristics. On the SRS, parents respond to 65 statements on a 4-point Likert scale (1 = Not True, 2 = Sometimes True, 3 = Often True, 4 = Almost Always True). Example items include "talks to people with an unusual tone of voice" and "has difficulty relating to peers." Higher scores indicate more ASD-related social characteristics, with scores greater than 59 being considered clinically significant. The SRS is used widely for autism screening and has demonstrated convergent validity with other established ASD instruments, including the Autism Diagnostic Interview – Revised (ADI-R; Lord et al., 1994), ADOS, and Social Communication Questionnaire (SCQ; Bölte et al., 2011; Constantino et al., 2003).

Spoken Language Skills. Children completed the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) as a norm-referenced measure of spoken language skills. Two subtests were utilized, the Pragmatic Judgment subtest and the Syntax Construction subtest. The Pragmatic Judgment subtest assesses knowledge and appropriate language use in everyday situations (e.g., "The phone rings and you answer. What do you say?"), and the Syntax Construction subtest assesses grammatically correct oral expression (e.g., "Here the boy is standing (examiner points to picture of boy standing). Here (examiner points to picture of boy sitting), the boy is ____"). Both subtests are administered for children ages 3–21 years. The CASL demonstrated good test-retest reliability (.65–.95) and was significantly correlated with other tests of language (e.g., PPVT-III, EVT) n the standardization sample (N = 2750 examinees ages 3–21 years who were nationally representative by gender, ethnicity, region, and maternal education). Clinical groups with language delay, language impairment, intellectual disability, and learning disability demonstrated significantly different mean scores from the control group, as expected. The CASL has also been utilized with samples of students on the autism spectrum (e.g., Reichow et al., 2008; Whyte & Nelson, 2015). For example, Reichow et al. (2008) used the Pragmatic Judgment and

Inferences subscales of the CASL to characterize adaptive language difficulties for N = 35 autistic children, finding the Pragmatic Judgment subscale to be significantly correlated with the Vineland Adaptive Behavior Scales Communication Domain. Previous work from this longitudinal project has found the CASL to be significantly associated with STRS scores for children on the spectrum (Caplan et al., 2016; Losh et al., 2019).

4.3. Procedures

This study consisted of an eligibility session and three subsequent assessments (Times 1–3) of children's functioning over the span of two academic years. Time 1 (T1) occurred in the Fall of Year 1 within 3 months of the start of the school year, Time 2 (T2) occurred in the Spring of Year 1 between 7 and 10 months after the start of the school year, and Time 3 (T3) occurred in the Spring of Year 2 between 4 and 6 months after the start of the following academic year. As a measure of IQ and to confirm the autism diagnosis, the WPPSI-III and the ADOS were administered to each student individually at the eligibility visit by trained (and supervised) doctoral students in special education and school or clinical psychology. Parents completed the SRS as a measure of autism characteristics. Teachers completed the STRS, AES, and TRF at all three time points (Times 1–3) as part of a larger teacher packet of measures.

4.4. Data analysis

First, descriptive statistics were generated for all variables using IBM SPSS Version 24.0 (IBM Corp, 2016). Extreme value outliers were identified using Tukey's method (observations ≤1st quartile value – 1.5 * interquartile range (IQR) and observations ≥ 3rd quartile value + 1.5 *IQR) and removed for subsequent analyses in order to minimize skewedness. Three outliers were identified for WPPSI scores (scores were ≤ 46 or ≥ 133), six outliers were identified for Time 1 BET (scores were ≤ 4.5), two outliers were identified for Time 2 STRS (scores were ≤ 75), and four outliers were identified for Time 3 STRS (scores were ≤ 82.5). Second, bivariate Pearson correlations between variables of interest (i.e., STRS and AES) and potential confounding variables (i.e., WPPSI, CASL, TRF Externalizing, and SRS) were conducted to confirm expected relationships between variables. Age was also explored as a possible confounding variable due to potential differences in educational settings related to children's different ages and corresponding grade levels. Those results informed the construction of a cross-lagged SEM model, which was conducted using the Lavaan program (Rosseel, 2012) for RStudio Version 1.2.5033 for Macintosh (RStudio, 2015). A full model was first tested with STR quality and behavioral engagement influencing one another over time in a reciprocal, transactional manner (i.e., all cross paths included). All additional variables that were significantly correlated with either AES or STRS were also included as confounding variables. Any paths in the model that were not significant at a level of $p<.05$ were then trimmed. It was hypothesized that the trimmed model would include significant cross paths from STRS to AES over time, but no cross paths from AES to STRS over time, highlighting the significant and unidirectional influence of STR quality on behavioral engagement.

