Person-Reference in Autism Spectrum Disorder: Developmental Trends and the Role of Linguistic Input

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Past research has provided mixed evidence of the nature and difficulty with personal pronouns of children with autism spectrum disorder. No study to date has examined the nature of person-reference in autism, more broadly, by looking at referential language both in terms of who is being referred to (self vs. other) and how (words with shifting reference: personal pronouns, vs. fixed reference: names and nouns). Furthermore, the role of linguistic input specifically in the domain of referential language in autism has not been investigated before. We collected natural language samples from parent–child interactions from children with autism (N = 38; 7 female) at three time points (age 2, 3, and 4 years) and administered a battery of standardized assessments to evaluate their language ability. The samples were transcribed and coded for person-referential language. Children with autism used increasingly more pronouns both when referring to themselves and to their parent, but pronoun reversals were extremely rare. Their person-reference use was associated with language ability only at age 2. Parental input was also characterized by an increase in pronoun use but only when referring to their child. Parents' and children's person-reference were not associated across time, but they were concurrently related at age 3. ***Autism Res*** *2019, 00: 1–11.* © 2019 International Society for Autism Research, Wiley Periodicals, Inc.

Lay Summary: In this study, we found that as children with autism grew older, they used more and more personal pronouns to refer both to themselves and their parents. Furthermore, they very rarely reversed their pronouns (used *I* instead of *you*) with only 1 child out of 38 making a pronoun error. This lack of pronoun errors suggests that pronoun difficulty in autism might not occur for long periods of time throughout development and might not be as prevalent in autism as previously thought.

Keywords: autism spectrum disorder; person-reference; linguistic input; pronoun reversal; natural language samples

The first written account of autism spectrum disorder (ASD) included a description of difficulty with personal pronouns [Kanner, 1943]. Ever since, many studies have yielded inconclusive evidence about the prevalence of this difficulty and its origins [e.g., Carmody & Lewis, 2012; Lee, Hobson, & Chiat, 1994; Naigles et al., 2016; Tager-Flusberg, 1994]. Marked by a wide range of theoretical and methodological limitations, past research leaves many questions unanswered, including, more broadly, what is the nature of person-reference in ASD? And what role do linguistic input and general language ability play in its acquisition? The present study aims to address these questions by examining everyday speech of children with ASD and their parents across the preschool years.

Defining person-reference

How people refer to one another, or person-reference, plays a central role in social interactions. Person-reference can be examined based on who is being referred to and how. Referential language can be used to refer to oneself, i.e., speaker, or to others, i.e., addressee or other people. Person-reference can also be classified based on the words used. Fixed person-reference, or *nouns/names* for short, includes words referring to people that have a fixed referent, like proper nouns (names), kinship terms, and other nouns (e.g., Simona, mommy, daddy, kiddo, sweetie). They should be easy to interpret because they refer to the same person in the context of a conversation [Mizuno et al., 2011]. In contrast, shifting person-reference, or *pronouns* for short, includes personal pronouns, which are considered a form of deixis because their referents shift depending on the speaker and the addressee, i.e., everyone's "I" denotes a different person. Linguistically, the mastery of pronouns in English requires a grasp of grammatical person (first, second, third), case (nominative, accusative, etc.), and number (singular, plural). This makes the acquisition of personal pronouns a challenging task. Yet pronoun errors, such as reversing "you" and "I," are not common in typical development

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[e.g., Chiat, 1982; Clark, 1978]; when they do occur, they are seen in precocious children, whose social cognition lags behind their language [Dale & Crain-Thoreson, 1993].

Developmentally, there is a distinct pattern of acquisition of pronouns with first-person pronouns, *I/me/my*, used before second-person, *you/your* [Brener, 1983; Charney, 1980; Chiat, 1986; Clark, 1978; Loveland, 1984], whereas third-person pronouns emerge later and are typically examined separately due to the different cognitive demands their acquisition poses. Furthermore, verbally distinguishing oneself from one's most common other in early childhood—one's parent, is key to successful social interactions. For these reasons, the present study, like the majority of past research, focuses on first- and second-person reference or how children refer to themselves and their parents.

Person-reference in ASD. When Kanner [1943] described pronoun reversals in his first account of ASD, he attributed these errors to repetition and imitation. Research, however, has shown that these errors also occur in nonimitative contexts [e.g., Naigles et al., 2016; Tager-Flusberg, 1994]. Nevertheless, the focus on pronoun reversal, and not on person-reference more broadly, has dominated past studies and can be found in numerous descriptions of language ability in ASD [e.g., Luyster & Lord, 2009; Tager-Flusberg, Paul, & Lord, 2005].

