ORIGINAL ARTICLE

Exploring the Relationships Between Theory of Mind, Social Skills, and Friendship Quality in Adolescents and Adults With and Without Autism Spectrum Disorder Through Structural Equation Modeling

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Abstract

This study examined friendship quality and theory of mind (ToM) in individuals with autism spectrum disorder (ASD) compared to non-autistic peers, and the influence of ToM, social skills, and problem behaviors on friendships. Participants included adolescents/young adults with ASD ($N=104$; Male: 74, M_{age} = 18.55 years) and without ASD ($N=192$; Male: 101, M_{age} = 16.65 years). Data were collected using measures of ToM, autistic traits, social skills, problem behaviors, and friendship quality. Independent samples t-tests and Pearson correlations were used to characterize group differences and variable relationships. Multi-group structural equation modeling (SEM) was employed to examine the roles of social skills and problem behaviors in the relationship between ToM and friendship quality across groups. Individuals with ASD reported lower friendship quality, with less companionship, help, security, and closeness, experienced more conflicts in friendships than their non-autistic peers, and exhibited lower ToM performance. Multi-group SEM indicated significant positive effects of ToM on social skills in both groups, with a stronger effect observed in ASD. Additionally, there was a significant direct effect of ToM on friendship quality, with social skills mediating this relationship in the ASD group. Conversely, the negative direct effect of problem behaviors on friendship quality was significant only in individuals without ASD. The findings provide insights into the social cognitive and behavioral processes that influence friendship quality in individuals with ASD and emphasize the importance of targeted interventions aimed at enhancing social skills and ToM abilities in this population.

Keywords Autism spectrum disorder · Friendship quality · Theory of mind · Social skills · Problem behaviors · Structural equation modeling

Introduction

Individuals with autism spectrum disorder (ASD) often struggle with initiating and reciprocating social interactions (American Psychiatric Association [APA], 2013), which can impact their ability to develop and maintain friendships (Brendgen & Poulin, 2018; Petrina et al., 2014). Adolescents and young adults with ASD encounter additional challenges as they navigate the complexities of social interactions and transition to independence (Billstedt et al., 2005; Seltzer et al., 2004). Adults with ASD frequently face challenges in establishing and maintaining friendships or romantic relationships (Black et al., 2024). They also often report friendship insecurity and social exhaustion (Crompton et al., 2020; Sosnowy et al., 2019). These experiences underscore the importance of understanding the factors contributing to such outcomes.

The current study identifies the gaps in previous research regarding the unique dynamics of friendships in ASD, the role of theory of mind (ToM) in social functioning across individuals with and without ASD, and how social skills and problem behaviors may influence the relationship between ToM and friendship quality. Specifically, this study explores and compares how ToM, social skills, and problem

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behaviors interact to shape friendship quality among adolescents and young adults with and without ASD.

The Nature of Friendships in ASD

Despite social communication challenges, individuals with ASD demonstrate a desire for social engagement and reciprocal friendships (Finke & McCarthy, 2019; Gillespie-Smith et al., 2024), albeit with unique dynamics and challenges (Black et al., 2024; Petrina et al., 2014). High-quality friendships showed positive impacts on psychological well-being (Bauminger et al., 2004; Crompton et al., 2020), including reduced loneliness and depression, increased peer acceptance, and enhanced self-worth in this population (Gillespie-Smith et al., 2024; Sedgewick et al., 2019).

In the general population, friendship typically blends companionship, conflict resolution, mutual aid, security, and closeness—the five elements that are fundamental to social connectedness and emotional well-being (Bukowski et al., 1994). Individuals with ASD may desire companionship and shared interests similar to neurotypical (NT) peers, yet struggle to achieve comparable closeness and security in relationships with NT peers (Bauminger & Kasari, 2000; Mazurek, 2014). They may feel insecure about their friendships and experience anxiety about fitting into non-autistic social norms (Black et al., 2024). However, they tend to feel greater comfort and authenticity in friendships with other autistic peers (Crompton et al., 2020; Gillespie-Smith et al., 2024), without the need for masking (Livingston et al., 2019). Notably, they often have smaller friendship networks and may occupy peripheral positions within peer groups (Petrina et al., 2014; Schroeder et al., 2014), with reports of receiving less friend assistance and feeling disconnected (Kasari et al., 2011; Sosnowy et al., 2019).

Heterogeneity in autistic individuals' expectations and motivations regarding friendships (Morrison et al., 2020; Sedgewick et al., 2016) has also been observed and may contribute to the variability in the quality and perceived content of friendships within this population (Cage & Troxell-Whitman, 2019; Sedgewick et al., 2019). For instance, Finke and McCarthy (2019) found that autistic young adults prioritize friends with shared interests over emotional confidants and are more likely to prefer physical and emotional distance in relationships. Sosnowy et al. (2019) note that autistic adults face distinct challenges in friendships, such as difficulty initiating interactions, but acceptance and appreciation of their social differences or involvement in communities centered on shared interests can help mitigate social isolation. However, few quantitative studies have comprehensively assessed friendship quality across the five elements of friendships in this population.

Furthermore, most research focuses on children and adolescents, with limited exploration of the friendship experiences of adults with ASD (Black et al., 2024; Crompton et al., 2020). As individuals transition from childhood to adolescence and early adulthood, their friendships progress from simple companionship to sharing feelings and experiences (Bauminger et al., 2008). However, this shift towards more emotional and intricate social interactions can pose challenges for many autistic individuals (Cook et al., 2018; Jindal-Snape et al., 2020). Difficulties in understanding or conforming to social rules and conventions (Freeman et al., 2015; Friedman et al., 2019) often lead to peer rejection and victimization (Black et al., 2024; Schroeder et al., 2014). On the other hand, these challenges are not simply due to autistic traits. As Gillespie-Smith et al. (2024) note, there is a two-way difficulty: autistic individuals may struggle with non-autistic social cues, and non-autistic peers also often fail to interpret autistic communication styles. Given the hurdles in navigating these complex social dynamics, it is crucial to understand the cognitive mechanisms that underpin successful social interactions.

Theory of Mind in ASD

Theory of mind (ToM) is an essential cognitive ability that involves attributing mental states, such as thoughts, feelings, and beliefs, to others (Baron-Cohen, 2000; Premack & Woodruff, 1978), enabling behavioral prediction, action rationalization, and interpretation of the social world (Grove et al., 2014; Sebastian et al., 2012). It is a core determinant of social competence (Semrud-Clikeman, 2007) and represents the cognitive aspect of social skills. It also includes awareness of social rules (Southall & Campbell, 2015), which is linked to self-regulation (Korucu et al., 2017). However, recent studies have challenged both the conceptualization of ToM and its measurement within the context of ASD (Gernsbacher & Yergeau, 2019; Livingston et al., 2019), demanding a more nuanced discussion of its role in autistic individuals' social functioning and outcomes.

ToM is often cited as a core feature contributing to the social interaction difficulties inherent in ASD (Baron-Cohen, 2000; Baron-Cohen et al., 1985; Hamilton et al., 2007; Mathersul et al., 2013; but see Gernsbacher & Yergeau, 2019). Individuals with ASD typically experience delayed or less advanced ToM development compared to NT peers and those with other developmental delays (Bora & Pantelis, 2016; Peterson et al., 2012). The atypical development and lower performance of ToM can persist into adolescence and adulthood (Hutchins et al., 2021; Murray et al., 2017; Peterson & Wellman, 2019).

However, the notion of universal ToM deficits in ASD has been challenged. Emerging evidence indicates that a subset

of individuals with ASD, particularly adolescents and adults with intact intellectual and verbal abilities, demonstrate proficiency in many ToM tasks (Mathersul et al., 2013; Murray et al., 2017; O'Reilly et al., 2014; Peterson et al., 2012). Additionally, some autistic individuals perform comparably to NT peers on basic ToM tasks, like false beliefs tasks, exhibiting deficits primarily in more advanced tasks, involving sarcasm, deception, or second-order beliefs (Hutchins et al., 2021). They also show a high level of self-insight into their own ToM strengths and challenges (Crehan et al., 2020). Other studies have found that autistic adolescents with intact intellectual and verbal abilities pass advanced ToM tasks but struggle to apply these principles in everyday social interactions (Hutchins et al., 2021; Scheeren et al., 2013). Moreover, heterogeneity in ToM performance within ASD may also stem from traditional measurement methods that heavily depend on verbal ability (Gernsbacher & Yergeau, 2019). This reliance can obscure autistic strengths in nonverbal contexts and lead to an underestimation of ToM in autistic individuals with verbal difficulties. Conversely, such assessments may overestimate ToM skills in those who use compensatory strategies, such as logical reasoning (Livingston et al., 2019).

