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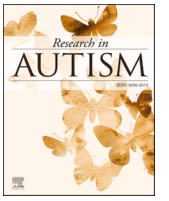

Do I enjoy my friends? Friendship and enjoyment during recess in autistic and non-autistic children

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ABSTRACT

Friendships play a crucial role in children's well-being and school experiences. This study aimed to gain a better understanding of how autistic and non-autistic children's friendships are related to their enjoyment of the school time spent with peers, i.e. at recess time (school break time). A multi-method approach, including self-reports, peer nominations, and objective measures based on sensor data was used. Forty-five autistic children and 45 non-autistic children from two special education schools participated, aged between 8 to 14 years. Outcomes showed that autistic and non-autistic children did not differ regarding the number of reciprocal and non-reciprocated friends. Yet, autistic children spent less time in contact with their reciprocal friends during recess at the schoolyard compared to their non-autistic peers. Also, while non-autistic pupils spent more time with reciprocal friends than with non-reciprocated ones, this difference was not found among autistic pupils. Notably, spending more time with non-reciprocated friends during recess was related to lower levels of enjoyment in both autistic and non-autistic children. Our findings suggest that autistic children may approach friendships with different priorities. Furthermore, this study underscores the need to consider broader factors beyond reciprocity when assessing children's social experience at school.

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Friends can make all the difference; having a friend in school can contribute to better well-being, enjoyment, and a greater sense of belonging (Bagci et al., 2017; Delgado et al., 2016; Foody et al., 2019). However, it is important to recognize that the concept of friendship may differ between autistic and non-autistic children. While friendships are often defined by neurotypical standards, typically emphasizing reciprocity, shared activities, and emotional intimacy, autistic children may perceive and experience friendships in ways that do not fully align with these definitions. Despite these potential differences, research has observed that autistic children tend to have fewer friendships in school compared to their non-autistic peers, and these friendships may be perceived as lower in quality or less reciprocal when compared to friendships in non-autistic peers (O'Connor et al., 2022). Additionally, autistic children often find themselves on the periphery of social networks during recess (school break time) (Chamberlain et al., 2007; Mendelson et al., 2016; Rotheram-Fuller et al., 2010). However, this does not necessarily translate into greater feelings of loneliness, as indicated by research on autistic children in primary schools (Bottema-Beutel et al., 2019; Chamberlain et al., 2007; Deckers et al., 2017). Instead, many autistic children report being satisfied with their friendships (Calder et al., 2013; Howard et al., 2006) and a third of them report enjoying their social interactions, including playing with friends (Clark & Adams, 2020). Possibly, autistic children might have different definitions of, and needs for, friendships than non-autistic children.

1. What is a friend for non-autistic children?

Most children want to have a friend, or multiple friendships, which applies to both non-autistic and autistic children (Calder et al., 2013). Support from friends can comfort children when they feel upset and increase their self-efficacy, thus enhancing their ability to cope with difficulties (Bauminger et al., 2004; Criss et al., 2002; Maunder & Monks, 2019; Sullivan, 1953). Most non-autistic and autistic children report having at least one friend in school (Libster et al., 2023), which can be an important protective factor when children have to face difficulties at school or from family.

Based on research on friendship in non-autistic youth, a 'gold standard' of friendship includes reciprocity (Bagwell & Schmidt, 2011). A strong and reciprocal friendship in non-autistic children is characterised by maximising positive qualities, such as companionship, reliable alliance, disclosure, support, and affection/admiration, and minimising negative qualities, such as jealousy, dominance, conflict, betrayal, and competition (Kouwenberg et al., 2013). This contrasts with a one-sided desire for a friendship, namely, when a friendship nomination is unreciprocated (Newcomb & Bagwell, 1995). These so-called 'non-reciprocated friendships' may be more fragile and endure less over time (Clark & Drewry, 1985).

However, is reciprocity in friendship really essential for children's feelings of enjoyment and social inclusion within their peer group? Interestingly, simply perceiving having friends seems to be sufficient for fostering a sense of social belonging in non-autistic children. Whether the perceived friend is mutual has little influence on children's sense of social inclusion in the peer group (Garrote et al., 2023; Ray et al., 2018). Reciprocity, which is a defining characteristic of genuine friendship in neurotypical individuals, may have more impact when deep emotional support is needed, such as in distressing and challenging situations, and when long-term loyalty and trustworthiness are expected (Gershman & Hayes, 1983; Newcomb & Bagwell, 1995). However, spending time with 'casual friends' or friendly peers, and enjoying light-hearted moments together can suffice in contributing to a sense of social belonging.

Note that while having reciprocal friends may not play a central role in enhancing the subjective feeling of social inclusion within a peer group, non-autistic children do tend to spend more time with reciprocal friends (Hayes et al., 1980) and experience a stronger mutual enjoyment and positive emotions when interacting with reciprocal friends than with non-reciprocated friends (Gleason & Hohmann, 2006).

2. What is a friend for autistic children?

Almost all aforementioned studies focused solely on non-autistic children. Only a handful of studies have investigated autistic children's perceptions of friendships. These studies found that autistic children define friendships more in terms of companionship and less in terms of closeness, intimacy, and affection (Bauminger et al., 2004; Bauminger and Kasari, 2000; Bossaert et al., 2015). Besides, multiple studies consistently showed a lower level of reciprocity in friendships among autistic children than among typically developing children (Chamberlain et al., 2007; Kasari et al., 2011; Rotheram-Fuller, 2005; Rotheram-Fuller et al., 2010), or children with behavioural problems (Petry, 2018). Autistic children also report lower levels of intimacy in their reciprocated friendships (Bossaert et al., 2015). Importantly, despite the different perceptions of friendships, autistic children in primary school do not report feeling lonelier and less content with their friends than their non-autistic peers. This raises the question of whether reciprocity is considered less crucial as a defining characteristic of friendship among autistic children than non-autistic children.