Although often described anecdotally, the prevalence and explanations for pronoun reversals in ASD remain a subject of controversy. In one longitudinal study of six children with ASD ages 3–7 years, pronoun reversals occurring in nonimitative contexts made up 13% of all personal pronouns during naturalistic interactions [Tager-Flusberg, 1994]. However, in a more recent study, reversals accounted for less than 3% of total pronouns produced by preschoolers with ASD during mother–child play [Naigles et al., 2016]. In an experimental study using a pronoun production task, reversals were even more rare [Lee et al., 1994]. In this task, participants were shown three cards with a different picture on each side, e.g., a teddy bear and a spade. The experimenter then held the card so that only one side was visible to the participant and asked, "Who sees the teddy bear?" Out of 25 adolescents with ASD, ages 14 and 17 with lower and higher verbal ability, only 3 reversed their pronouns.

In a subsequent experiment, the same participants were shown pictures of themselves, their peers, or the experimenter, and asked, "Who is this a picture of?" [Lee et al., 1994]. No pronoun reversals were observed; however, there were systematic differences in responding between the ASD and control group, specifically for the lower verbal ability participants. When referring both to themselves and to others, the adolescents with ASD were more likely to use nouns and names compared to CA- and MA-matched controls.

A similar pattern was reported in a study comparing pronoun comprehension and production of native-signers with and without ASD between the ages of 6 and 13 years using pronoun elicitation tasks [Shield, Meier, & Tager-Flusberg, 2015]. Although none of the participants reversed their pronouns, the children with ASD were more likely than controls to use names (often signed letter by letter) and nouns (e.g., "experimenter") than pronouns (indexical points in American Sign Language). In addition, pronoun use in ASD was positively correlated with ASL ability. This preference for nouns/names even in the medium of sign language where pronouns are easier to use (points to the referents) was interpreted as a strong evidence for pronoun avoidance in ASD, at least in the context of an experimental task [Shield et al., 2015].

Shield et al. [2015] also examined how participants with ASD spontaneously referred to themselves and the experimenter during the ADOS. No participants used their own name. Instead, they signed personal pronouns to refer to themselves and the experimenter. Both the high- and low-language groups referred to themselves more than to the experimenter with first-person pronouns accounting for over 75% of total pronouns and second-person pronouns for less than 15%.

Another study used an fMRI task similar to Lee et al.'s [1994] to examine the comprehension of pronouns vs. names when switching between reference to oneself and others [Mizuno et al., 2011]. Overall, both young adults with ASD and TD full scale and verbal IQ matched controls were faster and more accurate to comprehend names than pronouns (e.g., "What can Sarah/I see now?") and to respond to self than other referring questions. However, the young adults with ASD were slower and less accurate to respond when pronouns were used to switch to the other's perspective (e.g., "What can I see now?" asked by the virtual experimenter). This suggests that in ASD there is a difference not only in production but also in comprehension of person-reference that is contingent on who is being referred to and how.

So far past research has provided some possible explanations for the distinct pattern of person-reference in ASD like verbal imitation [Kanner, 1943], a different sense of self [e.g., Carmody & Lewis, 2012; Lee et al., 1994; Shield et al., 2015], and difficulty with understanding discourse roles (e.g., Tager-Flusberg, 1994). However, no study has examined how linguistic input and general language ability are related to it, and there is no comprehensive account of its development focusing on the trade-off between pronouns and nouns/names. Furthermore, past studies have been marked by some methodological inconsistencies and theoretical limitations.

Limitations of Past Research

Past research has relied on a wide range of methods to assess person-reference from parent questionnaires to experimental tasks to natural language samples. Although valid and

widely used, these methods are associated with different results. Consider the cognitive and social demands production tasks pose compared to everyday conversations captured by natural language samples. Indeed, only one study relying on tasks has reported pronoun reversals [Lee et al., 1994] compared to several studies relying on conversational speech [e.g., Naigles et al., 2016; Tager-Flusberg, 1994]. In contrast, evidence for use of one's name in ASD comes from studies relying on tasks and not on language samples [e.g., Lee et al., 1994; Shield et al., 2015].

There is also an inconsistency in reporting person-reference contingent on the study's methods. When tasks are used, reference to self is reported separately from reference to other [Lee et al., 1994; Shield et al., 2015]. But when speech is sampled, results focus of pronoun reversals grouped across self- and other-reference, and no rates of nouns/names are reported [Naigles et al., 2016; Tager-Flusberg, 1994].

The age of participants also varies across past studies. Experiments typically include a larger sample of older children and adolescents and test them at one time point [e.g., Lee et al., 1994; Mizuno et al., 2011; Shield et al., 2015]. In contrast, language sample studies tend to include a smaller number of preschoolers and follow them over time [e.g., Naigles et al., 2016; Tager-Flusberg, 1994]. When examining person-reference, the longitudinal approach is especially useful considering that even some, although few, typically developing toddlers go through a brief period of pronoun reversal as they acquire pronouns [e.g., Chiat, 1982; Clark, 1978].

