# Personal Pronoun Errors in Form versus Meaning Produced by Children with and without Autism Spectrum Disorder

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**Abstract:** The current study investigates whether the types of pronominal errors children with autism spectrum disorder (ASD) make are different from those of their TD peers at similar stages of language development. A recent review about language acquisition in ASD argues that these children show relative deficits in assigning/extending lexical meaning alongside relative strengths in morpho-syntax (Naigles & Tek, 2017). Pronouns provide an ideal test case for this argument because they are marked both for grammatical features (case) and features that reflect qualities of the referent itself (gender and number) or the referent's role in conversation (person). The form-meaning hypothesis predicts that children with ASD should struggle more with these latter features. The current study tests this hypothesis with data from a caregiver report, completed by caregivers of 151 children with and without ASD. Reported pronominal errors were categorized as meaning or form and compared across groups. In accordance with the form-meaning hypothesis, a higher proportion of children with ASD make meaning errors than they do form errors, and significantly more of them make meaning errors than TD children do.

**Key Words:** Autism, ASD, Pronouns, Language Acquisition, Word Learning, Reference

**Declarations**

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## 1.0 Introduction

The current diagnostic criteria for autism spectrum disorder (ASD) do not include impaired language (American Psychiatric Association, 2013), but there are certain aspects of language that are often difficult for this population. One of these aspects is pronoun use.

### *1.1 Pronouns in ASD*

The earliest account of ASD describes pronominal errors, specifically confusion between first- and second-person pronominal forms (Kanner, 1943). For example, Kanner (1943) describes one child asking his mother to take off his shoe by saying "Pull off your shoe" instead of "Pull off my shoe." Another child was described by her father as having previously referred to herself as *you*, while referring to her parents as *I*.

The incorrect use of second-person pronouns to refer to oneself and vice versa was later labeled a pronoun "reversal error," and has been argued to be a special characteristic of ASD (Bartak, Rutter, & Cox, 1975; Fay, 1979; Lee & Hobson, 1994; Seung, 2007; Tager-Flusberg, Paul, & Lord, 2005). However, reversal errors also appear in the early speech of typically-developing (TD) children (Chiat, 1982; Naigles et al., 2016). Thus, reversal errors are not unique to ASD, but they may be more frequent (Naigles et al., 2016) and/or developmentally persistent (Overweg, Hartman, & Hendriks, 2018) in this population. The idea that reversal errors are common in ASD is reflected in clinical tools; speech-language pathologists who work with this population often target pronoun reversals (e.g., Barbera, 2018).

While it is possible that reversal errors in ASD are due to echolalia (rote repetition of language previously heard), some children with ASD create novel utterances containing reversed pronouns (Evans & Demuth, 2012), suggesting that reversals are not always echoed. Moreover,

children also make reversal errors in comprehension (Overweg et al., 2018). This suggests that pronoun reversals reflect fundamental difficulties in understanding that first- and second-person pronouns depend on a referent's role in conversation. And although much of the research on pronoun use in ASD has focused on first- and second-person forms, studies on narrative production also point to problems with third-person pronouns (see Baixauli, Colomer, Roselló, and Miranda, 2016, for review), including reduced usage (Arnold, Bennetto, & Diehl, 2009; Hobson, Lee, & Hobson, 2010; Novogrodsky, 2013) and/or ambiguous use, where the pronoun's referent is unclear to the listener (Malkin, Abbot-Smith, & Williams, 2018; Novogrodsky, 2013; Novogrodsky & Edelson, 2016).

In explaining pervasive differences in pronoun use in ASD, researchers have invoked broader deficits including impaired theory of mind and perspective-taking (Baron-Cohen, Leslie, & Frith, 1985; Tager-Flusberg, 1999), reduced joint attention (Kelty-Stephen, Fein, & Naigles, 2020), atypical self-other awareness and differentiation (Hobson & Meyer, 2005; Lyons & Fitzgerald, 2013; Shield, Meier, & Tager-Flusberg, 2015), or even difficulties in working memory and other skills required for keeping track of referents in discourse (Kuijper, Hartman, & Hendriks, 2015). It is possible that there are different explanations for each of these behaviors: for example, children with ASD struggle to use first-/second-person pronouns appropriately because of difficulties with perspective-taking and third-person pronouns because of pragmatic impairments. But it is also possible that observations about pronoun use fit into a broader language pattern among children with ASD.

*1.2 Form is easy; meaning is hard*

A recent hypothesis about language acquisition in ASD articulates such a pattern and might provide an overarching explanation for difficulties with pronouns. This hypothesis argues

that “form is easy [while] meaning is hard” for children with ASD: “...[Certain] components of language, such as pragmatics and lexical/semantic organization, are disproportionately impaired in children with ASD, whereas other components of language, such as grammar, are relatively spared” (Naigles & Tek, 2017, p. 2). The authors describe how difficulties with meaning in ASD can result in the incorrect acquisition of semantic representation, and/or with problems processing meaning on-line. These two areas of difficulty are interrelated: If a young child struggles to process meaning in context, she may eventually form an incorrect—or at least less robust—denotation for a new word. And even if she eventually forms an accurate understanding of that word, she may still struggle to apply meaning given the immediate discourse context. On-line processing of meaning is particularly crucial for pronouns, whose reference shifts regularly.