Notably, while 'companionship' is regarded by autistic children as a key aspect of friendship, they tend to spend less time engaging in shared activities with friends, even when having a reciprocal relationship with that friend, compared to non-autistic children (Chamberlain et al., 2007; Kasari et al., 2011). In fact, autistic children spend overall more time in solitary activities, as observed by teachers during recess in school and by parents during play in the neighbourhood (Calder et al., 2013). There could be various reasons for this. For example, during recess, interacting with larger groups of peers could be unpredictable and anxiety-inducing for many autistic children (Ashburner et al., 2013; Cage et al., 2016; Cresswell et al., 2019). Moreover, the chaotic nature of school breaks - the noises, boisterous laughter, physical contact, and face-to-face interactions that often accompany play - can lead to sensory discomfort and fatigue in autistic children (Hazen et al., 2014; Kojovic et al., 2019). These children thus may seek more 'down-time' away from the overwhelming social/sensory environment to self-regulate. Despite less time in interactive activities, some autistic children do report enjoying social interactions (Clark & Adams, 2020), which might indicate that their social interactions meet their social needs.

Thus far, there is a scarcity of empirical research on how autistic children experience friendships and which role interacting with different types of friends plays in affecting their subjective experience in school. Understanding what friendships mean for autistic children can increase peer acceptance and help educators and parents find the best ways to support autistic children's needs. Most studies including autistic children have been conducted in mainstream educational settings, where autistic children often are the only ones in the group. Fox et al. (2024) showed that autistic children in special schools faced fewer friendship-related challenges than those in mainstream education, possibly because children tend to form friendships with peers who share similar characteristics, which is more feasible in special education settings where children present more diverse needs (Black et al., 2024; Fox et al., 2024; Petrina et al., 2014).

3. Present study

In primary school, friendships play an increasingly important and meaningful role in children's daily social lives. While younger children may primarily engage in simply playing together, older children often place a higher value on qualities such as loyalty, commitment, and genuineness in their friendships (Maunder & Monks, 2019). However, is this also the case for autistic children? The present study aimed to investigate autistic children's perceptions and experiences of friendships and peer contacts within the setting of special education. Specifically, first, we examined whether and how having reciprocal friends and non-reciprocated friends could differentially affect children's enjoyment during recess at school. In this study, 'recess' refers to the unstructured school break during which children can usually engage in free play at the playground. Non-reciprocated friends refer to peers nominated as best friends by the target pupils, but who did not nominate the target pupils in return. Additionally, we examined whether and how having contact with the two types of friends during recess could affect children's enjoyment of recess time.

To date, most studies comparing friendships in autistic and non-autistic children used typically developing children as a control group. Although some studies compared the friendships between autistic children and children with other special needs, such as specific learning difficulties (Jones et al., 2023) or motor and/or sensory disabilities (Bossaert et al., 2015; Petry, 2018), these studies were conducted in mainstream schools with neurotypical children as the majority, reflecting the dynamics of interactions between autistic and neurotypical children.

As highlighted by Milton's (2012) double-empathy problem, social dilemmas arise from mutual misunderstandings between autistic and non-autistic individuals, where both groups may find it challenging to fully grasp each other's perspectives. Therefore, understanding how autistic children experience friendships in different social contexts is essential. Our study offers a unique perspective by examining friendships in special education settings, where half of the pupils were autistic and the other half were non-autistic neurodivergent peers. This comparison allows us to explore how autistic children perceived and experienced friendships in a context where they interacted with peers who shared certain neurodevelopmental differences but were not autistic. By examining these interactions, we can gain valuable insights into the unique ways autism influences friendship formation, satisfaction, and reciprocity. This approach provides a more nuanced understanding of autistic children's perspectives on friendships, offering insights that complement and extend beyond research focused on their interactions with neurotypical children.

To do this, we used a variety of methods including peer-nomination, self-report, and wearable sensor technology (radio-frequency identification devices or RFID). Recently, there has been an increasing use of sensor technology to assess child social contacts on the playground (e.g., Eichengreen et al., 2024; Nasri et al., 2023). The RFID sensor badges utilised in our study were small and light-weighted, attached to a belt on children's waist. This arrangement allowed children to play naturally without the experimenters encroaching upon their space or influencing their behaviour (Veiga et al., 2017). Furthermore, such sensors can indicate the amount of time children spend in social contacts, and provide a substantial amount of fine-grained spatio-temporal data of simultaneous contacts within a large group (Nasri et al., 2023). Our hypotheses are the following.

