Pronoun Interpretation in Bilingual Children with Autism Spectrum Disorder: Evidence from 400 Autistic and Neurotypical Children

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1. Introduction

Children with Autism Spectrum Disorder (ASD) often experience significant communication (APA, 2022) and language difficulties (Schaeffer et al., 2023; Silleresi et al., 2023). Across languages, autistic children show heterogeneous patterns of pronoun use and interpretation: challenges tend to arise with forms that are dependent on discourse context or other pragmatic factors (e.g., the deictic pronouns I and you in conversation, third-person reference in narrative contexts, object pronouns that involve syntactic complexity such as accusative clitics). While production often improves with age, interpretation remains sensitive to perspective taking and cognitive demands (Barokova & Tager-Flusberg, 2019; Chanchaochai & Schwarz, 2023; Finnegan et al., 2021; Kuijper et al., 2021; Overweg et al., 2018; Perovic et al., 2013; Skrimpa et al., 2022; Terzi et al., 2014, 2016). Importantly, emerging evidence suggests that bilingual experience can enhance theory of mind and related perspective-taking abilities, including in autism. As such, autistic bilinguals may be more attuned to contextual cues in pronoun resolution (Peristeri et al., 2024; Skrimpa et al., 2022). Together, these patterns motivate the central questions that the current study seeks to address, namely how children with ASD interpret deictic pronouns in reported speech, and whether bilingual experience is associated with reduced difficulty in deictic pronoun interpretation.

The question of how bilingualism influences development is particularly relevant, as growing numbers of children are raised with two or more languages (Baker, 2011; Grosjean, 2024). Bilingualism has been associated with advantages in cognitive and communicative domains, including executive functioning (e.g., attention control, cognitive flexibility, inhibition and working memory; Bialystok et al., 2009; Gunnerud et al., 2020; van den Noort et al., 2019; but see Giovannoli et al., 2020; Lehtonen et al., 2018), and communicative skills, such as gesture comprehension (Wolfer et al., 2025). In addition, bilingualism has been linked to enhanced theory of mind in neurotypical children (Baumeister et al., 2025) and in

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children with ASD (Peristeri et al., 2021; 2024), suggesting that such advantages may support language development in autistic bilinguals.

In the current work, we focus on the deictic pronoun *I*. A well-known feature of the speech of young autistic children is their occasional reversal of the pronouns *I* and *you* (APA, 2022). While the few studies examining autistic children's interpretation of deictic pronouns find little or no difficulty in their interpretation of deictic pronouns in simple sentences (Hobson et al., 2010; Lee et al., 1994), difficulties can be observed in more complex sentence contexts. For example, Overweg et al. (2018) investigated how Dutch-speaking autistic children aged 6 to 12 interpret the deictic pronouns *I* and *you* in speech reports. Speech reports convey what someone else has said and can appear as either a direct speech report (quoted verbatim, as in (1)) or an indirect speech report (embedded within a complement clause, as in (2)).

(1) Mouse says: 'I get the ball'.
(2) Mouse says that I get the ball.

In direct speech reports, the pronoun *I* refers to the reported speaker (e.g., mouse in (1)), whereas in indirect speech reports, the pronoun *I* refers to the reporting, or actual, speaker (e.g., the speaker uttering (2)). Overweg et al. (2018) found that children with ASD showed adult-like performance in indirect speech, but significantly lower performance when interpreting *I* and *you* in direct speech compared to typically developing peers. They attribute this to difficulties with the shift to the reported speaker's perspective that is needed for understanding deictic pronouns in direct speech.

Pronoun interpretation in direct speech may be harder than in indirect speech due to the perspective shifting it requires. On the other hand, features of direct speech such as intonational modification and perceived liveliness (Groenewold et al., 2014) may facilitate interpretation. In contrast, indirect speech reports involve clausal embedding, which is challenging for autistic children: they produce few clausal complements (Durrleman & Zufferey, 2013; Durrleman, 2020) and show impaired comprehension of certain types of complement clauses (Lind & Bowler, 2009).

In the present study, we examine the interpretation of the deictic pronoun *I* in direct and indirect speech by monolingual and bilingual children with and without ASD. Specifically, we aim to investigate whether autistic children show specific difficulties with *I*, and whether bilingualism - especially in ASD - provides advantages for pronoun interpretation in reported speech. To this end, we address the following two research questions:

RQ1: How do typically developing children and children with ASD interpret the deictic pronoun *I* in direct and indirect speech reports?
RQ2: Does bilingualism enhance pronoun interpretation in children with ASD?

