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Individual and Environmental Factors Associated With Student-Teacher Relationships of Autistic Students

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ABSTRACT OF THE DISSERTATION

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by

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As the number of young autistic students increases in the general education setting, a critical relationship that fosters positive academic, behavioral, social, and emotional outcomes in all students is the student-teacher relationship (STR). Autistic students are at greater risk of experiencing poorer STRs, with less closeness and more conflict, compared to other student populations. Individual differences in autistic students' biological and behavioral characteristics and their interaction with the environment may play unique roles in understanding STR quality. Moreover, as numerous studies have investigated factors related to teacher-reported STRs, it is essential to consider autistic students' perspectives in the STR dyad. Thus, this study aimed to examine what student, parent, and teacher characteristics may be associated with teacher- and student-reported STRs. The current study included a sample of 122 young (aged 4-7 years) autistic students, their parents, and their teachers. Student, parent, and teacher factors contributing to teacher- and student-reported STR quality were explored using regression and moderation analyses. Findings suggested that better social skills and less negative parenting behaviors were significantly associated with STR

closeness, over and above other student characteristics; whereas poorer social skills and more time spent in the general education classroom were significant contributors to STR conflict. Regarding student-reported STRs, higher IQ was related to less student-reported negativity with their teachers; more frequent use of teacher praise and incentives was also related to more negativity with their teachers. On the other hand, better social skills and more positive parenting were significantly related to student-reported positivity with their teachers. Lastly, a moderation analysis was conducted to explore the interaction effect between student oxytocin receptor gene (OXTR) and parenting behaviors on STR quality. Results showed that student OXTR rs53576 allele variations were not significant moderators of the relationship between parenting behaviors and STRs. These findings provide new insights into the importance of not only individual student characteristics but also how parenting and teacher behaviors contribute to teacher- and student-reported STR quality.

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The representation of students with autism spectrum disorder (ASD) in general education classrooms has increased since the Individuals with Disabilities Education Act (2004) to ensure that all children with disabilities have access to free and appropriate education in the least restrictive environment. One critical relationship to fostering positive academic, behavioral, social, and emotional outcomes in all students is the student-teacher relationship (STR) (Pianta et al., 2008; Roorda et al., 2011; Wu et al., 2010). Given the cognitive, behavioral, and social communication challenges that impact autistic students' ability to fully engage within the educational setting, teachers may play a crucially pro-active and hands-on role in helping autistic students meet the everyday demands of school (Eisenhower et al., 2015). Individual child- and environment-related factors (e.g., parents, teachers, and school) may play a significant role in the development and consequences of STRs. More importantly, it is imperative that autistic student voices are heard and their perspectives on STRs are also considered. By evaluating both individual and environmental factors related to teacher-reported and student-reported STRs, we gain a better understanding of improving autistic student's academic success and building an inclusive and positive environment in which autistic students can thrive.

Student Characteristics and Behaviors Related to Teacher-Reported STRs

General education (GE) teachers have expressed challenges, but also positive attributes of having autistic students in the GE classroom. Mirenda et al. (2024) conducted interviews with GE teachers about the best things about their elementary autistic students at the ages of 7 to 8 years and again at 10 to 11 years; these students were predominantly in either GE classroom both with and without support staff or special

schools, and they received varied levels of accommodations and modifications (i.e., grade level learning outcomes, access to grade level curriculum, or modified/life skills curriculum only). Educators identified kindness, self-regulation, specific skills, and perseverance as elementary autistic students' most positive character traits; however, these positive traits were often described with qualifiers (e.g., *usually* polite or *often* has a positive attitude) (Mirenda et al., 2024). Across school settings and curriculum types, GE educators described their autistic students with traits of perseverance and intelligence when confronted with challenges when compared to autistic students in special schools with modified/life skills curriculum. Still, autistic students who exhibited more challenging behaviors and more severe ASD symptoms were less likely to persevere in the face of obstacles and educators were more likely to describe them unhappy (Mirenda et al., 2004). As such, autistic students contribute positively to inclusive GE classrooms; however, individual student attributes and characteristics may also contribute as protective and risk factors to building a STR.

For autistic students to be successful learners in school, it is important to understand how their unique student characteristics contribute to STRs. Within the autistic population, previous studies have shown that young autistic students who exhibit behavioral (i.e., externalizing behaviors) and social skill difficulties had teachers who reported more conflict and less closeness in their STRs (Blacher et al., 2014; Caplan et al., 2016; Eisenhower et al., 2015; Robertson et al., 2003; Zee et al., 2020). Autism symptoms related to social communication and challenging behaviors made it difficult for teachers to achieve a high-quality relationship with their students (Zee et al., 2020).

On the other hand, child social skills and IQ predicted change in student-teacher closeness and were categorized as protective factors of STR closeness (Caplan et al., 2016).

Although child language ability did not predict change in STR quality, it was related to both student-teacher conflict and closeness (Caplan et al., 2016). In this same sample of autistic children, Berkovitz et al. (2017) found that emotion regulation significantly predicted a change in both their social skills and externalizing behaviors, such that poorer emotion regulation was related to both worsening externalizing behaviors and social skills. This may suggest that autistic children with poor emotion regulation may have difficulty with self-regulation and externalizing behaviors and in turn, have fewer opportunities to build successful peer and teacher interactions and more chances for conflictual interactions. Interestingly, IQ and language ability were not related to emotion regulation suggesting that IQ and language abilities may not be a protective factor for autistic students in relation to emotion regulation (Berkovitz et al., 2017). Moreover, when assessing teacher-child conversations about emotions in special education middle schools as a strategy to improve emotion regulation, the quality of these dialogues was reflective of parents' ability to provide children with a psychologically secure base (Oppenheim & Koren- Karie, 2014) and to higher levels of child- report STR closeness (Spilt et al., 2021). Based on these findings, emotion regulation and awareness of emotions might relate to independent aspects of STR closeness and conflict and how parents and teachers can impact STRs.

Social Environmental Factors and STRs

From an attachment theory and parenting styles perspective (Baumrind, 1966; Bowlby, 1969), the parent-child relationship sets the foundation for children to build secure, close, and positive relationships with other adults (e.g., teachers). As autistic children exhibit challenging behavior and poor social communication abilities, their parents expressed higher levels of stress and psychological distress which was associated with greater use of authoritarian and/or permissive parenting styles (Estes et al., 2009; Hutchison et al., 2016). Authoritarian and permissive parenting have been related to more intrusive and negative parenting behaviors and poor child outcomes; whereas authoritative parenting was associated with positive parenting behaviors (i.e., parental involvement, positive reinforcement, stimulating behavior) and the most favorable child outcomes (Baumrind et al., 2010; Kuppens & Ceulemans, 2018). Regarding positive parenting, Kuenzel et al. (2021) found that positive parenting predicted a lower number of familial stressors (e.g., conflict in the child's interpersonal relationships) in both neurotypical (NT) and autistic children which may serve as a protective factor against cognitive, physical, and psychological consequences of negative life events. In addition, close parent-child relationships in early childhood predicted decreased behavior problems in later childhood and adolescence of children with intellectual disabilities (Totsika et al., 2014). These studies suggest a bidirectional, transactional relationship between children and parents, with parenting behavior affecting the child and child behavior affecting parenting.

However, the context in which parents engage in positive and negative parenting behaviors should also be considered. In a study examining different contexts in which positive and negative parenting were utilized, more instances of negative parenting were observed among mothers of children with developmental disabilities (DD) than NT children when demands were placed (Blacher et al., 2013). In contrast, during an unstructured (e.g., free play activity) setting, positive parenting behaviors were displayed to a greater extent across both DD and NT groups of children (Blacher et al., 2013). As the classroom resembles a structured setting where teachers place multiple demands each day, autistic students may be susceptible to teacher behavior that may reflect negative parenting. The compounded interactions of negative parenting and negative teacher behaviors may impact STR quality and form a negative cycle of poor interactions with adults and lead to poor child outcomes. In fact, Losh et al. (2019) found that parent intrusiveness predicted poorer STR quality. These studies propose that both positive and negative parent-child interactions may uniquely contribute to and likely serve as a model for the future development of relationships with their teachers.