The ramifications of ToM deficits in ASD extend beyond social interactions to impact the formation and maintenance of friendships (Happé, 2015; Hutchins et al., 2016; Mazza et al., 2017). Despite some individuals with ASD achieving age-appropriate ToM understanding (Begeer et al., 2010, 2015), these skills often fail to translate to daily social interactions (Tager-Flusberg, 2007). For example, some autistic adolescents or adults may succeed in false belief tasks (Fisher et al., 2005) but still struggle with anticipating another person's actions, social communication, and interaction (Senju, 2012; Senju et al., 2009), suggesting that ToM impairment may be one of several factors contributing to these challenges (Frith & Frith, 2003; Scheeren et al., 2013). Moreover, some studies have found that ToM performance on laboratory tasks correlates poorly with real-world friendship quality (Gernsbacher & Yergeau, 2019), as successful friendships depend on mutual understanding rather than adherence to neurotypical-centric measures of mentalizing (Crompton et al., 2020; Livingston et al., 2019). This discrepancy between performance on ToM tasks and real-world social interactions suggested that autistic individuals may face difficulties in spontaneously applying ToM, warranting investigation of whether and how ToM relates to social skills and friendship quality.

Relationships Between Theory of Mind, Social Skills, Problem Behaviors, and Friendship Quality

Research has highlighted a significant link between ToM and the friendship quality in both NT individuals and those with ASD (Devine et al., 2016; Fink et al., 2014), although this association may vary across developmental stages. Specifically, in childhood, ToM plays a critical role in establishing and fostering positive peer relationships (Imuta et al., 2016; Slaughter et al., 2015) by enhancing social communication and interaction skills (Fink et al., 2014; Slaughter et al., 2015) and promoting peer integration and acceptance (Szumski et al., 2019; Walker, 2005). However, some studies have found little to no association between ToM and social skills after controlling for age and verbal ability (Fombonne et al., 1994; Peterson et al., 2007). Moreover, these findings are primarily based on young children, and their applicability to older age groups remains limited.

In adolescents and adults with ASD, the relationship between ToM and friendship quality may be more nuanced. During these developmental stages, some autistic individuals prioritize friendships centered on shared interests over emotional closeness (Finke & McCarthy, 2019; Sedgewick et al., 2019), often preferring NT peers who understand and accept their social differences, or forming friendships with other autistic individuals where mutual understanding is more readily achieved (Sosnowy et al., 2019). Such relationship patterns may involve social skills and ToM expressed in distinct ways, as the focus on shared interests and acceptance shifts how intricate mental state inferences are enacted. For example, this can occur through mutual recognition of communication styles rather than strict adherence to neurotypical social cues (Crompton et al., 2020; Gillespie-Smith et al., 2024). However, limited empirical investigation has explicitly examined social skills as the mediator linking ToM and friendship quality, particularly in the context of ASD during adolescence and adulthood.

The relationship between ToM and problem behaviors is more nuanced and can also impact friendship quality. In NT individuals, more advanced ToM is associated with reduced aggression (Eisenberg et al., 1996; Hughes et al., 1998; Lemerise & Arsenio, 2000), better adherence to social rules, and enhanced self-regulation (Korucu et al., 2017). Problem behaviors such as aggression or social withdrawal can lead to social isolation, as peers may be less inclined to engage with individuals displaying disruptive or challenging behaviors (Heiman, 2000; Petrina et al., 2014). These behaviors are often exacerbated by poor social communication and difficulties in expressing needs and emotions, especially for individuals with ASD (Carter et al., 2005; Jones et al., 2017).

However, in NT individuals, advanced ToM has also been linked to antisocial behaviors aimed at personal gain, such as manipulation or exploitation of others (Gasser & Keller, 2009; Heerey et al., 2005; Sutton et al., 1999). Indeed, some studies reported positive associations between ToM and problematic behaviors (Sutton et al., 1999), including less sharing, more proactive aggression, and indirect social aggression, all of which can hinder the development and maintenance of friendships (e.g., Cowell et al., 2015; Gomez-Garibello & Talwar, 2015; Renouf et al., 2010). These findings highlight that ToM may interact with context and motivation to influence social behaviors and outcomes, with no single "optimal" expression across all social situations.

In contrast, among individuals with ASD, advanced ToM is associated with reduced restricted and repetitive behaviors (Baron-Cohen et al., 1985; Wellman, 1990; Jones et al., 2018), whereas ToM deficits heighten risk of both victimization and perpetration of bullying (Cappadocia et al., 2012; Caravita et al., 2010; Liu et al., 2018). These underscore the need for further exploration of how ToM relates to problem behaviors and influences friendship quality in both NT and ASD individuals.

The Current Study

A notable omission in previous studies is the comparative analysis of ToM development and its influence on friendship quality across adolescent and early adult stages in ASD versus non-autistic individuals. Furthermore, the potential mediating roles of social skills and problem behaviors in the relationship between ToM and friendship quality have not been extensively investigated, particularly in comparing this potential mediation between adolescents and adults with and without ASD. The current study aims to address these gaps through the following specific research questions: (1) What are the differences in the five elements of friendship quality, ToM, social skills, and problem behaviors between adolescents/young adults with ASD and their non-autistic peers? (2) Does ToM have a direct effect on friendship quality, and do these effects differ in strength between the ASD and non-autistic groups? (3) Do social skills and/or problem behaviors mediate the relationship between ToM and friendship quality, and if so, is this mediating effect comparable across the ASD and non-autistic groups?

To answer these questions, the current study compares friendship quality, ToM, social skills, and problem behaviors among adolescents and adults with ASD and their peers without ASD. It employs SEM to investigate the contribution of ToM to friendship quality through its influence on social skills and problem behaviors. We hypothesize that individuals with ASD will demonstrate lower levels of friendship quality and ToM compared to their non-autistic peers. Additionally, we hypothesize that social skills and problem behaviors will mediate the relationship between ToM and friendship quality. These investigations are designed to enhance understanding of the social cognitive processes that underpin friendship formation and maintenance in individuals with ASD. These also seek to inform evidence-based interventions targeted at improving social skills and friendship quality in this population.

Methods

Participants and Procedures

A total of 104 autistic participants and 192 participants without ASD participated in this study. These participants were selected from secondary schools and universities in Hong Kong and cities in Mainland China (Guangzhou, Shenzhen, Foshan, Zhuhai) as well as special schools in Foshan. All participants with ASD reported that they had received a formal diagnosis as indicated in the assessment reports by qualified healthcare professionals, and scored 30 or above on the Autism Spectrum Quotient scale (AQ, Baron-Cohen et al., 2006). Detailed information on the sample demographics and comorbidities is presented in Table 1. Written consent was obtained from both the participants and their parents/caregivers. Parents/caregivers of all participants completed all measures, except for the Friendship Quality Scale (FQS), which was rated by the participants themselves. The ToM tasks were administered by the first author in a controlled laboratory setting, following standardized procedures to ensure consistency and accuracy in task presentation and response recording.

Measures

The current study employed a combination of parent/caregiver-report, self-report measures and direct assessment tasks. Parents or caregivers completed the Autism-Spectrum Quotient (AQ; Baron-Cohen et al., 2006), the Adaptive Behavior Assessment System-II Communication subscale (ABAS-II; Harrison & Oakland, 2003), and the Social Skills Improvement System–Rating Scales (SSIS-RS; Gresham & Elliott, 2008). Participants themselves provided friendship ratings on the Friendship Qualities Scale (FQS; Bukowski et al., 1994). Direct assessment tasks administered to participants included Raven's Standard Progressive Matrices (Raven, 1977) for non-verbal intelligence, and two ToM tasks (Strange Stories Task, Happé, 1994; Five Advanced ToM Tasks, Begeer et al., 2011). Detailed descriptions of each measure follow below.

