RUNNING HEAD: Reference Production in Young Speakers

Reference Production in Young Speakers with and without Autism: Effects of Discourse Status and Processing Constraints

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ABSTRACT

We examine the referential choices (pronouns/zeros vs. names/descriptions) made during a narrative by high-functioning children and adolescents with autism and a well-matched typically developing control group. The process of choosing appropriate referring expressions has been proposed to depend on two areas of cognitive functioning: a) judging the attention and knowledge of one's interlocutor, and b) the use of memory and attention mechanisms to represent the discourse situation. We predicted possible group differences, since autism is often associated with deficits in a) mentalizing and b) memory and attention, as well as a more general tendency to have difficulty with the pragmatic aspects of language use. Results revealed that some of the participants with autism were significantly less likely to produce pronouns or zeros in some discourse contexts. However, the difference was only one of degree. Overall, all participants in our analysis exhibited fine-grained sensitivity to the discourse context. Furthermore, referential choices for all participants were modulated by factors related to the cognitive effort of language production.

Key words: Reference, language production, pronouns, autism, theory of mind, development

Autism is a disorder that is characterized by deficits in both social interaction and communication, in particular the pragmatic processes of using language appropriately in context (Baltaxe, 1977; Rapin & Allen, 1988; Tager-Flusberg, 1999). One of the most frequent pragmatic decisions that speakers make is the choice between referring expressions. They may use expressions that are very explicit, like names or descriptions (*Sylvester, the cat*), or less contentful descriptions like pronouns (*he, it*) or zeros (*…and Ø ran; …while Ø running).* We examine this production process in children and adolescents with autism, with the goal of understanding how it may differ from the same process in their typically developing peers. An understanding of specific language processes such as this one is important for the development of a language phenotype within the autism spectrum (Tager-Flusberg & Joseph, 2003).

Autism frequently involves linguistic impairments (e.g., Baron-Cohen, 1995; Rutherford, Baron-Cohen, & Wheelwright, 2002; Kanner, 1943; Tager-Flusberg, 2001a; Tager-Flusberg, Paul & Lord, 2005), especially in the pragmatic areas of language, that is, those processes that control the social and contextual appropriateness of language (Baltaxe, 1977; Rapin & Allen, 1988; Tager-Flusberg, 1999). While some individuals with autism never develop functional language (Tager-Flusberg, 2001a), even high-functioning autism is associated with pragmatic impairment (Bruner & Feldman, 1993; Diehl, Bennetto, & Young, 2006; Landa, Martin, Minshew, & Goldstein, 1995; Losh & Capps, 2003; Young, Diehl, Morris, Hyman, & Bennetto, 2005). As one example, Tager-Flusberg and Anderson (1991) found a lower use of contingent utterances (i.e., utterances that relate to the previous one) in their Autism group, compared with a Down syndrome group, although Hale and Tager-Flusberg (2005) later found that contingent discourse use improved over the course of development. Children with autism also often confuse first and second person pronouns (*I, you;* Lee, Hobson, & Chiat, 1994).

We focus on reference production because we expect that it may reveal systematic differences between populations with and without autism. Reference production is a ubiquitous part of communication, and specifically requires pragmatic judgments about what is appropriate in the current context. Moreover, reference production has been claimed to be impacted by two processes that have found to be impaired in individuals with autism: 1) mentalizing, and 2) cognitive load.

Mentalizing

A prominent explanation of the linguistic and social deficits of autism suggests that they stem from problems representing the mental state of others, as shown by the tendency for people with autism to perform relatively poorly on theory-of-mind tasks (e.g., Baron-Cohen, Leslie, & Frith, 1985; Baron-Cohen, Wheelwright, Hill, Yogini, & Plumb, 2001; Tager-Flusberg, 2001b). The relevance of theory-of-mind, or mentalizing abilities, for linguistic processing is demonstrated by Hale and Tager-Flusberg's (2005) finding that the use of contingent discourse by individuals with autism correlated with their performance on theory-of-mind tasks. Even though older children and adults with autism can pass first-order false belief tasks, there are a variety of advanced theory of mind tasks that have identified impairments in people with autism of all ages, even high-functioning individuals. Children and adults with autism tend to have difficulty with both social-cognitive tasks, like the Strange Stories task (Happé, 1994; Brent, Rios, Happé & charman, 2004; Kaland, Callesen, Møller-Nielsen, Mortensen, & Smith 2008), and social-perceptual theory of mind tasks, like the Eyes in the Mind task (e.g., Baron-Cohen et al., 2001; Kleinman, Marciano, & Ault, 2001; Rutherford et al., 2002).

Mentalizing also plays a role in standard explanations of how speakers choose referential expressions. It has been claimed that speakers only use underspecified expressions, like pronouns, when they assume that the referent is already in the focus of attention of their interlocutor, or at least when the reference is contextually unambiguous (e.g., Bard & Aylett, 2004; Brennan, 1995; Chafe, 1976, 1994; Grosz, Joshi, & Weinstein, 1995; Gundel et al., 1993; Levelt, 1989). As described by van der Meulen et al. (2001), "Speakers keep… a more or less veridical account of their addressee's state of mind, the so-called *discourse model,*" (p. 513, emphasis in original). This might mean that reference production requires detailed and explicit models of the listener's mental state, which could involve sophisticated mentalizing abilities.

The idea that reference production depends on assumptions about the listener's focus of attention comes in part from studies of how the linguistic context affects the choice between alternate possible expressions (see Arnold, 2008, for a review). For example, recently mentioned entities can be assumed to be in the focus of attention of all discourse participants, leading to a high proportion of pronouns and zeros, e.g.: *Jane worked all day, Ø went to the gym, and I didn't see her until 9pm*. (e.g., Ariel, 1990; Arnold, 1998; Givón, 1983; Gundel, et al., 1993). The structural and thematic properties of the last reference to an entity are also important. Pronouns are more likely for entities previously mentioned in subject, rather than object or oblique positions; for entities in the parallel grammatical function as the current referring expression; and for entities that previously played particular semantic roles (e.g., Arnold, 1998; 2001; 2003; Arnold & Griffin, 2007; Brennan, 1995; Givón, 1983; Stevenson et al., 1993). These factors together comprise the **discourse status** of each entity. When a referent enjoys a prominent discourse status, speakers tend to use underspecified expressions like pronouns.

The idea that referential expressions are designed to be interpretable is also supported by evidence that speakers use pronouns more often when the discourse context contains only one referent that matches the features of the pronoun. For example, pronouns are more frequent in a context with one female and one male character than in an identical context with two female characters (e.g., Arnold et al., 2000; Francik, 1987). This gender effect is often explained as an ambiguity avoidance strategy (but see Arnold & Griffin, 2007).

If pronoun use does depend on assumptions about the listener's mental state, we might expect individuals with autism to have difficulty producing contextually appropriate expressions. On the other hand, the mentalizing explanation for reference production is not uncontested. There is solid evidence that pronouns tend to be used when referring to something that is prominent in the discourse (Arnold, 1998, 2008). But since everything in the discourse is usually public to all interlocutors, it is also possible that speakers simply represent the discourse status of entities in their own mind, and ignore their addressee. A related idea is that the discourse context imposes constraints on appropriate reference use (e.g. Centering Theory's "use a pronoun for the backward looking center", Grosz, Weinstein & Joshi, 1995). Therefore, individuals with autism may be able to produce appropriate referring expressions without any judgments about their addressee's focus of attention, but rather by following discourse rules or their own focus of attention.

Cognitive Load

Recent evidence also suggests that speakers' choices are modulated by internal cognitive factors that affect their ability to represent the characters and actions in a discourse situation. Arnold and Griffin (2007) found that speakers were less likely to use pronouns in a story-telling experiment when a second character was present, drawing the speaker's attention away from the

other character. This occurred even though the target character was the most salient in the discourse context, and the second character always had a different gender from the target, so even a pronoun would be unambiguous. Thus, the speaker's ability to focus attention on even the main character can influence the use of pronouns and zeros. Further support for the role of production-internal processes comes from findings that pronoun use declined when the utterance was disfluent, reflecting effortful planning (Arnold & Griffin, 2007), when resources were consumed by a secondary digit-memory task (Griffin & Arnold, 2008), or when attention was directed toward a secondary beep-monitoring task (Babwah, 2008).

The ability to represent discourse characters and their activation is likely to draw on working memory and attentional mechanisms, which may be related to areas of cognitive impairment associated with autism. There is some evidence that individuals with autism have impairments in working memory compared with their peers (e.g., Bennetto, Pennington, & Rogers, 1996; Joseph, Steele, Meyer, & Tager-Flusberg, 2005; Minshew & Goldstein, 2001), although some studies have not found an autism-specific working memory deficit (e.g., Ozonoff & Strayer, 2001; Russell, Jarrold, & Henry, 1996). There is also evidence that individuals with autism allocate visual attention differently from those without autism in some circumstances, but not others (Townsend, Harris & Courchesne, 1996; Mann & Walker, 2007). These deficits may be related to a more general impairment in executive function processes (see Hill, 2004 for review). For example, people with autism often have difficulty switching attention or "cognitive set" from one thing to another (Ozonoff et al., 2004; Joseph, McGrath, & Tager-Flusberg, 2005; Russell, 1997). To the extent that these cognitive differences impact the representation of discourse characters, we might expect systematic differences in reference production choices. On the other hand, the effects of working memory and attentional processing on reference

production is not fully understood yet. Thus, this line of research yields only a cautious prediction of differences between groups in reference production.

What do we know about reference processing and autism?