For these analyses, missing data were estimated using the Full Information Maximum Likelihood (FIML) function, which is accepted as a robust method for estimating missing data in SEM analyses (Eisenhower, Blacher, & Bush, 2015; Enders & Bandalos, 2001; Schlomer et al., 2010). Model fit was assessed using the following absolute and relative fit indices: Chi-Square (χ^2), Root Mean Square Error of Approximation (RMSEA; Browne & Cudeck, 1993), Comparative Fit Index (CFI; Bentler, 1990), and Tucker Lewis Index (TLI; Tucker & Lewis, 1973). To indicate good fit, RMSEA should be below 0.08, and CFI and TLI, should be above 0.95 (Hooper et al., 2008).

5. Results

Bivariate Pearson correlations between the key variables (i.e., STRS and BE) were significant at a minimum of the $p<.05$ level (r =.22−.55), with the exception of T1 behavioral engagement with T3 STR quality. Of the potential confounding variables explored,

Table 2
Descriptive statistics and bivariate pearson correlations.

	n	Mean (SD)	1	2	3	4	5	6	7	8
1. WPPSI	143	88.5 (16.6)	–	–	–	–	–	–	–	–
2. CASL	133	164.5 (33.3)	.73**	–	–	–	–	–	–	–
3. TRF	142	58.1 (9.3)	-.15	-.22*	–	–	–	–	–	–
4. T1 STRS	144	109.5 (12.8)	.15	.28**	-.62**	–	–	–	–	–
5. T1 BES	137	10.7 (2.5)	.26**	.28**	-.48**	.51**	–	–	–	–
6. T2 STRS	118	109.2 (12.8)	.24**	.37**	-.42*	.54**	.30**	–	–	–
7. T2 BES	117	10.6 (3.1)	.29**	.36**	-.36**	.47**	.54**	.55**	–	–
8. T3 STRS	97	113.1 (10.5)	.23*	.32**	-.22*	.22*	.15	.39**	.27*	–
9. T3 BES	102	10.8 (3.0)	.38**	.42**	-.30**	.34**	.41**	.31**	.48**	.51**

Note. WPPSI = Wechsler Preschool and Primary Scales of Intelligence-III. CASL = Comprehensive Assessment of Spoken Language. TRF = Teacher Response Form Externalizing Scale. STRS = Student-Teacher Relationship Scale. BES = Behavioral Engagement Scale. T1 = Time 1. T2 = Time 2. T3 = Time 3.

* $p < 0.05$,

** $p < 0.01$

CASL, WPPSI, and TRF were significantly correlated with both STRS and BE across time points, with the exception of WPPSI and Time 1 STRS. Correlations and descriptive statistics for these variables are reported in Table 2. Age (in months; M = 65.5; SD = 12.1) was not found to be significantly correlated with STRS or BE at any time point. (r=.06−.16; p=.08−.55). SRS (M=79.6; SD=10.9) was not found to be significantly correlated with STRS or BE at any time point (r =.01−.11; p=.34−.89).

Using these results, the full path model included paths between all significantly correlated variables (see Fig. 1). The full reciprocal model with all cross paths did not meet criteria for a good fit according to any of the fit indices examined (see Table 3).

Next, all non-significant paths (see Table 4 for all coefficients) were removed from the model to construct a trimmed model. The only significant cross path that was retained was from STRS Time 1 to BE at Time 2 (see Fig. 2). No confounding variables were retained. The trimmed model was a good fit according to all fit indices examined (see Table 3). STR quality at T1 predicted gains in behavioral engagement by T2 (β=.26, p<.01) and T2 behavioral engagement in turn predicted T3 behavioral engagement (β=.45, p<.001), though the cross-lagged path directly from T2 STR quality to T3 behavioral engagement was not significant. Unstandardized and standardized coefficients for stability paths, cross-lagged paths, and covariance paths for the trimmed model are reported in Table 5.