First, we expected autistic children to have fewer reciprocal friends than the comparison group that consisted of non-autistic peers who had behavioral problems (Calder et al., 2013; Petrina et al., 2014; Rotheram-Fuller et al., 2010). Second, we expected the comparison group to be more in contact (i.e., having more contacts, spending longer time) with reciprocal friends than with non-reciprocated friends (Bauminger et al., 2008; Humphrey & Symes, 2011; Petry, 2018), whereas we expected autistic children to have less contact with friends than the comparison group, irrespective of the friendship type (Bauminger et al., 2008; Petry, 2018). Third, we expected a positive association between the number of friendships (irrespective of friendship type) and the level of enjoyment during recess in the comparison group (Bagci et al., 2017; Delgado et al., 2016; Foody et al., 2019). Fourth, we expected that having contact with reciprocal friends, as compared to having contact with non-reciprocated friends, was associated with a higher level of enjoyment during recess for the comparison group (Newcomb & Bagwell, 1995). Due to the lack of empirical evidence, we did not formulate hypotheses regarding the associations between the number of friendships and the level of enjoyment during recess for autistic children, nor did we formulate hypotheses on the associations between their amount of social contact with friends and the level of enjoyment.

4. Methods

4.1. Participants

Forty-five autistic children ($M_{age} = 10.23$ years, $SD_{age} = 1.05$; 93% male) and 45 non-autistic children ($M_{age} = 11.19$ years, $SD_{age} = 1.05$; 44% male) aged between 8 and 13 years participated in this study. The autistic children were younger ($t(88) = 4.14$, $p < .001$) and had fewer girls than boys ($\chi^2 = 25.09$, $p < .001$), compared to the non-autistic children.

Participants were recruited from two special education primary schools in the Netherlands, from grades 5 to 8. Both schools were members of the same educational board and adopted similar teaching methods and structured school activities and rules in a similar way. In the Netherlands, special education is divided into four clusters: 1: low vision; 2: serious communication difficulties (e.g., hearing loss or language disorder); 3: cognitive/physical disabilities or a chronic illness; 4: psychiatric or serious behavioural difficulties (e.g., autism, attention deficit hyperactivity disorder (ADHD), or oppositional defiant disorder (ODD)). Our participants were all from Cluster 4 schools and had behavioural problems. These students needed to receive extra care and support due to the fact that they often faced challenges such as emotional dysregulation, impulsive behaviours, and aggressive tendencies, or difficulties in adjusting to mainstream schools such as the pace of learning, class size, and peer interactions.

Prior to enrollment in a Cluster 4 school, the school must apply for a declaration of admissibility from the regional education council (the governmental organisation responsible for the administration of education in the region) on behalf of the child. The council can issue the declaration only after consulting with at least two experts from a committee comprising remedial education specialists, child psychologists/psychiatrists, social workers, and physicians. In this study, diagnostic information was provided by the parents of the participants and subsequently confirmed by the teachers following school approval.

None of the children were of lower cognitive functioning given that children with cognitive difficulties were admitted to Cluster 3 schools. Sixteen (36%) of the autistic children had additional diagnoses, such as ADHD. Seventeen (38%) non-autistic children also had a diagnosis (see Table 1). Note that both schools also admitted children who did not have a specific diagnosis but had switched from mainstream schools, because they needed extra support. Therefore, we referred to the two groups as BP+A (behavioural problems + autism) versus BP (behavioural problems) and interchangeably used 'autistic group' for the BP+A children, and 'comparison group' for the BP children.

This study was part of a larger-scale research project that examines factors affording social participation and social inclusion of children with different capacities and/or needs in schoolyards (e.g., Nasri et al., 2022, 2023; Tsou et al., 2025). Guardians of the participating children signed informed consent prior to the data collection. The study protocol and informed consent form were approved by the Psychology Research Ethics Committee of Leiden University, the Netherlands.

5. Procedures

After the guardians of the child participants provided informed consent, children were asked individually by a teacher or a researcher to fill out self-report questionnaires and peer nominations on a tablet in a separate room. Before they started, they were instructed through a video on how to fill out the questionnaire and peer nomination. Children were also explicitly told that they were welcome to ask questions if anything was unclear. Neither the teachers nor the researchers noted any problems or difficulties. All data were collected within a month.

Data about children's contact with peers during recess was collected using the proximity sensing technology (i.e., the RFID). Each participating child on the school playground wore an RFID tag, which was mounted on a belt that children wore on their waist. They were given the RFID-mounted belt at the beginning of each recess session, wore it throughout the session, and returned the belt when each recess session ended. The RFID data were collected from each child on two school days, during two recess sessions (i.e., morning and afternoon play break time) each day, resulting in a total of four measurements per child. Depending on the arrangements of the class teachers, each recess session lasted 11 to 30 min ($M = 18.97$ min; $SD = 6.62$). During all the break sessions included in this study, children were free to engage in unstructured play with specific instructions from teachers.

Before the data collection took place, teachers had explained to children, with the support of an instruction video, about the belt and that children were free to take off the belt when feeling uncomfortable with it. Yet only in 2% of the total recess sessions, one to two children took off the belt.

Table 1
Background characteristics of the participants.

	Autistic	Comparison
N	45	45
Age, years, mean (SD)	10.23 (1.05)	11.19 (1.05)
Gender, *n* (%)		
Girls	3 (7%)	25 (56%)
Boys	42 (93%)	20 (44%)
DSM-5R diagnoses, *n* (%)		
No diagnoses or unknown	-	28 (62%)
Autism only	29 (64%)	-
ADHD	15 (33%)	16 (35%)
Trauma + Attachment Problem	1 (2%)	0
Oppositional Defiant Disorder	0	1 (2%)

6. Measures

6.1. Friendship nomination

Peer nominations were administered to all the participating children. They were individually asked "Who are your best friends in school?" and wrote down the names on a tablet, where there was space to list a maximum of five names. Based on these nominations, two types of friendships were defined: i) reciprocal friends: when two children nominated each other as best friends; ii) non-reciprocated friends: when a child nominated a peer as a friend, but the peer did not nominate back.