Table 1 Demographic information of participants with autism spectrum disorder (ASD) and non-autistic controls

	Group		t/χ^2	p	Effect size (Cohen's d)
	ASD ($n=104$)	Non-autistic ($n=192$)			
Age (year)					
M (SD)	18.55 (1.80)	18.65 (2.15)	−0.39	0.678	0.05
Range	14–23	14–24			
Sex					
Male	74 (71.15%)	101 (52.60%)	**9.61**	**0.002**	\
Female	30 (28.85%)	91 (47.40%)			
Household income (monthly HK$)					
< $5,000	1 (1.00%)	5 (2.60%)	5.31	0.379	\
$5,000–$9,999	4 (4.00%)	6 (3.13%)			
$10,000–$19,999	11 (10.89%)	29 (15.10%)			
$20,000–$29,999	10 (9.90%)	30 (15.63%)			
$30,000–$39,999	16 (15.84%)	28 (14.58%)			
≥$40,000	62 (61.39%)	94 (48.96%)			
Father's educational level					
Primary school or below	3 (2.88%)	6 (3.13%)	6.38	0.172	\
Secondary school	30 (28.85%)	48 (25.00%)			
Post-secondary colleges	28 (26.92%)	36 (18.75%)			
Bachelor's degree or above	43 (41.35%)	94 (48.96%)			
Others	0 (0.00%)	5 (2.60%)			
Mother's educational level					
Primary school or below	5 (4.81%)	3 (1.56%)	3.15	0.369	\
Secondary school	40 (38.46%)	67 (34.90%)			
Post-secondary colleges	14 (13.46%)	31 (16.15%)			
Bachelor's degree or above	45 (43.27%)	86 (44.79%)			
Co-occurring condition					
ADHD	8 (7.69%)	7 (3.65%)	3.10	0.541	\
Dyslexia/Early learning difficulties	4 (3.85%)	1 (0.52%)			
Hearing/Visual impairment	0 (0.00%)	1 (0.52%)			
Depression	9 (8.65%)	10 (5.21%)			
Anxiety	10 (9.62%)	12 (6.25%)			
Non-verbal IQ					
M (SD)	102.73 (6.67)	103.19 (6.15)	−0.44	0.663	0.07
Range	91–129	92–131			
ABAS Communication skills					
M (SD)	7.73 (2.22)	8.09 (2.47)	−1.23	0.218	0.15
Range	1–10	1–10			

Bold values indicate statistical significance; ABAS=Adaptive Behavior Assessment System-II (Harrison & Oakland, 2003)

ASD Symptom Severity

The Autism Spectrum Quotient (AQ) (Baron-Cohen et al., 2006) was used to assess autistic traits. The Chinese version of the AQ has been reported to demonstrate good internal consistency (Cronbach's alpha=0.82, Zhang et al., 2016). It is a 50-item questionnaire scored on a 4-point Likert scale, ranging from "*definitely agree*" to "*definitely disagree*". The AQ assesses five different areas: social skills, attention switching, attention to detail, communication, and imagination. The total score ranges from 0 to 50, with higher scores indicating a greater presence of autistic traits. The internal consistency of the AQ in this sample was good, with Cronbach's alphas of 0.80 and 0.81 for the ASD and non-autistic groups, respectively.

Non-verbal Intelligence

Participants' non-verbal intelligence was assessed as a controlled variable using the Raven's Standard Progressive Matrices (Raven, 1977). The test consists of 60 items, arranged in increasing order of complexity. Participants were required to select the missing piece from a visual geometric design or pattern, choosing from six to eight multiple-choice options. The raw scores were converted into standard scores (Mean=100, SD=15) using the local norms provided by the Hong Kong Education Department

(Hong Kong Education Department, Educational Research Section, 1986). This task demonstrated good internal consistency, with a Cronbach's alpha of 0.86.

Adaptive Behavior - Communication Skills

The Adaptive Behavior Assessment System-II (ABAS-II; Harrison & Oakland, 2003) is a measure of an individual's ability to independently perform everyday activities necessary for personal and social success. For this study, the Communication skill area of the ABAS-II was selected for its relevance to the participants' functioning. The reliability coefficient for the subscale of Communication of ABAS-Chinese version was 0.91 (Shum et al., 2019a, 2019b). This subscale measures the abilities to engage in verbal and nonverbal communication on a 4-point Likert scale (1 = "never" to 4 = "almost always"). Standard scores were derived, with a mean of 10 and a standard deviation of 3, where lower scores indicated difficulties in communication. In the current sample, the Communication subscale demonstrated high internal consistency, with Cronbach's alpha coefficients of 0.93 for both the ASD and non-autistic groups.

Theory of Mind

The current study employed two measures of ToM—*Strange Stories Task* and *Five Advanced ToM Tasks*—to assess participants' abilities to understand and attribute complex mental states to others. Both the *Strange Stories Task* ($\alpha = 0.83$; Wang et al., 2022) and the *Five Advanced ToM Tasks* ($\alpha = 0.85$; Lee et al., 2023) have been validated in Chinese samples and demonstrate acceptable reliability. Both tasks consist of physical state and mental state stories. Physical state stories require the integration of information between sentences and inference from implicit information without mentalizing. Mental state stories involve characters whose behaviors are driven by false beliefs, deception, or other complex mental states. Participants were asked to explain these behaviors to assess higher-order ToM skills. A *total physical state score* was obtained by summing the physical state scores across both tasks. Similarly, the *total mental state score* was derived by summing the mental state scores from both tasks. These allow for a comprehensive assessment of participants' ToM abilities.

The *Strange Stories Task* consists of eight physical state stories and eight mental state stories (Happé, 1994; White et al., 2009). Participants' responses were scored on a scale from 0 to 2, with 0 indicating an incorrect answer, 1 indicating a partially correct answer, and 2 indicating a fully correct answer. The Maximum scores for both physical and mental state stories were 16, with higher scores indicating better inferencing and ToM abilities, respectively.

For the *Five Advanced ToM Tasks* (Begeer et al., 2011; Kaland et al., 2008; Scheeren et al., 2013; Sullivan et al., 1994), participants' responses were scored on a scale from 0 (incorrect) to 1 (correct) for five mental state questions and four physical state questions, with higher scores indicating more advanced ToM and inferencing abilities, respectively.

The first author administered all ToM tasks and collected data, documenting participants' complete responses. Responses were independently scored by the first author and a second trained rater who was blind to group allocation and the purpose of this study, with both raters conducting their scoring separately. Interrater reliability was assessed across all participants, yielding excellent agreement. The intraclass correlation coefficients were 0.996, 0.995, 0.993, 0.994 ($ps < 0.001$) for the physical and mental state scores of the Strange Stories Task and the Five Advanced ToM Tasks, respectively, indicating excellent consistency. For items with discrepant ratings, the two raters jointly reviewed all such cases and discussed them based on the original scoring criteria, ultimately reaching consensus scores that were used as the final data.

Social Skills and Problem Behaviors

The Social Skills Improvement System-Rating Scales (SSIS-RS, parent form; Gresham & Elliott, 2008) is a 4-point Likert scale designed to evaluate social skills and problem behaviors. In this study, the Social Skills and Problem Behaviors domains (excluding the Autism Spectrum subscale) of the Chinese version of the SSIS-RS-Parent form were used (Cheung et al., 2017). The Social Skills domain is composed of seven subscales that assess various aspects of children's social skills: Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-control. The Problem Behaviors domain consists of the Externalizing, Bullying, Hyperactivity/Inattention, and Internalizing subscales, which assess different types of challenging behaviors that may impede social functioning.

Items in the two domains are rated on a four-point Likert rating scale (ranging from 0 = "never" to 3 = "almost always") indicating how frequently the participants exhibit a particular social skill and/or problem behavior, with higher total scores representing better social skills and more problem behaviors, respectively. The internal consistencies of the Social Skills domain (Cronbach's alphas = 0.85 −0.86) and the Problem Behaviors domain (Cronbach's alphas = 0.82) were consistently high for both the ASD and non-autistic groups.