Some basic linguistic ability is necessary to use person-reference, specifically pronouns, and both Lee et al. [1994] and Shield et al. [2015] reported that reference patterns were associated with language ability. Therefore, accounting for language is essential when studying person-reference in ASD but has not been done consistently [e.g., Carmody & Lewis, 2012].

Finally, no study has examined the role of linguistic input in the acquisition of person-reference in ASD. This is an inviting avenue for research considering past work has shown that parental input influences language ability more broadly for all children, including those with ASD [e.g., Bang & Nadig, 2015; Fusaroli, Weed, Fein, & Naigles, 2019; Hoff & Naigles, 2002; Rowe, 2012; Venker et al., 2015; Warren et al., 2010; Wolchik, 1983]. Although no study has looked at the role of input in person-reference directly, He, Luyster, Hong, and Arunachalam [2018] compared maternal input to infants between 3 and 19 months at high and low risk for ASD by virtue of having an older sibling with ASD. There were no differences between mothers of high- and low-risk infants in the way they referred to themselves: all used more pronouns, *I*, than nouns, *mommy*. However, mothers differed in the way they referred to their children. Even though overall they all used more pronouns, *you*, than their children's names, the relative frequency of pronouns out of names and pronouns was lower for mothers of high-risk infants. This difference in input between groups was hypothesized to contribute to previously reported differences in pronoun use between older children with and without ASD. Although He et al. [2018] did not assess children's speech, their findings lay the foundation for examining the role of input in person-reference in ASD.

Current Study

We examined person-reference in preschoolers with ASD and their parents during free play at three time points: 2, 3, and 4 years of age. The context of naturalistic interaction was chosen over experimental tasks as being more representative of children's every day speech. The longitudinal design across the preschool years allowed us to examine developmental change in person-reference. Like past research, we focused exclusively on reference to oneself and to the conversational partner/parent.

We addressed three questions. The first one was about the nature of person-reference in ASD and how it changed over time, with an emphasis on the role of language, pronoun reversals, and use of name.

Hypothesis 1: Based on past research, we predicted that children's person-reference would be associated with their language ability. More specifically, using nouns/names to refer both to oneself and other, as well as making pronoun reversal errors, would be associated with lower language ability and would diminish with age.

The second question was about parental input.

Hypothesis 2: We hypothesized that parents' use of nouns/names to refer to themselves and their child would decrease over time, and that it would be higher for children with lower language ability because nouns/names are easier to comprehend.

Our last question was about the association between input and children's person-reference.

Hypothesis 3: Based on reported differences in input of children at high and low risk of ASD [He et al., 2018], we predicted that parents' person-reference would be associated with that of their children concurrently and longitudinally.

Methods

Participants

The sample included 38 (7 girls) children with ASD who were enrolled in a larger study examining developmental trajectories in ASD (for details, see Carter et al., 2007). Diagnoses of ASD were confirmed using the Autism Diagnostic Interview–Revised [Lord, Rutter, & Le Couteur, 1994] and the Autism Diagnostic Observation Schedule–General (Lord et al., 2000; for modules and scores, see Table 1), as well as by a clinician. Children with known

Table 1. Children's Age and Standardized Assessment Scores from ADOS and MSEL at Each Time Point

		Time 1		Time 2		Time 3	
	N	M	SD	M	SD	M	SD
Age, in months	38	27.13	4.06	39.63	4.27	51.68	4.34
ADOS	38						
ADOS Module: number of participants		1–35		1–23		1–12	
		2–3		2–15		2–20	
						3–6	
Communication Score		4.21	1.36	4.79	1.89	5.29	1.69
Reciprocal Social Interaction Score		9.50	2.57	8.66	2.69	8.76	2.85
Communication + Reciprocal Social Interaction Score		13.71	3.35	13.45	3.95	14.05	4.04
Stereotyped Behaviors and Restricted Interests Score		3.50	1.70	3.00	1.45	3.08	1.73
MSEL	38						
Verbal Developmental Quotient		62.84	24.44	82.03	28.34	85.95	25.51
Non-Verbal Developmental Quotient		84.55	15.25	86.03	25.47	91.05	23.49

genetic conditions, neurological diseases, or physical disability were excluded.

Regarding race and ethnicity, 31 of the children were white, 2 were Asian American and white, 1 was African American and white, and 1 was Black Irish based on parental report. Data were missing from the remaining 3 participants.

Parent education was collected as a categorical variable. All parents had taken high school classes or had a higher level of education completed. Following what has been done in the literature [Rowe, 2008], each category was assigned a value that was equivalent to the number of years spent attaining the corresponding educational level (here we only show the categories represented in our sample: 9th–11th grade = 10 years; high-school degree or GED = 12 years, associates or 2-year degree, and courses toward college degree = 14 years, college degree = 16 years, master's degree = 17 years, professional degree = 18 years). The parents averaged 15 years of education (SD = 1.99; range 10–18 years). Based on previous reports of associations between parental education and children's expressive language measures [e.g., Rowe, 2008], we tested the correlations between our measures of children's and parents' pronoun use and parental education at each time point but none reached statistical significance, and hence parental education was not included in further analyses.