Within the school context, it is critical that teachers not only learn to create a supportive and inclusive classroom where autistic students can grow and learn with their NT peers but also recognize how to build positive STRs with their students. When mothers of autistic students were asked how to improve teacher engagement and interactions with their child, they described the need for more teacher encouragement by spending more 1:1 time with their child to learn about their child's interests and develop a trusting relationship (Zeedyk et al, 2021). In answer to this call from mothers of autistic

children, Losh et al. (2023) found that teachers who frequently used positive response strategies (i.e., more praise and incentives) had closer STRs with their autistic students, even after accounting for student risk factors associated with poor STRs such as lower cognitive abilities, low language abilities, and higher levels of externalizing behaviors. The use of a reward system in the form of earning stickers or earning special privileges also helped reduce and prevent challenging behaviors and increase students' ability to stay focused and motivated to continue their work (Lindsay et al., 2014). Other strategies that teachers have successfully used were breaks, reinforcement, and intentional social interactions to not only improve self-regulation and academic engagement, but also build a closer relationship with their autistic students (Kincade et al., 2020; Oliver-Kerrigan et al., 2021). In all, the combinations of positive teaching strategies (i.e., praise and positive reinforcement) and intentional social interactions to understand autistic students' interests may help reduce problem behaviors in the classroom and increase opportunities for teachers to build positive relationships with their autistic students.

Less is known about how teacher characteristics may contribute to STR closeness and conflict. Surprisingly, more years of teaching experience were associated with student-teacher less conflict **and** more closeness; a higher teacher degree (Master's or above) was associated with relative increases in student-teacher conflict over time (Caplan et al., 2016). On the other hand, Feldman et al. (2019) found that teachers with more experience also reported higher levels of closeness with autistic students. It is likely that teacher's level of experience with autistic students and flexibility with their teaching strategies contributed to building a toolbox of strategies to not only support and scaffold

their student's learning but also positive relationship-building (Sulek et al., 2021). While teacher characteristics such as education degree and level of experience contribute to the STR, it may be difficult for teachers to engage in relationship-building with their autistic students if they are spending a limited amount of time in the general education classroom.

When autistic students spend less time in the classroom (i.e., level of inclusion), there is a lack of social engagement with other NT peers and opportunities for the teacher to engage and build rapport with autistic students (Goodman & Williams, 2007). In one study, Brown and McIntosh (2012) found that the level of problem behavior and percent of time receiving general education curriculum predicted STR quality, such that fewer problem behaviors and more time spent in the GE classroom were related to better STR quality. The authors noted that these findings were based on a small sample of autistic students who also may have had less impairment and higher levels of functioning than the overall population of autistic students; thereby limiting the generalization of these findings. In another study, teachers who worked with students in the special education setting reported higher ratings of closeness than teachers working in general education settings, suggesting that the educational context in which teachers were interacting with their students may be related to STR closeness (Feldman et al., 2019). Based on these mixed findings, further examination of time spent in the classroom and educational context is warranted to understand its contribution to STR closeness and conflict.

Student Perspective of STRs

Most of the literature has investigated NT student's perspective of STRs while the voice of autistic students is just emerging. For example, children's perceptions of overall teacher support, particularly feelings of closeness and emotional support, were related to how much children reported liking going to school. In contrast, children who perceived low levels of total teacher support were more likely to report a desire to avoid school (Murray et al., 2008). From the perspective of middle school students, those who perceived their teacher as engaging in prosocial behaviors like scaffolding instruction, providing encouragement, listening to students, and respecting students, reported having high-quality STRs (Prewett et al., 2019). Adolescents seemed to observe teacher behaviors such as complimenting, encouraging, and comforting them as behavioral cues from their teachers and perceived these prosocial behaviors as experiencing a close relationship with their teacher (Prewett et al., 2019).

In a qualitative study of autistic adolescents' perceptions of STR, autistic adolescents identified relatedness (i.e., building strong rapport), active listening, firmness, fairness, and flexibility as positive teacher characteristics that helped students feel supported and successfully included in the classroom (Sagger, 2015). Conversely, teachers who either yelled at them, were too strict, or were too inflexible were a major concern for students and negatively influenced their school experience (Sagger, 2015). Roorda (2021) also found that special education male students experienced more conflict in their relationship with their respective teachers than general education male students. However, the special education students did not report experiencing less closeness with

their teachers which may suggest that special education students do not experience difficulties with building warm and close relationships with their teachers. Similarly, Losh et al. (2022) found that a majority of autistic students reported a positive perception of the STR and a small number of autistic students reported negative perceptions of the STR. These findings across autistic and special education samples are promising in that students may perceive closeness and conflict as distinct aspects of the STR relationship that may not impact each other. Moreover, there are still opportunities for teachers to use positive teaching and relationship-building strategies to build a close relationship with their students, regardless of experiencing conflict in the STR.

While the student perspective is an essential piece to understanding both sides of the dyadic relationship, numerous studies have highlighted the lack of accordance between teacher and student raters on STRs (Murray et al., 2008; Poulou, 2017; Zañartu & Perez-Salas, 2023). Reasons for the lack of agreement may be explained by qualitative differences between positive and negative aspects of the STR (Murray & Murray 2004), unreliable reporting due to autistic students' difficulty with understanding their internal state (Mazefsky et al., 2011), and teachers' ideals that might distort their own self-report of interpersonal behavior (Poulou, 2017). To remove these possible biases of student and teacher report, Doumen et al. (2009) included peer-report as an objective and independent rating of STR compared to teacher- and student-reports. Findings revealed high concordance between teacher and peer-report of STR closeness, such that peer reporters observed more warmth and physical contact between teachers and the students (Doumen et al., 2009). Regarding STR conflict, teachers and peers agreed to some extent on the

degree of STR conflict, where peers reported observing more fussy and difficult behavior towards the teacher and less compliance and cooperation (Doumen et al., 2009). To note, when peers observe these teachers' negative reactions toward children with behavior-related disabilities such as ADHD and ASD (Zee et al., 2020), there is a concern that their NT peers may also adopt the teacher's negative reactions and socially withdraw from their neurodivergent peers.

Regarding differences in STR ratings between autistic adolescents and their respective NT peers, Zañartu and Perez-Salas (2023) found that there was no significant difference in STR when comparing autistic students and their NT peers' ratings. Although previous studies have reported that autistic special education students experience less closeness and more conflict compared to NT peers (Roorda et al. 2021), results from Zañartu and Perez-Salas (2023) may suggest that both autistic adolescents and NT peers experience similar STRs. This discrepancy in results between Roorda et al. (2021) and Zañartu and Perez-Salas (2023) may invalidate the argument that autistic students may not be reliable reporters due to the difficulty with autistic youth understanding their own internal state. As such, autistic student's perception of the STR should be considered reliable; thus, further investigation is needed to understand what student, parent, or teacher characteristics may contribute to student-perceived positivity and negativity of the STR in hopes of targeting these factors to improve the STR.

Biological Mechanisms, Parenting Behaviors, and STRs

Oxytocin (OT) is a neuropeptide that is naturally produced and released by the brain and binds to receptors to regulate social bonding and social recognition in animals and humans (Meyer-Lindenberg et al., 2011). OT consists of a receptor gene, single nucleotide polymorphisms such as OXTR rs53576, and their genetic variations (e.g., guanine (G) to adenine (A) alleles) that contributed to individual differences in social cognition and behaviors, including attachment, social recognition, and social exploration (Meyer-Lindenburg et al., 2011; Meyer-Lindenburg & Tost, 2012).