Friendship Quality

The Friendship Qualities Scale (FQS; Bukowski et al., 1994) is a 23-item questionnaire that evaluates five key dimensions of friendship quality, including Companionship, Help, Security, Closeness, and Conflict. *Companionship* reflects the voluntary time spent together; *Help* encompasses both aid and protection from victimization; *Security* comprises trust and the belief that the relationship will withstand challenges; *Closeness* measures the emotional bond and perceived affection; and *Conflict* indicates the presence of disagreements or arguments within the friendship. Previous research with Chinese adolescents has demonstrated good internal consistency of the FQS (Cronbach's alphas = 0.88, Teja & Schonert-Reichl, 2013). Participants were asked to rate how true each statement was regarding one of their friendships (typically the best friendship) on a five-point Likert scale ranging from 1 (*never*) to 5 (*always*). Higher scores on each dimension indicate a better perceived quality of friendship in that aspect, while higher Conflict scores reflect more disagreements or arguments within the friendship. High internal consistencies were observed for all the FQS subscales, with Cronbach's alphas as follows for the ASD and non-autistic groups, respectively: Companion = 0.81 and 0.82; Help = 0.90 and 0.90; Security = 0.79 and 0.82; Closeness = 0.83 and 0.85; Conflict = 0.90 and 0.86.
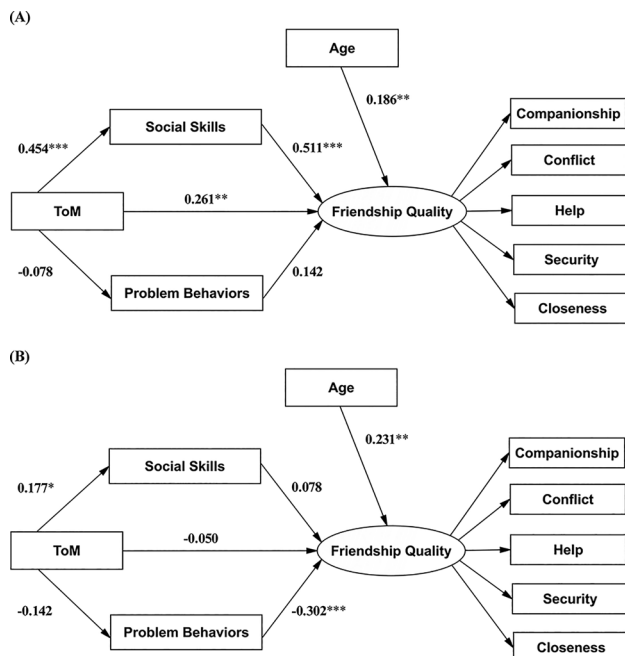
Fig. 1 Parameter estimates for the mediation models for **A** the ASD group and **B** the non-autistic group

Statistical Analyses

Descriptive statistics, independent samples t-tests, and correlation analyses were conducted using Jamovi (Version 2.2, The Jamovi Project, 2021). Structural equation modeling (SEM) analyses were performed to explore the potential mediating roles of social skills and problem behaviors in linking ToM with friendship quality (Fig. 1). A multi-group approach was utilized to assess the measurement and structural invariance across ASD and non-autistic groups using IBM SPSS Amos 29 (Arbuckle, 2019). The models were specified to include latent variables for friendship quality, with observed indicators being the FQS subscale scores for Companionship, Help, Security, Closeness, and Conflict. The SSIS Social Skills and Problem Behaviors scores were treated as observed endogenous variables (i.e., mediators), while the total mental state score for ToM was considered an observed exogenous variable. Model fits were evaluated using Chi-square tests, Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI). The Chi-square test provides an initial indication of model fit, although it is sensitive to sample size. The P CMIN/DF index, which measures fit per degree of freedom, is considered acceptable if values are less than 3, with values less than 2 indicating a good model fit (Byrne, 1989; Marsh & Hocevar, 1985). The RMSEA, CFI, and TLI offer a more nuanced assessment of fit, with recommended values of less than 0.05 for RMSEA, greater than 0.90 for CFI and TLI indicating a good fit (Hu & Bentler, 1999).

Results

Descriptive Statistics and Group Comparisons

Descriptive statistics of participants' demographic information and performance in non-verbal IQ and communication skills are presented in Table 1. The ASD and non-autistic groups were not different in age, non-verbal IQ, or communication skills. The two groups were also similar in monthly household income, father's and mother's educational level, and comorbidity. However, there was a significant difference in the sex ratio between the two groups ($\chi^2 = 9.61$, $p = .002$), with the ASD group having a higher proportion of males.

Descriptive statistics and comparisons of participants' performance in ToM, autistic symptom severity, social skills, problem behaviors, and friendship quality are presented in Table 2. Participants with ASD showed significantly higher AQ total score ($t = 16.62$, $p < .001$) and subscale scores ($ps < 0.013$) than those without ASD, which indicated more severe autistic traits in the ASD group.

Table 2 Descriptive statistics (Means and SDs) and group comparison of autistic symptom severity, tom, social skills, problem behaviors, and friendship quality

Variables (Possible Range)	Group		t	p	Effect size (Cohen's d)
	ASD ($n=104$)	Non-autistic ($n=192$)			
AQ					
Total score (0–50)	29.47 (6.44)	17.35 (5.06)	16.62	**<0.001**	2.17
Social skills (0–10)	6.96 (2.14)	2.96 (2.35)	14.41	**<0.001**	1.75
Attention switching (0–10)	7.34 (1.90)	4.43 (1.71)	13.00	**<0.001**	1.63
Attention to detail (0–10)	5.54 (2.21)	4.92 (1.94)	2.50	**0.013**	0.31
Communication (0–10)	5.03 (2.47)	2.14 (1.78)	10.56	**<0.001**	2.40
Imagination (0–10)	4.58 (1.73)	2.91 (1.76)	7.86	**<0.001**	1.25
ToM					
Total mental state (0–20)	10.21 (4.10)	14.95 (2.12)	−11.60	**<0.001**	1.60
Total physical state (0–21)	15.56 (2.26)	16.70 (2.26)	−3.67	**<0.001**	0.51
Strange Stories Task					
Physical state (0–16)	12.67 (1.66)	13.19 (1.84)	−2.15	**0.033**	0.30
Mental state (0–16)	8.35 (3.46)	12.17 (1.72)	−11.24	**<0.001**	1.55
Five Advanced ToM Tasks					
Physical state (0–4)	2.89 (1.04)	3.51 (0.90)	−4.73	**<0.001**	0.65
Mental state (0–5)	1.86 (0.89)	2.78 (0.89)	−7.47	**<0.001**	1.03
SSIS					
Social skills total (0-138)	82.51 (22.13)	105.35 (18.30)	−9.51	**<0.001**	1.16
Communication (0–21)	13.16 (4.09)	17.14 (3.16)	−9.30	**<0.001**	1.32
Cooperation (0–18)	11.60 (3.24)	14.20 (2.87)	−7.11	**<0.001**	0.87
Assertion (0–21)	11.55 (4.42)	14.64 (3.38)	−6.72	**<0.001**	0.82
Responsibility (0–18)	11.72 (3.90)	14.48 (2.86)	−6.96	**<0.001**	0.85
Empathy (0–18)	11.30 (3.73)	14.50 (2.91)	−8.17	**<0.001**	1.00
Engagement (0–21)	10.72 (4.12)	15.22 (3.53)	−9.87	**<0.001**	1.20
Self-control (0–21)	12.46 (3.59)	15.16 (3.02)	−6.86	**<0.001**	0.84
Problem behavior total (0–90)	32.27 (9.74)	24.17 (12.15)	5.85	**<0.001**	0.71
Externalizing (0–36)	11.63 (3.55)	8.98 (4.44)	5.22	**<0.001**	0.64
Bullying (0–15)	5.17 (1.84)	3.65 (2.17)	6.08	**<0.001**	0.74
Hyperactivity/Inattention (0–21)	7.10 (2.74)	5.23 (3.14)	4.85	**<0.001**	0.59
Internalizing (0–21)	7.05 (2.38)	5.11 (2.91)	5.81	**<0.001**	0.70
FQS					
Companionship (4–20)	11.93 (3.07)	13.39 (2.70)	−4.23	**<0.001**	0.52
Conflict (4–20)	9.55 (2.34)	8.98 (2.19)	2.06	**0.040**	0.25
Help (5–25)	19.21 (3.32)	20.48 (3.48)	−3.04	**0.003**	0.37
Security (5–25)	14.51 (3.10)	15.29 (2.91)	−2.16	**0.032**	0.26
Closeness (4–20)	18.12 (3.33)	19.39 (3.47)	−3.05	**0.003**	0.37

Bold values indicate statistical significance; AQ = Autism-Spectrum Quotient Adolescent Version (Baron-Cohen et al., 2006); ToM = theory of mind; SSIS = Social Skills Improvement System-Rating Scales (Gresham & Elliott, 2008); FQS = Friendship Qualities Scale (Bukowski et al., 1994)

In terms of ToM, participants with ASD scored lower in both mental state inferencing ($t = -11.60$, $p < .001$) and physical state inferencing ($t = -3.67$, $p < .001$), compared to participants without ASD. Even after controlling for the total physical state score, participants with ASD still had a lower total mental state score than the non-autistic group ($F[1, 228] = 115.45$, $p < .001$, $\eta_P^2 = 0.336$). Additionally, the ASD group continued to score lower on the mental state questions after controlling for the ABAS communication skills scores ($F[1, 226] = 127.55$, $p < .001$, $\eta_P^2 = 0.361$).