The extant literature offers support for the idea that reference production and comprehension may be compromised in autism. Nadig, Vivanti, and Ozonoff (2008) examined how children with and without autism referred to objects on a display. Some of the children with autism had more difficulty using the perspective of their interlocutor than the typically developing children did: while there were some who performed just like the comparison group, some were more likely to say "the cup" when modification was needed (e.g., "the short cup"), and some were more likely to say "the short cup" when "the cup" would have been sufficient. Related evidence comes from the word-learning literature, which has shown that typically developing toddlers tend to follow the speaker's eye gaze to identify the referent of a novel word (Baldwin, 1991; 1993; see Baldwin & Tomasello, 1995, for a review). By contrast, children with autism were more likely to map the word to the object in their own focus of attention (Baron-Cohen, Baldwin, & Crowson, 1997; Preissler & Carey, 2005). Both of these findings support the hypothesis that people with autism have difficulty reasoning about the knowledge and attention of others, and that this impacts how they refer and understand references.

But there is very little evidence about whether people with autism respond to different discourse settings in the same fine-grained way as people without autism. In situations where most evidence about shared knowledge comes from the discourse structure itself, mentalizing deficits may not be as apparent. One small-scale study analyzed the speech of two boys with autism (Weber, 2003), and found that it tended to adhere to the predictions of Preferred Argument Structure (Du Bois, 1987). For example, the highest incidence of pronouns/zeros

occurred in intransitive subject position, less in transitive subject position, and the least in object position. Likewise, the rate of reference to previously mentioned information declined from intransitive subjects to transitive subjects to objects, and so did the incidence of reference to animate entities. However, Weber did not specifically analyze the relationship between pronouns/zeros and the discourse status of the referents, nor did she provide any direct comparison with a typical control group in the same situation.

In sum, there is little direct evidence about how speakers with autism choose referential expressions in a discourse context. Moreover, no previous studies have assessed the effects of cognitive load on reference production for individuals with autism.

Methodological approach and predictions

The current study takes a processing approach to understanding the reference form choices of children and adolescents with autism, seeking evidence of the effects of both discourse context and current cognitive load. We report an analysis of the referential choices made by children and adolescents with high-functioning autism and a well-matched control group of typically developing adolescents, as they told a narrative. Each participant viewed a Sylvester and Tweety cartoon (Canary Row, see also McNeill, 1992), in three installments, and told the narrative to an experimenter who feigned ignorance of the story. We analyzed each reference to the three main characters: Sylvester the cat, Tweety the bird, and Granny, the bird's owner. Because the story was provided by the cartoon, we could infer in most cases who the intended referent was, based on what happened in the video. We calculated the frequency with which each participant used underspecified expressions (pronouns or zeros) out of all singular references to that character.

The approach used here offers several advantages. First, we investigate reference within the context of a fine-grained analysis of the linguistic context. This is important because it allows us to ask whether participants with and without autism respond in the same way to each discourse context. Moreover, it makes it possible to observe differences that occur only in certain contexts, which would be missed by a simple count of pronouns. We predicted that both groups would be sensitive to the discourse context (Weber, 2003), but might differ quantitatively in their rate of using pronouns in each condition.

Second, we examine how referential choices correlate with a set of discourse features that index the processing load experienced during the production of individual utterances: disfluency and utterance length. As Arnold and Griffin (2007; see also Griffin & Arnold, 2008) have argued, reduced cognitive resources during utterance planning can lead to a reduction in the activation of the referent in working memory, leading to a higher rate of explicit referential expressions. Our analysis thus additionally provides a test of this proposal.

Third, our study compares reference production between matched autism and control groups. This comparison is critical because all people (adults and children) occasionally produce references that seem somewhat odd upon closer inspection, so the presence of unpredicted tokens is not evidence of atypicality. The same is true of our sample; Tables 1 and 2 show examples of two kinds of pragmatically odd references. Table 1 demonstrates cases where a pronoun or zero is used when the intended referent is not currently the most salient entity that matches the expression (for further discussion of this issue see page 25 of this paper). These would probably cause confusion for the comprehender. Table 2 shows cases where the speaker used an expression that is too explicit, repeating a name or description when it is the most salient entity in the current segment. Although these references do not pose the same kind of communication

problems as the unclear pronouns, this kind of reference can slow comprehension (Hudson-D'Zmura and Tanenhaus, 1998; Gordon, Grosz, and Gilliom's 1993). Both overspecific and underspecific references were produced by both autism and control participants, demonstrating that their simple occurrence cannot be used diagnostically.

Table 1. Examples of unclear referential choices (underlined in each example). The right column specifies the intended referent for pronouns and zeros, as well as points of confusion.

1. Control participant, age 15 (*him* used for Sylvester when Tweety has been more recently mentioned)	
• and uh tweety started flipping out	
• and Ø ran	Ø = Tweety
• and Ø got the old lady	Ø = Tweety
• and the old lady whacked him	him = Sylvester
• and threw him down to the ground	him = Sylvester (last two uses of "him" would initially be interpreted as coreferential with Tweety)
2 Participant with autism, age 15	
• and there's a guy named um sylvester	
• and he's this black like cat a er yeah he's a cat yeah	(he = Sylvester)
• and um there's a yellow tweety bird	
• and he's in the cage	(he = Tweety)
• and um first you see him looking through at um like outside to see what he sees	(him = ?) (he = ?)
• and um then he's trying to find ways to um get the bird	(he = Sylvester)

Table 2. Examples of overspecific referential choices, where a repeated name or description is used even though the referent is currently in discourse focus.

1. Control participant, age 12 • and then he starts looking for the bird • and then the granny gives him a shiny penny • and then he lifts his hat • and then the granny whacks him in the head again • and then the granny calls the desk clerk 2 Participant with autism, age 10 • but it like hits the wall next to the window where the bird is • and um then the cat's like thinking some more • and the cat climbs up a like electric wire

Instead, the question to be examined here is whether referential patterns are systematically and quantitatively different. If speakers with autism have difficulty modeling the comprehension needs of their addressee, they might produce contextually odd tokens more frequently. However, the literature on mentalizing does not make clear predictions about the direction the difference. We might assume that children with autism would overuse pronouns and zeros, perhaps in situations where the referent is accessible in their own mind but not their addressee's. This was observed in Tager-Flusberg's (1995) narrative data, where children with autism failed to introduce new characters with full lexical NPs, instead using pronouns. However, Tager-Flusberg's narratives were told in the context of an illustration, making it possible to use pronouns deictically (a strategy that is also attested for young children, Karmiloff-Smith, 1985). On the other hand, a mentalizing deficit might predict that children with autism would be less confident that a pronoun would be understood, and instead might overuse

explicit expressions (for observations supporting this prediction, see Baltaxe, 1977). The literature on cognitive load makes more specific predictions. If autism is associated with impairments in the kinds of memory and attentional processes relevant for discourse representation, we would predict fewer pronouns in the autism group.

Methods

The narratives analyzed here were collected as part of a larger study of communication in autism at the University of Rochester.

Participants

Participants were 23 children and adolescents with autism between the ages of 9 and 17 years, and 23 children and adolescents with typical development (see Table 3). For the autism group, diagnoses were confirmed with a combination of the Autism Diagnostic Interview-Revised with the parent (ADI-R, Rutter, LeCouteur, & Lord, 2003) and the Autism Diagnostic Observation Schedule with the participant (ADOS, Lord, Rutter, DiLavore, & Risi, 1999). An experienced clinician, trained in the use of these instruments, used data from the ADOS and ADI-R to determine that all participants met criteria for Autistic Disorder using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 2000). For the control group, all participants did not meet criteria for any pervasive developmental disorder based on the ADOS with the participant, and parent report on either the ADI-R or Autism Symptom Questionnaire (ASQ; Berument, Rutter, Lord, Pickles, & Bailey, 1999). There was also no evidence in the control participants of learning disabilities, language delays, or other behavioral or psychiatric disorders, and no concerns about autism spectrum disorders in their first- or second-degree relatives.

Depending on participant's age, we administered the Wechsler Intelligence Scale for Children-3rd Edition (Wechsler, 1991) or Wechsler Adult Intelligence Scale-3rd Edition (Wechsler, 1997). Receptive language level was further evaluated with the Peabody Picture Vocabulary Test, 3rd Edition (PPVT-III, Dunn & Dunn, 1997).

Table 3. Participant characteristics.

	Autism		Control	
	Younger (n = 10)	Older (n = 13)	Younger (n = 10)	Older (n = 13)
Chronological Age	11.1 (0.3)	15.1 (0.2)	11.6 (0.3)	14.6 (0.4)
Verbal IQ	114 (3.9)	117 (4.0)	117 (3.6)	120 (4.3)
Performance IQ	110 (8.4)	113 (6.5)	110 (3.8)	115 (4.5)
Full-scale IQ	114 (5.5)	117 (4.8)	116 (3.0)	120 (4.5)
Receptive Language	112 (3.6)	119 (3.0)	115 (4.3)	119 (3.5)
Gender (M:F)	9:1	11:2	9:1	12:1

Note: Numbers presented are group means, with standard error of the mean in parentheses. Verbal, Performance, and Full Scale IQ scores were measured with the Wechsler Intelligence Scale for Children-3rd Ed. or the Wechsler Adult Intelligence Scale-3rd Ed. Receptive Language was measured with the PPVT-III Standard Score.

Participants were matched by group means on age, Full Scale IQ (FSIQ), Verbal IQ (VIQ), PPVT-III Standard Score, and gender composition. For the purposes of evaluating developmental trends, participants were grouped by age into younger (n=10 in each group; ages 9.8 – 12.9) and older (n=13 in each group; ages 13.1-17.8) age groups, using the same

chronological age criterion for both diagnostic groups. For each of the participant characteristics in Table 3, we assessed potential differences between groups by submitting the data to analyses of variance (ANOVA), with diagnostic group and age group as the independent variables. There were no significant effects of diagnostic group, age group, or the interaction between them (all F's < 2.3, all p's > 1.3) in any of the analyses (except the obvious main effect of age group for Chronological Age).

This research was approved by the University's Research Subjects Review Board. Prior to testing, written informed consent was obtained from parents and written assent was obtained from the participants.