Procedure

This study obtained IRB approval before participants were tested. Participants were first enrolled between 20 and 33 months of age (Time 1: $M = 27.13$) and were assessed annually for 3 years (age Time 2: $M = 39.63$; Time 3: $M = 51.68$; Table 1). During each visit, a battery of assessments was administered to evaluate their autism symptoms, social communication, and cognitive and language ability. A parent–child natural language sample was collected, as well.

Standardized assessment of language. Children's cognitive and language ability were assessed with the Mullen Scales of Early Learning (MSEL; Mullen, 1995). The MSEL is a standardized assessment that consists of four subscales: Fine Motor, Visual Reception, Expressive Language, and Receptive Language. In our analyses, we used the MSEL Verbal Developmental Quotient (VDQ) computed by combining expressive and receptive language scores (Table 1). By using a standardized measure of language ability, we did not confound language measures with person-reference measures by deriving them from the same speech sample.

Parent–child language samples. At each time point, a language sample was collected during a parent–child interaction lasting between 15 and 30 min (one sample is missing from Time 1). The interaction consisted of free play with developmentally appropriate toys and eating a snack. Parents were instructed to play with their child as they normally would at home. The mother was the child's conversational partner for all collected samples except one at Time 3 for which it was the father.

Person-reference measures & planned analyses. All language samples were video-recorded and later transcribed using the Systematic Analysis of Language Transcripts software (SALT; Miller, Andriacchi, & Nockerts, 2011) following standard procedures. Each sample was transcribed by a trained transcriber and checked by a second transcriber. All disagreements were resolved through consensus. Transcripts were coded for correct use of first- and second-person pronouns, and counts of person-reference words by category were extracted for both children and parents (see Table 2 for coding scheme). We calculated percentages of different types of reference out of total number of words (TNW), thus controlling for the variability in the amount of speech across participants and time points (Table 3).

Table 2. Coding Scheme for Child and Parent Person-Reference Based on How and Who Is Being Referred to (Pronouns vs. Nouns/Names and Self vs. Other

	Child		Parent	
	Pronouns (shifting reference)	Nouns/names (fixed reference)	Pronouns (shifting reference)	Nouns/names (fixed reference)
Self	I, I'd, I'll, I'm, me, mine, my, myself	Child's NAME, boy, bud, buddy, child, cutie, daughter, dude, girl, honey, hun, kid, kiddo, pal, son, sweetie	I, I'd, I'll, I'm, me, mine, my, myself	ma, mama, mom, momma, mommy, mother[a]
Other	You, your, yours, yourself, yourselves	Ma, mama, mom, momma, mommy, mother[a]	You, your, yours, yourself, yourselves	Child's NAME, boy, bud, buddy, child, cutie, daughter, dude, girl, honey, hun, kid, kiddo, pal, son, sweetie

[a]The father was the primary conversational partner for only one language sample; for this specific sample, the coding scheme was adjusted to include nouns referring to the father (dad, dada, daddy, father, pa, papa).

All analyses were conducted separately for reference to self and to other. Due to the relatively small number of participants ($N = 38$), the nonnormal, zero-inflated distribution of our measures, and the number of time points (3), we were not able to use a growth curve modeling approach to model rates of change and the role of covariates, like language ability and parental input, within an omnibus model like it has been done in past studies [e.g., Fusaroli et al., 2019]. Instead, due to the constraints of our data, we relied on comparisons between two time points and correlations between person-reference measures and parental input and general language ability within and across time points. Nonparametric tests were used when variables were not normally distributed. All post hoc tests and correlation analyses were corrected for multiple comparisons by applying the Bonferroni correction. Hypothesis 1: To examine children's self-reference, we ran Wilcoxon signed-ranks tests to compare percentage of self-referring pronouns, *I/me/my/mine*, to percentage of self-referring nouns/names, *Johnny/kid*, out of TNW at each time point (Table 3). Next, we focused on the trade-off between the use of pronouns and nouns/names, which, following He et al. [2018], we operationalized as the relative percentage of pronouns out of total self-reference (both pronouns and nouns/names). We described qualitatively the frequency distribution of the relative percentage of pronouns at each time point (Table 4). Then we performed the Friedman test and post hoc Wilcoxon signed-rank tests to examine change over time and to check for differences between time points in the relative percentage of pronouns (Table 5). Finally, the association between children's self-reference and their language ability was assessed with Pearson's correlations between their relative percentage of pronouns and their VDQ at each time point. All children, even ones who produced no words or no person-reference, were included in these analyses by including their percentages as 0.