In addition, participants with ASD scored lower than the non-autistic group on the SSIS social skills total score ($t = -9.51$, $p < .001$) and in all social skills subdomains ($ts < -6.72$, $ps < 0.001$). The ASD group also displayed more behavioral problems across the subdomains in the SSIS problem behaviors domain ($ts > 4.85$, $ps < 0.001$), resulting in a higher total domain score ($t = 5.85$, $p < .001$).

Participants with ASD reported lower levels of companionship ($t = -4.23$, $p < .001$), help ($t = -3.04$, $p = .003$), security ($t = -2.16$, $p = .032$), and closeness ($t = -3.05$, $p = .003$), but more conflicts ($t = 2.06$, $p = .040$) in their friendships, compared to the non-autistic group.

Multi-group SEM Analyses

The multi-group SEM analyses were conducted to explore the relationships between ToM, social skills, problem behaviors, and friendship quality among individuals with

and without ASD. Participants with complete data on ToM, social skills, problem behaviors, and friendship quality were included in the SEM analyses (ASD: $n = 81$; non-autistic: $n = 150$), and no missing value operation was conducted. Bootstrapping with 5000 resamples was employed to provide more robust estimates.

Model Selection Process

To more precisely examine the relationships between variables and to rule out potential confounding effects, we considered several control variables in the model-building process, specifically age and ABAS scores. We compared the fit indices of four models: (1) without control variables, (2) controlling for age only, (3) controlling for ABAS only, and (4) controlling for both age and ABAS. The most appropriate model was selected based on the best fit to the data. The results are presented in Table 3.

Compared to the model without control variables, the model controlling for age alone showed a significant chi-square difference of 10.85 ($df = 1$, $p < .001$), with increases in CFI and TLI of 0.021 and 0.033, respectively, indicating a significantly better fit. The model controlling for ABAS only yielded an insignificant chi-square difference, and CFI and TLI showed negligible changes, suggesting that controlling for ABAS alone was ineffective. Although the model controlling for both age and ABAS demonstrated significant chi-square differences and increases in CFI and TLI compared to the models without control variables or controlling for ABAS alone, adding ABAS as a control variable did not further enhance the model fit beyond controlling for age alone (Table 3). As such, the model controlling for age was retained as the final model.

Model Fit

For the selected model (i.e., model controlling for age only), the CFI and TLI values of the model were 0.937 and 0.932, indicating a good model fit. The RMSEA values were 0.049, which is within the acceptable range for adequate model fit.

The chi-square test for model fit resulted in a significant value, χ^2 (55) = 86.04, $p = .005$. The CMIN/DF index, which provides a measure of fit that is independent of sample size and model complexity, was 1.564, suggesting a good fit per degree of freedom.

Direct Effects and Indirect Effects

The structural equation modeling results, including standardized direct and indirect effects of the ASD and non-autistic groups, as well as comparisons of the effects, are presented in Table 4. In the ASD group (Fig. 1A), ToM was found to have a significant positive direct effect on social skill scores ($\beta = 0.454$, $p < .001$) and friendship quality ($\beta = 0.261$, $p = .033$), but a non-significant effect on problem behaviors ($\beta = -0.078$, $p = .466$). Additionally, social skills had a significant positive direct effect on friendship quality ($\beta = 0.511$, $p < .001$). Conversely, problem behaviors did not have significant direct effect on friendship quality ($\beta = 0.142$, $p = .105$). Notably, age was significantly and positively associated with friendship quality ($\beta = 0.186$, $p = .002$). The indirect effect of ToM on friendship quality through social skills was significant ($\beta = 0.157$, $p = .013$), while the indirect effect through problem behaviors was not significant ($\beta = 0.024$, $p = .872$).

For the non-autistic group (Fig. 1B), ToM was significantly and positively associated with social skills ($\beta = 0.177$, $p = .047$), but not problem behaviors ($\beta = -0.142$, $p = .103$) or friendship quality ($\beta = -0.050$, $p = .547$). Problem behaviors scores exhibited a significant negative direct effect on friendship quality ($\beta = -0.302$, $p = .009$). However, the direct effect of social skills on friendship was not significant ($\beta = 0.078$, $p = .434$). Consistent with the trend observed in the ASD group, age showed a significant positive direct effect on friendship quality in individuals without ASD ($\beta = 0.231$, $p = .003$). The indirect effects of ToM on friendship quality through social skills ($\beta = 0.016$, $p = .194$) and problem behaviors ($\beta = 0.091$, $p = .277$) were both insignificant.

These findings suggest that the mediating role of social skills in the relationship between ToM and friendship quality

Table 3 Multi-group SEM model fit summary and nested model comparisons

Models/Model Comparisons	Model fit and model comparison index						
	χ^2	df	p	CMIN/DF index	CFI	TLI	RMSEA
1. Model without control variables	96.88	56	0.001	1.730	0.916	0.899	0.056
2. Model controlling for age only	86.04	55	0.005	1.564	0.937	0.932	0.049
Comparing with model without control variables	10.85	1	0.001	\	0.021	0.033	\
3. Model controlling for ABAS only	95.30	55	0.001	1.733	0.918	0.888	0.057
Comparing with model without control variables	1.58	1	0.209	\	0.002	−0.001	\
4. Model controlling for both age and ABAS	84.43	54	0.005	1.564	0.938	0.933	0.049
Comparing with model without control variables	12.45	2	0.002	\	0.022	0.033	\
Comparing with model controlling for age only	1.60	1	0.206	\	0.001	0.001	\
Comparing with model controlling for ABAS only	10.87	1	0.001	\	0.020	0.033	\

Table 4 Multi-group SEM results for the ASD and non-autistic groups

Path/Effect	ASD Group		Non-autistic Group		Group Difference	
	β [95% CI]	p	β [95% CI]	p	z-value	p
Latent Variable Loadings						
Friendship Quality → Companionship	0.962 [0.807, 1.228]	**<0.001**	0.745 [0.595, 0.843]	**0.001**	\	
Friendship Quality → Help	0.290 [0.006, 0.866]	**0.046**	0.638[0.461, 0.785]	**0.001**	\	
Friendship Quality → Security	0.503 [0.292, 0.685]	**<0.001**	0.722 [0.592, 0.822]	**0.001**	\	
Friendship Quality → Closeness	0.389 [0.165, 0.621]	**0.002**	0.853 [0.592, 0.822]	**<0.001**	\	
Friendship Quality → Conflict	0.052 [−0.194, 0.277]	0.694	−0.236 [−0.434, −0.020]	**0.034**	\	
Direct Effect						
ToM → Social Skills	0.454 [0.232, 0.637]	**<0.001**	0.177 [0.008, 0.363]	**0.047**	2.022	**0.043**
ToM → Problem Behaviors	−0.078 [−0.307, 0.156]	0.466	−0.142 [−0.314, 0.027]	0.103	0.438	0.662
ToM → Friendship Quality	0.261 [0.034, 503]	**0.033**	−0.050 [−0.202, 0.111]	0.547	2.160	**0.031**
Social Skills → Friendship Quality	0.511 [0.280, 0.761]	**<0.001**	0.078 [−0.124, 0.275]	0.434	2.761	**0.007**
Problem Behaviors → Friendship Quality	0.142 [−0.037, 0.322]	0.105	−0.302 [−0.486, −0.089]	**0.009**	3.253	**0.001**
Age → Friendship Quality	0.186 [0.072, 0.356]	**0.002**	0.231 [0.089, 0.388]	**0.003**	−0.045	0.669
Indirect Effect						
ToM → Social Skills → Friendship Quality	0.157 [0.024, 0.338]	**0.013**	0.016 [−0.024, 0.338]	0.194	1.156	0.248
ToM → Problem Behaviors → Friendship Quality	0.034 [−0.229, 0.311]	0.872	0.091 [−0.129, 0.311]	0.277	−0.320	0.749

Bold values indicate statistical significance; ToM = theory of mind

may be specific to autistic individuals, while the association between increased problem behaviors and diminished friendship quality is unique to individuals without ASD. Moreover, the direct effect of ToM on social skills was more pronounced in the ASD group compared to the non-autistic group ($z=1.75$, $p=.046$), suggesting that the enhancement of social skills through ToM may be more critical for individuals with ASD.