Cognitive and linguistic functioning of participants in our sample

The data analyzed here comes from a larger project, in which the participants' performance was examined on a number of tasks. Reports from other papers provide a richer understanding of the characteristics of this group of participants. Bennetto, Diehl, & Arnold (under review) report an analysis of story and utterance planning for a slightly smaller subset of this sample (43 of our 46 participants). They found that the autism group was less likely than controls to provide settings for their stories, revealing the planning difficulties often associated with autism (Hughes, Russell, & Robbins, 1994; Ozonoff et al., 2004; Turner, 1997). On the other hand, there was no difference between groups in the distribution of disfluencies within each utterance, suggesting that the planning difficulties do not extend to local, utterance planning. For a subset (42 participants), Diehl, Watson, Bennetto, McDonough, & Gunlogson (under review) found that the speech of the autism group exhibited more prosodic variance than the speech of the control group, supporting observations that autism is often associated with altered prosodic phrasing. This set of findings demonstrates that our groups differ on at least

some linguistic measures. Moreover, the "gold standard" diagnostic measures used in this study clearly support differentiation between our groups based on socio-communicative and other characteristics of autism.

Narrative elicitation

Participants watched "Canary Row," a Sylvester and Tweety Bird cartoon that has previously been used to elicit narratives and gestures (McNeill, 1992) . The cartoon involves a clear story line in which Sylvester the cat attempts (unsuccessfully) to catch Tweety the bird, who is protected by its owner, Granny. The 7.5-minute cartoon was divided into three segments to decrease memory load; each segment was between 2 and 3 minutes long. After each segment the participants retold the story to a confederate who pretended not to have seen the cartoon. This was the only break between viewing each segment.

Transcription and Coding

Two coders at the University of Rochester, who were blind to the participants' diagnoses, transcribed the videotaped narratives. All verbal aspects of the narratives were transcribed, including disfluencies. We randomly selected 10% of the narratives for reliability; coders achieved 95% reliability on a word-by-word basis. Each narrative was then divided into clauses, which contained a main or subordinate clause, all its arguments and adjuncts, and any dependent subordinate clauses (see Table 4). Coders achieved 96% reliability for determining clause breaks. For each clause, coders recorded the number of words in the clause (not including disfluent or repaired words). A separate analysis of the presence and types of disfluency is reported elsewhere for a subset of this sample (Bennetto, Diehl, & Arnold, under review).

Three coders at the University of North Carolina at Chapel Hill, also blind to the participants' diagnoses, then examined each clause for any singular references to Sylvester,

Tweety, or Granny. Seven participants were coded by two or more coders to check for cross-coder reliability. They achieved 95% reliability for identifying the form of reference (pro, zero, or name/NP); nearly all mismatches occurred because one coder failed to provide a coding. The independent variables were also checked for cross-coder reliability for all references that had not been omitted altogether by one or more coders. Coders achieved 98% accuracy on grammatical function of the referent, 94% accuracy on the number of clauses since last mention of the entity, and 94% accuracy on the grammatical function of the last mention of the referent. The first author checked all codings for consistency and corrected if necessary. In most cases, it was obvious who the speaker was referring to, given the events in the cartoon. The few truly ambiguous references were excluded from analysis. If there was more than one reference to the same character in a clause, only the first one was analyzed. If a referential form was repaired to another form in the same clause, the first form chosen was used in the analysis (e.g., *alright, Sylvester was he went he climbed up the gutter pipe inside*)

The referring expression type was coded as one of the following categories: zeros *(and Ø ran)*, pronominal (*he, she)*, name (*Sylvester, Tweety, Granny)*, definite NP (*the cat)*, indefinite NP (*a cat)*, or bare NP (*cat*). Examples are provided in Table 4. These categories were collapsed into a binary contrast between the underspecified zeros and pronouns, and the more explicit names and NPs (cf. Givón, 1983; Gundel et al., 1993). This constituted the dependent variable, which is reported here as the proportion of pronouns/zeros out of all singular references (i.e., all pronouns/zeros and names/descriptions). Possessive references (*his head*) and compound references (e.g., *they*, *Tweety and Granny*) were not included in the analysis, but they counted as prior mentions.

The grammatical function of each reference in its utterance was coded as subject or nonsubject (i.e., object/object-of-preposition). Each reference was also coded for the number of clauses since the most recent reference to the same character: 1 clause back (i.e., previous clause), 2 clauses back, 3 or more clauses back, or no prior mention. For references to something that had been mentioned in the previous clause, the grammatical function of its prior mention was coded as subject or nonsubject. At the start of each episode, all characters were considered to have no prior mentions.

Table 4. Examples of coding categories.

A. Examples of clauses	
Simple main clause:	*he went up*
Coordinated main clause:	*and Ø ran*
Subordinate finite clause:	*while he ran*
Main clause with dependent clause:	*and then he tries to swing over into the other building*
B. Referential form	
Zero:	*he grabbed it; Ø ran out the back alley; Ø opened it up* (Autism, age 15.3)
Pronoun:	*after that he got kicked out* (Autism, age 10.3)
Definite NP:	*while um the bird was singing* (Control, age 12.3)
Name:	*Tweety flew out yelling help me help me* (Autism, age 15.3)
Not included in the analyses:	
Possessive:	*and um I think maybe she saw his ears* (Control, age 12.0)
Plural:	*and it's being driven by Tweety and Granny* (Control, age 14.5)
C. Recency of mention	
1 clause back:	*while Sylvester was in a different one* *and he he just ran into the building* (Autism, age 10.3)
2 clauses back:	*and he's start he's running away with Tweety bird down the street.* *and um the weight comes back down* *and hits him on the head* (Control, age 17.8)
3 clauses back:	*and Tweety spotted him* *Tweety flew out yelling help me help me* *and uh Granny came* *and uh threw Sylvester out the window* (Autism, age 15.3)

no prior mention: *okay um well basically I just watched a uh merry melodies cartoon um it's uh this one was about um uh Tweety bird (*Control, age 17.8)

D. Grammatical function of current expression and mention in previous clause:

Current expression:Previous mention	
Subject:Subject	*and he runs* *and Ø gets zapped again* (Autism, age 11.8)
	and he had binoculars *and he was looking at it* (Control, age 10.3)
Subject:Nonsubject	*and Ø got the old lady* *and the old lady whacked him* (Control, age 15.1)
	in in the last part the the cat it got the bird *and um th the bird i it drove* (Autism, age 10.0)
Nonsubject:Subject	*and then he climbs through the water pipe.* *and then tweety sees him* (Control, age 12.4)
	and Ø chases tweety *and the granny mistakes him for a monkey* (Autism, Age 14.5)
Nonsubject:Nonsubject	*Ø trying to find the bird* *And he finds it* (Control, age 13.3)
	and the cat is trying to chase the bird *but he never catches her* (Autism, age 10.0)

NOTE: Example references are underlined.

Results

All results are reported here as the average of participant means for the Autism and Control groups, divided by age group. The reliability of each pattern was assessed by submitting the participant means to ANOVAs. All ANOVAs included the between-subject independent variables of Diagnostic Group (Autism vs. Control) and Age (younger vs. older). The critical analyses of discourse and cognitive effort effects also included within-participant variables, as

described below. For proportion data, each ANOVA was conducted with both the raw data and with an arcsine transformation of each participant mean (Winer, Brown, & Michels, 1991). For transparency we report the raw means and analyses; the arcsine analysis always produced the same significance patterns unless otherwise noted.

Table 5. Overall narrative length and number of words and references

	Autism		Control	
	Younger	Older	Younger	Older
Average # clauses per narrative	59	79	93	99
Average # words per clause	7.2	7.0	6.9	7.2
Sylvester: % pro (avg. # refs.)	77 (41)	90 (55)	86 (62)	85 (66)
Tweety: % pro (avg. # refs.)	23 (11)	27 (14)	35 (17)	30 (19)
Granny: % pro (avg. # refs.)	29 (7)	58 (10)	54 (10)	58 (12)

Note: The percentage of pronouns are reported out of all singular references, averaged by participant within each participant group. The average number of references to each character is in parentheses.

General Narrative Characteristics

As background to understanding the analysis on choices between more- and less- explicit expressions, it is important to assess the distribution and frequency of references overall, and within each discourse context. Perhaps the most notable difference between groups was the tendency for participants with autism to produce fewer references overall than typically developing controls (see Table 5). The total number of references were submitted to a 2x2

ANOVA with Group and Age as between-participants independent variables; this revealed a main effect of Group, $F(1,42) = 6.62$, $p = .014$, but no effects or interactions with age. This finding stems directly from the tendency for participants with autism to produce shorter narratives. A 2x2 ANOVA on narrative length revealed again a main effect of Group, $F(1,42) = 7.09$, $p = .011$, and no effects or interactions with Age. Nonetheless, the average length of each clause was the same for Autism and Control groups, and for both age groups. The narrative and clause length effects are reported for a subset of this sample by Bennetto et al (under review). Examples of the first episode of two narratives (those with the median lengths for each group) are provided in the Appendix.

Of particular relevance to the process of choosing referential expressions is the distribution of different discourse contexts within each participant's narrative. Pronouns and zeros are most likely to occur when the referent was prominently mentioned (e.g., recently or in a prominent syntactic position), and especially when the referring expression was in a parallel position (i.e., subject-to-subject or object-to-object). Figure 1 presents the proportion of reference types, categorized by the syntactic position of the current referring expression and the syntactic position of the last mention of the referent. Despite the differences in narrative lengths, all participant groups were remarkably similar in their distribution of reference types. There were more references occurring in subject position than nonsubject position (80% of all references; i.e., the top three categories in the bars in Figure 1). Most of these referred to something that had also been in subject position in the previous clause, making subject-to-subject reference the most frequent type of reference for all groups.