6. Discussion and implications

Results of the cross-lagged analyses supported a model with a unidirectional cross-lagged path from STR quality at Time 1 to behavioral engagement at Time 2, across one school year, for the present sample of young autistic students. Behavioral engagement outcomes at the end of the first school year remained stable, persisting into the second school year. These results suggest that early STR quality can have a lasting influence on behavioral engagement for autistic students in preschool and early elementary grades. Importantly, potential child risk factors to poorer quality STRs and lower behavioral engagement (e.g., language skills, cognitive skills) did not remain significant in the model after accounting for the influence of STR quality on later behavioral engagement and the stability of STR quality and behavioral engagement across two school years. Developing positive STRs and promoting behavioral engagement early may be critical for later STRs and engagement, serving a protective role against other student risk factors. For autistic students who face barriers to success in the classroom due to different social communication and behavioral characteristics and needs, developing quality STRs (i.e., high in closeness and low in conflict) in early schooling may be a critically important protective factor for promoting their classroom engagement and success over time.

Although some previous work with non-autistic samples in the early school years has suggested reciprocal effects between STR quality and engagement over time (Hughes et al., 2008), much has supported the strong influence of STR quality on engagement (Archambault et al., 2013; Doumen et al., 2012; Engels et al., 2016; Hughes et al., 2008; O'Connor & McCartney, 2007; Roorda et al., 2017). Findings from the present study expanded this literature to young autistic students, a population at risk for lower levels of behavioral engagement, supporting a unidirectional path from STR quality to behavioral engagement. This is aligned with an attachment theoretical framework, in that students who develop closer, more supportive (i.e., secure) relationships with their teachers (i.e., their caregivers in the classroom) may be more willing to explore their learning environment and try new things (Bergin & Bergin, 2009). The strength of the impact of STR quality on engagement over time in the present sample could reflect the vulnerable transition period into early school for young students with disabilities (Fowler et al., 1991; McIntyre et al., 2006) during which families must learn to navigate a new service delivery system (i.e., school) and students must adjust to new social demands (e.g., teachers, school staff, service providers, peers), expectations (e.g., IEP goals), schedules, and structures. During these challenging transitions, STR quality is especially salient in promoting students' school success. Indeed, STRs may play an even stronger protective role for students who are vulnerable to poor school adjustment and outcomes, including young students on the spectrum (Baker, 2006; Elledge et al., 2016; Hamre & Pianta, 2001; Silver et al., 2005). Notably, these results differ from previous work that supports other behavioral characteristics, particularly externalizing behaviors, as driving STR quality for autistic students (Eisenhower, Blacher, & Bush, 2015; Roorda et al., 2021). This is not unexpected, however, as teachers often cite externalizing behaviors, but not academic engagement, as a critical barrier to their inclusion of and relationship with autistic students (Barned et al., 2011; Roberts & Simpson, 2016). The

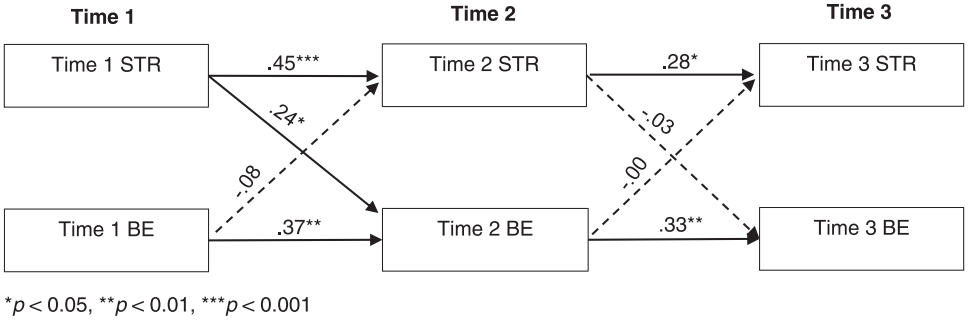

Fig. 1. *Standardized Estimates for Full Model; Dashed Lines Indicate the Non-Significant Paths.* * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. *Note.* STR = Student-Teacher Relationship. BE = Behavioral Engagement. Covariances between key variables and with confounding variables excluded from diagram for clarity (see Table 4).

Table 3
Fit indices for full and trimmed models.

Model	χ^2 (p-value)	*d.f.*	RMSEA (CI)	CFI	TLI
Full	91.695 (.000)	11	.224 (.183-.268)	.794	.325
Trimmed	6.268 (.509)*	7	.000 (.000-.095)*	1.000*	1.008*

* Good fit (RMSEA <.08; CFI >.95; TLI >.95).