In NT adults, there is inconsistent evidence regarding how variations of OXTR rs53576 genotype (i.e., GG, AG/ AA alleles) were associated with social and emotional functioning. Some studies found that rs53576 GG carriers showed more prosocial behaviors (Wu & Su, 2015), more trusting behaviors (Kreuger et al., 2012), more social empathy (Rodrigues et al., 2009), and better cognitive capability in processing visual and auditory information during social interactions (Tops et al., 2011; Verhagen et al., 2014) when compared to individuals with AA/ AG carriers. Regarding AA/AG carriers, conflicting findings suggested that AA carriers were associated with more negative emotionality (Kryski et al., 2014) and less empathy (Rodrigues et al. 2009), but also exhibited better emotion recognition and less social impairment (Lucht et al., 2009; Park et al., 2010; Slane et al., 2014). In NT children, individuals with lower AA/AG alleles relative to GG alleles were less empathetic and more reactive to stress, exhibited lower trust-related behavior, and proved to display less parental sensitivity (Bakermans-Kranenburg & van Ijzendoorn, 2008; Krueger et al., 2012; Rodrigues, et al, 2009).

Numerous studies have tried to further understand the relationship between genetic variations of OXTR rs53576 in autistic individuals as well. In autistic adults, the A allele has been associated with an increased risk of ASD and reduced sociability (Kogana et al., 2012; Lucht et al., 2009; Wu et al., 2005). In contrast, Caplan et al. (2021) found no association of OXTR A alleles and social skills in autistic children. Interestingly, Wu et al. (2005) found a preferential transmission of A alleles over G alleles from parents to their children, suggesting an association between the genetic vulnerability of OXTR rs53576 A alleles and autism. However, when examining the association between GG genotype and social behaviors in autistic individuals, Wilcynski et al. (2019) found that rs53576 modulated social cognition across both autistic and NT individuals. However, autistic carriers of the G allele were linked to deficits in social affect recognition and social withdrawal (Parker et al., 2014; Rijlaarsdam et al., 2017). Similarly, in a comparison of the relationship between OXTR rs53576 alleles and social ability across autistic children and children with attention-deficit hyperactivity disorder (ADHD), autistic G allele carriers presented with more social difficulties compared to children with ADHD AA/AG allele carriers (Baribeau et al., 2017). These findings suggest a divergent association between GG alleles and social functioning in NT and autistic individuals across the lifespan, and unclear findings regarding AA/AG alleles in both populations. Nevertheless, a key factor of gene expression is the gene x environment interaction.

From a gene x environment standpoint, OXTR influences important social-emotional outcomes via interactions with early social environments which may play a role in the development of early relationships with parents and teachers. In one study, rs53576 was found to moderate the effect of unsupportive parenting on NT children's coping styles especially when faced with negative social interactions (McInnis et al., 2015). For toddlers at risk for developing ASD, McDonald et al. (2016) found that when compared to children with at least one OXTR rs53576 A allele, children with GG alleles were susceptible to having lower levels of empathy and lower-quality positive early parent-child interactions, as defined by reduced mutuality of emotions between the child and parent and less shared positive affect within the dyad. This association suggests that rs53576 GG allele may moderate the relationship between positive parenting and empathy in toddlers who are at high or low biological risk for developing ASD such that toddlers with rs53576 GG alleles might be more sensitive to both positive and negative variations in the quality of parent-child interactions which may, in turn, influence empathy development. As both parents and teachers play a major role in the early years of a child's development, Hygen et al., (2017) found that change in parenting behaviors when NT children were 4-6 years predicted change in student-teacher relationships when NT children were 6-8 years, which was moderated by child's OXTR rs53576 AA alleles in Norwegian children, but not in children in the United States (U.S.). The authors reported potentially no predicted change in U.S. STRs in comparison to Norwegian STRs, in part because change in STRs were rated by the same Norwegian teacher across three years, while in the US different teachers rated STRs each year. Thus, the interaction

effect of OXTR rs53576 genotype x environment, as well as genetic variations (G and A alleles), on autistic children and their caregiver and teacher's relationships, warrants further investigation.

The Present Study

The following statements summarize the literature framing the present study: (1) Previous studies have shown that autistic students have poorer STRs, with less closeness and more conflict, than other student populations (Blacher et al., 2014; Caplan et al., 2016; Longobardi et al., 2012). (2) Student characteristics, such as cognitive ability, language ability, challenging behaviors, and social skills, were identified as risk and protective factors of STR quality among autistic students (Caplan et al., 2016; Eisenhower et al., 2015). (3) Environmental features such as level of inclusion, parenting behaviors, and teacher characteristics or behaviors (i.e., positive reinforcement, educational degree) also predicted STR quality (Brown & McIntosh, 2012; Caplan et al., 2016; Losh et al., 2019, 2022).

Thus, individual differences in student biological and behavioral characteristics and their interaction with the environment may play unique roles in understanding STR quality among autistic students. More importantly, although multiple studies have focused on STRs from the teacher's perspective, it is important to recognize the student's perspective as well. As previous literature has found that student-teacher conflict and student-teacher closeness were not related to each other and may operate more independently among young autistic students (Caplan et al., 2016), the present study addresses the following questions:

1. What student, teacher, and parent characteristics and behaviors are associated with *teacher-reported* STR closeness and conflict?
2. What student, teacher, and parent characteristics and behaviors are associated with *student-reported* STR positivity and negativity?
3. Does the OXTR gene (i.e., rs53576 alleles) moderate the relationship between parenting behaviors and *teacher-reported* STR quality?

Methods

Participants (N=122) were young autistic students, their parents, and their teachers who were enrolled in a larger longitudinal, multi-site study examining the transition into early school for autistic students in general education settings. The longitudinal study involved the collection of student, parent, and teacher data across four-time points: (a) Time 1 in the Fall of School Year 1, (b) Time 2 in the Spring of School Year 1, (c) Time 3 in the Winter of School Year 2, and (d) Time 4 three to five years after Time 1. All students who completed the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) at Time 3 were included in this sub-study. Participants were recruited in the greater Boston and Southern California regions through online and print flyers, local school districts, clinicians, autism resource centers, intervention agencies, autism-related conferences, and parent support groups. All participating parents and teachers provided informed consent and all procedures were approved by the University of California, Riverside Institutional Review Board (IRB).

Eligible criteria for students were those between the ages of 4 to 7 years (i.e., enrolled in early elementary, Pre-K to second grade) upon entry to the study. Students were either diagnosed with ASD by a private evaluation and met criteria for ASD on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000; Lord et al., 2012) or had a school classification of autism (i.e., did not meet clinical diagnosis of ASD). For eligible students who were classified under autism in school, the Autism Diagnostic Interview, Revised (ADI-R; Le Couteur et al., 2003) was conducted with the primary caregiver to confirm a score in the autism or autism spectrum range. To participate in study tasks, cognitive abilities were set at IQ > 50 using the short form of the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III; Wechsler, 2002). Teachers and parents provided demographic information via self-report survey. See Table 1 for teacher and child demographics.

Table 1. Child and school demographics

Variable	% or mean (SD)
Child (N=122)	
Sex (% male)	80%
Age at eligibility visit (years)	5.1 (1.1)
IQ, *M(SD)*	*87.9 (17.9)*
Race (n=103)	
White	58%
Bi/Multiracial	18%
Latinx	13%
Asian American	5%
Black or African American	4%
Education Setting and Services	
Receiving special education services	88%
School setting	
Public	71%
Private	3%
Special school for children with ASD or other developmental disabilities	4%
Household data	
Household income (%> $50,000)	72%
Teacher (N= 92)	
Sex (% female)	70%
Highest degree (Master's)	49%
Teacher type (General education)	60%
Professional training in ASD	25%

Measures

Student characteristics

Wechsler Preschool and Primary Scales of Intelligence, Third Edition (WPPSI-III; Wechsler, 2002). The WPPSI-III is an individually-administered test of cognitive abilities for children between the ages of 2 years and 6 months and 7 years and 3 months. It yields

IQ scores with a normative mean of 100 and standard deviation of 15. The abbreviated version consisted of three subtests (Vocabulary, Matrix Reasoning, Picture completion) were summed to generate a full-scale IQ score using Sattler's conversion tables (Sattler, 2008). The WPSSI-III demonstrates strong psychometric properties, including excellent internal consistency (α=0.86-0.97) and test-retest reliability (r=0.84-0.92; Wechsler, 2002). As part of the eligibility process, the abbreviated version of the WPPSI-III was administered and collected at Time 1.

Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999). The CASL is a standardized assessment of spoken language for youth between the ages of 3 and 21 years. The CASL provides an assessment of semantic, syntactic, and pragmatic language indices. In this study, a composite spoken language score was generated using the sum of two subtests: (a) syntax construction and (b) pragmatic judgment, chosen to represent syntactic and pragmatic language skills, respectively. An age-based standard score is derived with a mean of 100 and a standard deviation of 15. The CASL has shown good construct validity and strong test-retest reliability (r=.92-.96) across indices (Carrow-Woolfolk, 1999) and has been widely used among children with autism spectrum disorder, language delays, aphasia, and intellectual disabilities (Reichow et al., 2007). In this study, the Total Standard Score was used and was collected at Time 3.

Teacher Response Form (TRF; Achenbach & Rescorla, 2000; 2001). The TRF is a teacher-report from of the Child Behavior Checklist (CBCL). It contains 112 items depicting a broad range of child behavioral and emotional problems. There are two forms of the TRF, one for ages 1 ½ -5 and another for ages 6-18. Both versions contain items

that are rated on a 3-point scale (0= not true, 1=somewhat true or sometimes true, 2= very true or often true). Participating teachers completed both versions that corresponded to the target student's age. T-scores of 60-63 are considered borderline for clinical significance, and T-scores greater than 63 are in the clinical range (Achenbach & Rescorla, 2000). The externalizing broadband scale demonstrated excellent reliability and validity, including concurrent validity with other measures of behavior problems (Achenbach & Rescorla, 2000). Within the current sample, α=0.94 for the age 6-18 form and α=0.93 for the age 1.5-5 form. For this study, the externalizing broadband T-score at Time 3 was used as a measure of externalizing behavior.

Social Skills Improvement System (SSIS; Gresham & Elliot, 2008). A teacher-report questionnaire for children ages 3-18 that broadly assesses child social skills using a three-point scale from 0 (never) to 2 (very often). The SSIS yield a Social Skills Total standard score with a mean of 100 and standard deviation of 15. The SSIS Total score demonstrates high internal consistency (α=0.96-0.97), test-retest reliability (r=0.82-0.84), and convergent validity with the Vineland Adaptive Behavior Scale, Second Edition and the Behavior Assessment System, Second Edition (see Gresham & Elliot, 2008). Standard scores at Time 3 were used from this measure. Higher scores represent better social skills.

Emotion Regulation Checklist (ERC; Shields & Cicchetti, 1997). A parent-report measure of a child's method for managing emotional reactions. The 24-items on the ERC yield scores for two subscales, the Negativity/Lability scale and Emotion Regulation (ER) scale. The Negative/Lability scale assesses a child's lack of flexibility, rapid mood

changes, and dysregulation of affect. The Emotion Regulation scale measures the child's overall mood and ability to label and express appropriate levels of positive and negative emotions in social contexts. The ERC has been successfully used with autistic children, demonstrating high reliability (α=0.83) and predictive validity (Berkovits et al., 2017). For the current study, the Emotion Regulation subscale at Time 3 was utilized. Higher scores on the ERC-ER represent higher levels of emotion regulation abilities.

Genotyping OXTR single nucleotide polymorphism. DNA samples were extracted using Oragene DNA collection kits or ORAcollect for Pediatric kits (Ottawa, ON, Canada). All SNP genotyping (OXTR) were performed by Laragen, Inc. (Culver City, CA). See Caplan et al., 2021 for more details. OXTR SNP rs53576 A and G alleles were selected due to their established relationship with social phenotypes and relation to parenting and STRs (Hygen et al., 2017; Kumsta & Heinrichs, 2013).

Teacher characteristics

Teacher Strategies Questionnaire (TSQ; Carlson et al., 2011; Webster-Stratton et al., 2001). The TSQ is a measure of teachers' use of specific classroom management strategies. The original scale includes 27 items/ teacher strategies that results in four subscales. Praise and Incentives (6 items), Proactive Strategies (7 items), Limit-Setting Strategies (5 items), and Inappropriate Strategies (9 items). An additional seven items are not included in any subscale (items 28-34). For each item, teachers rated how often they use each strategy (1= Rarely/Never to 5= Very often) as well as how useful they find each strategy (1= Not at all useful to 5= Very useful). Webster-Stratton et al. (2001) and Carlson et al. (2011) reported good internal consistency for this measure. Losh and

Blacher (2023) revised the Praise and Incentive subscale by summing the existing six items and including two additional positive responses to students ("send notes home to report positive behavior" and "call parents to report positive behavior"). The revised subscale demonstrated good internal consistency in the current sample (α=0.80). Teachers completed the TSQ at Time 3.

Classroom Climate Inventory. Teachers at Time 3 completed this questionnaire to assess teacher and school characteristics. Teachers were asked to report their number of years teaching, percentage of time student spent in the general education (GE) classroom, and highest educational degree (Associate's, Bachelor's, Master's, PhD). Teachers' highest educational degree was collapsed into Bachelor's or below versus Master's or above, given that relatively few teachers endorsed high school/ Associate's degrees (n=8) or a PhD (n=0). Teachers also reported the percentage of time students spent in the classroom (1= ≤ 25%, 2= 26-50%, 3=51-75%, and 4= 76-100%). Given that many students (n=41) spent less than 75% of their time in the GE classroom, the percentage of time spent in the classroom was dichotomized into "general education" (i.e., 76-100%) or "special education" (i.e., 75% or below), respectively. As new teachers were assigned to students at Time 3, teachers completed a new Classroom Climate Inventory and data at Time 3 was used in the present study.

Parent characteristics

Parent-Child Interaction Rating System (PCIRS; Belsky et al., 1995; Fenning et al., 2007). The PCIRS is a rating system of parenting behavior that can be used to assess observed parent-child interactions. It includes five-point Likert scale ratings (1=not at all

characteristic, 5= highly characteristic) for six dimensions of parenting behavior: (a) positive affect defined as the degree to which parents verbally or nonverbally expressed positive regard, warmth, and affection toward their child, (b) negative affect indicated the expression of negative affect, disapproval, and hostility through verbal means (e.g., harsh tone of voice) or nonverbal behavior (e.g., strained expression, look of disgust), (c) sensitivity defined as the degree to which the parent was "child-centered" and responded quickly, appropriately, and consistently to the child's needs, (d) intrusiveness indicated parent behavior that was adult-centered rather than child-centered, (e) detachment defined as parent passivity or disengagement and lack of awareness of the child's needs, and (f) stimulation of cognitive development indicated parent attempts to foster the child's cognitive development at a developmentally appropriate level. To represent the broader context of parenting style, a two- factor principal-component analysis was performed (see Blacher et al., 2013). The first factor was named "positive parenting" which included positive affect, sensitivity, stimulation of cognition, and detachment (reverse coded). The second factor was named "negative parenting" which included negative affect and intrusiveness. The PCIRS has been used extensively to code parent-child interactions in diverse populations of young children including young children at developmental risk or with developmental delays or ASD (Baker & Crnic, 2005; Blacher et al., 2013; Fenning et al., 2007). At Time 2, parents and children completed a semi-structured shared reading interaction task which was videorecorded and later coded by a lead coder and two project staff, who were trained using videotaped lab observations until reliability was met. The PCIRS reliability criteria were set at 70% exact agreement and

90% within-one-scale point agreement with the lead coder, which aligned with other studies use of the PCIRS (e.g., Blacher et al., 2013; Fenning et al. 2007). For this study, negative and positive parenting were used in the analyses. Higher scores indicate more frequent use of positive parenting and negative parenting, respectively.