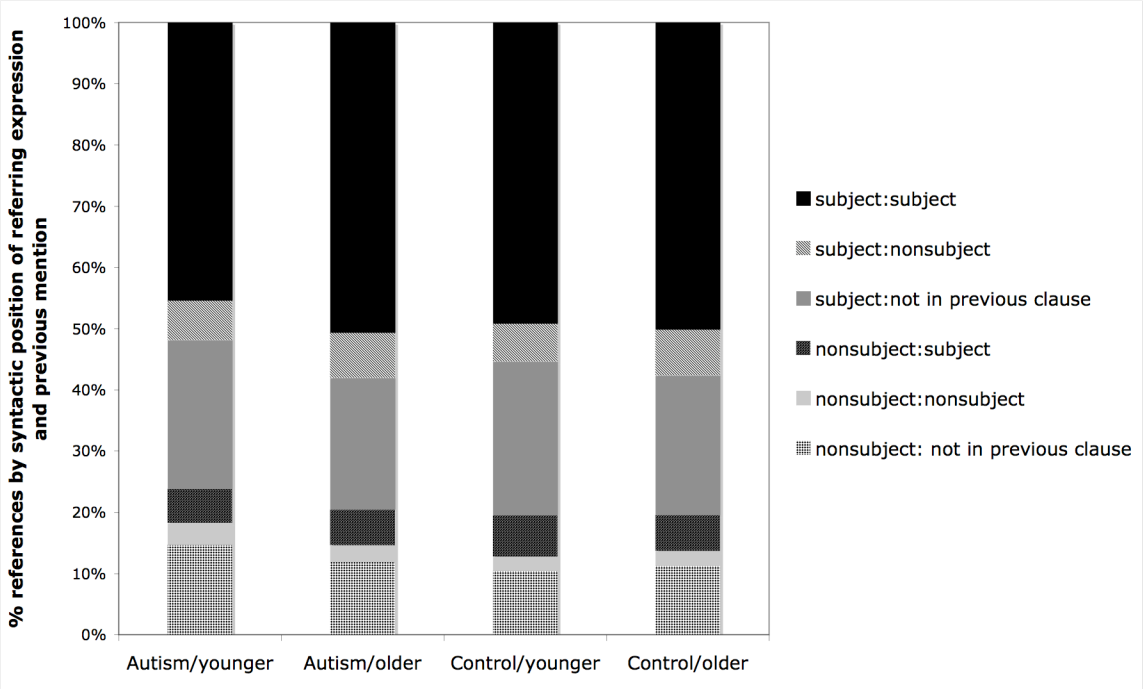

Figure 1. Percentage of references by discourse context, averaged by participant within each diagnostic / age group.

Reference Form Choices

We examined how the production of pronouns and zeros by participants of different ages and from each diagnostic group were influenced by two categories of constraint: 1) The discourse status of the referent, as assessed by the linguistic characteristics of how it had last been mentioned (i.e., how recently, and in what syntactic position), and 2) Phenomena that are expected to influence the cognitive load that the speaker is currently experiencing (i.e., disfluency and clause length). As described above, both discourse status and cognitive load have been shown to correlate with the reference form choices of typical adults.

Discourse Status Effects. Two measures of discourse status were examined: recency of mention of the character and, for those things that had been mentioned in the previous clause, the

syntactic positions of both the current expression and the last mention of the same entity. Recency of mention was calculated as the number of clauses since the character was last mentioned, grouped into four categories: previous clause, 2 clauses back, 3 or more clauses back, never mentioned within the episode. The analyses presented below show that both age groups and both diagnostic groups exhibited sensitivity to both of these measures, as predicted by adult reference production in other studies (Arnold, 1998, 2001, 2003; Arnold & Griffin, 2007; Brennan, 1995; Givón, 1983; Stevenson et al., 1993). At the same time, the Autism group differed from the Control group by showing a developmental trend: the younger participants produced fewer pronouns than the older ones.

As shown in Figure 2, all participants used the most pronouns/zeros when the referent was last mentioned in the previous clause. As the number of clauses since the last mention of the referent increased, the use of pronouns and zeros decreased. However, the youngest Autism group used fewer pronouns per category than the older Autism and both Control age groups. This interaction was especially pronounced in the two categories of discourse context where the choice of referring expression is not as strongly constrained (i.e., when the referent was previously mentioned, but not in the immediately preceding clause). That is, all groups converged on a high rate of pronouns/zeros when the referent was just mentioned; and all used nearly 100% explicit expressions when it had not been mentioned at all, but the younger Autism group tended to use more explicit expressions in the middle two categories.

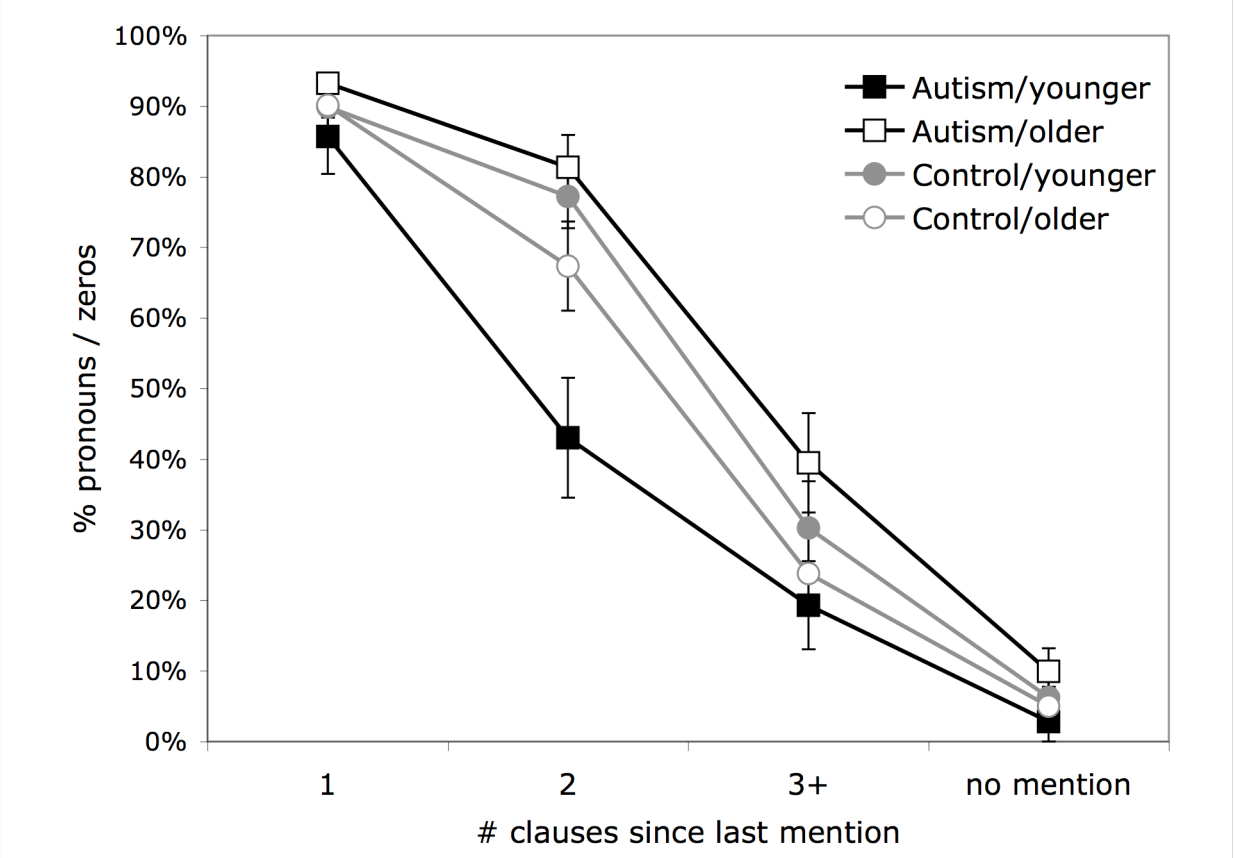

Figure 2. The average rate of pronoun use according to the recency of the last mention of the referent character.

These data were submitted to a 2x2x4 ANOVA with two between-participant variables (Diagnostic Group and Age) and one within-participant variable (Recency of mention: previous clause vs. 2 clauses back vs. 3 clauses back vs. no previous mention)[1]. As expected, there was a main effect of Recency, $F(3,126) = 308.77$, $p < .001$. The critical finding was a significant three-way interaction between Diagnostic Group, Age, and Recency, $F(3,126) = 4.94$, $p = .003$. There was also a main effect of Age $F(1,42) = 4.77$, $p = .035$, and Group x Age interaction, $F(1,42) = 12.57$, $p = .001$. Separate ANOVAs with data from the Autism and Control groups revealed that

[1] One participant in the younger Autism group had one missing cell, which was replaced by the participant mean.

the three-way interaction was carried by a developmental trend in the participants with autism, who exhibited main effects of both Age, $F(1,21) = 11.84$, $p = .002$, and Recency, $F(3,63) = 152.44$, $p < .001$, and an Age x Recency interaction, $F(3,63) = 6.04$, $p = .001$. In contrast, the use of pronouns/zeros in the Control group was only influenced by Recency, $F(3,63) = 157.28$, $p < .001$.

It may seem surprising that there were any pronouns/zeros at all when the character had not been previously mentioned. There were 19 such references in the database (11 from the Autism group, and 8 from the Control group). All occurred in the second or third episodes on the first mention of the character. That is, despite the categorization of these references as "no previous mention," they had in fact been mentioned within the experimental session, just not within that episode. Seventeen of these were references to Sylvester, who could have been considered so salient to the story that he did not require naming. One reference was to Tweety (*well first uh the cat tries to get uh him again*), and another to Granny *(… she threw him out the window again*), both of which were understandable in context. These tokens underscore the fact that while discourse status is highly constraining, it does not fully determine speakers' choices.