There are many reasons to suspect that both the acquisition and on-line processing of language meaning (pragmatics and semantics) are difficult for children with ASD. Children with ASD show a decreased tendency to engage in episodes of joint attention (Leekam & Ramsden, 2006; Mundy, Sigman, & Kasari, 1990), thereby missing opportunities for acquiring novel object labels (Adamson, Bakeman, Suma, & Robins, 2017; Charman, 2003; Mcduffie & Yoder, 2006; Murray et al., 2008), and they may have difficulty understanding how a label extends to other category members (Abdelaziz, Kover, Wagner, & Naigles, 2018). Additionally, other features of the cognitive profile of individuals with ASD could negatively impact processing and acquisition of language meaning. For example, individuals with ASD may show weak central coherence, focusing on local detail but struggling to connect that detail to the larger context (e.g., Happé & Frith, 2006). The meaning of words is crucially connected to context—not only the larger linguistic context, as in how that word contributes and connects to the message of a narrative or

conversation, but also the extralinguistic context, or the experiential world within which that word is used.

The dependency between meaning and context is crucial for interpreting pronominal reference. In the case of third-person pronouns, meaning frequently relies on linguistic context. For instance, if someone says "Sarah is hilarious. She cracks me up", it is clear that *she* refers to Sarah. But the meaning of a third-person pronoun can also be deduced from extralinguistic cues, like pointing or gaze. If a speaker looks or points towards a person and says, "He's next in line", it is understood that *he* refers to the person indicated by the speaker's direction of gaze or pointing. And, as described earlier, for first- and second-person pronouns, reference depends on context as well. The person speaking is *I* and the person listening is *you*, so that both members of a conversation will alternate between being called *I* or *you*, depending on who is speaking. If individuals with ASD struggle to integrate local detail with the larger context, pronominal reference should be particularly hard for them to infer.

Meanwhile, there are many reasons to suspect that pronominal form (e.g., syntax and morphology) might be relatively easier for children with ASD to acquire. The derivation of grammatical rules does not necessarily depend on understanding meaning and/or social context (Naigles & Tek, 2017). Relatedly, the morphosyntactic form of pronouns, including case, mainly depends on local, sentential context (e.g., whether a noun is a syntactic subject or object: "She is loved by me" vs. "I love her."), rather than the global discourse context. This means that problems with central coherence should affect pronominal form less than it does pronominal reference. Further, at least in their own productions, children may to some extent avoid form errors simply because they do not hear them, given that children with ASD may echo speech they hear (e.g., Barrera & Sulzer-Azaroff, n.d.; Gernsbacher, Morson, & Grace, 2016; Prizant &

Duchan, 1981; Prizant & Rydell, 1984). There are tokens in the input in which an object pronoun appears directly before a verb, such as in a non-finite subordinate clause, e.g., *you saw him jump*, which might lead to form errors (as they appear to for children with developmental language disorder, e.g., Leonard, Fey, Deevy, & Bredin-Oja, 2015). But these tokens are doubtless less frequent than those where a subject pronoun precedes the verb.

### *1.2.1 Testing the form-meaning hypothesis on pronoun use in ASD*

We argue that pronouns provide an excellent test for the form-meaning hypothesis for language acquisition in ASD. In English, selection of the appropriate pronominal form depends on both grammar and meaning, because pronouns are marked independently for case, person, gender and number. The first of these features, case, depends on grammar (form), but not necessarily on meaning or reference. Case-marking results in the selection of a phonological form depending on whether the pronoun is subjective (e.g., *they*/*I*), objective (e.g., *them*/*me*), or possessive (e.g., *theirs*/*mine*). While case-marking can map straightforwardly to thematic (semantic) roles in other languages, this is not true for Modern English (e.g., consider the consistent semantic role, patient, of the objective vs. subjective first-person singular pronoun in *Hannah hugged me* vs. *I was hugged by Hannah*). Importantly for the objectives of the current study, whether a person uses appropriate subjective, objective, or possessive case depends on the word's position in the sentence, but not on whether that word accurately reflects features of the referent itself. Thus, grammatical case is dissociated from word-to-referent mapping.

In contrast, pronouns are also marked for person, gender, and number, and these features reflect qualities of the referent (meaning). Person-marking depends on the referent's role in a conversation. It identifies whether the referent is the speaker (first person), the listener (second

person), or another person who is not being spoken to directly (third person). Gender- and number-marking provide semantic information about the *attributes* of the referent being talked about—whether that referent is male, female or neither, and whether that referent includes a single member (singular) or multiple members (plural). Although both number and gender play a role in grammar, there are reasons to believe that number- and gender-marking indicate conceptually meaningful information in English, particularly for pronouns. In the case of gender, although many languages have grammatical gender-marking systems, in Modern English, pronominal gender maps closely onto notional distinctions, rather than arbitrary grammatical categories (Comrie, 1999; Curzan, 2003). And while English must represent number in grammar to signal subject-verb agreement, number-marking on pronouns has been shown to be governed by conceptual distinctions between the singular vs. plural entities to which they refer (Bock, Nicol, & Cutting, 1999). Further, for English, and even for languages with grammatical gender systems, there is evidence that children come to the task of learning both number- and gender-marking by establishing links between conceptual and grammatical features (Barner, Thalwitz, Wood, Yang, & Carey, 2007; Martinez & Shatz, 1996; Sera, Berge, & del Castillo Pintado, 1994). Thus, case functions differently from gender/number/person when it comes to considering pronominal acquisition, and the form-meaning hypothesis predicts that children with ASD should show disproportionate mastery of case compared to gender/number/person.