Dependent Variable- Measures of student-teacher relationship quality

Student-Teacher Relationship Scale (STRS; Pianta, 2001). This 28-item teacher-report measure assesses relationship quality between a teacher and individual student (grades pre-K through 3rd grade). For each item, teachers rate their level of agreement using a 5-point Likert scale (1= "definitely does not apply" to 5 "definitely applies"). The measure is composed of three subscales: Conflict (12 items) which measures the teacher's feelings of negativity or conflict with the student; Closeness (11 items) which measures teacher's feelings of affection and open communication with the student; and Dependency (5 items) which measures the extent to which the teacher views the student as overly dependent. Cronbach's alphas for this sample were: Closeness α =0.76, Conflict α =0.86, and Dependency α =0.58. The lower alpha for the Dependency subscale is in alignment with previous studies using the STRS (e.g., Blacher et al., 2014; Doumen et al., 2009; Mantzicopoulos & Neuharth-Pritchett, 2003; Ogelmana & Seven, 2014; Rey et al., 2007) and with the standardization sample (Pianta, 2001). The total relationship quality score was not utilized in this study because it is intended to sum all three subscale scores (Pianta, 2001); only STR Closeness and Conflict were the subscales of interest. Subscales at Time 3 were used in this study. Higher scores indicate higher levels of closeness and conflict.

My Teacher and Me Questionnaire (MTMQ; Losh et al., 2022). A 15- item student-report measure of STR quality including 10 items to measure positivity and 5 items to measure negativity. A small 3-point Likert scale was utilized (i.e., 1= No, 2= Sometimes, and 3= Yes) to promote clarity, feasibility, and concreteness with young children. A visual aid was developed to promote comprehension by making the Likert scale points more concrete. The visual aid depicted black-and-white bars of varying fullness (i.e., completely shaded bar represented "yes," half shaded bar represented "sometimes," and empty bar represented "no") to clarify the response choices. An examiner verbally administered the paper questionnaire by reading the instructions, list of items, and response options aloud to each student paired with the visual aid. Students could respond verbally or non-verbally by pointing at the corresponding visual bar. The positivity scale indicates warmth, liking, and openness (e.g., "I like my teacher") reflecting security and closeness in the relationship, similar to items in the Closeness subscale of the STRS. The negativity scale reflected conflict, hostility, and tension in the relationship (e.g., "I get angry with my teacher"), much like the items in the Conflict subscale of the STRS. In the current sample, an acceptable level of internal consistency for the Positivity subscale (α =0.73) was found; however, the internal consistency of the Negativity subscale (α =0.52) was low, possibly due to the inclusion of only three items (Losh et al., 2022). Higher scores on each scale indicate more positivity and negativity. In this study, only the Time 3 scores on this measure were used.

Procedure

As part of the larger, longitudinal study data were collected through laboratory observations, assessments, student-completed questionnaires, parent-completed questionnaires, teacher-completed questionnaires, and DNA-collection procedure. All procedures were reviewed and approved by the IRB. Participants completed an eligibility session and three subsequent assessment sessions (Time 1-3) across two academic years and a DNA-collection procedure (Time 4). Time 1 occurred 3 months within the start of the school year, Time 2 occurred between 7 and 10 months after the start of the school year, Time 3 occurred between 4 and 6 months after the start of the following academic year, Time 4 occurred 3-5 years after their eligibility visit when children were 7-12 years old. At Time 4, DNA was collected from 104 children. All students who completed the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999) at Time 3 were included in this sub-study.

At each visit, parents were provided with a packet of questionnaires to bring to the child's primary teacher and provided their consent to have the child's teacher complete study measures. Teacher participation was voluntary, and all participating teachers provided informed consent. The eligibility visit consisted of the WPPSI-III as a measure of the child's cognitive ability and the autism diagnosis was confirmed with the ADOS. As the eligibility and Time 1 visits were within a month of each other, data from both visits will be referred to as Time 1 measures.

At Time 2 only, parents and children participated in a shared literacy task in which they were provided four storybooks without words. These interactions were video recorded and coded using the PCIRS (see Losh et al., 2019 for more details). At Time 3, students completed the researcher-administered CASL as a measure of language ability and teachers completed the TRF as a measure of teacher-perceived externalizing problem behaviors. In addition, the ERC was completed by parents as a measure of parent-perceived emotion regulation, the SSIS was completed by teachers as a measure of teacher-perceived social skills, and the TSQ was completed by teachers as a measure of teachers' use of praise and incentives, respectively. Also at Time 3, teachers and students completed the STRS and MTMQ as measures of perceived STR quality, respectively. Thus, multiple measures from multiple sources prevented shared method variance. For the DNA-collection procedures, see Caplan et al. (2021).

Data Analytic Plan

Missing data analysis indicated that data were missing completely at random (Little's MCAR test: $\chi^2(186, N=122) = 107.44$, $p > .05$). All statistical analyses were conducted using IBM SPSS Version 29.0.1.1 (IBM Corp 2016) using expectation maximization (EM) to estimate missing data. Twenty-four percent of children were missing teacher-reported data; EM has shown to be robust to bias at this level of missingness and yielded similar estimates and standard errors to full-information maximum likelihood (FIML) and multiple imputation (MI) (Dong & Peng, 2013).

Preliminary bivariate Pearson correlations were conducted to examine relationships between variables of interest for each of the research questions. Specifically, all student-, parent-, and teacher-characteristics were correlated with student- and teacher-reported STR quality subscales. Only variables that were significantly correlated with student- and teacher-reported STR subscales were included in regression models.

To address research question 1 and examine which student-, teacher-, and parent-characteristics contributed to STR Closeness and Conflict, sequential regression models were conducted. For STR Closeness, three sequential regression models were conducted - Models 1 and 2 included significantly correlated student characteristics and Model 3 added significantly correlated parent characteristics. For STR Conflict, two sequential regression models were conducted- Model 1 with significantly correlated student characteristics and Model 2 added significantly correlated teacher characteristics. To explore the motivational aspects of teacher practices (i.e., praise and incentives) and teacher- and student-reported STRs, two multivariate one-way ANOVA's were conducted using TSQ Praise and Incentive which was dichotomized into a "high" and "low" use of praise and incentives, using a median split to categorize. To address research question 2 and evaluate the predictive properties of significant correlations with MTMQ Positivity and Negativity, sequential linear regressions were conducted with significantly correlated variables, respectively. Finally, to address question 3, a moderation analysis was conducted using SPSS's PROCESS macro (Hayes, 2013) to explore the relationship between parenting behaviors and STR quality through OXTR

rs53576 A and G alleles. As there was a lack of evidence to single out AA, AG, or GG carriers as a prior grouping of hetero or homozygotes, all variations were considered in examining the effects of parenting behaviors on STRs.

Results

Descriptive statistics for each of the student, parent, and teacher measures are presented in Table 2. Within this sample, 54% scored at least one standard deviation below the mean (T score < 85) and 15% scored at least two standard deviations below the mean (T score < 70) on the SSIS Teacher report at Time 3 and 35% of the sample scored above the clinical cut off on the TRF Externalizing T-score, with an additional 10% of the sample scoring in the borderline clinical range. Thus, a notable percentage of this sample of children had lagging social skills and behavior challenges. The mean scores of the STRS Closeness were lower than average and fell in the 25th percentile, while STRS Conflict mean was elevated and fell in the 93rd percentile relative to the standardization sample (Pianta, 2001).