As a second measure of discourse status, we examined all references to something that had also been mentioned in the previous clause (65% of all references across all participants), analyzing the effect of the syntactic position in which the character had last been mentioned. It is widely established that speakers tend to use pronouns and zeros more often for entities that were just mentioned in subject position, compared with those just mentioned in nonsubject positions (Arnold, 1998; Brennan, Friedman, & Pollard, 1987; Brennan, 1995; Stevenson et al., 1994; see Arnold, 2008, for a review). It has been suggested that subject position confers salience on the entities referred to, such that the speaker can assume that the listener is more likely to focus

attention on things in subject than nonsubject positions. An independent factor is the parallelism between the syntactic position of the referring expression itself and the last mention of the referent, where pronouns and zeros are more common for parallel than nonparallel reference.

Participants in both age groups were sensitive to both the syntactic position in which a referent had previously been mentioned, and parallelism with the current referring expression. We analyzed these two factors as independent variables in an analysis of all references to something that had been mentioned in the previous clause in the singular (i.e., not as part of a compound). However, the relatively low occurrence of references in object position meant that 12 participants (8 Autism, 4 Control) were missing one of the cells for nonsubject referring expressions. Each of these 12 cells (out of a total of 184) was replaced by that participant's mean. This is a conservative strategy because it reduced the chance of finding the critical differences. Nonetheless, as shown in Table 6, participants in all Age/Diagnostic groups showed the predicted tendency to use pronouns more for something that was previously mentioned in subject position than something previously mentioned in object position. In addition, there were relatively more pronouns/zeros when the current referring expression and last mention of the referent were in parallel syntactic positions. These data were submitted to an ANOVA including the independent variables Group, Age, Syntactic Role of Previous Mention (subjects vs. nonsubject) and Parallelism of reference (parallel vs. nonparallel). Results revealed a main effect of previous syntactic position, $F(1,42) = 34.25$, $p < .001$, and a main effect of parallelism, $F(1,42) = 6.19$, $p = .017$. There were no effects or interactions with Group or Age.

Table 6. Percentage of pronouns/zeros out of all singular references, depending on the syntactic position in which the referent was last mentioned (subject vs. nonsubject), and whether the current syntactic position is the same (parallel) or not (nonparallel). Standard errors of the mean are presented in parenthesis.

	Autism		Control	
	Younger	Older	Younger	Older
References to Previous Subject				
Parallel (Subject-to-Subject)	96 (2)	97 (1)	95 (3)	96 (1)
Nonparallel (Nonsubject-to-Subject)	81 (8)	94 (3)	80 (8)	88 (4)
References to Previous Nonsubject				
Parallel (Nonsubject-to-Nonsubject)	72 (8)	77 (7)	80 (8)	76 (6)
Nonparallel (Subject-to-Nonsubject)	70 (12)	81 (4)	74 (6)	62 (6)

Because of the large number of missing cells, we also assessed the effect of the syntactic position of previous mention by further restricting the analysis to references in subject position (87% of all of the references to something mentioned in the previous clause). Figure 3 shows that all participants exhibited the predicted effects of syntactic position: nearly exclusive use of pronouns or zeros for parallel reference to something that was previously mentioned in subject position, and fewer pronouns/zeros for nonparallel reference to something previously mentioned in a nonsubject position. A 2 (Group) x 2 (Age) x 2 (Syntactic role of previous mention) ANOVA revealed a main effect of Previous Mention $F(1,42) = 47.79$, $p < .001$, and no effects or interactions with Group or Age. The lack of Group or Age effects suggests that the developmental trend in the Autism group is restricted to references when the last mention of the referent occurred prior to the preceding clause.

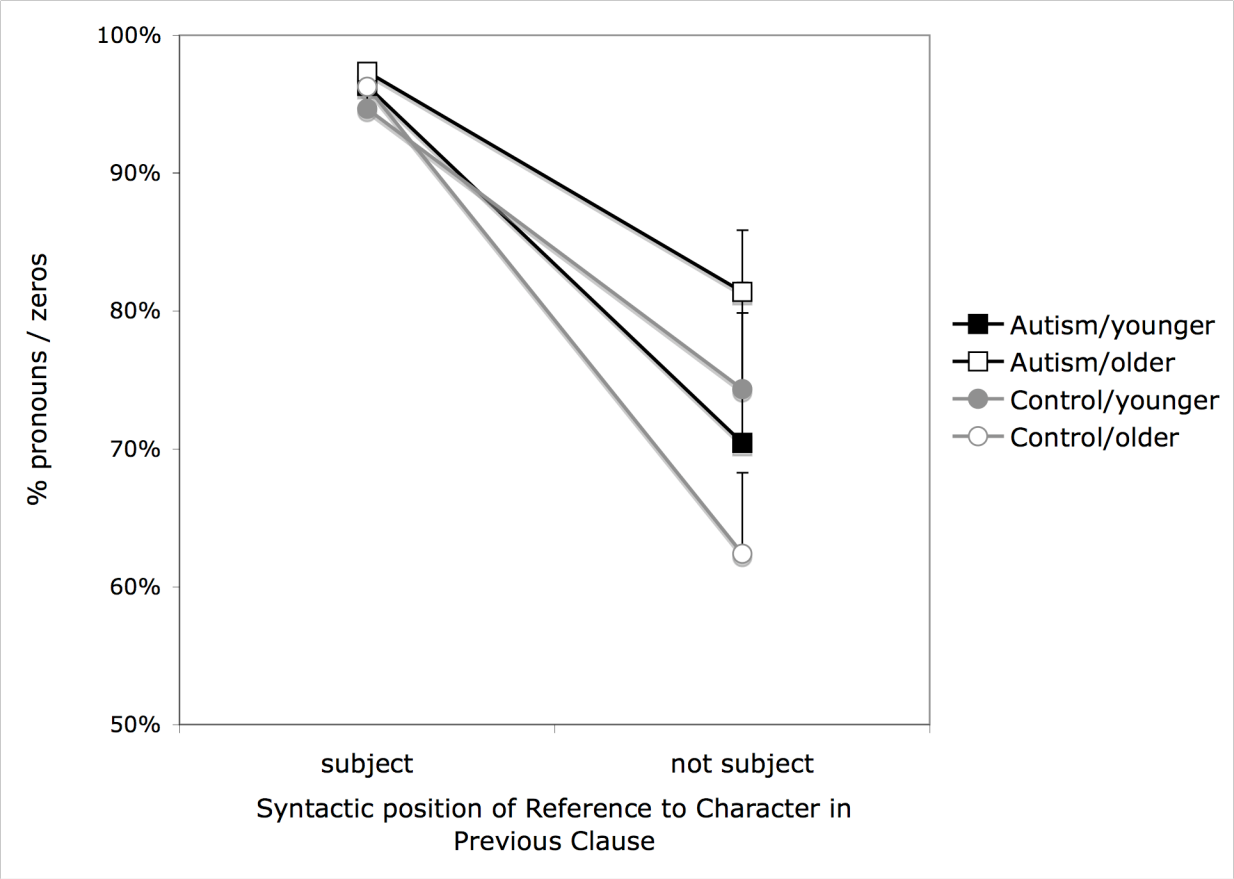

Figure 3. Rate of pronoun use according to the grammatical function of the last mention of the referent, only including references in subject position and where the referent was also mentioned in the previous clause. Error bars represent standard error of the mean.

Effects of Cognitive Load. To assess the effects of processing effort on reference production choices, we analyzed the rate of pronouns/zeros under two conditions where the speaker was likely to be experiencing cognitive load: 1) the presence of disfluency, and 2) the number of words in the clause being currently being produced.

Disfluency occurs naturally in spoken language, as speakers utter disfluent filler words like *uh* or *um*, repeat or repair words, or even use disfluent pronunciations like "thiy" (rhyming

with "tree") instead of "thuh" for *the* (Clark & Fox Tree; 2002; Clark & Wasow, 1998; Fox Tree and Clark, 1997). It is generally agreed that disfluent elements like these occur under conditions where the speaker is having some difficulty planning and/or producing their utterance (Bortfeld et al., 2001; Goldman-Eisler, 1968; Siegman, 1979; Beattie, 1979; Clark & Fox Tree, 2002; Clark & Wasow, 1998). Support for this comes from evidence that speakers tend to be disfluent more often at the onset of longer clauses (e.g., Clark & Wasow, 1998), a pattern that also held for both groups in the subset of these narratives analyzed by Bennetto et al. (under review). Even though such difficulty can occur for many reasons, the presence of disfluency can be used as a metric that some amount of difficulty occurred – even if it is not greater than the normal load incurred by planning an utterance. If such load adversely affects the speaker's ability to represent the discourse context, we might expect a lower rate of pronouns and null references under conditions of disfluency. This is what Arnold & Griffin (2007) observed for typical adult speakers.

As predicted, participants in both the Autism and Control groups in the current sample were more likely to use a pronoun or zero in fluent utterances than disfluent ones (see Table 7). To control for variations in clause complexity, this analysis was limited to only references in subject position[2], although disfluency also predicts reference choice in the full dataset. The ANOVA (including Disfluency, Age, and Group as independent variables) revealed a main effect of Disfluency, $F(1,42) = 38.87$, $p = .001$. As in the analyses above, there was also an interaction between Group and Age, $F(1,42) = 5.69$, $p = .02$, reflecting the same overall lower use of pronouns by the younger Autism group. There were no other main effects or interactions.

[2] Nonsubject references tend to occur in longer clauses than subject references do, on average.

Table 7. Average percentage pronouns/zeros used in each participant group for clauses with and without disfluent elements, calculated out of all singular references in subject position. Standard errors of the mean are in parentheses.