### *1.3 Current study*

The current study analyzes the types of pronominal errors made by children with ASD and TD children who are at the same language level. We hypothesized, based on Naigles and

Tek's (2017) form-meaning hypothesis, that children with ASD would show a relatively higher ratio of meaning errors to form errors as compared to TD peers.

Data collection was completed via caregiver report, a recommended practice for measuring early language development in ASD (Nevill et al., 2019; Tager-Flusberg et al., 2009) which correlates with other language measures for children with and without ASD, especially when measuring language production (vs. comprehension) (Charman, 2004; Ebert, 2017; Luyster, Kadlec, Carter, & Tager-Flusberg, 2008; Nordahl-Hansen, Kaale, & Ulvund, 2014). Caregiver report offers many advantages in the study of pronoun use. First, it allows for an examination of children's use of the more than 20 personal pronouns in English, when it would be difficult to design an experimental paradigm to capture the child's production of all of them. Second, it allows for a large sample (in this paper, we report results from 151 children). Finally, it provides a picture of how the child produces these pronouns naturally (i.e., at home and not in a laboratory setting). While this latter feature is also true of a corpus study, a caregiver report is more likely to capture meaning errors (as opposed to case/morphology), for which an understanding of the context and the child's intent is critical.

## 2.0 Methods

### *2.1 Participants*

We recruited caregivers of children with ASD via the Interactive Autism Network (IAN) Research Database at the Kennedy Krieger Institute, Baltimore, as well as autism support groups. Caregivers of children with and without ASD were recruited through social media, word-of-mouth, parenting groups and social groups. To participate, individuals had to identify as a

primary caregiver of a child under the age of six, for whom English is the primary language spoken at home, and who uses at least five spoken words.

Respondents' children were split into two groups: ASD and TD. Children were included in the TD group when their caregiver indicated that they had never been diagnosed with ASD, nor with any other psychiatric, language or intellectual disability. If caregivers confirmed that their child had formally received a diagnosis of ASD (and provided related details including specific diagnosis received, age at diagnosis, and other co-morbid diagnoses), that child was included in the ASD group.

To obtain a measure of expressive language level for each child, caregivers were asked to classify their child's primary utterance type. They were provided with three categories for doing so: single words, phrases, or full sentences, and they were also asked to provide several example utterances of their child's speech. We categorized these examples according to the three classifications as well; our categorizations accorded with those provided by the caregivers for all children.

In total, 153 caregivers of children with ASD and 127 caregivers of TD children participated in providing information about their children's use of pronouns. Pronominal use and accuracy patterns for all 280 children are described in an earlier report (Zane, Arunachalam, & Luyster, 2021). For the current analysis, we narrowed our sample to 151 children (78 ASD and 73 TD). We first excluded 80 reports (50 ASD; 30 TD) because the caregiver's answer to the question asking for an example pronoun error suggested they did not understand the question. Some of these caregivers described behavioral (rather than pronominal) errors demonstrated by their child (e.g., "My child often uses my lipstick and doodles on the wall") and many others simply listed the pronouns their child used in error (e.g., "He, she, her, they, and we"). We then

further narrowed our sample to children who were using pronouns but who had not mastered them yet (i.e., children who make pronoun errors), so that we could compare error types across groups. To do this, we first excluded children who used 100% of their pronominal inventory correctly ($n$ = 20; ASD $n$ = 10; TD $n$ = 10). We also excluded children who were not yet speaking in phrases ($n$ = 28; ASD $n$ = 14; TD $n$ = 14), since it is not possible to judge grammaticality of single-word uses of pronouns. We then excluded children ($n$ = 1; ASD $n$ = 1; TD $n$ = 0) who used fewer than two pronouns, since our interest is in errors suggesting confusion *between* pronouns (e.g., between *me* and *you*). If the child is only using one pronoun, they may be assigning that pronoun to the wrong referent simply because they are not yet using any other pronoun(s). Participant groups (ASD vs. TD) did not significantly differ in expressive language level ($\chi^2$ = 0.338, $p$ = 0.560) or caregiver education ($\chi^2$ = 6.421, $p$ = 0.093). As is often the case when attempting to match on language level, the TD group was significantly younger than the ASD group ($t$ = 10.749, $p$ <0.001). Given the over-representation of males in ASD diagnosis, groups also differed by sex ($\chi^2$ = 4.017, $p$ = 0.045). See Table 1 for details.