Table 4
Coefficients for full model.

	b (SE)	*β*
Stability Paths		
STR T1 –> T2	.44 (.11)***	.45
STR T2 –> T3	.23 (.09)*	.28
BE T1 –> T2	.43 (.13)**	.37
BE T2 –> T3	.32 (.11)**	.33
Cross-Lagged Paths		
STR T1 –> BE T2	.06 (.03)*	.24
STR T2 –> BE T3	-.01 (.03)	-.03
BE T1 –> STR T2	-.41 (.53)	-.08
BE T2 –> STR T3	-.01 (.41)	-.00
Within-Time Covariance		
STR T1 – BE T1	16.35 (3.05)***	.51
STR T2 – BE T2	11.42 (2.74)***	.42
STR T3 – BE T3	10.76 (2.75)***	.45
Confounding Variables		
IQ -> STR T2	.06 (09)	.08
IQ -> STR T3	.05 (.10)	.08
IQ -> BE T2	.03 (.02)	.15
IQ -> BE T3	.01 (.03)	.04
CASL -> STR T2	.05 (.05)	.14
CASL -> STR T3	.04 (.05)	.14
CASL -> BE T2	.00 (.01)	.01
CASL -> BE T3	.02 (.01)	.25
TRF -> STR T2	-.24 (.14)	-.18
TRF -> STR T3	-.06 (.12)	-.05
TRF -> BE T2	-.00 (.03)	-.01
TRF -> BE T3	-.04 (.03)	-.14

Note. STR = Student-Teacher Relationship. BE = Behavioral Engagement. T1 = Time 1. T2 = Time 2. T3 = Time 3.
* $p < 0.05$,
** $p < 0.01$,
*** $p < 0.001$.

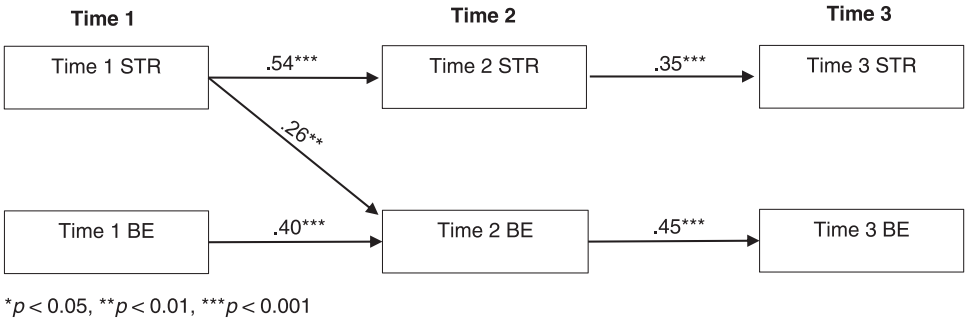

Fig. 2. *Standardized Estimates for Trimmed Model.* * $p < 0.05$, **$p < 0.01$, ***$p < 0.001$. *Note.* STR = Student-Teacher Relationship. BE = Behavioral Engagement. Covariances between key variables excluded from diagram for clarity (see Table 5).

present results suggest that STR quality uniquely influences classroom behavioral engagement for autistic students.

Notably, STR quality at the beginning of the first school year influenced engagement at the end of the school year but STR quality at the end of the school year did not influence engagement in the following school year. Given that teachers generally remained the same across the first two time points but changed by the third (a new academic year), the paths of varying significance could reflect

Table 5
Coefficients for trimmed model.

	b (SE)	β
Stability Paths		
STR T1 –> T2	.57 (.08)***	.54
STR T2 –> T3	.27 (.07)***	.35
BE T1 –> T2	.49 (.11)***	.40
BE T2 –> T3	.43 (.08)***	.45
Cross-Lagged Paths		
STR T1 –> BE T2	.06 (.02)**	.35
Within-Time Covariance		
STR T1 – BE T1	16.36 (3.05)***	.50
STR T2 – BE T2	12.22 (2.91)***	.43
STR T3 – BE T3	12.49(3.05)***	.48