	Autism		Control	
	younger	older	younger	older
Fluent clauses	75 (4)	85 (2)	82 (2)	80 (2)
Disfluent clauses	64 (5)	75 (3)	68 (4)	65 (4)

Although disfluency is a good indicator of cognitive load, participants can also expend cognitive effort in the planning and production of fluent utterances. In particular, planning and production processes are expected to increase as the length of the clause being produced increases (Clark & Wasow, 1998; Watson & Gibson, 2004; see also Ford, 1982). Thus, it is possible that planning longer utterances may incur processing demand, even during fluent utterances. If this cognitive load influences referential choices, we would expect a greater rate of pronouns for shorter (1-6 words) than longer utterances (7+ words). The data support this prediction, as shown in Table 8. In order to isolate the effect of clause length, this analysis was restricted to fluent utterances[3], and again only references in subject position. The ANOVA with independent variables Group, Age, and Clause Length (short vs. long) revealed a main effect of Clause Length, $F(1,42) = 9.05$, $p = .004$. As before, there was an interaction between Group and Age, $F(1,42) = 5.29$, $p = .03$, although it was marginal in the arcsine-transformed analysis, $F(1,42) = 3.87$, $p = .056$. There was no effect of Group nor interactions with it. When the entire

[3] Fluent utterances tend to be shorter (average = 6.5 words) than disfluent utterances (average = 8.8 words), even though the disfluent words themselves do not contribute toward our measurement of utterance length.

dataset was included (including disfluent references and those not in subject position), Clause Length still predicted pronoun/zero use.

Table 8. Average percentage pronouns/zeros used in each participant group for short and long clauses, calculated out of all singular and fluent references in subject position. Standard errors of the mean are in parentheses.

	Autism		Control	
	younger	older	younger	older
Short clause (1-6 words)	81 (4)	89 (3)	83 (3)	84 (2)
Long clause (7+ words)	68 (9)	79 (4)	80 (3)	74 (4)

Comparison between Groups

In sum, participants in both the Control and Autism groups in our sample chose referential expressions on the basis of the same discourse criteria that have been shown to influence adults in other studies (e.g., Arnold, 1998; 2001; Arnold & Griffin, 2007; Brennan, 1995). All participants used pronouns and zeros more often for entities that had been recently or prominently mentioned, especially when referring in a parallel syntactic position. All participants were also influenced by cognitive effort, as indicated by disfluency and clause length effects. These effects were observable in both younger and older participants, both with and without autism.

But as predicted, there was also a quantitative difference between diagnostic groups. This emerged in the younger group of participants with Autism, who tended to use fewer pronouns/zeros than the older participants with Autism and the control participants of all ages. This effect was most pronounced for references to things that had been mentioned, but not in the

previous clause. Another way of saying this is that there was a developmental trend in the Autism group, but not the Control group. Further support for this comes from correlations between age and the percent of pronouns/zeros used in reference to something that was mentioned two clauses previously. We chose this discourse category as the critical variable, because it yielded the largest group difference in the full analysis. Age was positively correlated with percent of pronouns/zeros for the Autism group, $r(21) = .60$, $p = .003$, such that younger children used more explicit expressions than older children. By contrast, this correlation was not observed for the Control group, $r(21) = -.11$, $p = .64$. The difference between these correlations was significant when converted with Fisher's r to z' transformation, $Z = 2.54$, $p = .01$ (Cohen & Cohen, 2003).

Discussion

There are two primary conclusions to be drawn from the above findings. The reference form choices of both participants with autism and typically developing controls were sensitive to the same discourse and processing conditions that have been shown to influence adults, and in the same ways. But despite this overall similarity, the younger participants with autism were more likely to use explicit expressions than the other participants, after controlling for discourse context. This finding is consistent with Baltaxe's (1977) observation that adults with autism often used referential expressions that were more specific than needed. However, it contrasts with Tager-Flusberg's (1995) data, in which children with autism failed to specify the introductory mention with a full noun phrase, perhaps because they were using pronouns deictically more often. Our finding suggests that when deictic reference is not available, high-functioning children with autism err on the side of overspecification.

The reason we were able to observe both a difference between groups and an overall sensitivity to discourse and cognitive load constraints was because of our fine-grained analysis of the discourse structure. The relative overspecification of references in the younger autism group was most prominent for references to something that had been previously mentioned, but not for two or more clauses. This contrast did not stem from any systematic differences in the types of discourse contexts produced by each group, which were very similar. These findings give rise to two overlapping questions. First, what different processes are likely to underlie the finding that children with autism tended to overuse explicit expressions? Second, why did we not see greater differences between the groups, given the predictions from the literature?

Why do younger children with autism produce fewer pronouns?

First we turn to the question of the mechanisms underlying reference production, and how they might explain the observed overuse of explicit expressions. It is generally agreed that one major determinant of referential choices is the referent's conceptual status: if it is likely to be important to the upcoming discourse, discourse participants focus their attention on it, and speakers can use underspecified expressions for referring to it (for a review see Arnold, 2008). The speaker must represent this conceptual status, whether it involves explicitly modeling the listener or not. One way to model this calculation is in terms of activation, where the activation of each entity in the speaker's mental representation indicates the degree to which the referent is focused, in a graded way. Thus, recently and prominently mentioned entities are highly activated, but this activation decays as other referents become more central. This representation guides the choice between alternate referring expressions. Other things being equal, pronouns

and zeros tend to be chosen if the referent has a sufficiently high enough activation (Arnold & Griffin, 2007).

Under this model, there are two possible calculations that could explain the observed tendency for younger participants with autism to use fewer pronouns/zeros than the other participants. One possibility is that they have difficulty maintaining activation on referents that have not been mentioned recently. If activation decays more rapidly for these participants, then it will fall below the threshold for choosing an underspecified expression more quickly, for example as soon as one or two other references intervene. This explanation is consistent with evidence that decreases in memory capacity under conditions of memory load can lead to a reduction in the use of pronouns and zeros (Griffin & Arnold, 2008). It is also broadly consistent with the correlation between autism and low performance on memory span tasks (Bennetto, Pennington & Rogers, 1996). This was true in our sample too: performance on a forward- and backward- digit span task[4] was lower for participants with autism, both the younger group (M = 9.2, $S.E.$ = 0.9) and older group (M = 9.0, $S.E.$ = 0.9), compared with both the younger control group (M = 10.4, $S.E.$ = 0.9) and older control group (M = 12.14, $S.E.$= 0.6). Digit span was analyzed with an ANOVA including Group and Age as independent variables, which yielded a main effect of Group, $F(1,42) = 7.38$, $p = .01$, and no effects or interactions with Age. While the working memory deficit for the autism group might explain the overspecific reference for the younger children with autism, it does not explain why the older children with autism (who also have lower digit spans) produced the same rate of pronouns and zeros as the control groups. Thus, working memory cannot be the only explanation.

[4] Digit span is the scaled score (M=10, SD=3) from the Wechsler IQ test.

Another possibility is that the younger participants with autism tend to represent activation in the same way as other participants, but they have a higher threshold for deciding that a pronoun or zero is sufficient. For the most recently mentioned and syntactically prominent referents, they appear to be confident that a pronoun or zero is warranted. But for a referent with slightly decayed activation, they appear to be more likely to assume that the pronoun would no longer be acceptable. We speculate that the setting of a threshold for using an underspecified expression may be impacted by judgments about what an addressee might need to successfully understand the reference. It has been proposed that autism is characterized by a developmental delay in theory-of-mind abilities (Tager-Flusberg, 2001b). Even though people with autism continue to have some degree of mentalizing deficit even into adulthood (e.g., Kleinman, Marciano, & Ault, 2001; Rutherford, Baron-Cohen, & Wheelwright, 2002), it may be that the deficit attenuates with development. If theory-of-mind abilities are needed to set an appropriate threshold, such an attenuation may explain our finding of overspecific reference in the younger but not older children with autism.

Whatever mechanisms are involved, the difference between groups here is best characterized as a presence or absence of a developmental trend. The younger children with autism tended to overspecify somewhat, but not categorically so, and this difference disappeared for the older children. Although we do not have data for very young typically developing children, reports in the literature suggest a similar sensitivity to the discourse context for 4-5 year old English-speaking children (Hickman & Hendricks, 1999), who show a higher rate of pronouns for Subject-to-Subject reference (83%), less for Nonsubject-to-Subject (64%) or Subject-to-Nonsubject (54%), and least for Nonsubject-to-Nonsubject (37%). Although we cannot compare these data quantitatively to the productions of the control participants in our

sample, at the very least there is no evidence that very young children under-use pronouns. This suggests that the developmental trend we observed may be specific to autism.

Why do we not see greater differences between groups in our task?

At the same time, our results demonstrated an equally important finding, that all participant groups were sensitive to the same discourse context and cognitive constraints. It is well established that mentalizing tasks are difficult for people with autism, even high-functioning individuals (Hale and Tager-Flusberg, 2005; Tager-Flusberg, 2001b). It is also frequently claimed that speakers choose referential forms based on judgments about their addressee's knowledge and focus of attention (Gundel et al., 1993; Chafe, 1995; Levelt, 1989). If reference production truly does involve this kind of mentalizing, we might expect individuals with autism to show a significantly different pattern of choosing referential expressions. Why then did we not find greater differences?

There are two possible explanations. One possibility is that our particular participants with autism did not in fact have any difficulty with mentalizing tasks. Since we did not conduct any theory-of-mind assessments, we cannot ignore this possibility. It is known that theory-of-mind abilities vary on a continuum in autistic populations (Tager-Flusberg, 2001b), and that theory of mind abilities correlate with linguistic abilities (Fisher, Happé, & Dunn, 2005; Happé, 1993, 1995). However, other studies have found that high-functioning people with autism score lower on mentalizing tasks than control participants, both in childhood and adolescence (Brent et al., 2004; Kaland et al., 2008), as well as through adulthood (Kleinman et al., 2001; Rutherford et al., 2002). Based on this literature, it seems likely that our participants with autism had at least some degree of difficulty with higher-order mentalizing abilities.