Thus, with this measure, we were able to compute the number of each of the two friendship types for each participant. When a child nominated a teacher or a peer from outside the school, the nomination was considered invalid and excluded from further analyses. The number of valid nominations was further standardized per playgroup by computing a Z-score for each participant in each playgroup, which ensured comparability among children from different playgroups that varied in size.

Moreover, we were able to identify with which type of friends children had contact with during recess on their playground (see below).

6.2. Social contact during recess

During their recess on the school playground, children each wore an RFID tag (OpenBeacon, n.d.), which is a proximity sensor that measures face-to-face contact between children when they are within a distance of 1.5 m. That is, RFID sensors register a signal when two participants are within 1.5 m and facing each other (Nasri et al., 2022). A receiving station for detecting RFID signals and registering contacts was installed on each school playground. It had a coverage of 15 m^2 and was placed at a predetermined location to ensure that different areas on the playground could be maximally detected. Given that the signals of RFID tags may be interrupted during a social contact due to e.g., other children passing by or the participant turning their body, we considered contacts that had interruptions shorter than 35 s as one single contact and applied interpolation between two successive contacts between the same children (Nasri et al., 2022, 2023). Multiple contacts could be detected simultaneously. When the participant was detected by the receiving station for $<$ 50% of the recess time, which suggests that the child might have moved outside the detectable range (e.g., into the building or to the toilet), the data for that participant in that recess session were excluded from further analyses to ensure comparability between children.

For each dyad of children in contact (Child A and Child B) as detected by the RFID, we identified the type of friendship between the two children based on the nomination data. Accordingly, we computed two variables:

Total time in social contacts. This variable indicated the proportion of time a child spent in face-to-face contact with reciprocal friends and non-reciprocated friends, respectively. First, the total duration of time when Child A was in contact with Child B in a given recess session was computed, corrected by the total duration of time Child A was detected by the receiving station in that session. Next, across all the pairs of contacts detected, we computed the mean proportion of time for each type of friendship. Lastly, the data from the four measurements (two recess sessions x two days) were averaged, and we obtained an indicator for the total time in social contact across the recess sessions for each friendship type.

The Proportion of different types of friends as contact partners. This variable indicated the proportion of contacts with reciprocal friends and non-reciprocated friends among all the different partners that a child was in contact with on the playground during recess, collapsed over four measurements (two recess sessions x two days).

Note that these variables were computed based on the data of each separate dyad. Thus, when Child A and B were also in contact with Child C, Child A's contacts with B and C were considered distinct contacts and computed separately. Likewise, if Child A is a reciprocal friend with B but not with C, the time Child A spent with Child B was considered time with reciprocal friends, whereas that with Child C was time with non-reciprocated friends.

6.3. Enjoyment of Recess

The Lunchtime Enjoyment of Activity and Play Questionnaire (LEAP, Hyndman et al., 2013) is a self-report questionnaire used to measure the level of enjoyment a child experienced during their school recess. The LEAP includes a total of 39 items that measure the extent to which a child enjoys different aspects of recess, including intrapersonal components (e.g., overall enjoyment and the enjoyment of different activities), interpersonal components (e.g., social play), and the physical environment (e.g., play equipment; playground size; weather conditions). Children indicated their enjoyment level on a 5-point scale from *very unhappy* (1) to *very happy* (5). These response options were accompanied by graphical images of smiley faces to help children answer each item.

For the purpose of this study, we selected five items from the LEAP that reflect children's overall experience of outdoor recess time ("At school, how much do you enjoy playing at play break?"; "At school, how much do you enjoy playing at recess?"; "How happy are you with the amount of things within your school playground (e.g. equipment, trees, playground equipment, basketball rings, ovals etc)?"; "How much do you enjoy sitting within your school playground?"; "How much do you enjoy playing outside at play break?"). We excluded items about specific playground conditions or social play, which were not suitable for our measurement of enjoyment, as playground conditions can vary between schools and social play may not be enjoyable to all children. The internal consistency of the scale based on the selected five items was good (Cronbach's $\alpha = .85$).

7. Statistical analyses

The RFID data were preprocessed and computed using Python 3.9 (Van Rossum & Drake, 1995). Statistical analyses were conducted using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA). Preliminary analyses showed that the time in social contact with friends showed collinearity with the proportion of these friend types (rho =.93 and .95 for reciprocal and non-reciprocated friends respectively). Therefore, only time in social contact was used in further analyses.

First, a series of repeated measure analyses of variance (ANOVA) was performed to analyse the extent to which BP+A and BP children differed in their number of friendships (reciprocated and non-reciprocated), and in their time in social contact with these friends during recess; and to examine whether children spent more time with reciprocal friends than with non-reciprocated friends during recess. Friendship Type (reciprocal or non-reciprocated) was entered as a within-group independent variable, and Group (BP+A or BP) as a between-group variable, while age was included as a covariate.

Next, to understand the extent to which the amount of each friendship type and the time spent in contact with different types of friends were related to children's enjoyment of recess, partial Pearson's correlation analyses were conducted, with age controlled for. Additionally, Fisher's r-to-z transformations were applied to examine if autistic children and the comparison group differed in the strengths of these correlations. Given that the data for time in social contacts with non-reciprocated friends was positively skewed, nonparametric tests (i.e., Mann-Whitney *U* test, Wilcoxon's signed ranks tests, and Spearman's correlation) were used in the analyses related to this variable. The significance level for the analyses was set to $p < .05$.