We predict that if perspective shifting is crucial for deictic pronoun interpretation, children will struggle more with deictic pronouns in direct speech, which require a shift in perspective. Conversely, if clausal embedding drives the difficulty with deictic pronoun interpretation, interpretation should be more difficult in indirect speech, which involves an embedded clause. Furthermore, we predict that greater bilingual balance, which arguably trains perspective-taking skills, will be associated with fewer errors in pronoun interpretation given its reported link to these skills.

2. Methods

2.1. Participants

The participants included 404 children from Canada, France, Germany, Scotland, Spain, Switzerland and the United States: 150 children with ASD and 254 TD children (Table 1). ASD diagnoses were confirmed according to the DSM-5 criteria (APA, 2022) by qualified clinicians using gold-standard diagnostic instruments (e.g., ADOS-2; Lord et al., 2012 and ADI-R; Lord et al., 1994). TD children had no suspected or diagnosed ASD or other reported developmental, linguistic, cognitive, visual or auditory impairments.

Table 1. Participant characteristics

	Autistic children *N* = 150	TD children *N* = 254
Age – Mean in years;months (*SD*, [range])	8;7 (2;4 [3;1-13;4])	7;10 (2;5 [2;9-11;11])
Gender		
N Male	118	125
N Female	29	126
N Other	0	1
N NA	3	2
Language of testing		
N English	18 (12%)	50 (19.7%)
N French	68 (45.3%)	58 (22.8%)
N German	33 (22%)	88 (34.6%)
N Italian	5 (3.3%)	29 (11.4%)
N Spanish	26 (17.3%)	29 (11.4%)
Proficiency L1	0.7 (0.2)	0.8 (0.2)
SES – Mean (*SD*, range)	4.0 (1.2, 0-5)	4.6 (0.7, 2-5)
TROG z-scores – Mean (*SD*)	-0.8 (1.3)	0.2 (1.1)
Autism severity (SCQ) – Mean (*SD*, range)	19.4 (6.9, 1-34)	4.9 (4.2, 0-31)

The testing languages of the study were English, French, German, Italian, and Spanish. The children were assessed in their most proficient language when possible ($N = 355$); otherwise, their second-most proficient language was used ($N = 24$). When children's proficiency was equal across languages, the language of interaction with the experimenter was used ($N = 25$).

Participants were recruited via school contacts, social media, flyers, clinical and hospital contacts, and autism-related association websites. Parents provided written informed consent prior to their inclusion in the study, and children received a gift card for participation (CHF 35 / EUR 35 / CAD 60 / USD 35). This study was approved by the Swiss Association of Research Ethics Committees *Swissethics* (Project ID-2022-00878).

2.2. Procedure

This study is part of a larger study that includes a battery of cognitive tasks, a gamified language task and parental questionnaires. First, caregivers filled in online questionnaires, which took about 60 minutes. Each child was then tested at home or school across two or three sessions (1–1.5 hours each), scheduled on different days to minimize fatigue. The sessions took place in a quiet setting, with a trained experimenter present to provide support as needed, while the children completed the tablet-based tasks. The gamified language task tested several syntactic structures in an app and was designed for young children and children with linguistic or cognitive impairments, with efforts to minimize unnecessary visual and verbal complexity.

2.3. Materials

2.3.1. Pronoun interpretation task

To test children's interpretation of the first-person singular deictic pronoun (*I* in English), a sentence-picture matching task was used. The task included 12 items. Half of them presented the pronoun in a direct speech report, and the other half in an indirect speech report. Because the complementizer *that* in indirect speech reports is optional in English, which may create ambiguity between the direct and indirect speech readings, the reported clause in the direct speech condition was pronounced with a high-pitched ('funny') voice to emphasize quotation. For cross-linguistic consistency, the high-pitched voice was present in the direct speech condition in all five test languages.

The items were presented in random order across six different blocks alongside other items from the gamified language task. For each item testing pronoun interpretation, three characters appeared on the screen, each with the same object placed nearby (see Figure 1). A fairy, who guided the game as the third character, introduced the other characters (two animals), uttered the test sentence, and finally asked a question prompting the child to touch the character that received the object. The position of the animal referred to by a full NP in the test phrase and the oddball animal were counterbalanced across items. The fairy,

serving as a main character throughout the whole game, was always positioned on the right side of the screen.