Table 3. Child's and Parent's Total Number of Words, and Percentages of Person-Reference Based on How and Who Is Being Referred to (Pronouns vs. Nouns/Names and Self vs. Other) out of Total Number of Words at Each Time Point

			Child				Parent			
			N	M		SD	M		SD	
TNW	Time 1		37	111.78		172.59	1247.62		589.82	
	Time 2		38	308.11		236.61	1653.08		544.32	
	Time 3		38	517.39		359.78	1931.39		628.06	
			Pronouns		Nouns/names		Pronouns		Nouns/names	
			M	SD	M	SD	M	SD	M	SD
Percentage of *SELF* reference out of TNW	Time 1	37	0.98	2.36	0.05	0.20	2.02	0.85	0.65	0.54
	Time 2	38	3.68	3.43	0.15	0.35	2.28	0.93	0.59	0.52
	Time 3	38	5.34	2.90	0.41	0.64	2.75	1.10	0.50	0.51
Percentage of *OTHER* reference out of TNW	Time 1	37	0.14	0.39	0.55	1.03	6.92	1.36	1.95	1.12
	Time 2	38	1.00	1.34	1.22	1.73	6.38	1.30	1.66	1.04
	Time 3	38	1.43	1.31	1.08	1.34	6.60	1.27	1.24	0.80

Note. At Time 1, we are missing a language sample.

Table 4. Frequency Distribution of Number of Children and Parents by Relative Percentage of Self- and Other-Referring Pronouns (0%, [01;20], [21;40], [41;60], [61;80], [81;99], 100%) at Each Time Point

		Child (*N*)			Parent (*N*)		
Relative percentage of pronouns		Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
SELF	0	27	12	3			
	1–20						
	21–40	1					
	41–60		2		8	6	3
	61–80		3	2	12	12	10
	81–99	2	2	21	13	17	23
	100	7	19	12	4	3	2
OTHER	0	31	15	6			
	1–20	1	3	1			
	21–40	2	3	5			
	41–60		3	9	2	2	1
	61–80	1	9	9	17	15	9
	81–99		1	5	18	21	28
	100	2	4	3			

Table 5. Child and Parent Relative Percentages of Self-Referring Pronouns out of Total Self-Reference (Pronouns and Nouns/Names) and of Other-Referring Pronouns out of Total Other-Reference (pronouns and nouns/names) at Each Time Point

				Child		Parent	
			N	M	SD	M	SD
SELF	Pronouns/(pronouns + nouns/names)	Time 1	37	24.96	42.64	75.57	16.76
		Time 2	38	63.13	45.14	78.96	15.90
		Time 3	38	87.11	26.90	83.02	16.02
OTHER	Pronouns/(pronouns + nouns/names)	Time 1	37	9.15	25.46	78.60	10.22
		Time 2	38	37.89	37.33	80.24	9.91
		Time 3	38	53.77	32.71	84.39	9.23

The same analyses were conducted for children's reference to parents.

To examine pronoun reversals and the use of own name, we extracted their frequency distribution at each time point (Table 6). Because these specific types of reference were so rare in our language samples (see Results), they were described qualitatively, and no statistical analyses were performed.

Table 6. The Number of Times Each Child Committed a Pronoun Reversal Error (also Expressed as Percentage out of Total First- and Second-Person Pronouns) or Used Their Own Name (also Expressed as Percentage out of Total Nouns/Names Self-Reference) by Time Point

	Pronoun error		Own name use					
Child	Time 3	%	Time 1	%	Time 2	%	Time 3	%
1	0		3	100	0		0	0
2	0		0		0		2	40
3	0		0		0		1	50
4	0		0		1	33.33	1	100
5	0		0		0		1	100
6	0		0		1	100	0	0
7	0		0		2	66.67	0	0
8	0		0		0		2	66.67
9	2	3	0		0		0	
10	0		0		2	100	0	0
11	0		0		2	100	0	
12	0		0		2	50	0	0
13	0		1	100	0		0	0
14	0		0		4	100	1	100
15	0		1	100	0		0	0

To evaluate Hypothesis 2—the nature of linguistic input and its relation to children's language—we conducted the same sequence of analyses as for Hypothesis 1 but replaced the children's measures with those of the parents. First, we compared percentages of parents' self-referring pronouns to self-referring nouns/names out of TNW at each time point. Then we examined the frequency distribution and change over time in relative percentage of self-referring pronouns out of total self-reference (pronouns and nouns/names). Finally, parents' relative percentage of self-referring pronouns was correlated with children's VDQ at each and across time points. The same analyses were conducted for parents' reference to their child. Because parents' use of child's name is an interesting subcategory of other-reference, we also computed the relative percentage of child's name out of parents' total noun/name reference to their child and examined how it changed over time (Table 7). Then we correlated this relative percentage with children's VDQ concurrently and across time.