**Table 1.** Demographic information for participants included for error-type comparisons. Data are shown as mean ± standard deviation or as *n*s and percentages and are compared by *t*-test or Chi-Square.

| Characteristics | | ASD ($n$ =78) | TD ($n$ =73) | $p$ |
|---|---|---|---|---|
| Age, months | | 55.385 ±11.044 | 34.479 ±12.986 | <0.001 |
| Female/male, *n* | | 11/67 | 21/52 | 0.045 |
| Language level, *n* (%) | Phrases | 41 (53%) | 33 (45%) | 0.366 |
| | Sentences | 37 (47%) | 40 (55%) | |

| | | | | |
|---|---|---|---|---|
| Caregiver's highest level of education, *n* (%) | No post-secondary education | 11 (14%) | 3 (4%) | 0.093 |
| | Some college up to two-year degree | 22 (28%) | 19 (26%) | |
| | Bachelor's Degree | 24 (31%) | 21 (29%) | |
| | Graduate degree | 21 (27%) | 30 (41%) | |

Of the children in the ASD group, 35% had been diagnosed with a language impairment (LI), and 9% with intellectual disability (ID). Because both of these factors may affect pronominal error types, we report secondary analyses excluding children with either diagnosis.

*2.2 Procedures*

Procedures were approved by the Institutional Review Boards of Emerson College and New York University. All participants provided informed consent electronically. After consenting, they completed Part I of the study, focusing on child, family and household characteristics.

Once Part I was complete, they were given instructions to prepare for Part II. They were provided a list of pronouns and pronominal determiners and were asked to carefully observe their child's use of those words during the following 24-48 hours. This feature of our report—the period during which caregivers were asked to directly observe an aspect of their child's behavior—makes our report a hybrid between a caregiver diary (a classic tool in language acquisition research, e.g., Clark, 1993; Dromi, 1987; Tomasello, 1992) and a caregiver questionnaire (e.g., the MacArthur-Bates Communicative Development Inventory; Fenson et al., 1993). The instructions explained that caregivers would be required to answer questions about

their child's use of these words in the second report (Part II) (we did not specifically mention our interest in form vs. meaning, nor do we expect most caregivers to be aware of this distinction).

Within 48 hours after caregivers submitted Part I, they received an email linking to Part II, where they rated mastery of 23 pronouns and/or pronominal determiners (*I, me, my, mine, you, your, yours, we, us, our, ours, he, him, his, she, her, hers, it, its, they, them, their, theirs*[1]) according to whether the child consistently uses the pronoun correctly or not. At the end of the rating portion, caregivers were asked to provide example errors for any pronouns that the child was not yet using correctly. The caregiver-reported exemplar errors are the focus of the present analyses.

*2.3 Coding*

Errors were categorized as form or meaning. Form errors were those where the pronoun's form is not allowable, either because it is inappropriate for its grammatical position (*case*) and/or because the form does not exist in English. The latter errors, which we labeled *morphological*, are instances where a child overregularizes possessive /-s/ (or plural /-s/) to create forms like "hims" and "shes". Meaning errors were uses of a pronoun that inaccurately reflected aspects of the referent itself; they did not match its referent due to *number* (plural vs. singular), *gender* (masculine vs. feminine vs. neuter), and/or *person* (first- vs. second- vs. third-person). The following lists all error types and provides sample caregiver examples for each.

**FORM**

(1) ***Case*** (e.g., "Will use <u>*us*</u> instead of <u>*we*</u>. Example: <u>*Us*</u> *is going to the grocery store*"; "*The ball belongs to she*")

[1] Due to methodological error, three pronouns/determiners were left out for more than half of the children: *ours, them,* and *their*. This oversight is unlikely to affect the current analysis, since we focus on caregiver examples, which could include any of the pronouns.

(2) ***Morphological***[2] (e.g., "*That is shes cup*"; "*This is yous* instead of *this is yours*"; "*It's hims*")

**MEANING**[3]

(1) ***Number*** (e.g., "He uses the word *us* for almost all references to himself")

(2) ***Gender*** (e.g., "Sometimes says *he* when he means *she* and vice versa"; "Will sometimes use *it* in place of *her* or *he*. Example: *It wants to play...*")

(3) ***Person*** (e.g., "...*you had ball* instead of *she had ball*"; "...says *you* when means to say *me*")

When a person error involved confusing a first-person with a second-person pronoun, the error was additionally coded as a reversal error. Secondary analysis of reversal errors was performed across groups.

In coding errors, the first author categorized caregivers' example errors according to the above scheme, and the second author reviewed all categorizations. Discrepancies between the two authors were settled by consensus. In total, four changes were made to the first author's initial categorizations. The child's diagnostic group was hidden from both authors during coding.

Final categorizations were converted into two sets (one for form and one for meaning) of binary codes per child (0 for no error and 1 for an error), so that each child earned a 0 or a 1 for both form and meaning. As an example, if a caregiver described their child as confusing gender pronouns, the child would receive a 1 for meaning and a 0 for form. Another example: If a

[2] Uses of *mines* (e.g., "this is mines") were not counted as erroneous, since this form is acceptable in some dialects of American English. One caregiver of a child with ASD reported that their child uses "myself" instead of "I" (e.g., *myself am hungry*). We labeled this a morphological error in order to include it in form comparisons.