Little's MCAR test showed that the data were not missing completely at random ($\chi^2 = 87.22$, $p < .001$). The RFID data were missing for 11 children (8 BP+A, 3 BP), and the self-reported enjoyment data for 8 children (7 BP+A, 1 BP). These data points were missing for known reasons, i.e., out of the RFID detection range for > 50% of the recess time and refused to finish the questionnaire. Therefore, we assumed that the data were missing at random and the multiple imputation (MI) technique was employed, to reduce the biases caused by the missing data and increase statistical power (Azur et al., 2011; Schafer & Graham, 2002; Van Ginkel et al., 2020). Based on the characteristics of participants and the observed relations in the data with other participants, MI filled in the missing data and ten imputations were conducted in the process.

Considering the age gap and taking the different gender distributions between the two groups into account, as well as the potential impact of the school of origin, the widely used inverse probability of treatment weighting (IPTW) method was applied to adjust for the confounding variables. A weight was given to each child participant according to the probability (i.e., propensity) of the child to be in the autistic vs. the comparison group, while each participant's characteristics were also taken into account. Thus, by using IPTW, potential confounds (i.e., age, gender, and school) were balanced across the autistic and the comparison groups (Austin & Stuart, 2015; Chesnaye et al., 2022; Ruth et al., 2015). Pooled and weighted results were reported. Results based on raw data (i.e., unweighted and before multiple imputation) were reported in Table 2. To provide more information on friendship nominations and social contacts, including the outdegree (nominations given), indegree (nominations received) and, alone time during recess, as well as the effect of sex, autism, and ADHD diagnosis on nominations and social contact, Appendix A, B, and C were generated.

8. Results

8.1. Friendship nomination

The descriptive statistics showed that most BP+A (n = 39; 87%) and BP (n = 37; 82%) children nominated at least one friend in school, and 28 BP+A children (62%) and 32 BP children (71%) had at least one reciprocal friend. On average, autistic children had 1.00 (SD = 1.09) reciprocal friends and 1.09 (SD = 1.06) non-reciprocated friends, whereas the number was 1.33 (SD = 1.09) and 1.00 (SD = 1.09) respectively for the comparison group, as shown in Table 2. Note that some participants in both groups nominated themselves, their teacher, or other peers from outside their school, which were counted as invalid nominations, and excluded from the data analyses. A *t*-test showed that autistic children made more invalid nominations than the comparison group ($t(87) = -2.17$, $p =$

Table 2
Mean levels and standard deviations (SD) of the study variables (based on data unweighted and before multiple imputation).

		Autistic	Comparison
	Scale	Mean (SD)	Mean (SD)
Friendship nomination			
Reciprocal friends	1 −5	1.00 (1.09)	1.33 (1.09)
Non-reciprocated friends	1 −5	1.09 (1.06)	1.00 (1.09)
Time during recess*			
With reciprocal friends	0 −1	.14 (.24)^{a1}	.23 (.25)^{b2}
With non-reciprocated friends	0 −1	.09 (.19)^{b1}	.06 (.11)^{a1}
Enjoyment during recess			
Enjoyment level (LEAP)	1−5	3.85 (.66)	3.81 (.89)

Note. Means with different superscript letters in each row differed significantly ($p < 0.05$). Means with different superscript numbers in each column differed significantly ($p < 0.001$).
* Calculated as a proportion by dividing the total duration of time when Child A was in contact with Child B by the total duration of time Child A was detected by the receiving station.

.033; mean 1.04 (SD = 1.07) and 0.61 (SD =.78) respectively), as shown in Appendix A.

Regarding the number of friendships as measured by friendship nominations (standardised per playgroup): the 2 (Friendship Type: reciprocal, non-reciprocated) x 2 (Group: autistic, comparison) repeated measures ANOVA revealed no main effects of either Friendship Type ($F(1, 119) = .96$, $p = .330$) or Group ($F(1, 119) = 1.69$, $p = .197$), nor the interaction between them ($F(1, 119) = .38$, $p = .540$), when age was controlled for. This suggests that the autistic and the comparison groups did not differ in the number of reciprocal and non-reciprocated friends they had.

9. Time in social contact during recess

Compared between groups, the autistic and the comparison groups spent 54% and 58%, respectively, of their recess time (while they were detected by RFID) in contact with peers, although not significantly different (univariate ANOVA with age controlled for: $F(1, 85) = .024$, $p = .877$). Of this contact time, the 2 × 2 repeated measures ANOVA controlling for age showed a main effect for Friendship Type ($F(1, 119) = 5.19$, $p = .024$), which was qualified by an interaction of Friendship Type x Group ($F(1, 119) = 9.58$, $p = .002$). Mean scores in Table 2 show that children in the comparison group spent more time with reciprocal friends than non-reciprocated friends ($t(46) = -5.22$, $p < .001$), but this difference did not show for children in the autistic group ($t(39) = .41$, $p = .408$). Moreover, autistic children spent less time with reciprocal friends than the comparison group ($t(85) = 2.23$, $p = .015$), but more with non-reciprocated friends instead ($t(52.33) = -2.00$, $p = .025$). No main effect was found for Group ($F(1, 119) = .35$, $p = .558$). These outcomes were also confirmed by the additional inspection with nonparametric tests.

10. Associations with enjoyment during recess

Having more reciprocal friends or spending more time with them was unrelated to children's self-reported overall enjoyment at their playground in either group, including their overall enjoyment of playing, sitting, and playground facilities during recess. (see Table 3).