Table 2. Descriptive statistics for child, parent, and teacher characteristics at Time 3

	Mean	SD
Student characteristics		
IQ Time 1	87.9	17.9
CASL	157.8	49.3
TRF Externalizing behaviors	59.1	10.4
SSIS- Teacher	84.5	12.5
ERC Emotion Regulation	23.4	3.5
Parent characteristics		
PCIRS positive parenting	13.9	2.3
PCIRS negative parenting	2.7	.89
Teacher characteristics		
TSQ Praise and Incentives	30.6	4.8
Years of Experience	13.5	8.1
Outcome variables		
STRS Closeness	40.1	7.2
STRS Conflict	21.5	7.2
MTQM Positivity	9.6	2.4
MTMQ Negativity	2.0	1.5

Table 3. Correlations between student, parent, teacher characteristics and outcome STR Closeness and Conflict at Time 3

	STR Closeness	STR Conflict
Student characteristics		
IQ	.36***	-.11
CASL	.36***	-.11
ERC Emotion Regulation	.13	.10
TRF Externalizing Behavior	.07	.03
SSIS- Teacher	.68***	-.37***
Parent characteristics		
PCIRS positive parenting	.18	-.06
PCIRS negative parenting	-.41***	.09
Teacher characteristics		
TSQ Praise and Incentives	.14	.05
Teacher degree	-.12	.08
Years of experience	.14	-.18
% Time spent in the classroom [a]	.10	.22**

**p<.05, **p<.01, ***p<.001*

[a] Teachers reported the percentage of time spent in the classroom is on an ordinal scale (1= ≤ 25% to 4= 76-100%)

Table 4. Correlations between student, parent, teacher characteristics and outcome MTMQ Positivity and Negativity at Time 3

	MTMQ Positivity	MTMQ Negativity
Student characteristics		
IQ	.03	-.30***
CASL	.21*	-.22*
ERC Emotion Regulation	.19*	-.01
TRF Externalizing Behavior	-.18*	-.06
SSIS- Teacher	.32***	-.14
Parent characteristics		
PCIRS positive parenting	.27**	.10
PCIRS negative parenting	-.06	.10
Teacher characteristics		
TSQ Praise and Incentives	.00	.18*
Teacher Degree	-.10	-.10
Years of experience	.14	.00
Time spent in the classroom[a]	.15	.11

**p<.05, **p<.01, ***p<.001*

[a] Teachers reported the percentage of time spent in the classroom is on an ordinal scale (1= ≤ 25% to 4= 76-100%)

Preliminary Analyses

Pearson correlations, presented in Table 3, were conducted between student-, parent-, and teacher- characteristics and STR Closeness and Conflict at Time 3 respectively. There were separate significant positive associations between STR Closeness and IQ, between STR Closeness and CASL, and between STR Closeness and SSIS- Teacher. STR Closeness was negatively associated with PCIRS negative parenting. A significant negative association was found between STR Conflict and SSIS- Teacher report. A significant positive association was found between STR Conflict and percentage of time spent in the classroom.

Pearson correlations, presented in Table 4, were conducted between student-, parent-, and teacher- characteristics at Time 3 and MTMQ Positivity and MTMQ Negativity at Time 3, respectively. Regarding MTMQ Positivity, there were four significant positive correlations: (1) between CASL and MTMQ Positivity; (2) between ERC Emotion Regulation and MTMQ Positivity; (3) between SSIS- Teacher and MTMQ Positivity; and (4) between PCIRS positive parenting and MTMQ Positivity. There was a significant negative relationship between TRF Externalizing behaviors and MTMQ Positivity. There was a significant positive relationship between TSQ Praise and Incentives and MTMQ Negativity. There were two significant negative relationships between IQ and MTMQ Negativity and between CASL and MTMQ Negativity.

Table 5. Sequential regressions of student, teacher, and parent characteristics and STR Closeness Time 3

	STR Closeness		
	β	R^2	AIC
Model 1: Student characteristics		.15***	436.93
IQ	.22		
CASL	.20		
Model 2: Student characteristics		.47***	381.49
IQ	.11		
CASL	-.04		
SSIS- Teacher	.65***		
Model 3: Parent characteristics		.50***	374.93
IQ	.06		
CASL	-.05		
SSIS- Teacher	.61***		
PCIRS negative parenting	-.21**		

**p<.05, **p<.01, ***p<.001*
Note: ΔR^2 for STR Closeness, Step 1= N/A, Step 2=.32, Step 3= .03.

Table 6. Sequential regressions of student and teacher characteristics and STR Conflict Time 3

	STR Conflict		
	β	R^2	AIC
Model 1: Student characteristics		.14***	467.99
SSIS- Teacher	-.37***		
Model 2: Teacher characteristics		.19***	461.48
SSIS- Teacher	-.38***		
76-100% in GE classroom	.24**		

**p<.05, **p<.01, ***p<.001*
Note: ΔR^2 for STR Conflict, Step 1= N/A, Step 2=.05

Research Question 1: Student, teacher, and parent characteristics related to STR Closeness and Conflict

Multiple linear regressions were conducted sequentially using significantly correlated student, teacher, and parent characteristics as predictors of STR Closeness and STR Conflict (see Tables 5 and 6). Only significantly correlated variables were included in the regressions. Regarding STR Closeness, in Model 3, SSIS teacher-reported social skills and PCIRS negative parenting explained a significant proportion of the variance of STR Closeness, over and above other student characteristics, $F(4,121) = 29.66$, $p < .001$. Teacher-reported social skills were positively associated with STR Closeness whereas negative parenting was negatively associated with STR Closeness indicating that higher social skills and less negative parenting behavior were associated with higher STR Closeness, even when accounting for student IQ and language ability.

Regarding STR Conflict, parent characteristics were not significantly correlated with STR Conflict, so it was not added to the sequential regression model. In Model 2, SSIS teacher-reported social skills and more time spent in the GE classroom were examined as predictors of STR Conflict. Results indicated that SSIS teacher-reported

social skills was a negative predictor and time spent in the GE classroom was a positive predictor of STR Conflict, $F(2,121) = 14.25$, $p < .001$, such that worse teacher-reported social skills and more time spent in the GE classroom were related to higher STR Conflict.

Teacher Characteristics and Student- and Teacher- Reported STRs

Two multivariate one-way ANOVAs were conducted to compare the effects of TSQ Praise and Incentives on student- and teacher-reported STR quality. The first multivariate ANOVA compared the effects of high and low use of TSQ Praise and Incentives on MTMQ Positivity and STRS Closeness. There was no significant effect of TSQ Praise and Incentives on MTMQ Positivity, $F(1,121) = .07$, $p > .05$, or STR Closeness, $F(1,121) = 1.05$, $p > .05$.

The second multivariate ANOVA compared the effects of high and low use of TSQ Praise and Incentives on MTMQ Negativity and STR Conflict. There was no significant effect of TSQ Praise and Incentives on MTMQ Negativity, $F(1,121) = 1.53$, $p > .05$, or STR Conflict, $F(1,121) = .003$, $p > .05$.