Correlations Analyses

The correlations among autistic symptom severity, ToM, social skills, problem behaviors, and friendship quality for both ASD and non-autistic groups are presented in Table 5. To control for the risk of Type I errors due to multiple comparisons, Benjamini-Hochberg correction was applied, with correlations having $p \geq .035$ considered non-significant after correction.

In the ASD group, the AQ total score did not show a significant correlation with the total physical state score ($r = -.08$, $p=.499$) of the ToM tasks. A weak correlation, albeit not significant, was observed with the mental state score ($r = -.22$, $p=.053$). Conversely, in the non-autistic group, the AQ score showed negative correlations with both the total physical state score and mental state score of the ToM tasks. These correlations were significantly stronger in the non-autistic group compared to the ASD group (AQ and physical state: $z=3.17$, $p<.001$; AQ and mental state: $z=2.24$, $p=.012$).

Correlations between ToM and social skills indicated that the total mental state score was positively correlated with the SSIS social skills total score and all social skills

subdomains (except for Engagement) for the ASD group. In contrast, associations between ToM and social skills were weaker in the non-autistic group, with significant correlations observed only for the social skills total score and two subscales, i.e., Communication and Engagement. Conversely, neither the SSIS total problem behavior score, nor its subdomain scores showed significant correlations with ToM for either the ASD or non-autistic group.

When examining the associations between friendship quality and other measured variables in autistic individuals, Companionship ($r=.50$, $p<.001$) of the FQS was found to positively correlate with ToM. Moreover, Companionship and Security subscales both showed positive correlations with the SSIS social skills domain and almost all its subdomains. Another FSQ subscale, Closeness, correlated with most of the SSIS social skills subdomains, except for Assertion and Responsibility; while the Help subscale of the FSQ was only significantly associated with Communication in the SISS. Notably, none of the friendship quality subscales were significantly correlated with the total problem behaviors score or its subdomains of the SSIS for the ASD group.

For friendship quality in the non-autistic group, both Help and Closeness were positively correlated with the total social skills score ($ps < 0.001$) and almost all its subdomains. Security in friendship was significantly correlated only with Engagement ($r=.17$, $p=.021$). The negative associations between problem behaviors and friendship quality were more pronounced in the non-autistic group. Higher total scores for problem behaviors and higher subdomain scores were related to lower levels of Companionship, Help, Security, and Closeness in friendships. However, Conflict

Table 5 Correlations among autistic symptom severity, tom, social skills, problem behaviors, and friendship quality for the ASD group and non-autistic group

| | ASD Group | | | | | | | Non-autistic Group | | | | | | |
| | AQ | ToM | FQS | | | | | AQ | ToM | FQS | | | | |
			Companionship	Conflict	Help	Security	Closeness			Companionship	Conflict	Help	Security	Closeness
AQ	–	–	-0.649***	-0.136	-0.179	-0.292**	-0.377***	–	–	-0.150	0.012	-0.152	-0.012	-0.171*
ToM total mental state	-0.216	–	0.495***	-0.118	0.086	0.230	0.055	-0.459***	–	-0.033	-0.206*	0.077	-0.046	0.067
SSIS Social skills (total)	-0.536***	0.430***	0.540***	-0.049	0.210*	0.344***	0.322***	-0.446***	0.181*	0.103	-0.076	0.266***	0.143	0.245***
SSIS Communication	-0.485***	0.424***	0.522***	-0.005	0.298**	0.393***	0.414***	-0.489***	0.215**	0.013	-0.117	0.192**	0.074	0.155*
SSIS Cooperation	-0.371***	0.406***	0.437***	-0.118	0.163	0.276**	0.270**	-0.298***	0.045	0.093	-0.064	0.286***	0.093	0.214**
SSIS Assertion	-0.409***	0.391***	0.446***	-0.042	0.139	0.292**	0.170	-0.334***	0.122	0.066	-0.071	0.153	0.138	0.192**
SSIS Responsibility	-0.351***	0.399***	0.406***	-0.114	0.172	0.264**	0.205	-0.374***	0.143	0.085	-0.047	0.276***	0.117	0.220**
SSIS Empathy	-0.455***	0.361***	0.412***	-0.076	0.072	0.279**	0.221*	-0.382***	0.151	0.118	-0.100	0.282***	0.135	0.314***
SSIS Engagement	-0.522***	0.213	0.421***	0.076	0.154	0.206	0.229*	-0.490***	0.221**	0.180*	-0.033	0.236***	0.167*	0.210**
SSIS Self-control	-0.459***	0.272*	0.440***	-0.022	0.196	0.252**	0.348***	-0.238***	0.154	0.044	-0.016	0.158*	0.110	0.150
SSIS Problem behavior (total)	0.103	-0.028	0.003	0.134	0.040	-0.004	-0.099	0.431***	-0.143	-0.266***	0.037	-0.333***	-0.262***	-0.276***
SSIS Externalizing	0.066	-0.015	0.048	0.111	0.042	0.026	-0.115	0.429***	-0.107	-0.200**	0.025	-0.254***	-0.227**	-0.156*
SSIS Bullying	0.139	-0.082	-0.103	0.030	-0.024	-0.140	-0.204	0.364***	-0.103	-0.167*	0.066	-0.368***	-0.193**	-0.281***

Table 5 (continued)

	ASD Group								Non-autistic Group							
	AQ	ToM	FQS						AQ	ToM	FQS					
			Companionship	Conflict	Help	Security	Closeness				Companionship	Conflict	Help	Security	Closeness
SSIS Hyperactivity/Inattention	0.090	−0.093	−0.025	0.206	0.043	0.053	−0.066		**0.424*****	−0.062	**−0.200****	0.032	**−0.246*****	**−0.212****	**−0.159***
SSIS Internalizing	0.121	0.030	−0.002	0.152	0.094	0.066	−0.095		**0.344*****	−0.153	**−0.232****	0.050	**−0.268*****	**−0.233****	**−0.251*****

Bold values indicate statistical significance as follows: $*p<.035$ (corrected for multiple correlations); $**p<.01$; $***p<.001$

AQ=Autism-Spectrum Quotient Adolescent Version (Baron-Cohen et al., 2006); ToM=theory of mind; SSIS=Social Skills Improvement System-Rating Scales (Gresham & Elliott, 2008); FQS=Friendship Qualities Scale (Bukowski et al., 1994)

was not significantly correlated with the problem behaviors domain or its subdomains for the non-autistic group.

Discussion

The current study compared friendship quality, ToM, social skills, and problem behaviors among adolescents and adults with ASD and their non-autistic peers, and investigated the mediating roles of social skills and problem behaviors in the relationship between ToM and friendship quality. Results showed that individuals with ASD perceived less companionship, security, and closeness, and received less help in their friendships, while reporting more conflicts. This population exhibited lower levels of ToM and social skills and showed a higher propensity for problem behaviors compared to their peers without ASD. This triad of challenges contributes to difficulties in forming and maintaining high-quality friendships.

Correlation analyses revealed significant relationships between ToM, social skills, problem behaviors, and friendship quality in both groups, but with nuanced differences. ToM had a positive direct effect on social skills in both groups, with the effect being stronger in the ASD group. Moreover, the direct effect of social skills on friendship quality was only observed in the ASD group. Notably, the negative direct effect of problem behaviors on friendship quality was significant only in individuals without ASD. In addition, a significant mediation effect of social skills on the relationship between ToM and friendship was observed in the ASD group.