To test Hypothesis 3—the associations between child and parent person-reference—we computed Pearson's correlations between children's relative self-reference (percentage of self-referring pronouns out of total self-referential pronouns and nouns/names) and parents' relative self-reference concurrently and across time points. The same was done for other reference. Only statistically significant concurrent and longitudinal correlations are reported.

Results

Hypothesis 1

Self. Children produced significantly more pronouns than nouns/names at Time 1 (Z = 2.701, $P < 0.05$), Time 2 (Z = -4.372, $P < 0.001$), and Time 3 (Z = -5.153, $P < 0.001$; Table 3).

Table 4 shows the frequency distribution of relative percentage of pronouns. Based on it, the number of children who produced no self-reference decreased over time (T1 = 27, T2 = 12, T3 = 3), while the number of children, whose self-reference consisted mostly or exclusively of personal pronouns, increased (N children whose relative percentage of pronouns was between 80% and 100% at T1 = 2, T2 = 2, and T3 = 21). There was a statistically significant change in the relative percentage of pronouns out of total self-reference over time ($\chi^2(2) = 16.190$, $P < 0.001$; Table 5). Specifically, children's relative percentage of pronouns was significantly higher at Time 2 compared to Time 1 (Z = -3.694, $P < 0.001$) and at Time 3 compared to Time 1 ($Z = -4.542$, $P < 0.001$), but there was no difference between Time 2 and 3.

There was a significant correlation between children's relative percentage of pronouns and VDQ scores only at Time 1 ($r_s(35) = 0.538$, $P < 0.05$).

Table 7. Average Number of Times Parents Used Their Child's Name at Each Time Point, and Percentage of Child's Name out of Parents' Total Other-Referring Nouns/Names

		Use of child's name		Percentage of child's name	
	N	M	SD	M	SD
Time 1	37	16.27	12.16	69.18	23.98
Time 2	38	20.29	16.82	75.17	22.78
Time 3	38	14.42	11.30	59.17	26.25

Other. In contrast to what we found for self-reference, at Time 1 children produced significantly more nouns, mommy/mom, than pronouns, you/your, to refer to their parent (Z = -2.272, $P < 0.05$; Table 3). However, there were no significant differences at Time 2 and 3.

The frequency distribution of relative percentage of pronouns (Table 4) showed that fewer and fewer children produced no other-reference at each time point (T1 = 31, T2 = 15, T3 = 6). Children's relative percentage of pronouns out of total reference to their parent changed significantly over time ($\chi^2(2) = 28.912$, $P < 0.001$; Table 5). In particular, it was higher at Time 2 compared to Time 1 ($Z = -3.617$, $P < 0.001$), and at Time 3 compared to Time 1 ($Z = -4.763$, $P < 0.001$).

There was a statistically significant correlation between children's relative percentage of pronouns and their VDQ only at Time 1 ($r_s(35) = 0.492$, $P < 0.05$).

Pronoun reversals and use of own name. Table 6 presents the frequency distributions of children's pronoun reversals and use of own name by time point. No children made pronoun reversals at Time 1 and Time 2, and only one did so at Time 3. This child reversed 2 (3.3%) personal pronouns out 61 total first- and second-person pronouns.

Three children at Time 1, seven children at Time 2, and six children at Time 3 used their own name (Table 6). Only two children used their own name at more than one time point (Time 2 and 3), and the child who committed a pronoun error was not among those who used their own name.

Hypothesis 2

Self. Parents used significantly more pronouns, I/me/my, than nouns/names, mommy/mom, to refer to themselves at Time 1 ($Z = -5.137$, $P < 0.001$), Time 2 ($Z = -5.258$, $P < 0.001$), and Time 3 ($Z = -5.243$, $P < 0.001$; Table 3). There was no statistically significant change in parents' relative percentage of pronouns out of total self-reference over time. Based on visual inspection of the frequency distribution of parents' relative percentage of pronouns, more and more parents use mostly pronouns to refer to

themselves (*N* parents whose relative percentage falls between 81 and 99% at T1 = 13, T2 = 17, and T3 = 23).

Children's VDQ scores at Time 1 were correlated with parents' relative percentage of pronouns at Time 2 ($r_s(35) = 0.567$, $P < 0.001$).

Other. Similar to our results in the self-category, parents used significantly more pronouns, you/your, than nouns/names to refer to their children at all time points (Time 1: $Z = -5.303$, $P < 0.001$; Time 2: $Z = -5.373$, $P < 0.001$; Time 3: $Z = -5.373$, $P < 0.001$; Table 3). In addition, there was a statistically significant change in the parents' percentage of pronouns out of total other-reference over time ($\chi^2(2) = 12.811$, $P < 0.05$; Table 5), with the relative percentage of pronouns higher at Time 3 compared to Time 1 ($Z = -3.085$, $P < 0.05$), and at Time 3 compared to Time 2 ($Z = -2.661$, $P < 0.05$). Visual inspection of the frequency distribution of relative percentage of pronouns showed a similar trend with the number of parents, whose relative percentage falls between 81% and 99% increasing from 18 at Time 1 to 21 at Time 2 to 28 at Time 3.