Table 7. Sequential Regression with Significant Correlates of MTMQ Positivity

	MTMQ Positivity		
	β	R^2	AIC
Model 1: Student characteristics		.14***	206.14
CASL	.05		
ERC Emotion Regulation	.10		
TRF Externalizing Behavior	-.15		
SSIS - Teacher	.29**		
Model 2: Parent characteristics		.20***	200.60
CASL	.01		
ERC Emotion Regulation	.07		
TRF Externalizing Behavior	-.11		
SSIS - Teacher	.32***		
PCIRS positive parenting	.24**		

**p<.05, **p<.01, ***p<.001*
Note: ΔR^2 for MTMQ Positivity, Step 1= N/A, Step 2=.06

Table 8. Sequential Regression with Significant Correlates of MTMQ Negativity

	MTMQ Negativity		
	β	R^2	AIC
Model 1: Student characteristics		.09**	85.29
IQ	*-.28**		
CASL	-.02		
Model 2: Teacher characteristics		.13***	82.22
IQ	-.32**		
CASL	.01		
TSQ Praise and Incentives	.19*		

**p<.05, **p<.01, ***p<.001*
Note: ΔR^2 for MTMQ Negativity, Step 1= N/A, Step 2=.04

Research Question 2: Student, teacher, and parent characteristics related to MTMQ Positivity and Negativity

Research question 2 examined possible student, parent, and teacher predictors of student-reported MTMQ Positivity and Negativity (see Table 7 and 8). Sequential linear regressions were conducted with significant student and parenting correlates of MTMQ

Positivity and Negativity, respectively. For MTMQ Positivity, in Model 2, SSIS teacher-reported social skills and PCIRS positive parenting were positive significant predictors, $F(5,121) = 5.71$, $p < .001$, over and above other student characteristics. This suggests that better teacher-reported social skills and more positive parenting behaviors were related to more student-perceived positivity with their teacher, over and above student language ability, emotion regulation, and externalizing behaviors. Finally, a sequential regression was conducted with student and teacher predictors of MTMQ Negativity. In Model 2, IQ was a significant negative predictor and TSQ Praise and Incentive was a significant positive predictor, such that higher IQ was related to lower student-reported negativity with their teacher and more teacher-reported praise and incentives was related to higher student-reported negativity with their teacher, $F(3,121) = 5.74$, $p = .001$.

Research Question 3: Moderation of OXTR on parenting behaviors and teacher-reported STRs

A moderation analysis was conducted to examine if there was an interaction effect between parenting behaviors (i.e., positive and negative) and OXTR rs53576 G and A allele variations. The outcome variables were STR Closeness and STR Conflict. The predictor variables were PCIRS positive and negative parenting. The moderator variable evaluated was OXTR rs53576 variations of GG/ AG/ AA alleles.

Interaction between parenting and OXTR variations on STR Conflict

In observing the outcome variable, STR Conflict, and predictor variable, PCIRS negative parenting, the interaction between PCIRS negative parenting and OXTR rs53576 AG/AA was not statistically significant [$\beta = -.25$, 95% CI (3,78), $p > .05$)].

Second, the interaction between PCIRS negative parenting and OXTR rs53576 AA was not statistically significant [β = 1.58, 95% CI (3,78), $p > .05$)]. Third, the interaction between PCIRS negative parenting and OXTR rs53576 GG was not statistically significant [β = -.15, 95% CI (3,118), $p > .05$)]. Lastly, PCIRS negative parenting and OXTR rs53576 GG/AG was not statistically significant [β = -1.58, 95% CI (3,78), $p > .05$)]. In sum, results indicated no significant moderation effects of OXTR rs53576 AA, AG, or GG allele variations on the relationship between PCIRS negative behaviors and STR Conflict.

In observing the outcome variable, STR Conflict, and predictor variable, PCIRS positive parenting, the interaction between PCIRS positive parenting and OXTR rs53576 AG/AA was not statistically significant [β = .20, 95% CI (3,78), $p > .05$)]. Second, the interaction between PCIRS positive parenting and OXTR rs53576 AA was not statistically significant [β = -.67, 95% CI (3,78), $p > .05$)]. Third, the interaction between PCIRS positive parenting and OXTR rs53576 GG was not statistically significant [β = .26, 95% CI (3,118), $p > .05$)]. Lastly, PCIRS positive parenting and OXTR rs53576 GG/AG was not statistically significant [β = .67, 95% CI (3,78), $p > .05$)]. In sum, results indicated no significant moderation effects of OXTR rs53576 AA, AG, or GG allele variations on the relationship between PCIRS positive behaviors and STR Conflict.

Interaction between parenting and OXTR variations on STR Closeness

In observing the outcome variable, STR Closeness, and predictor variable, PCIRS positive parenting, the interaction between PCIRS positive parenting and OXTR rs53576 AG/AA was not statistically significant [β = -.19, 95% CI (3,78), $p > .05$)]. Second, the

interaction between PCIRS positive parenting and OXTR rs53576 AA was not statistically significant [β = -.31, 95% CI (3,78), $p > .05$)]. Third, the interaction between PCIRS positive parenting and OXTR rs53576 GG was not statistically significant [β = .19, 95% CI (3,118), $p > .05$)]. Lastly, the interaction between PCIRS positive parenting and OXTR rs53576 GG/AG was not statistically significant [β = -.19, 95% CI (3,78), $p > .05$)]. In sum, results indicated no significant moderation effects of OXTR rs53576 AA, AG, or GG allele variations on the relationship between PCIRS positive behaviors and STR Closeness.

In observing the outcome variable, STR Closeness, and predictor variable, PCIRS negative parenting, the interaction between PCIRS negative parenting and OXTR rs53576 AG/AA was not statistically significant [β = .86, 95% CI (3,78), $p > .05$)]. Second, the interaction between PCIRS negative parenting and OXTR rs53576 AA was not statistically significant [β = 2.68, 95% CI (3,78), $p > .05$)]. Third, the interaction between PCIRS negative parenting and OXTR rs53576 GG was not statistically significant [β = -1.98, 95% CI (3,118), $p > .05$)]. Lastly, the interaction between PCIRS negative parenting and OXTR rs53576 GG/AG was not statistically significant [β = -2.68, 95% CI (3,78), $p > .05$)]. In sum, results indicated no significant moderation effects of OXTR rs53576 AA, AG, or GG allele variations on the relationship between PCIRS negative behaviors and STR Closeness.

Discussion

The present study examined: a) which potential student, teacher, and parent characteristics were related to student- and teacher-reported STRs, and b) if OXTR rs53576 alleles moderated the association between STRs and parenting behaviors. Five key findings were observed. First, higher scores on teacher-reported social skills and less negative parenting behaviors were significant contributors to STR closeness, over and above other student characteristics. Second, lower scores on teacher-reported social skills and more time spent in the GE classroom were significant contributors of STR conflict. Third, higher student IQ scores were significantly related to less student-reported negativity with their teachers; and inversely, more frequent use of praise and incentives was significantly related to more student-reported negativity with their teachers. Fourth, higher scores on teacher-reported social skills and more positive parenting behaviors were significant predictors of student-reported positivity with their teachers, over and above student characteristics. Finally, OXTR rs53576 was not a significant moderator of the relationship between parenting behaviors and STRs.

Consistent with previous studies, autistic students demonstrated relatively poor STR quality with elevated levels of conflict and less closeness compared to STR quality reported among NT children and their teachers (Blacher et al., 2014; Eisenhower et al., 2015; Robertson et al., 2003; Zee et al., 2020). When individually examining STR closeness and conflict, results indicated separate student, teacher, and parenting characteristics were related to STR quality. Our study found that better IQ, language ability, social skills were associated with higher levels of STR closeness; similarly, less

negative parenting was also associated with higher levels of STR closeness. Even when controlling for IQ and language ability, better social skills and less negative parenting behavior were significant contributors to STR closeness. This may suggest that autistic students benefit from parents who utilize more positive affect in their tone of voice and follow their child's lead when engaging in activities, which may set the foundation for a secure attachment base from which to build closer relationships with their teachers (Bowlby, 1969). Moreover, similar to findings by Totsika et al. (2014), less intrusiveness and more positive parent-child interaction and relationships in early childhood may increase opportunities for autistic students to learn and practice social skills, which may have positive implications for relationship-building with their teachers and other NT peers. As Caplan et al. (2016) categorized social skills as a protective factor for STR closeness, our findings may also suggest that fewer negative parenting behaviors may serve as an additional protective factor of STR closeness. It may be helpful to pair evidence-based interventions focusing on parent-child interactions and child social skills as potential strategies to improve STR closeness.