Also, the number of non-reciprocated friends was unrelated to children's enjoyment for the total group, yet Fisher's r-to-z transformation showed that the correlation coefficients were different in the two groups ($z = -2.05$, $p = 0.020$), but neither of them reached significance either when tested separately.

Notably, spending more time with non-reciprocated friends was related to less enjoyment in both groups ($r = -.38$, $p < .001$). Moreover, among autistic pupils, longer contact with non-reciprocated friends was related to significantly less enjoyment than contact with reciprocal friends ($z = -2.47$, $p = .007$). Whilst, among the comparison group, levels of enjoyment did not differ whether in contact with reciprocal or non-reciprocated friends ($z = -.09$, $p = .464$). The nonparametric Spearman correlation tests also confirmed these findings.

11. Discussion

Friendships are important for children's well-being and development. This study aimed to gain a better understanding of how autistic and non-autistic children experience their friendships at school since the school environment is where most children spend a substantial part of their time and where they are expected to develop not only cognitively, but also socially and emotionally. Notably, our study shed light on the unique influence of autism on children's perception and experience of friendships by comparing autistic children and non-autistic children in schools for children with behavioural problems. We employed a multi-method approach, including self-reports, peer nominations, and objective measures based on sensor data. The findings of our study showed that, as expected, the comparison group spent more time having contact with reciprocal friends than with non-reciprocated friends. Additionally, as expected, autistic children had less contact with reciprocal friends during recess than the comparison group. However,

Table 3
Partial Pearson's correlations with enjoyment of recess (controlling for age; pooled and weighted results).

	Correlation (*r*) with enjoyment		
	All	Autistic	Comparison
Friendship nomination			
Reciprocal friends	.10	-	-
Non-reciprocated friends	−.02	.23[a]	−.23[a]
Time during recess			
With reciprocal friends	−.01	.06[b]	−.19
With non-reciprocated friends	**−.38**[*]	**−.49**[*b]	−.21

Note. Nomination data were standardized per playgroup to ensure comparability between pupils. Correlation coefficients for separate groups are reported only when the Fisher's r-to-z transformation showed a significant difference in the strength of correlations between the groups, or between the two friendship types; otherwise, the correlation coefficients for the entire sample are reported.

[a] Fisher's r-to-z transformation showed a significant difference ($p < .05$) in the strength of correlations between groups.

[b] Fisher's r-to-z transformation showed a significant difference ($p < .05$) in the strength of correlations between the friendship types within the group.

[*] $p \leq .017$ (the adjusted significance level for multiple testing).

there were also unexpected findings. First, autistic children did not differ from the comparison group in the number of friends (reciprocal and non-reciprocated) they nominated, and they spent more time with non-reciprocated friends than the comparison group. Second, we did not find a positive association between the number of friends (reciprocal and non-reciprocated) that children had and the enjoyment during recess in both groups of children. Additionally, while spending time in contact with reciprocal friends was not associated with children's enjoyment during recess, spending more time in contact with non-reciprocated friends was associated with less enjoyment during recess for both autistic and the comparison groups. We discuss these outcomes in detail below.

First, in contrast to previous findings, our study revealed that autistic children did not exhibit a lower number of reciprocal friends when compared to their non-autistic peers. This divergence may stem from the fact that our autistic participants attended special education schools, where a significant portion of their peers also presented neurodivergent conditions (Locke et al., 2013; Petry, 2018). Unlike their counterparts in mainstream schools, autistic children attending special education settings may experience greater acceptance and less social exclusion from their peers, which in turn increases the possibility of establishing reciprocal friendships. It is also important to note that earlier studies, which indicated fewer reciprocal friends for autistic children, often compared them to children without any disabilities (Chamberlain et al., 2007; Kasari et al., 2011; Rotheram-Fuller, 2005; Rotheram-Fuller et al., 2010). However, many non-autistic children who participated in the current study also had behavioural problems. These children might encounter similar challenges in establishing reciprocal relationships as their autistic peers.

Nevertheless, as we expected, autistic children still spent less time in contact with their reciprocal friends during recess than the comparison group. Whilst the comparison group showed a clear preference for having contact with reciprocal friends over non-reciprocated friends, autistic children seemed less 'selective', and they spent a similar amount of time with both types of friends during recess. Possibly, autistic children are less focused on reciprocity in friendships than non-autistic children, because they have less desire to share intimacy and affection with a friend (Bauminger et al., 2004; Bauminger and Kasari, 2000; Bossaert et al., 2015). Alternatively, autistic children might find it more challenging to have contact with peers in a reciprocal and intimate way, as it requires sustained attention to social cues that they may not always understand, and some autistic children may also tend to mask their social difficulties, which can cost them more energy than non-autistic children (Cook et al., 2021; Ross et al., 2023). However, more studies are needed to verify these possible interpretations. Future research could also further investigate the role that the number of friends plays in affecting the time children spend in social contacts, but also how different types of friendship, from acquaintance to best friends, might differently affect the time children spend with them and friendship experiences.