A second possibility is that reference production does not require on-line calculations about the mental state of the addressee, or at least not as much as implied by the literature. This idea is consistent with reports that very young children also tend to use pronouns appropriately (Hickman & Hendricks, 1999), even though they have not fully developed their theory-of-mind abilities at this age (Wellman, 1990; Wellman & Liu, 2004). Gundel, Ntelitheos, and Kowalsky (2007) describe a number of examples of reference from very young children, which attest appropriate usage of a variety of referential forms (pronouns, definite NPs, etc.) by age 3. They propose that this correct usage indicates that "children… are sensitive to the memory and attention state of their interlocutors" (p. 16). While this conclusion seems to be at odds with the tendency for children of this age to fail false-belief tasks, Gundel et al. suggest that the kind of information needed for reasoning about the addressee's current focus of attention may be different, and easier, than what is needed to pass a false-belief task.

A more extreme version of their proposal, which is consistent with their results and ours, is that reference production does not always, or even typically, require explicit representations of the addressee's mental state. Even though speakers do monitor for cues to their addressee's focus of attention, like eye gaze (Clark & Krych, 2004), the discourse often provides enough information for speakers to produce appropriate expressions without engaging in sophisticated audience design. We therefore speculate that the choice between pronouns/zeros and more explicit expressions involves fewer mentalizing processes than previously suggested (e.g., Bard & Aylett, 2004; Brennan, 1995; Gundel et al., 1993; Levelt, 1989). Although our participants with autism are likely to have some mentalizing deficit, it is clearly within the limits of what is required for reference production – particularly for the older children, but even for the majority

of references by the younger children. This idea can be tested in future research by assessing whether pronoun use correlates with direct measures of theory of mind.

While we can only speculate about the degree to which mentalizing influenced reference production in our participants, our results clearly supported the claim that reference production is modulated by speaker-internal constraints (i.e., the effects of cognitive load). Participants in all groups produced fewer pronouns in utterances that were disfluent (indicating some level of production difficulty), or while under the load of planning a longer utterance. This supports other findings that speakers produce more pronouns when there are fewer characters in the discourse to compete with each other (Arnold & Griffin, 2007), and when memory resources are not devoted to a secondary task (Griffin & Arnold, 2008). Likewise, speakers' prosodic choices are influenced by both communicative goals and speaker-internal processing load (Watson et al., 2008). Thus, while our findings do not preclude the possibility that speakers sometimes choose expressions on the basis of the addressee's needs, they are also consistent with a growing body of evidence that production choices are often more sensitive to speaker-internal constraints (Arnold, Wasow, Asudeh, & Alrenga, 2004; Ferreira & Dell, 2000; Ferriera, 2003; Ferreira, Slevc, & Rogers, 2005; Horton & Keysar, 1996).

In summary, the results of our study have implications for both questions about how autism impacts language production processes, and the processes involved in reference production more generally. Our study provides arguably the most detailed (to date) discourse analysis of referential choices for individuals with autism. With this approach, we identified the tendency for our younger participants with autism to overspecify references in the conditions where the discourse context was less constraining. This finding demonstrated the importance of

utilizing fine-grained linguistic analyses to identify specific areas where the speech of autism is likely to be affected.

The focus of our study was identifying potential processing differences between children with and without autism. But our results also have implications for the understanding of the processes involved in reference production more generally. There was clear support for recent suggestions that cognitive load affects referential choices (Arnold & Griffin, 2007; Griffin & Arnold, 2008; Watson, et al., 2008). If we assume that our autism group was representative of the overall population and had some degree of mentalizing deficit, our results also suggest that theory-of-mind problems do not result in a wholesale failure to choose contextually appropriate expressions.

We also established that referential problems for high-functioning children with autism are likely to occur in the direction of overspecification. This runs counter to the prediction that referential failure is most likely to result in uninterpretable references. Instead, it suggests that the differences associated with autism are not really failures at all. Overspecified references may sound clumsy or pedantic, but ultimately result in the listener successfully understanding the message. This is consistent with other descriptions of the pragmatic linguistic choices associated with autism (e.g., Ghaziuddin & Gerstein, 1996; Wing, 1981), but is not evidence of insensitivity to the appropriate use of reference. The identification of this processing difference establishes a contrast that may assist in the development of a language phenotype for autism, as well as the development of clinical treatments.

Appendix

Examples of narrations of the first episode of *Canary Row*.

(1) Autism, age 14; participant with the median narrative length in Autism group (total length = 63 clauses)

oh boy here we go again.

um Sylvester wanted to &s get Tweety bird.

and he was in a cage at the broken arms hotel.

and Sylvester was at thiy bird watcher's anominous place across the street.

and he tried going through the front door

to get the bird.

but this guy kicked him out.

so then he tried the gutter.

and he went up there.

and he tried to get him.

but the old lady kicked him out.

and then that's about all I've seen so far.

(2) Control, age 10; participant with the median narrative length in Control group (total length = 83 clauses)

ok the cat um or the putty cat uh goes to this bird watchers society.

and uh he &h gets a &p pair of binoculars

and looks through them

and sees

and looking for uh a bird to eat.

and he sees Tweety.

and then Tweety sees him through her pair of binoculars.

and she's you know, screaming for help.

but the cat comes the cat comes.

and uh well he goes into the place where she's staying

and gets &g kicked out

because it says no dogs or cats allowed.

so then the next part is uh

&a and then he tries again climbing up ay um uh climbing up a like a

um, what is it called.,

like uh where water would come through.

and she climbs up that

and goes so where she is.

and and Tweety is singing a song.

and he's acting like the conductor.

and then &w she then she notices him

and she gets out of &th she gets out of the cage.

and the cat goes after him.

and then the granny gets him

and throws him out of the &w where they're staying.

and he falls in a pile of cans

and that's the story.

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References

American Psychiatric Association. (2000). *The Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition*. Washington, DC: American Psychiatric Association Press.

Ariel, M. (1990). *Accessing noun-phrase antecedents*. London: Routledge.

Arnold, J. E. (1998). Reference form and discourse patterns (Doctoral dissertation, Stanford University, 1998). *Dissertation Abstracts International, 59,* 2950.

Arnold, J. E. (2001). The effect of thematic roles on pronoun use and frequency of reference continuation. *Discourse Processes, 31,* 137–162.

Arnold, J. E. (2003). Multiple constraints on reference form: Null, pronominal, and full reference in Mapudungun. In J. W. Du Bois, L. E. Kumpf, & W. J. Ashby (Eds.), *Preferred argument structure: Grammar as architecture for function*. Philadelphia: John Benjamins.

Arnold, J. E. (2008). Reference Production: Production-internal and Addressee-oriented Processes. *Language and Cognitive Processes*, 23, 495-527.

Arnold, J. E., & Griffin, Z. (2007). The effect of additional characters on choice of referring expression: Everyone competes. *Journal of Memory and Language*.

Arnold, J. E., Wasow, T., Asudeh, A., & Alrenga, P. (2004). Avoiding attachment ambiguities: The role of constituent ordering. *Journal of Memory and Language, 51,* 55–70.

Babwah, L. (2008). Distraction and its effects on reference processes and audience design. Unpublished Honors Thesis, University of North Carolina at Chapel Hill.

Baldwin, D. A. & Tomasello, M. (1997). Word Learning: A Window on Early Pragmatic Understanding. Proceedings from the 29th Child Language Research Forum. E. V. Clark. Stanford, CSLI publications.

Baldwin, D. A. (1991). Infants' contribution to the achievement of joint reference. *Child Development, 62,* 875-890.

Baldwin, D. A., (1993). Infants' ability to consult the speaker for clues to word reference. *Journal of Child Language, 20,* 395-418.

Baltaxe, C.A.M. (1977). Pragmatic deficits in the language of autistic adolescents. *Journal of Pediatric Psychology, 2*, 176-180.

Bard, E. G., & Aylett, M. P. (2004). Referential form, word duration, and modeling the listener in spoken dialogue. In J. C. Trueswell & M. K. Tanenhaus (Eds.), *Approaches to*

studying world-situated language use: Bridging the language-as-product and language-as-action traditions (pp. 173-191). Cambridge, MA: MIT Press.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind.* Cambridge, MA: MIT Press.

Baron-Cohen, S. Wheelwright, S., Hill, J., Yogini, R., & Plumb, I. (2001). The 'Reading the Mind in the Eyes' Test Revised Version: A study with normal adults, and adults with Asperger Syndrome or High-Functioning Autism. *Journal of Child Psychiatry and Psychiatry*, *42*, 241-252.

Baron-Cohen, S., Baldwin, D. A., & Crowson, M. (1997). Do children with autism use the speaker's direction of gaze strategy to crack the code of language? *Child Development*, *68*, 48-57.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition, 21*, 37-46.

Beattie, G. W. (1979). Planning units in spontaneous speech: Some evidence from hesitation in speech and speaker gaze direction in conversation. *Linguistics, 17,* 61-78.

Bennetto, L., Diehl, J. J., & Arnold, J. E. (under review). *Local and global planning in the narratives of children with high-functioning autism.* Unpublished manuscript, University of Rochester.

Bennetto, L., Pennington, B.F., & Rogers, S.J. (1996). Intact and impaired memory functions in autism. *Child Development*, *67*, 1816-1835.

Berument, S.K., Rutter, M., Lord, C., Pickles, A., & Bailey, A. (1999). Autism Screening Questionnaire: Diagnostic validity. *British Journal of Psychiatry*, *175*, 444-451.

Bortfeld, H., Leon, S. D., Bloom, J. E., Schober, M. F., & Brennan, S. E. (2000). Disfluency rates in conversation: Effects of age, relationship, topic, role, and gender. *Language and Speech, 32,* 229-259.

Brennan, S. E. (1995). Centering attention in discourse. *Language and Cognitive Processes, 102,* 137–167.