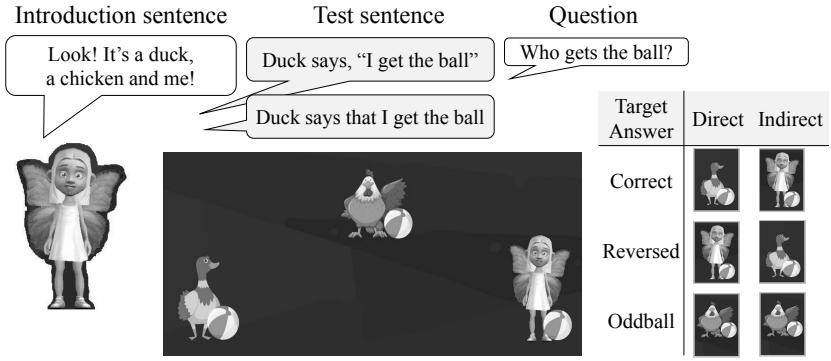

Figure 1. Example of trial from the pronoun comprehension task.

In the direct speech condition, the correct response was the reported speaker (the character mentioned in the main clause); the reversed response was the fairy; and the oddball was the remaining animal. In the indirect speech condition, the correct response was the actual speaker (the fairy); the reversed response was the reported speaker; and the oddball was again the remaining animal.

2.3.2. Bilingual characterization

Children's language experience was assessed using the parental questionnaire *Quantifying Bilingual Experience*, Q-BEx (De Cat et al., 2022). Q-BEx collects biographical information and measures the duration, quantity and quality of exposure, use and proficiency of up to three languages. The present study used data from the *Background Information, Language Exposure and Use, Proficiency,* and *Richness* modules. L1 proficiency was relative to same-age peers and assessed via parental ratings.

To capture the multidimensional nature of bilingual experience, three continuous measures were derived from the Q-BEx: (1) *length of language exposure*, which is the length of exposure measured in months; (2) *length of language use* in months; and (3) *language proficiency*. Entropy scores ($-\sum p_k \times \ln[p_k]$) were used to quantify the balance of exposure and use, with p_k representing the proportion of exposure or use devoted to each language k (see Baumeister et al., 2025 for a detailed description of the calculations). Higher entropy values correspond to a more balanced distribution of exposure or use across languages, serving as an index of how evenly children engage with their linguistic environments. Considering both cumulative and distributional dimensions of bilingualism enabled us to examine not only the amount of bilingual experience a child possessed, but also the degree to which that experience was diversified.

2.3.3. L1 Proficiency

Children's L1 proficiency scores were derived from the Q-BEx, where parents rated their child's proficiency relative to same-age peers on a four-point Likert scale ranging from *Hardly at all* (0) to *Very well* (3). For each domain (comprehension, production, writing and reading) participants' scores were summed across relevant tasks. An average proportion score was then calculated by dividing the summed score by the total possible score, ensuring comparability across participants.

2.3.4. TROG

Participants completed the Test for Reception of Grammar (TROG-2; Bishop, 2003). This test evaluates general receptive morphosyntactic abilities using a tablet-based picture selection task in the language being assessed. Since the different language versions varied in scoring procedures, target structures, and total item counts, z-scores were calculated to ensure comparability of performance across all participant groups.

2.3.5. SES

Parental education level was used as a proxy for socioeconomic status. Parents reported their highest educational attainment on a five-point Likert scale: (1) elementary school, (2) middle school, (3) high school, (4) post-secondary qualification, and (5) university degree. For each child, the higher of the two caregivers' scores was used in the analyses.

2.4. Data analyses

Generalized linear mixed-effects models were created in R (R Core Team, 2025) with a logit link function using the lme4 package (Bates et al., 2015). Model building was hypothesis-driven.

To address RQ1 regarding the interpretation of the first-person deictic pronoun by TD children and children with ASD, a mixed effects model was built. In this model, *Accuracy* was used as the dependent variable, and a random intercept for *Participants* as well as a random slope for *Condition* by *Participant* were included. Initially, a random intercept for *Item* was included as well, but as this led to convergence errors it was excluded in subsequent models. *Condition* (Direct vs. Indirect speech report), *Diagnostic Group* (ASD vs. TD) and their interaction were included as fixed effects. These predictors were sum-coded (-0.5, +0.5) to improve the readability of the model output. The continuous predictors like *Age, Language Proficiency, TROG z-score,* were standardized for the same reason of model interpretation and were included as fixed factors in the model. We also calculated the correlation coefficient between participant-level variables to assess multicollinearity. Although we did not hypothesize or predict differences

between the five different languages that were tested, language was included as a control variable to ensure that the data behaved similarly across languages.