Different from what we expected, having more reciprocal friends or spending more time with them was unrelated to children's overall enjoyment of playing, sitting, and playground facilities during recess at the playground, in both autistic and the comparison groups. Possibly, the benefits of reciprocal friends do not necessarily apply to the playground setting where children can move around in smaller or larger groups, alone or in dyads, from one child to another, depending on the activity they do or the mood they are in. 'Best friends', which children were asked to nominate in this study, might be more important in other settings, for example, when one needs emotional support in stressful moments or to share a secret, or while doing a difficult assignment for school. Thus, having reciprocal relationships with one or more best friends may contribute to an overall positive sense of school belonging (Bagci et al., 2017; Delgado et al., 2016; Foody et al., 2019), but not necessarily contribute to more joy and pleasure during recess. Other factors may be more relevant when studying children's subjective experience at the playground, such as the architecture of the built environment (Nasri et al., 2022; Yuill et al., 2007).

Additionally, some previous studies suggest that reciprocity in friendship can be beneficial but not essential for fostering a sense of belonging for school children (Garrote et al., 2023; Ray et al., 2018). Simply having the perception that one has more friends at school, irrespective of whether the feeling is mutual, was reported to relate to stronger feelings of social inclusion (Garrote et al., 2023). Based on this literature, we had expected that having more non-reciprocated friends and having contact with them would also be related to more enjoyment during recess. Notably, we found a negative association in both autistic and comparison groups. This is probably because, in our study, children were asked to nominate 'best friends', whereas, in the former studies, children gave other kinds of nominations, such as 'the children you like to play with'. Therefore, our measure reflected the stronger and highly valued connections in school whom children could immediately recall and were more likely to have positive interactions. This might explain the negative association we found, as having more contacts with non-reciprocated friends might also mean less positive interactions, and possibly more rejection or ostracism, thus bringing about more negative experiences.

Notably, when comparing the levels of enjoyment during contact with reciprocal friends and with non-reciprocated friends, no statistically significant difference was observed for the comparison group. However, for autistic children, engaging with non-reciprocated friends was linked to less enjoyment compared to contact with reciprocal friends. This implies that non-reciprocated friends may have a more detrimental effect on autistic children than on their non-autistic counterparts. It is plausible autistic children may encounter greater difficulty in regulating the emotional arousal triggered by negative social experiences. This in turn makes non-reciprocated friendships have a more pronounced negative impact on autistic children than on their non-autistic peers. Future research could further investigate the role that the 'unanswered' friendships play in affecting children's school experience, but also how different levels of friendship, from acquaintance to best friends, might differently affect children's well-being in the school environment.

Last but not least, unlike previous studies comparing friendships in autistic and non-autistic children from mainstream schools (e.g., Chamberlain et al., 2007; Kasari et al., 2011), our study included participants from two special education schools for children with behavioural problems, of whom half were autistic. This approach allowed us to attribute the differences we found between the two groups more specifically to autism, rather than other psycho-developmental conditions. Although the outcomes of our study may not be generalised to autistic children in mainstream settings, the similarities we found between autistic and non-autistic children in friendships suggest that the school environment and children's individual characteristics may also affect autistic children's experiences

of friendships. It is important to note that autistic children in mainstream settings often form a minority, which may cause "minority stress" (Botha & Frost, 2020). However, in special education settings, like in our study, autistic children form about half of the population, they may experience more opportunities to freely explore interpersonal relations, cultivate friendships, and interact with peers in ways that suit their individual needs. Future studies are encouraged to consider environmental factors and the interaction between environment and child characteristics when studying friendships among autistic children.

12. Limitations

Our multi-method approach that combined sensor technology, peer nomination, and self-reports enabled us to obtain objective information on child behaviour at the playground as well as gain insight into their subjective feelings of contact with friends. Yet, there are also limitations that must be taken into account when interpreting the findings.

First, this study focused on friendship reciprocity rather than friendship quality. Although friendships can bring children positive feelings, such as a sense of belonging, contact with friends may also expose them to the dark side of friendships, such as aggression, exclusivity, or bullying. Especially for children with behavioural problems, they often experience a low quality of friendships, which are characterised by more conflict, less stability, less acceptance, and more rejection, compared to typically developing peers (Blachman & Hinshaw, 2002; Deptula & Cohen, 2004; Grotpeter & Crick, 1996; Hoza et al., 2005). In our study, all participants were from two special education schools for children with behavioural problems, and half of our participants were autistic, which could have impacted the quality of their friendships. However, our study did not examine the quality of their friendships, and thus it is unclear how it relates to their feelings. Future research could further explore the quality of friendships between autistic children and their reciprocal and non-reciprocated friends, and how it impacts their well-being.

Second, the RFID tags detect face-to-face contacts within 1.5 m, but social contacts are not always face-to-face or in such close proximity, and being physically close may not necessarily entail interaction. Children might stay in proximity without talking or playing with each other. As RFID data only provided information about whether two children are in proximity, but not the nature of such contacts, some interactions might have been missed and some contacts detected might not involve actual interaction. Moreover, noise and errors in the sensing technology could have also impacted our proximity sensing results. Nonetheless, we measured children's social contacts for an extended period of time throughout each recess, within an entire playgroup, with which the detected contacts can give a meaningful, relative indication of children's interactions, thus compensating for possible measurement errors. Future studies could adopt more advanced algorithms (e.g., spatio-temporal features of proximity; Nasri et al., 2023) to also analyse social contacts over time, or combine sensor data with field observation to gain further insights regarding the nature of children's social contacts and networks.