Friendship Quality in Individuals with ASD

Prior research suggests that individuals with ASD tend to have less deep and reciprocal friendships (Black et al., 2024; Gillespie-Smith et al., 2024; Mazurek, 2014). Consistent with these findings, the current study confirms that autistic adolescents and young adults experience lower levels of companionship, help, security, and closeness in their friendships, along with more frequent conflicts. These disparities in friendship experiences may stem from difficulties with social-emotional reciprocity (Black et al., 2024), atypical sensory experiences that lead to discomfort in social situations (Thye et al., 2018), and challenges in navigating NT social norms, which often result in anxiety and misinterpretation (Crompton et al., 2020). Such factors can limit their ability to experience the warmth and security typically associated with friendships (Sedgewick et al., 2019).

Additionally, challenges in social communication, interpretation of social cues (Crompton et al., 2020; Petrina et al., 2014), and nonverbal communication issues such as

atypical eye contact and body language (Rodda & Estes, 2018) may induce anxiety, hinder natural connection, and reduce intimacy and reciprocity in friendships (Black et al., 2024). Moreover, the higher incidence of conflict within friendships among individuals with ASD may arise from difficulties in understanding social norms and expectations (Crompton et al., 2020) and struggles with emotion regulation (Mazefsky & White, 2014). Mismatched social expectations or differing neurocultural frameworks across ASD and NT individuals for communication and social interaction can also lead to conflicts (Gillespie-Smith et al., 2024), with non-autistic peers sometimes misinterpreting autistic communication styles as "unfriendly" (Black et al., 2024). Furthermore, lower perceived security and closeness in friendships for individuals with ASD may reflect the emotional toll of camouflaging, i.e., the suppression of autistic traits to fit in with NT peers (Hull et al., 2019). Unlike interactions with other autistic peers, where they can "be their authentic selves" (Crompton et al., 2020), friendships with NT peers often require sustained effort to mask autistic traits, leading to emotional fatigue and reduced intimacy (Black et al., 2024).

From the perspective of individuals with ASD, it is crucial to recognize their active efforts and successes in seeking and maintaining friendships (Jaswal & Akhtar, 2019; Scott et al., 2021). Understanding their viewpoints and supporting their social needs can lead to more inclusive and effective interventions, ultimately fostering more fulfilling social experiences for individuals with ASD (Black et al., 2024; Shum et al., 2019a, 2019b). Shared interests and activities, or friendships centered around specific hobbies, can provide common ground that transcends social communication challenges and fosters companionship (Black et al., 2024; Brownlow et al., 2015; Finke & McCarthy, 2019).

Moreover, we recognize that autistic individuals may experience friendships through unique perspectives, such as prioritizing shared interests, valuing authenticity in autistic-autistic relationships, and facing distinct challenges in cross-neurotype dynamics (Crompton et al., 2020; Finke & McCarthy, 2019). These differences may influence responses to questionnaires like the FQS, which interpret friendship through neurotypical-centric dimensions. However, our findings still reflect meaningful subjective experiences: for example, autistic participants' self-reported lower feelings of security and closeness align with qualitative accounts of anxiety when navigating NT norms (Black et al., 2024). Importantly, these results do not negate the value of autistic-autistic friendships, where alternative measures (e.g., shared engagement, reduced masking) may better capture relationship quality (Gillespie-Smith et al., 2024). Instead, they highlight the need for context-specific measurement: while the FQS provides insights into cross-neurotype experiences, future research should incorporate mixed methods (e.g., qualitative interviews, autistic-led validation of scales) to capture the full spectrum of autistic friendship experiences.

ToM Abilities and Autistic Traits

The results confirmed the anticipated lower levels of ToM in autistic adolescents and young adults with intact intellectual and verbal abilities compared to the non-autistic group, consistent with previous research (Hutchins et al., 2021; O'Reilly et al., 2014). However, the lack of correlation between AQ scores and ToM task performance challenges the assumption that autistic traits inherently impair ToM. This finding may be partly attributed to the diverse range of cognitive and social abilities present within the ASD population, suggesting that autistic traits alone cannot entirely explain the variability in ToM abilities (Happé, 2015; Peterson et al., 2012). Some previous studies have proposed that ToM deficits in ASD are neither universal nor specific to autistic traits, but may partly stem from language-related differences, especially in tasks that rely heavily on linguistic competence (Gernsbacher & Yergeau, 2019; Livingston et al., 2019). However, in the current study, even after controlling for verbal abilities—including ABAS communication skills scores and physical state scores of ToM tasks—ToM deficits still persisted in the ASD group. Conversely, this variability may reflect compensatory mechanisms or training effects in some individuals with ASD, such as advanced reading skills or executive function strategies (e.g., cognitive flexibility, working memory; Livingston & Happé, 2017; Wade et al., 2018). These skills may not be uniformly distributed within the ASD population and could influence ToM performance or mask differences in some individuals (Baron-Cohen & Wheelwright, 2004; Jones et al., 2018; White et al., 2017).

The debate surrounding the universality of ToM deficits in ASD has been extensively deliberated, with some reports indicating that adolescents and adults with ASD perform comparably to their non-autistic peers on ToM tasks (Gernsbacher & Yergeau, 2019; Tager-Flusberg, 2007). However, the current study found notably lower ToM performance in autistic adolescents and young adults with intact intellectual and verbal abilities. Moreover, a significant negative correlation between ToM and autistic traits was only found in individuals without ASD, and variations in autistic traits within the ASD group did not significantly affect ToM performance. These findings suggest that difficulties in interpreting others' mental states and engaging in social reciprocity among individuals with ASD may persist regardless of performance levels on ToM tasks (Baron-Cohen, 2000; Mathersul et al., 2013; Tager-Flusberg & Joseph, 2005).

Relationships Between ToM, Social Skills, Problem Behaviors, and Friendship Quality

The correlation and multi-group SEM analyses indicated significant positive associations between ToM and social skills in both the ASD and non-autistic groups, aligning with previous research highlighting the universal importance of ToM in social skill development (Conway & Bird, 2018; O'Reilly et al., 2014; Peterson et al., 2012; Slaughter et al., 2015). Particularly, the ASD group showed more pronounced correlations between ToM and social skills, with more social skills subdomains significantly correlated with ToM compared to their peers without ASD. Specifically, positive associations were observed between ToM and social skills such as communication, cooperation, assertion, responsibility, empathy, and self-control in the ASD group, emphasizing the fundamental role of understanding mental states in fostering effective social interactions (Fink et al., 2014; Frith et al., 1994; Slaughter et al., 2015).

The heightened impact of ToM on social skills in the ASD group suggests that individuals with ASD may heavily rely on explicit mental state comprehension to navigate social interactions effectively. This increased dependence on ToM might serve as a compensatory mechanism for the inherent social challenges faced by this population (Happé, 2015). It highlights the critical importance of ToM abilities in maneuvering through social complexities, empathizing with others, and appropriately responding to social cues for individuals with ASD (Imuta et al., 2016; Peterson et al., 2007; Slaughter et al., 2015).

On the contrary, the nonsignificant correlations between ToM and problem behaviors in both the ASD and non-autistic groups indicated that while there might be a tendency for individuals with stronger ToM to exhibit fewer problem behaviors, this relationship was not substantial (Korucu et al., 2017; Liu et al., 2018). This echoes previous studies showing that ToM development is not always linked to the prevalence of problematic social behaviors (Caravita et al., 2010; Sutton et al., 1999; Szumski et al., 2019). It is also worth noting that the impact of ToM on problem behaviors might be influenced by other factors, such as self-regulation skills (Korucu et al., 2017), underscoring the need for further investigation.

Regarding friendship quality, the positive correlations between ToM and companionship in friendships within the ASD group resonate with previous research linking ToM abilities to peer relationship quality (Banerjee et al., 2011; Devine & Hughes, 2013). This implies that the ability to understand mental states contributes to high-quality friendships in ASD (Devine et al., 2016; Fink et al., 2014), especially in terms of companionship in relationships. Moreover, our SEM findings revealed significant direct effects of ToM

and social skills on friendship quality in the ASD group, along with a significant indirect effect of ToM on friendship quality mediated by social skills. These results further support the critical role of ToM development in fostering high-quality friendships for individuals with ASD (Happé, 2015). They also suggest that social skills serve as a crucial pathway through which ToM influences friendship quality for individuals with ASD, highlighting the importance of interventions targeting both ToM and social skills (Begeer et al., 2011).