* $p < 0.05$,
Note. STR = Student-Teacher Relationship. BE = Behavioral Engagement. T1 = Time 1. T2 = Time 2. T3 = Time 3.
** $p < 0.01$,
*** $p < 0.001$

differences in teacher expectations, peer comparisons, classroom rules and environments (e.g., class size), as well as differing teacher perceptions of student behaviors (e.g., attention, persistence, effort) between the academic years. A small minority of teachers in the second year of this study reported having taught the student previously (8.5%); while we were unable to examine this closely due to the small number of repeated teachers, it is possible that the association between STR quality and behavioral engagement is different when teachers have spent more time with a student (e.g., STR quality may be more influential on engagement when students and teachers have spent more than one year together). Indeed, in a meta-analytic study of the influence of STRs on engagement and achievement, Roorda et al. (2011) found that relations between STR and engagement were stronger when the same informant was consistent across data points and when fewer months elapsed between data points. Of course, students do typically have different teachers from one year to the next, so in this respect, a non-significant relationship between STR quality at Time 2 to Time 3 was certainly ecologically valid. Instead, the impact of STR quality in the first year on engagement in the second year was indirect, occurring by Time 1 STR quality significantly influencing Time 2 behavioral engagement, and those levels of behavioral engagement at Time 2 remaining stable into the following school year (i.e., Time 3).

These results further support extant research highlighting STRs as a key influential protective factor for a group of students at risk for negative school adjustment, classroom functioning, and downstream outcomes (Baker, 2006; Decker et al., 2007; Elledge et al., 2016; Hamre & Pianta, 2001, 2005). Here, early levels of STR quality impacted later behavioral engagement, even after accounting for students' cognitive skills, language skills, and externalizing behaviors, all of which could impede students' engagement in the learning environment. For students on the spectrum who often face compounded barriers to positive classroom experiences and school success, high-quality STRs may act as a buffer against lower levels of classroom behavioral engagement. When young students on the spectrum have supportive, close relationships with their teachers, they may feel more comfortable, involved, and motivated in the classroom environment, enabling learning and growth (Eisenhower, Bush, & Blacher, 2015; Goetz et al., 2020). Supporting teachers in developing better relationships with their autistic students early on is likely a critical component of promoting young autistic students' engagement in the classroom.

6.1. *Limitations and future directions*

As in all studies, limitations should be considered when interpreting the present results. First, the multi-year, multi-informant design presents a strength in being able to examine realistic changes and impacts over time, including influences that may persist across multiple school years and/or teachers. However, this study relied on teacher report of STRs and behavioral engagement, both of which are common methods of assessment across the literature but provide a one-sided perspective nonetheless. Future research should aim to assess and incorporate young students' perspectives of their STRs (e.g., Losh et al., 2022; Zee et al., 2020). First-person student perspectives could provide insight into the processes by which interactions and relationships with teachers influence students' effort, attention, and persistence in the classroom. Second, future work should aim to corroborate teacher report data of student engagement with direct behavioral observations (e.g., The Classroom Measure of Active Engagement; Sparapani et al., 2016), which can be a less biased measurement method. Third, the present sample was limited to students with IQ $\geq$ 50, with the average IQ well into the typical range, which is not representative of all students on the spectrum. Therefore, results should not be generalized to students on the spectrum with significant intellectual disability. Fourth, although the present sample of nearly 150 young children on the autism spectrum was sufficient to support an initial model attesting to one critical impact of early STR quality, future studies may wish to recruit a larger sample size. The sample size to parameter ratio in the present model exceeded ten cases per parameter, but a larger ratio would be more robust to avoid detecting false significance (Westland, 2010). Recruiting a larger sample would also allow for closer examination of additional child, teacher, and classroom characteristics as contributing factors to STRs (e.g., teacher-child dyad incongruence in racial or ethnic backgrounds, multiple school years with the same teacher; Saft & Pianta, 2001; Thijs et al., 2012) and engagement (e.g., student gender, self-regulation skills; Cadima et al., 2015; Meece et al., 2009; Searle et al., 2014). Finally,

future longitudinal research should be conducted over longer time periods in order to examine (a) if the impact of STR quality on behavioral engagement persists into later elementary and (b) impacts of these dynamic relations on student academic, social, emotional, and behavioral outcomes.

Nevertheless, these results may point researchers to STRs as potential intervention targets to better support autistic students' success in the classroom. Indeed, intervening directly with teachers aligns with the stated desire of many teachers for autism-specific strategies around inclusion and relationship-building (Able et al., 2015; Bolourian et al., 2021; Lindsay et al., 2013). The field is ready for more articulated models that would allow for a better understanding of the complex relations between these two key indicators of school success and additional contributing risk and protective factors.

CRediT authorship contribution statement

Ainsley Losh: Conceptualization, Methodology, Formal analysis, Writing – original draft. **Abbey Eisenhower:** Writing – review & editing, Supervision, Project administration. **Jan Blacher:** Writing – review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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