[3] It is acceptable to use a third person plural pronoun (e.g., *they*/*them*) to refer to a singular third-person entity, either as a generic pronoun or as a specific, gender-neutral pronoun. Therefore, before beginning coding, we elected not to count such examples as either number or gender errors. In fact, no caregiver provided such an example.

caregiver uses “her is hungry” to mean that the child herself is hungry, the child would receive a 1 for both meaning (person) and form (case).

*2.4 Analysis*

Before comparing example error types (form vs. meaning) between groups, we conducted an analysis to gain a preliminary sense of overall accuracy patterns. To this end, we calculated a 2x3 (diagnostic group by expressive language ability by caregiver-education level) ANOVA on proportions of pronouns used accurately out of those used at all.

For our main analysis (comparing the number of form and meaning errors between and within groups), we used a series of Fisher’s Exact Tests to compare proportions of binary categorizations of example errors. Between-group differences in proportions of form and meaning errors were performed by: 1) Comparing the number of children in each group who made meaning errors vs. those who did not; 2) Comparing the number of children in each group who made form errors vs. those who did not. Within-group comparisons were performed by two using Fisher’s Exact tests (one per group) to compare the number of children making form or meaning errors reported to the number of these errors expected if form and meaning errors were equally represented in the population.

**3.0 Results**

*3.1 Overall accuracy*

Zane et al. (2021) presented use and accuracy patterns for the original sample of 280 children and found that children with ASD used a relatively smaller proportion of their pronominal inventory correctly as compared to TD children. The same was true for this subgroup of 151 children: Children in the ASD group used approximately 26% of their pronominal inventory correctly, on average, while TD children used approximately 44% of their pronominal

inventory correctly. A 2x2 ANOVA (diagnostic group by expressive-language level) revealed a significant main effect of group ($F = 19.12$, $p < 0.001$), a significant effect of expressive language ability ($F = 23.47$, $p < 0.001$), but no significant interaction between these two factors ($F = 2.67$, $p = 0.104$). There was no significant effect of caregiver education ($F = 0.313$, $p = 0.577$), nor were there any significant interactions between caregiver education and the other predictors (diagnostic group and expressive-language level).

*Form v. meaning*

Fisher's Exact Tests compared proportions of children making form and meaning errors between and within groups. Results of between-group comparisons (See Table 2) showed that the proportion of children who produce meaning errors was significantly higher in the ASD versus the TD group (0.56 ASD vs. 0.34 TD, $p = 0.009$). Groups were not significantly different in proportions of children making form errors (0.22 ASD vs. 0.29 TD, $p = 0.353$). There were a small number of children included in both comparisons, as they produced both meaning and form errors (ASD n = 5; TD n = 4). A between-group comparison of proportions of these children (those who made both kinds of errors) was not statistically significant (0.07 ASD vs. 0.05 TD, $p = 1$). Figure 1 presents proportions of error types in each group of the children whose caregivers provided example errors that were categorizable as form, meaning, or both.

Table 2. Total number of children in each group whose example errors were categorized as form, meaning, or both form and meaning, and number of children whose example errors were not categorizable or not provided at all. Data are shown as *n*s and percentages (per group) and are compared using Fisher's Exact tests.

| Error Type | ASD (*n* =78) | TD (*n* =73) | *p* |
|---|---|---|---|
| Form, *n* (%) | 17 (21.79%)[4] | 21 (28.77%) | 0.353 |
| Meaning, *n* (%) | 44 (56.41%) | 25 (34.25%) | 0.009 |

[4] Numbers and percentages of children who make form and meaning errors include the children who make both kinds of errors. In other words, the five ASD children who make both types of errors, and the four TD children who do, are included in form and meaning error counts/percentages as well as counting for "both".

| | | | |
|---|---|---|---|
| Both form and meaning, *n* (%) | 5 (6.41%) | 4 (5.48%) | 1 |
| Not categorizable or not provided | 22 (28.21%) | 31 (42.47%) | 0.088 |

[FIGURE 1]

To determine whether differences in proportions were influenced by children with a comorbid LI and/or ID, we reran the Fisher's Exact Tests after excluding them ($n$ = 26). The pattern of results did not change: the proportion of children with ASD who made meaning errors was significantly higher (ASD 0.62 vs. TD 0.34, $p$ = 0.005). The difference between proportions of children who made form errors was not significant (ASD 0.23 vs. TD 0.29, $p$ = 0.673), nor was the difference between proportions of children who made both types of errors (0.09 ASD vs. 0.05 TD, $p$ = 0.710).

For the above comparisons, proportions of form vs. meaning do not sum to one per group because some caregivers provided example errors that were not categorizable (e.g. "I know he doesn't always use *his* and *hers* correctly. Can't think of a sentence offhand."). See the "Not categorizable" row in Table 2. Thus, significant differences in proportions of meaning errors between groups may simply reflect a larger number of TD caregivers not providing categorizable examples. To account for this, we narrowed our sample to children whose caregivers provided a categorizable error (ASD n = 56; TD n = 42)[5] and then used a Fisher's Exact Test to compare proportions of children from each diagnostic group (ASD vs. TD) making up the total count of meaning and form errors. Example errors categorized as both form and meaning were included in both counts.