To address RQ2 regarding the effect of bilingualism on pronoun interpretation in children with ASD, two more mixed effects models were created, one assessing the effects of entropy scores of exposure across contexts, and another examining exposure within contexts. In both models, again *Accuracy* was used as the dependent variable and a random intercept for *Participants* as well as a random slope for *Condition* by *Participant* were included. The sum-coded predictors *Condition* (Direct vs. Indirect speech report) and *Diagnostic Group* (ASD vs. TD) were included as fixed effects. Either *Entropy scores of exposure across context* or *Entropy scores of exposure within contexts* was standardized and added to the model, including a three-way interaction between *Entropy Score*, *Condition* and *Diagnostic Group*. Furthermore, like previously, the continuous predictors *Age, Language Proficiency,* and *TROG z-score,* were standardized and included as fixed factors in the model.

3. Results

3.1. Group differences

Table 2 shows participants' accuracy in the pronoun interpretation task.

Table 2. Mean accuracy in proportions (SD) in the pronoun interpretation task

	ASD	TD
Direct speech report	0.79 (0.41)	0.88 (0.33)
Indirect speech report	0.50 (0.50)	0.72 (0.45)

Results showed a main effect of *Condition* ($\beta = -1.96$, $p < .001$), indicating better interpretation in the direct speech condition. Children with ASD performed significantly less accurately than their TD peers ($\beta = 0.92$, $p = .004$), and this difference varied by condition, as reflected in a significant *Condition* × *Diagnosis* interaction ($\beta = 1.07$, $p = .031$). Specifically, post-hoc comparisons using estimated marginal means showed that autistic children had greater difficulty with the indirect than the direct speech condition ($\beta = 2.50$, $p < .001$), relative to their TD peers ($\beta = 1.43$, $p < .001$). In addition, higher age ($\beta = 0.71$, $p < .001$), greater language proficiency ($\beta = 1.01$, $p < .001$), and better TROG z-scores ($\beta = 0.60$, $p < .001$) were all associated with higher accuracy. The language of task administration did not significantly affect performance. Correlations were low to moderate, indicating that multicollinearity was not a concern.

3.2. Bilingualism

We next examined whether bilingual experience, operationalised as entropy scores, predicted pronoun interpretation. When using across-contexts entropy, the main effect of entropy was not significant ($\beta = 0.15$, $p = .263$), nor were any of its interactions with *Condition* or *Diagnostic Group*. In contrast, when using within-contexts entropy, we observed a significant interaction with *Condition* ($\beta = 0.63$, $p = .013$).

Post-hoc analyses indicated that greater bilingual balance within specific contexts was associated with higher accuracy in the indirect speech condition ($\beta = 0.47$, $p = .035$). No main effect of *Entropy Score* or interactions with *Diagnostic Group* were significant. In both models, *Age*, *Language Proficiency*, and *TROG z-scores* remained robust positive predictors, and the *Condition* × *Diagnosis* interaction again indicated that autistic children had disproportionate difficulty in the indirect speech condition (Figure 2).