Children's VDQ at Time 1 was significantly correlated with parents' relative percentage of pronouns at Time 2 ($r(35) = 0.486$, $P < 0.05$).

Use of Child's name. All parents used their child's name at least once during the mother–child interaction (Table 7). The relative percentage of child's name out of total nouns/names changed over time ($\chi^2(2) = 7.959$, $P = 0.019$). Specifically, it was higher Time 2 compared to Time 3 ($Z = -2.889$, $P < 0.05$).

Furthermore, children's VDQ at Time 1 was significantly correlated with parents' relative percentage of child's name at Time 1 ($r_s(35) = 0.452$, $P < 0.05$) and at Time 3 ($r(36) = -0.540$, $P < 0.001$). Children's VDQ at Time 2 was correlated with parents' relative percentage at Time 3 ($r(36) = -0.494$, $P < 0.05$).

Hypothesis 3

Self. Children's relative percentage of pronouns out of total self-reference was significantly correlated with parents' only at Time 2 ($r_s(36) = 0.507$, $P < 0.05$).

Other. Children's relative percentage of pronouns out of total other-reference was significantly correlated with parents' only at Time 2 ($r_s(36) = 0.498$, $P < 0.05$).

Discussion

There were four major findings in our study. First, children's use of pronouns relative to nouns/names to refer both to themselves and their parents increased over the preschool years and was associated with their language ability only at 2 years of age (Time 1). Second, children's language was not concurrently associated with parents' person-reference at any time point. But longitudinal language ability at 2 years (Time 1) was significantly correlated with parents' person-reference at 3 years (Time 2). Third, the only associations between parents' and children's person-reference were at 3 years (Time 2). Fourth, children's rates of pronoun reversals and own name use were very low.

The overall number of children who used any person referential language at all to refer to themselves and their parents increased over time. Furthermore, children used increasingly more pronouns relative to nouns/names for both self- and other-reference during the preschool years, which supports our hypothesis that fixed forms of reference would diminish with age. Children's reference was also significantly correlated with their concurrent language ability at 2 years (Time 1) but, contrary to what we predicted, not at 3 or 4 years. Perhaps, at age 2, our participants were still in the process of acquiring the baseline language skills necessary for flexible use of personal pronouns, and once they had mastered them, by age 3, factors beyond language determined what person-reference they used and how much. Further support for this explanation is that at age 2, children used significantly more nouns, mommy/mom, than pronouns, you/your, to refer to their parents, but the pattern was reversed for children's reference to themselves. The early use of first-person pronouns followed by second-person pronouns is a robust finding in the literature from typical development [e.g., Loveland, 1984] and could be attributed both to the higher frequency of first-person pronouns [e.g., Shield et al., 2015] and to the lower cognitive demands associated with tracking their referent, always the speaker, in comparison to second-person pronouns.

Our second major finding was about parents' person-reference and how it related to children's language. The way parents referred to themselves did not change over time. They used more pronouns, I/me/my, than nouns, mommy/mom, at all time points, and the trade-off between the two forms of reference remained the same over time. This lack of relative decrease in use of mommy/mom could be attributed to the already very low percentages of self-reference found in our samples reflecting the parents talking mostly about their children. When referring to their child, parents used more pronouns, you/your, than nouns/names at each time point, and this trade-off increased over time. Parents' use of their child's name, specifically, also decreased over time. Thus, our hypothesis that parents would use fewer nouns/names over time was supported at least within other-reference.

Surprisingly, there were no concurrent associations between children's language and parents' person-reference, and there was only one longitudinal association between children's language at age 2 (Time 1) and their parents' person-reference at age 3 (Time 2). The higher the language ability of the child at 2 years, the relatively more pronouns

over nouns/names the parent used both in reference to the child and herself at 3 years. This result, in addition to the longitudinal correlations between children's language (age 2 and 3) and parents' use of the children's names (age 4), suggests that there might be a complex interaction between children's language and parental input. This view is further supported by a recent account of language ability in ASD showing the bidirectional, autoregressive relations between children with ASD and their parents' language across time points [Fusaroli et al., 2019]. Limitations in our sample size, number of time points, and distribution of our data precluded the possibility of conducting such complex statistical analyses. This is a major limitation of the current study, and future studies should try to address the bidirectional relations between parent and child language measures along with the role of multiple covariates within the same omnibus growth curve model.