While we acknowledge the limitations of traditional ToM measurements—such as their reliance on verbal abilities and the potential overestimation of skills through compensatory strategies (Gernsbacher & Yergeau, 2019; Livingston et al., 2019)—our findings highlight the nuanced utility of ToM assessment in understanding social functioning in ASD. For example, the stronger positive effect of ToM on social skills in the ASD group, along with its direct and mediated associations with friendship quality, underscore that, for many autistic individuals, understanding mental state remains a meaningful contributor to navigating social interactions. This aligns with intervention research showing that targeted ToM training, when paired with real-world social skill practice, can enhance social competence in ASD (e.g., Begeer et al., 2015; Ma et al., 2023). Thus, ToM retains relevance in contexts where social interactions depend on interpreting neurotypical social cues, particularly in cross-neurotype friendships (Black et al., 2024).

Notably, the findings of the current study may not fully capture the nuanced dynamics of autistic-autistic friendships. Research increasingly highlights that autistic individuals often exhibit enhanced, automatic insight into the cognitive states of their autistic peers (Crompton et al., 2020; Gillespie-Smith et al., 2024). This aligns with Milton's (2012) double empathy theory, which identifies reciprocal understanding difficulties across neurotypes alongside greater attunement within the same neurotype. Unlike cross-neurotype friendships, where autistic individuals often rely on explicit mental state reasoning to navigate NT social cues (Black et al., 2024), interactions between autistic individuals are facilitated by direct communication styles, mutual recognition of sensory needs, and aligned processing of social information (Crompton et al., 2020). This suggests that autistic individuals may exhibit enhanced cognitive empathy and social attunement with other autistic peers (Gillespie-Smith et al., 2024). Autistic-autistic relationships may involve intuitive social alignment or straightforward communication, making mental state inferences less challenging (Crompton et al., 2020). Satisfaction in these friendships often stems from social similarity, like the freedom to be authentic without camouflaging (Crompton et al., 2020), and from engaging in shared interests (Black et al., 2024;

Finke & McCarthy, 2019). However, the current study did not explicitly assess whether participants' reported friendships were with autistic or non-autistic peers, highlighting an important direction for future research to better characterize the unique dynamics of autistic-autistic interactions.

In contrast, for the non-autistic group, ToM was negatively related to conflicts in friendships, a pattern not observed in the ASD group, and it was not significantly associated with other positive friendship qualities. This suggests that more developed ToM skills may help individuals in anticipating and averting potential conflicts in friendships, though further research is needed to investigate this possibility (see Zıvralı Yarar et al., 2021). However, our SEM results showed that neither the direct effect of ToM nor its indirect effect through social skills on overall friendship quality were significant for the non-autistic group. The direct effect of social skills on friendship quality was also not significant for the non-autistic group. These findings suggest that ToM abilities and social skills per se might not be sufficient to support perceived high-quality friendships during adolescence and early adulthood for the general population, implying the influence of additional factors on friendship quality.

When compared to the ASD group, problem behaviors in the non-autistic group exhibited more pronounced negative correlations with friendship qualities, including companionship, help, security, and closeness. Additionally, the SEM analysis revealed a significant negative direct effect of problem behaviors on overall friendship quality in individuals without ASD, suggesting a stronger detrimental impact of problem behaviors on friendships in the general population (Scheeren et al., 2013). This finding indicates that the presence of problem behaviors poses a greater challenge to friendship maintenance among individuals without ASD (Humphrey & Symes, 2011). Problem behaviors can act as barriers to forming and maintaining friendships, reflecting broader social expectations and the role of social conduct in shaping relationships within the general population, whereas the social challenges faced by the ASD group may be more deeply rooted in fundamental social cognitive processes like ToM.

Notably, the current study also revealed that age was positively associated with friendship quality in both groups. Although adolescence involves social uncertainty and challenges (Brown, 2004; Veenstra & Laninga-Wijnen, 2022), our findings suggest friendship quality perceptions improve with the transition to young adulthood. This aligns with developmental trajectories where social competence and relationship experiences improve with age, as individuals accumulate social experiences, develop better navigate interpersonal dynamics, reflecting more aligned peer interactions and greater autonomy in choosing social partners

(Clarke & Lord, 2024; Saban-Bezalel et al., 2025). However, the cross-sectional nature of the current study limits our ability to determine the underlying causes of these age-related improvements. Future longitudinal research would help clarify this association and identify specific factors driving positive change (Billstedt et al., 2005; Peterson & Wellman, 2019), while underscoring the value of supporting autistic individuals during early social transitions.

Implications for Intervention and Future Directions

The findings of this study carry significant implications for developing targeted interventions to enhance social skills and ToM abilities in individuals with ASD. While traditional ToM measures have limitations—including verbal biases and discrepancies between laboratory performance and real-world application, the significant direct effects of ToM on social skills and friendship quality within the ASD group underscore its value as a foundational target for intervention. Improving ToM may help individuals with ASD better navigate social interactions through enhanced social skills, which in turn can lead to higher-quality friendships, particularly in cross-neurotype contexts. However, ToM interventions often produce short-term gains on laboratory-based tasks but show limited generalization to everyday social interactions (Fletcher-Watson et al., 2014). Future interventions should integrate ToM and social skills training with practical applications in real-world social contexts to promote transfer (Fletcher-Ma et al., 2023). Moreover, interventions should aim to cultivate specific social skills, such as communication, cooperation, assertion, responsibility, empathy, engagement, and self-control. Evaluating the effectiveness of various approaches and identifying the most beneficial components for enhancing social competence and friendship quality will be essential. Additionally, interventions should also adopt a unique focus on autistic-autistic friendships. Rather than emphasizing neurotypical-centric social norms, strategies could leverage autistic strengths by fostering environments that prioritize shared activities, reduce social pressure, and validate authentic interaction styles.

A limitation of this study is its cross-sectional design. Future research employing longitudinal methodologies could help clarify the directionality of the observed relationships. Replication of these findings in larger and more diverse samples—encompassing different cultural backgrounds and age groups—would enhance generalizability. In addition, the gender ratio in our sample limits the applicability of the results to autistic females, who may exhibit distinct social-cognitive profiles (e.g., differences in camouflaging; Allely, 2019) and friendship dynamics not captured here (Sedgewick et al., 2019). Moreover, the approach used

to control for verbal ability may not fully account for the influence of language-related factors on ToM performance. Since the ToM tasks employed are inherently language-dependent, requiring complex verbal comprehension and expression, they may disproportionately challenge autistic individuals, even when basic verbal abilities are controlled for. Future research should incorporate nonverbal or minimally verbal measures of ToM (e.g., eye-tracking paradigms, animated social scenarios; Gernsbacher & Yergeau, 2019) to better isolate social cognitive processes from language skills and explore their unique relationships with social skills and friendship quality.

Furthermore, the current study did not account for the role of executive functions, which may serve as a third variable influencing both ToM and social skills, as well as the associations observed in our findings (Livingston et al., 2019). Executive functions, such as working memory, cognitive flexibility, and self-regulation, are suggested to support complex social cognitive processes and social skills (e.g., Korucu et al., 2017; Wade et al., 2018). Future research should examine how executive functions interact with or mediate the relationship between ToM and social skills, as well as their combined impact on friendship experiences in both autistic and NT populations. Notably, our focus on general ToM and social skill measures may overlook the unique mechanisms that sustain fulfilling autistic-autistic friendships. Future studies could explore these specific dynamics and factors influencing such relationships, which may be underestimated in terms of their quality and stability.

Data Availability The data that support the findings of this study are available from the corresponding author, K. K. M. Shum, upon reasonable request.

Declarations

Conflict of interest The authors declare that they have no conflict of interest. There are no financial or non-financial interests directly or indirectly related to the submitted work.

Ethical Approval The study is approved by the Human Research Ethics Committee (HREC) at the authors' affiliated university (EA220194).

Author contributions All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Jiaxi Li. All authors contributed to the writing of the manuscript's first draft, commented on its previous versions, and read and approved the final manuscript.

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