Third, some limitations in friend nominations and self reports should be noted. Free recall of up to five best friends in school was used in this study to investigate friendship reciprocity instead of providing participants with a list of classmates. This method allowed our participants to also nominate peers who they played with outside the classroom, thus ensuring that we captured the most relevant peer connections a child had in the school environment. Despite explicit instructions to all participants that peer nominations had to involve peers in school, autistic children made more invalid nominations (e.g. self-nominations) than the comparison group. These invalid nominations may have contributed to a lower outdegree and fewer reciprocal friends in both groups, but this might have had a stronger effect in the autistic sample. In addition, the possibility of false nominations cannot be ruled out, such as nominating popular peers instead of actual good friends. Future studies could possibly first do a practice session on peer nominations to prevent or decrease these kinds of invalid nominations. Furthermore, although our measure for enjoyment (LEAP) showed good internal consistency in this study, and was also found reliable when administered to neurodivergent children in previous research (Hyndman et al., 2016; Hyndman & Chancellor, 2015), it should be noted that this measure has only been validated among neurotypical children. Further research is required to understand how neurodivergent children may construe enjoyment.

13. Conclusions

This study revealed several intriguing findings that add nuance to our understanding of how autistic and non-autistic children perceive and experience friendships within the school environment. First, our outcomes affirm previous findings that autistic children tend to have less contact with reciprocal friends during recess compared to their non-autistic peers. This suggests that autistic children may have different priorities in friendship, or they find certain aspects of friendship, such as reciprocity, less accessible and more challenging. Additionally, for both autistic and non-autistic children, having reciprocal friendships might not necessarily enhance their positive experience during play, but lacking reciprocity in friendships did contribute to reduced enjoyment in both groups. These findings highlight the importance of considering factors beyond reciprocity, such as the built environment and the broader perception of having friends, in affecting children's social experience at school.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki, and the informed consent form and the research protocol were approved by the Psychology Research Ethics Committee of Leiden University (V2–2428, dated 04 June 2020; V3–2685, dated 24 October 2020). Informed consent was obtained from all children's parents involved in the study before the test procedures.

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CRediT authorship contribution statement

Zhao Jiayin: Writing – review & editing, Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Li Boya:** Writing – review & editing, Writing – original draft. **Rieffe Carolien:** Writing – review & editing, Writing – original draft, Supervision, Funding acquisition, Conceptualization. **Tsou Yung-Ting:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Baratchi Mitra:** Writing – review & editing, Methodology. **Blijd-Hoogewys Els:** Writing – review & editing. **Gülen Özgür:** Data curation.

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Conflicts of interest

No conflicts of interest were reported.

Appendix A
Mean and standard deviations (SD) of the study variables (results based on data unweighted and before multiple imputation).

		Autistic	Comparison
	Scale	Mean (SD)	Mean (SD)
Friendship nomination			
Reciprocal friends	1 –5	1.00 (1.09)	1.33 (1.09)
Non-reciprocated friends	1 –5	1.09 (1.06)	1.00 (1.09)
Outdegree	1 –5	2.09 (1.36)	2.39 (1.45)
Indegree	1 –5	1.93 (1.60)	2.31 (1.51)
Invalid nominations	1 –5	1.04 (1.07)*	0.61 (.78)
Teachers	1 –5	.40 (.72)	.50 (.73)
Non-school-peers	1 –5	.51 (.84)* *	.09 (.42)
Time during recess[a]			
With reciprocal friends	0 –1	.14 (.24)*	.23 (.25)
With non-reciprocated friends	0 –1	.09 (.19)*	.06 (.11)
Alone	0 –1	.47 (.23)* *	.30 (.23)
Enjoyment during recess			
Enjoyment level (LEAP)	1 –5	3.85 (.66)	3.81 (.89)

[a] Calculated as a proportion by dividing the total duration of time when Child A was in contact with Child B by the total duration of time Child A was detected by the receiving station.

* $p < 0.05$.

* * $p < 0.01$.

Appendix B
Mean and standard deviations of the study variables as a function of autism diagnosis and sex.

	Autistic		Comparison
	Mean (SD)		Mean (SD)
Boys		n = 42	n = 20
Number of reciprocal friends	1.00 (1.13)		.08 (.89)
Number of non-reciprocated friends	1.10 (1.08)		1.00 (1.09)
Time with reciprocal friends	.17 (.22)		.29 (.27)
Time with non-reciprocated friends	.12 (.19)		.05 (.10)
Girls		n = 3	n = 25
Number of reciprocal friends	1.00 (.00)		1.28 (1.06)
Number of non-reciprocated friends	1.00 (1.00)		1.16 (1.21)
Time with reciprocal friends	.24 (.41)		.20 (.22)
Time with non-reciprocated friends	.08 (.07)		.08 (.12)

Appendix C

Mean and standard deviations of the study variables as a function of autism and ADHD diagnosis.

	No ADHD	With ADHD
	Mean (SD)	Mean (SD)
Autistic	n = 29	n = 15
Number of reciprocal friends	1.28 (1.19)	.47 (.64)
Number of non-reciprocated friends	.86 (.99)	1.47 (1.13)
Time with reciprocal friends	.21 (.25)	.10 (.18)
Time with non-reciprocated friends	.12 (.22)	.11 (.10)
Comparison	n = 28	n = 16
Number of reciprocal friends	1.39 (1.17)	1.31 (.95)
Number of non-reciprocated friends	.96 (1.11)	1.13 (1.09)
Time with reciprocal friends	.27 (.26)	.21 (.22)
Time with non-reciprocated friends	.06 (.11)	.08 (.12)

Note. The participant with trauma and attachment problem in autistic group and the participant with oppositional defiant disorder in the comparison group were excluded in this table.

Data Availability

Data will be made available on request.

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