Our third major finding was the lack of concurrent and longitudinal associations between children's and parents' person-reference. Children's reference both to themselves and their parent was concurrently associated with parents' only at age 3. In addition, children's reference was concurrently associated with their own language ability only at age 2. These two findings paint an interesting picture of the trajectory of person-reference in ASD. It is possible that at the earliest time point, at age 2, children's person-reference was significantly influenced by their language ability as they were in the process of acquiring the skills necessary for flexible use of person-reference. Once they had acquired these skills, their person-reference was associated with their parents', that is, nonlinguistic, social factors started playing a role in the person-reference of children with ASD. Nevertheless, in light of past research showing a general effect of parental input on expressive language in ASD, it is surprising that we found no longitudinal and just one concurrent association between children's and parents' person-reference. Perhaps when it comes to person-reference, the abilities of children with ASD are primarily determined by factors unrelated to linguistic input. Our participants received extensive treatment of over 20 h per week throughout the duration of the study [Tager-Flusberg, 2018], and past research has suggested that in addition to language ability, the correct use of person-reference may be contingent on social communication skills [Naigles et al., 2016]. Therefore, it is plausible that if our children had the baseline linguistic ability necessary for mastery of pronouns, and they had acquired the nonlinguistic skills through intensive treatment, then input would not be so closely associated with their person-reference. In order to test this explanation, future research should address the role of nonlinguistic factors like initiation of joint attention and engagement in pretend play as well as language ability and input within the same experimental design. Furthermore, it would be valuable to collect information about the kind of therapy children with ASD have access to, and whether their parents have received specific advice on how to refer to them, with pronouns or nouns/names.

This brings us to our most surprising finding: the lack of pronoun reversals and use of own name in the speech of children with ASD. Three children at age 2, 7 at age 3, and 6 at age 4 used their own name, and for children who used their own name, they did so less than five times for the duration of the interaction. One explanation of these very low rates compared to past research could be the high language ability and social skills of our participants due to the extensive treatment they had received. Another explanation could be related to their age. Both Lee et al. [1994] and Shield et al. [2015] tested older children (over 6 years) and adolescents, so perhaps it is the context of school and the social interactions associated with it that contribute to findings of own name use in ASD. Yet, another explanation could be attributed to the method used to assess person-reference. Specifically, both studies reporting the use of own name in ASD relied on elicitation tasks [Lee et al., 1994; Shield et al., 2015]. From a pragmatic standpoint, using one's name to refer to a picture of oneself may be more pragmatically acceptable than using it during a conversation. This calls into question how representative of everyday speech in ASD performance on elicitation tasks is. To address this, future studies should directly compare person-reference from conversational samples and from experimental tasks.

Children in our sample not only did not prefer to use their own name but also rarely reversed their pronouns. This study grew out of the initial striking observations of pronoun reversal errors in ASD [Kanner, 1943] and yet, only 1 child of 38 reversed their pronouns and at only one time point. This prevalence, in terms of number of children, is lower than what has been reported previously (e.g., in Naigles et al. (2016): from 1 to 8 children out of 15 at different time points); however, the rate of reversal (3.3% our of total pronouns) is somewhat similar (2.79% at 36 months and 1.35% at 48 months in Naigles et al., 2016, but 13% in Tager-Flusberg, 1994]. There are a couple possible explanations for this very low prevalence and rate. One could be the high language ability of our participants. However, upon closer inspection, participants' VDQs were comparable to, if not lower than, those of the children with ASD in Naigles et al. [2016]. This leaves us with another explanation related to our sampling procedure. We sampled children's speech once a year, and pronoun reversals might only occur over a relatively brief period of time, which our yearly samples did not capture. This interpretation is consistent with the fact that the two past studies reporting higher rates of pronoun reversal relied on denser sampling (every 4 months in Naigles et al. [2016] and every 2 months in Tager-Flusberg (1994)). If pronoun reversals occur for a period of time so brief that our yearly samples cannot capture them, then are they really a hallmark of speech in ASD?

Perhaps, differences in person-reference in ASD compared to typical development lie not in reversals and own name use, but in how much children refer to themselves vs. others and in the trade-off between pronouns and nouns/names, which should be the focus of future research.

In conclusion, we found that our sample of children with ASD showed no preference for nouns/names, fixed forms of person-reference, over pronouns, shifting forms person-reference, when referring to themselves and others, and the same was true for their parents. The pattern of association between children's language ability, their person-reference, and that of their parents was different across time points. Early on, at 2 years of age children's person-reference was correlated with their language ability, but at age 3 children's person-reference was correlated with that of their parents. This suggests that the factors associated with how children with ASD refer to themselves and their parents might change over time. The direction of these associations remains to be determined. Our last major finding was the really low rates of pronoun reversal in our sample, which puts into question whether pronoun errors should continue to be cited as the hallmark of expressive language in ASD.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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