[5] As seen in Table 2, there is not a significant difference in proportions of caregivers who provided categorizable example errors (vs. those who didn't) between diagnostic groups (Fisher's exact test, $p$ = 0.088).

This test revealed a significant difference in proportions for the two diagnostic groups ($p$ = 0.042). That is, of the meaning errors, a higher proportion of them were made by children with ASD (ASD 0.65 vs. TD 0.35) and vice versa for the set of children who made form errors (ASD 0.41 vs. TD 0.59). Without children with LI and/or ID, results followed the same pattern (meaning proportions: ASD 0.54 vs. TD 0.46; form proportions: ASD 0.29 vs. TD 0.71) and approached statistical significance ($p$ = 0.076).

A post-hoc analysis compared proportions of different types of meaning errors between groups (person, gender, and number). For this analysis, we compared, for each type of meaning error, the number of children who made that error to the number of children who did not. Only gender showed significant differences in proportions across diagnostic group (Gender, $p$ = 0.046; Person, $p$ = 0.104; Number, $p$ = 0.621); children with ASD made more gender errors than TD children. See Figure 2. We followed the same procedure to compare proportions of reversal errors between groups (0.37 ASD vs. 0.21 TD); this was not significant ($p$ = 0.370).

[FIGURE 2]

We repeated these tests excluding children with LI and/or ID and patterns were the same: children with ASD made significantly more gender errors ($p$ = 0.002), but comparisons for person, number, and reversal errors did not approach significance ($p$ = 0.320, $p$ = 0.297, $p$ = 0.784, respectively).

To calculate within-group comparisons, we used a Fisher's Exact test (one per group) to compare the number of children whose caregivers reported form vs. meaning errors to the numbers that would be expected if form and meaning errors were equally represented amongst the population. In order to ensure independence in each cell of the contingency tables, we narrowed our sample in each group to the children whose caregivers provided a categorizable

error, and we excluded children in each group who produced both types of errors, as these children would be sampled twice (included in the number of children who produce form errors and the number of children who produce meaning errors) within each group. This sample included 51 children with ASD and 38 TD children. See Table 3 for the number and proportion of children in each of these subsets who produced form or meaning errors, along with the corresponding *p*-values from Fisher's Tests. The proportions of meaning vs. form errors in the ASD group (0.765 and 0.235, respectively) were significantly different from what would be expected (0.5) if form and meaning errors were equally represented in the population ($p = 0.007$). The same comparison for meaning vs. form errors in the TD group (0.553 and 0.447, respectively) was not statistically significant ($p = 0.818$).

Table 3. Total number of children in each group whose example errors were categorized as form or meaning. Data are shown as *n*s and percentages (per group) and are compared using Fisher's Exact tests comparing observed proportions to what would be expected if form and meaning errors were equally distributed within groups.

| Group | Form | Meaning | *p* |
|---|---|---|---|
| ASD ($n = 51$) | 12 (23.53%) | 39 (76.47%) | 0.007 |
| TD ($n = 38$) | 17 (44.74%) | 21 (55.26%) | 0.818 |

**4.0 Discussion**

Results support a form-meaning account for pronoun errors in ASD. A significantly higher proportion of children with ASD are reported as making meaning errors as compared to their TD peers and as compared to what would be expected if meaning and form errors were equally frequent in the population. In contrast, form errors are reported significantly less often for children with ASD than what would be expected if they were as common as meaning errors for this population. Similarly, form errors are not more commonly reported amongst the ASD

sample as compared to the TD sample, and in fact, a follow-up analysis suggests that a higher proportion of our sample of form errors were reported by caregivers of TD children.

Children's difficulty with pronoun meaning, as compared to pronoun form, may be due to fundamental differences in social engagement and attention (American Psychiatric Association, 2013; Constantino et al., 2017; Hobson et al., 2010; Klin, Lin, Gorrindo, Ramsay, & Jones, 2009; Yirmiya, Kasari, Sigman, & Mundy, 1989). For example, early differences in joint attention—a skill that is foundational to perspective-taking—have been well-documented in young children, where children with ASD show relatively infrequent (or even absent) responses to and initiations of joint attention bids (Adamson et al., 2017; Gillespie-Lynch, 2013; Kasari, Freeman, & Paparella, 2006; Leekam & Ramsden, 2006). A recent article directly connects joint attention to pronoun use in children with ASD, finding that their frequency of pronoun use correlates with their time spent responding to joint attention (Kelty-Stephen et al., 2020). We take this further and suggest that not only pronoun use, but *appropriate* pronoun use may depend on early social attention and perspective-taking skills, like joint attention.