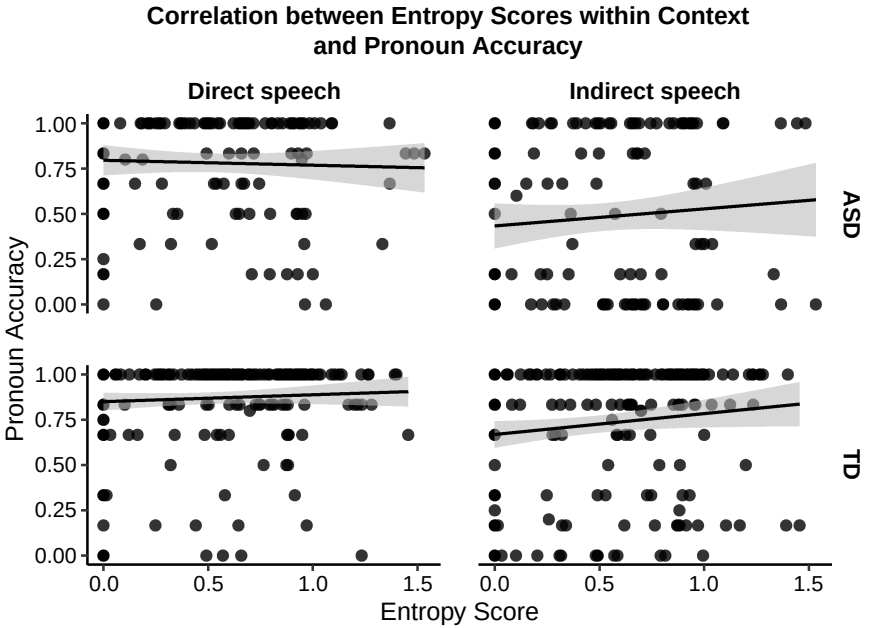

Figure 2. Relationship between entropy scores within context and pronoun interpretation accuracy, for direct (left) and indirect (right) speech and ASD (top) and TD (bottom) groups.

4. Discussion

Our first research question was how typically developing children and children with ASD interpret first-person deictic pronouns such as English *I* in

direct and indirect speech reports. The analyses showed that autistic children experienced more difficulties in pronoun interpretation compared to typically developing children. This confirms the general pattern found in the literature that autistic children tend to struggle with pronoun interpretation in certain contexts (e.g., Finnegan et al., 2021).

Furthermore, we found that both typically developing children and autistic children performed better on pronoun interpretation in direct than in indirect speech. This contrasts with previous findings in Dutch (Köder & Maier, 2016; Overweg et al., 2018) and might be explained by the use of a high-pitched voice to mark direct speech in the current experiment. This could have emphasized the role of the reported speaker, and therefore facilitated the perspective shift from the actual speaker to the reported speaker in direct speech. At the same time, pronouns in indirect speech reports may be difficult to understand for children with ASD because they occur in an embedded clause. As clausal embedding is challenging for children with ASD (Durrleman & Zufferey, 2013, Durrleman, 2020; Lind & Bowler, 2009), this could explain why they find pronouns in indirect speech more difficult to understand than pronouns in direct speech.

Regarding the second research question, whether bilingualism enhances pronoun interpretation in children with ASD, we used two separate entropy scores reflecting different aspects of language exposure. The entropy score for exposure within contexts captures how predictable it is to hear one of several languages in a specific setting, whereas the entropy score for exposure across contexts indicates how predictable language use is at any given moment, without considering in what situation the language is used.

Our results showed that more balanced bilingual children with ASD, as well as more balanced bilingual TD children, performed better on pronoun interpretation in the indirect speech condition compared to less balanced bilinguals. However, this finding only holds for bilinguals who are more balanced within contexts, and not for bilinguals who are more balanced across contexts. It is possible that more balanced bilinguals who frequently alternate between languages within the very same context (e.g., school), gain more intense practice in shifting through diverse perspectives compared to less balanced bilinguals, thus enhancing these abilities which in turn support pronoun interpretation. This does not follow from our hypothesis that perspective shift would be uniquely related to pronoun interpretation in the direct speech condition, however, since bilingualism instead boosted performance in the indirect condition. More work is needed to assess whether perspective taking, which has been explicitly related to subordinate clauses in both TD and ASD children (de Villiers, 2007; Durrleman et al. 2023), may also contribute to pronoun interpretation in indirect speech.

Further research is also essential to better understand whether the potential bilingual advantages in pronoun interpretation may relate to other cognitive factors not considered here, such as performance on working memory or cognitive flexibility tasks (Peristeri et al., 2021; 2024; Baumeister et al., 2025). An explanation of our finding that more balanced bilinguals experience less difficulties in deictic pronoun interpretation may be found in enhanced cognitive strengths in these domains that arguably facilitate pronoun interpretation in

embedded clauses (Schouwenaars et al., 2026). By investigating these relationships, future studies may offer valuable insights into how bilingual experience influences language and cognitive abilities in children with autism.

To conclude, this study illustrates how autistic and TD children interpret deictic pronouns in speech reports. Children with ASD showed greater difficulties than TD children in interpreting pronouns overall, but particularly in indirect speech. The relatively better performance in direct speech suggests that perceptual cues, such as intonation or 'liveliness' of the reported speech, can support pronoun comprehension in perspective-shifting contexts. Moreover, the advantage observed in more balanced bilingual children indicates that bilingual experiences may bolster pronoun interpretation.

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