On the other hand, poorer social skills and more time spent in the GE classroom were significantly related to higher STR conflict. This is in line with previous findings that autistic individuals with social skill difficulties lead to teachers reporting more conflict (Blacher et al., 2014; Robertson et al., 2003; Zee et al., 2020). As autistic students struggle to socially interact and communicate with their teacher and peers, teachers may build a negative schema of the autistic student based on these negative interactions which may bias them to report higher levels of STR conflict. In contrast to

previous findings that special education students reported experiencing more conflict with their teachers than general education students (Roorda et al., 2021), results indicated that teachers who worked with autistic students in GE settings reported higher ratings of conflict than teachers in special education settings. This may suggest that teachers in the GE setting may be using intrusive teaching styles, instead of positive responsive strategies. In fact, in an inclusive high school, autistic students encountered GE teachers who either yelled at them, were too strict, or too inflexible and negatively influenced their school experience (Sagger, 2015). Furthermore, in another study using participants from this same sample (Feldman et al., 2019), indicated that only twenty-five percent of the teachers previously received training in ASD, suggesting a need for more professional development and training to create a positive and supportive environment for autistic students in the GE setting.

Although previous literature has focused on NT students and autistic adolescents' perspectives of the STR, this study focused on young autistic students' perception of STRs. Findings in our study highlight social skills and positive parenting behaviors as driving factors of student-perceived positivity in the STR, over and above other student characteristics, in the early school years. Surprisingly, teacher-reported use of praise and incentives was a predictor of student-perceived negativity in the STR, and higher IQ (i.e., cognitive ability) was related to less student-perceived negativity in the STR. Past studies have shown that the use of praise and incentives has been used to reduce and prevent challenging behaviors and increase students' ability to stay on task and focused (Lindsay et al., 2014), allowing teachers to build closer relationships with their autistic students

(Kincaide et al., 2020; Oliver-Kerrigan et al., 2021). However, in line with the voice of autistic adults that compliance-drive programs may be dangerous and damaging (Laurent, 2019), the present findings might suggest that autistic students perceive praise and incentives negatively as a conditional means for compliance and to appease their teacher expectations for academic productivity and engagement. Instead, as suggested by mothers of autistic students (Zeedyk et al., 2021), teachers may need to spend more 1:1 time with their students to actively listen and build a strong rapport with them. We hypothesize that autistic students may perceive more positivity when their teacher's positive attention is noncontingent on good behavior or productivity and simply to build a connection with them. Moreover, there was no significant effect of the use of teacher-reported praise and incentives on teacher's own self-reported STR or on student-reported STRs. This may further suggest that praise and incentives may not be a critical component to relationship building between teachers and students. These results shed light on how teacher strategies and classroom practices may be negatively perceived by their young autistic students and propose the need for more intentionality and compassion in their relationship-building with their young autistic students.

Regarding positive perceptions of the STR by autistic students, social skills, positive parenting, and IQ may serve as both protective and risk factors. From the protective factor perspective, better social skills, positive parenting, and higher IQ were significantly associated with more positive perceptions of the student-reported STR. As both IQ and social skills were identified as protective factors of STR closeness (Caplan et al., 2016), higher cognitive abilities and better social skills may set the foundation for

more positive interactions between teachers and their autistic students. This is in line with a study by Prewett et al. (2019) where adolescents seemed to observe positive teacher behaviors, such as complimenting, encouraging, and comforting them as behavioral cues from their teachers that promoted closer relationships with them. Thus, autistic students may rely on their teacher's positive behavioral cues to inform their relationship quality. Furthermore, as previously supported by Kuppens and Ceulemans (2019), positive authoritative parenting styles may set the foundation for more favorable outcomes including lower problem behaviors and more supportive and warm interactions with other adults. Conversely, from the risk factor perspective, autistic students with poorer social skills, lower cognitive abilities, and less exposure to positive parenting behaviors may be at risk for less positive and more negative perceptions of student-reported STR. In creating a supportive and inclusive classroom, teachers should learn to build a positive relationship with their autistic students regardless of students' social and cognitive abilities. As older autistic students have voiced strategies such as building strong rapport, active listening, and flexibility as a few ways to help them feel supported and successful in the classroom (Sagger, 2015), it is critical to validate and listen to their perspectives as they provide insight into different avenues for teachers to continue to build close and warm relationships with their autistic students. With a closer STR, teachers may then begin to create an environment in which autistic students can be successful and thrive in, socially and academically.

From an exploratory approach, our results showed that OXTR rs53576 and its allele variations were not significant moderators of the relationship between parenting behaviors and STRs. In contrast to Hygen et al. (2017), we did not replicate findings that OXTR rs53576 AA alleles moderated the relationship between the change in parenting behavior and STRs from their Norwegian sample. However, our findings were in line with their U.S. sample (Hygen et al., 2017), in which they found that OXTR rs53576 AA alleles in U.S. children did not moderate the relationship in parenting behaviors and STRs. Differences in our findings compared to Hygen et al. (2017) may be explained by a smaller sample size, heterogeneity in genes from an autistic U.S. sample compared to a more homogenous Norwegian sample, differing measures of parenting behaviors, and finally, our study did not measure change over time between parenting behaviors or STRs.

Although our findings were not significant, they may lend support towards the neurodiversity movement and autistic advocates who challenge the use of biological underpinnings to discover "cures and preventions" for autism (Pellicano & Stears, 2011). Autistic individuals and their parents also reported concerns and worries that focusing on genetic causes of autism devalues autistic lives (Lilley et al., 2023). Our current findings did not support the role of OXTR in explicating the gene x environment interaction for autistic students, similar to Caplan et al. (2021). As ASD is a polygenic, highly heterogenous condition (SFARI Gene, 2024) that encompasses multiple genes and/or gene mutations with the environment (Cheroni et al., 2020; Wei et al., 2021), the assessment of gene x environment is complex. More recently, researchers have started to

use computational frameworks such as interaction network analysis to identify an array of genes involved in autism (Rastegari et al., 2023). As such, the focus on one gene such as OXTR rs53576 may not be sensitive enough to detect a moderating effect on parenting behaviors and STRs. Moreover, more research is needed to understand these complex polygenetic models that may provide more insight into the heterogeneity of autistic individuals; more importantly, such research should include the voices and concerns of autistic individuals as valued participants in this research.

Limitations and Future Directions

While there were many strengths to the current study, including its inclusion of a large sample of young autistic students, multi-site design, and multi-year longitudinal study that included the perspectives of autistic students of their STRs, certain limitations should be acknowledged. First, although this study sampled a wide range of student characteristics, such as cognitive, language, social, and behavioral functioning, students with moderate-to-severe cognitive functioning (i.e., co-occurring Intellectual Disability) or those who were nonspeaking were not included in this study. Future research should consider including children with a wider range of cognitive and language abilities. Second, the measure of teacher-reported praise and incentives specified the frequency of general classroom teaching strategies but did not specify the context of using the positive response strategies with the target autistic student. More information should be collected about the type and delivery of praise (i.e., specific labeled praise; enthusiastic vs. non-enthusiastic) and incentives utilized in the classroom with the target autistic student. Interestingly, Gale et al. (2023) found that in comparison to NT children, autistic children

preferred enthusiastic praise over non-enthusiastic praise. Furthermore, the process of creating incentives for students may provide insight into how teachers build rapport and incorporate a student's interest into their rewards and privileges. Third, due to the small sample size of genetic data in comparison to large samples, findings should be interpreted as exploratory. More polygenic studies should examine the gene x environment effects using a larger sample size and interaction network analyses.

Conclusion

The results of this study have implications for considering individual and environmental factors that may influence our understanding of teacher-reported and student-reported STRs. Findings suggest that parenting behaviors set a foundation for building a close relationship between autistic students and their teachers. There is also a need for more professional development training about ASD and possible consultation and collaboration with special education teachers to be more intentional in building rapport and interacting with autistic students in the classroom. Most importantly, student's perspectives of their relationship with their teachers can provide new insights into how student, parent, and teacher characteristics play a role in the dyadic relationship. Research in this field must continue to include students' perspectives and consider environmental factors that may contribute to the STR, with the goal to improve autistic student's academic success and to help build an inclusive and positive environment for them.

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