Another reason that individuals with ASD might struggle to interpret pronoun meaning is related to reported difficulties integrating local details (e.g., individual words) with larger context (e.g., a narrative, conversation, or experiential context) (Booth & Happé, 2010; Frith & Happé, 1994; Happé, 1999; Nuske & Bavin, 2011; Plaisted, 2001). When people use pronouns to refer to entities in the world around them, reference can be resolved from the larger linguistic context, communicative cues that indicate referents nonverbally (gaze, pointing), and/or the referent's saliency in the experiential context (e.g., a person suddenly entering the room in which the speaker/listener are talking). Firsthand reports from adults with ASD offer helpful articulations of the conscious experience of struggling to integrate context to resolve pronoun reference. For

example: “When my friends tell me a story with ... more than two characters, I may get lost in the pronouns” (Grace, 2013). Accounts like Grace’s show not only that some individuals with ASD recognize their own difficulties interpreting pronominal reference but also indicate that such struggles can continue into adulthood. In contrast, individuals like Grace may show relative ease interpreting (and using) morphosyntactic pronominal features, like case, as these features depend on the local, sentential context (e.g., “She was kissed by me” vs. “I kissed her.”), rather than depending on connecting pronouns with referents and other information in the global discourse context.

When we explore differences in meaning-error types across groups (gender vs. person vs. number), we find that significantly more children with ASD make gender errors. However, gender conceptualization also seems difficult for TD children to master. While most TD children display rudimentary understanding of stereotypical gender around 18 months (Poulin-Dubois, Serbin, & Derbyshire, 1998; Zosuls et al., 2009), it is only by around 40 months that they consistently match pictures of referents to gendered labels, particularly when the images depict non-adult referents (“boy” vs. “girl”) (Leinbach & Fagot, 1986). This suggests that TD children are still solidifying gender categories well after they have turned three. In contrast, English-acquiring children can consistently distinguish between plural and singular nouns by around 24 months (Barner et al., 2007) and they master the production and comprehension of person-marking between 21 and 30 months (Girouard, Ricard, & Girouard, 1997). Thus, the comparatively higher number of gender errors in the ASD group may reflect a relatively protracted acquisition of a concept that is slow to develop for all children. However, there was another kind of gender error—unique to the ASD group—that does not directly pertain to the difference between male and female. Five children with ASD were reported to use the pronoun *it*

to refer to human beings. It is possible that children with ASD do not understand that *it* cannot be used to refer to humans, but it is also possible that such uses of *it* are a strategy for avoiding a male-vs.-female determination (something like the nonbinary pronoun, *they*).

There were also other kinds of errors that were almost entirely unique to the ASD group. For instance, there were only four number errors noted across all participants (e.g., a child with ASD described as using *we* to refer to himself), and three of four of them were made by children with ASD. Similarly, children who made non-reversal person errors (e.g., using *you* to refer to a third-person, or using *he* to refer to oneself) were almost exclusively ASD. Only one TD child was described as making such an error. Such qualitative differences—error types that are unique or nearly unique to the ASD group—lead us to believe that our results do not reflect a pattern whereby children with ASD are merely slower to acquire pronoun meaning across the board. Instead, some children with ASD show differences in their understanding of pronominal reference, suggesting that they are acquiring pronoun meaning differently from their TD peers.

However, even if results do simply reveal delayed acquisition of pronominal meaning among children with ASD, it is important to stress that their grasp of pronominal meaning is delayed, not only compared to language-matched TD children, but also to their own grammatical abilities. Pronoun errors in ASD were significantly more likely to reflect meaning confusion but not form (grammatical) confusion, suggesting a fundamental difference in the acquisition pattern of pronouns across groups, where TD children seem to master person/number/gender earlier than they master case, and children with ASD show the opposite pattern.

Many reports suggest that some children with ASD have a comorbid language impairment (Kjelgaard & Tager-Flusberg, 2001; Rapin & Dunn, 2003). And research finds that a significant minority of children with ASD exhibit language deficits indicative of a grammatical

impairment, similar to what is observed in developmental language disorder (DLD) (Wittke, Mastergeorge, Ozonoff, Rogers, & Naigles, 2017). Thus, it is possible that our findings are due to comorbid DLD among a subset of our children with ASD, rather than the result of broad pronoun impairments. One reason to suspect this is not the case is that the error patterns noted among our participants with ASD are different from what would be expected in DLD in two important ways. First, research has shown that children with DLD make more pronominal errors than age-matched TD children but *not* language-matched TD children (i.e., younger TD children whose MLU is equivalent to older children with DLD) (Moore, 1995, 2001). In contrast, our results show that children with ASD make more meaning errors than significantly younger children who are at the same expressive language level. Second, children with DLD have been shown to produce more grammatical (case) errors than TD peers at similar ages and language abilities (Bol & Kasparian, 2009; Loeb & Leonard, 1991; Moore, 2001), but not more meaning errors, like gender (Moore, 2001) or reversals (Bol & Kasparian, 2009), and this is the opposite of what was found in our group comparisons between ASD and TD.

We end our discussion emphasizing relative strengths in pronoun use among our set of children with ASD. The ASD group was relatively skilled at using appropriate pronoun case and morphology. Some other studies have shown that a subset of children with ASD acquire grammar similarly to TD children (Tek, Mesite, Fein, & Naigles, 2014; Waterhouse & Fein, 1982), and we are not the first to show that pronominal case may develop in ASD in line with TD children (Tager-Flusberg, 1994). Perhaps the fact that grammar is relatively systematic and rule-based makes it especially decipherable for children with ASD, who may be good at "systemi[z]ing", as compared to their TD peers (Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Lawson, Baron-Cohen, & Wheelwright, 2004). Similar arguments have

been used to explain why hyperlexia is more common in ASD than it is in the general population or among people with other kinds of developmental disorders (Frith & Snowling, 1983; Newman et al., 2007). But it is also possible that children with ASD avoid grammatical errors because they are simply repeating chunks of speech they have heard, a well-documented behavior in ASD (e.g., Barrera & Sulzer-Azaroff, n.d.; Gernsbacher, Morson, & Grace, 2016; Prizant & Duchan, 1981; Prizant & Rydell, 1984), so they may avoid form errors (e.g., "This is hims") because they do not hear them. To explore this, it is crucial to test the comprehension of pronouns among young children with ASD (e.g., Arunachalam & Luyster, 2018; Clancy, He, Luyster, & Arunachalam, 2019). If their avoidance of case errors is simply a byproduct of delayed echolalia, there should be a disparity between production and comprehension: Namely, they should show relatively good production (few case errors) alongside relatively impaired identification of grammatical vs. ungrammatical use of pronouns by others. If, however, children with ASD truly have a superior mastery of pronominal case and morphology, their use *and* their recognition of these features should exceed that of their TD peers.

There are limitations to this study, including the fact that there may be other contributors to form-meaning differences between groups, unrelated to diagnostic status. For instance, although we found no statistically significant difference in the proportions of caregivers with varying education outcomes between groups, there are numerically more caregivers in the TD group who have attained higher degrees (e.g., graduate degrees) and more caregivers in the ASD group who do not have postsecondary education or who have only attended some college. Differences in socioeconomic status (including the level of caregiver education) have been

shown to correlate with language and literacy outcomes for typically developing children[6] (McGillion et al., 2017; Merlo, Bowman, & Barnett, 2007; Sirin, 2005; Walker, Greenwood, Hart, & Carta, 1994), so it is certainly possible that pronoun error types are affected by caregiver education as well. Future research should better control for group differences on such factors, so that form-vs.-meaning comparisons can be attributed more straightforwardly to diagnostic group.

In addition to issues with matching, the most significant limitation of our current study is the use of caregiver report (rather than direct assessment) to gather omnibus information about diagnosis and language level, as well as details about pronoun use and errors. While there are many benefits to using a report (e.g., the ability to administer it to a large sample, the ability to collect data when in-person laboratory testing is prohibited for health and safety reasons, and the ability to get a picture of the child's language used at home), it is inferior to direct assessment that systematically elicits pronoun production. With respect to the current study, because pronouns are frequently a target for speech therapy intervention for children with ASD, it is possible that caregivers of these children may have been especially aware of and attentive to their child's use of pronouns as compared to caregivers of TD children. This may well have affected the ratings they provided of pronoun accuracy (whether or not their child used each pronoun correctly or not).

However, there are strong reasons to suspect that error comparisons are nevertheless reliable. While some caregivers may not have accurately indicated their child's mastery of a given pronoun, it is less likely that caregivers would misremember specific errors. During the interim between Parts 1 and 2 of the report, caregivers were specifically instructed to attend to

[6] Although, some research exploring factors that predict later language attainment for children with ASD, specifically, has found that other factors (e.g., the child's ability and/or willingness to imitate other's motor movements) are better predictors of language outcome than socioeconomic status is (Stone & Yoder, 2001).

their child's daily use of pronouns, so it is probable that pronominal errors stood out to them. Further, while some caregivers of children with ASD have been trained to pay special attention to their child's pronominal errors, it is highly unlikely that they would suspect a form-meaning disparity, or to even be aware of the distinction that is reflected in our analysis. Thus, if caregivers of children with ASD were relatively attentive to pronoun errors, then one would predict that a significantly higher proportion of children with ASD would be reported to make *both* meaning and form errors as compared to TD children, and this was not the case. Another reason to suspect that caregiver attention did not affect group differences is that form errors are arguably more salient than meaning errors. Form confusion is clearly erroneous; if a child produces the sentence "her is funny" caregivers can easily identify this as an error since it is ungrammatical. Meaning errors are more subtle. The sentence "she is funny" (used to describe a male referent) can only be identified as erroneous if the listener knows to whom *she* is meant to refer, and such an error may only become apparent if the child regularly uses *she* to refer to male entities. In short, the relative salience of form errors should result in more attention to them across both groups. Because, in contrast, we found relatively few examples of form errors in our ASD group, we argue that reported errors are likely indicative of actual language patterns and not due to relative vigilance by caregivers of ASD.

In conclusion, our results offer preliminary evidence for a simple explanation of pronoun confusion in ASD: Namely, that pronoun reference is difficult for these children because of overarching struggles with meaning and reference. The results support Naigles's hypothesis for typically developing children (Naigles, 2002) as well as children with ASD (Naigles & Tek, 2017) that acquisition of form and meaning can be dissociated. This dissociation may be starker, and have consequences later in development, for children with ASD.

## Figure Captions

**Fig. 1.** Proportions of children from each group whose example errors were coded as form and/or meaning errors.

**Fig. 2.** Proportions of children from each group whose example errors were coded as gender, number or person errors.

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