Brennan, S. E., Friedman, M. W., & Pollard, C. J. (1987). A centering approach to pronouns. In *Proceedings from the 25th annual meeting of the Association for Computational Linguistics* (pp. 155–162). San Francisco: M. Kaufmann.

Brent, E., Rios, P., Happé, F., & Charman, T. (2004). Performance of children with autism spectrum disorder on advanced theory of mind tasks, *Autism*, *8*, 283-299.

Bruner, J., & Feldman, C. (1993). Theories of mind and the problem of autism. In S. Baron-Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.), *Understanding other minds: Perspectives from autism* (pp. 267–291). Oxford: Oxford University Press.

Chafe, W. L. (1976). Givenness, contrastiveness, definiteness, subjects, topics, and point of view. In C. N. Li (Ed.), *Subject and topic* (pp. 25–56). New York: Academic Press.

Chafe, W. L. (1994). *Discourse, consciousness, and time*. Chicago: Chicago University Press.

Clark, H. H., & Fox Tree, J. E. (2002). Using *uh* and *um* in spontaneous speaking. *Cognition, 84*, 73-111.

Clark, H. H., & Krych, M. A. (2004). Speaking while monitoring addressees for understanding. *Journal of Memory and Language, 50*, 62-81.

Clark, H. H., & Wasow, T. (1998). Repeating words in spontaneous speech. *Cognitive Psychology*, *37*, 201-242.

Cohen, J., & Cohen, J. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences*, 3rd ed. Mahwah, N.J.: L. Erlbaum Associates. Probably a newer edition, but I don't have it.

Diehl, J. J., Bennetto, L., & Young, E. C. (2006). Story recall and narrative coherence of high-functioning children with autism spectrum disorders. *Journal of Abnormal Child Psychology, 34*, 87-102.

Du Bois, J. W. (1987). The discourse basis of ergativity. *Language*, *63*, 8095-855.

Dunn, L.M., & Dunn, L.M. (1997). *Peabody Picture Vocabulary Test, 3rd Ed.* Circle Pines, MN: American Guidance Services.

Ferreira, V. S. (2003). The persistence of optional complementizer production: Why saying 'that' is not saying 'that' at all. *Journal of Memory and Language, 48,* 379–398.

Ferreira, V. S., & Dell, G. S. (2000). Effect of ambiguity and lexical availability on syntactic and lexical production. *Cognitive Psychology, 40,* 296–340.

Ferreira, V. S., Slevc, L. R., & Rogers, E. S. (2005). How do speakers avoid ambiguous linguistic expressions? *Cognition, 96,* 263–284.

Fisher, N., Happé, F., Dunn, J. (2005). The relationship between vocabulary, grammar, and false belief task performance in children with autistic spectrum disorders and children with moderate learning difficulties. *Journal of Child Psychology and Psychiatry*, 46 (4), 409-419.

Ford, M. (1982). Sentence planning units: Implications for the speaker's representation of meaningful relations underlying sentences. In J. Bresnan (Ed.), *The mental representation of grammatical relations* (pp. 797-827). Cambridge, MA: MIT Press.

Fox Tree, J. E., & Clark, H. H. (1997). Pronouncing "the" as "thee" to signal problems in speaking. *Cognition, 62,* 151-167.

Francik, E. P. (1985). Referential choice and focus of attention in narratives (discourse anaphora, topic continuity, language production) (Doctoral dissertation, Stanford University, 1985). *Dissertation Abstracts International, 46*(04), 1363.

Ghaziuddin, M., & Gerstein, L. (1996). Pedantic speaking style differentiates asperger syndrome from high-functioning autism. *Journal of Autism and Developmental Disorders*, 26, 585-595.

Givón, T. (1983). Topic continuity in discourse: An introduction. In T. Givón (Ed.), *Topic continuity in discourse: A quantitative cross-language study* (pp. 1–42). Amsterdam: John Benjamins Publishing.

Goldman-Eisler, F. (1968). *Psycholinguistics: Experiments in spontaneous speech*. London: Academic Press.

Gordon, P. C., Grosz, B. J., & Gilliom, L. A. (1993). Pronouns, names, and the centering of attention in discourse. *Cognitive Science, 17,* 311–347.

Griffin, Z. M., & Arnold, J. E. (2008, March). Cognitive resources modulate pronoun use. Paper; CUNY conference on human sentence processing, Chapel Hill, NC.

Grosz, B. J., Joshi, A. K., & Weinstein, S. (1995). Centering: A framework for modeling the Local Discourse. *Computational Linguistics, 21*(2), 203-225.

Gundel, J. K., Hedberg, N., & Zacharski, R. (1993). Cognitive status and the form of referring expressions. *Language, 69,* 274–307.

Gundel, J. K., Ntelitheos, D., & Kowalsky, M. (2007). Children's use of referring expressions: Some implications for Theory of Mind. In D. Bittner & N. Gagarina (Eds.), *ZAS Papers in Linguistics: Intersentential Pronominal Reference in Child and Adults Langauge. Proceedings of the Conference on Intersentential Pronominal Reference in Child and Adult Language, 48.*

Hale, C. M. & Tager-Flusberg, H. (2005). Social communication in children with autism: The relationship between theory of mind and discourse development. *Autism*, *9*, 157-178.

Happé, F. (1993). Communicative competence and theory of mind in autism: A test of relevance theory. Cognition, 48(2), 101-119.

Happé, F. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped and normal children and adults. *Journal of Autism and Developmental Disorders, 24,* 129-154.

Happé, F. (1995). The Role of Age and Verbal Ability in the Theory of Mind Task Performance of Subjects with Autism. *Child Development*, 66 (3), 843-855.

Hickmann, M., & Hendriks, H. (1999). Cohesion and anaphora in children's narratives: a comparison of English, French, German, and Mandarin Chinese. *Journal of Child Language*, *26*, 419-452.

Hill 2004, Evaluating the theory of EF deficits in autism, *Developmental Review*, 189–233.

Horton, W. S., & Keysar, B. (1996). When do speakers take into account common ground? *Cognition, 59,* 91–117.

Hudson-D'Zmura, S. & Tanenhaus, M. K. (1998). Assigning antecedents to ambiguous pronouns: The role of the center of attention as the default assignment. In M. Walker, A. Joshi, & E. Prince (Eds.), *Centering theory in discourse* (pp. 199-226). Oxford: Oxford University Press.

Hughes, C., Russell, J., & Robbins, T.W. (1994). Evidence for executive dysfunction in autism. *Neuropsychologia*, 32, 477-492.

Joseph, R.M., McGrath, L.M., & Tager-Flusberg (2005). Executive dysfunction and its relation to language in children with autism. *Developmental Neuropsychology*, 27, 361-378.

Joseph, R.M., Steele, S.D., Meyer, E., & Tager-Flusberg, H. (2005). Self-ordered pointing in children with autism: failure to use verbal mediation in the service of working memory? *Neuropsychologia*, *43*, 1400-1411.

Kaland, N., Callesen, K., Møller-Nielsen, A., Mortensen, E. L., & Smith, L. (2008). Performance of children and adolescents with asperger syndrome or high-functioning autism on advanced theory of mind tasks. *Journal of Autism Developmental Disorder* 38, 1112-1123.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*, 217-250.

Karmiloff-Smith, A. (1985). Language and cognitive processes from a developmental perspective. *Language and Cognitive Processes, 1* (1), 61-85.

Kleinman, J., Marciano, P. L. & Ault, R. L. (2001). Advanced theory of mind in high-functioning adults with autism. Journal of Autism and Developmental Disorders, 31, 29-36.

Landa, R., Martin, M., Minshew, N., & Goldstein, G. (1995). *Discourse and abstract language ability in non-retarded individuals with autism*. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Indianapolis, IN.

Lee, A., Hobson, R.P., & Chiat, S. (1994). I, you, me and autism: An experimental study. *Journal of Autism and Developmental Disorders, 24,* 155-176.

Levelt, W. J. M. (1989). *Speaking*. Cambridge, MA: MIT Press.

Lord, C., Rutter, M., DiLavore, P.C., & Risi, S. (1999). *Autism Diagnostic Observation Schedule*. Los Angeles, CA: Western Psychological Services.

Losh, M., & Capps, L. (2003). Narrative ability in high-functioning children with autism or Asperger's syndrome. *Journal of Autism and Developmental Disorders*, *33*, 239-251.

Mann, T. & Walker, P. (2007). Autism and a deficit in broadening the spread of visual attention. *Journal of child psychology and psychiatry and allied disciplines*, 44, 274-284.

McNeill, D. (1992). *Hand and mind: What gestures reveal about thought*. Chicago: University of Chicago Press.

Minshew, N. J., & Goldstein, G. (2001). The pattern of intact and impaired memory functions in autism. *Journal of Child Psychology and Psychiatry, 42,* 1095-1101.

Nadig, A., Vivanti, G., & Ozonoff, S. (2008). Adaptation of object descriptions in typical development and in high-functioning autism. Paper presented at the 21st annual CUNY conference on human sentence processing, Chapel Hill, NC.

Ozonoff, S., & Strayer, D.L. (2001) Further evidence of intact working memory in autism, *Journal of Autism and Developmental Disorders*, 31, 257–263.

Ozonoff, S., Cook, I., Coon, H., Dawson, G., Joseph, R.M., Klin, A., et al. (2004). Performance on Cambridge Neuropsychological Test Automated Battery subtests sensitive to frontal lobe function in people with autistic disorder: Evidence from the Collaborative Programs of Excellence in Autism Network. *Journal of Autism and Developmental Disorders*, 34, 139-150.

Preissler, M. A., & Carey, S. (2005). The role of inferences about referential intent in word learning: Evidence from autism. *Cognition*, *97*, B13-B23.

Rapin, I. & D.A. Allen. (1988). Syndromes in developmental dysphasia and adult aphasia. In F. Plum (Ed.), *Language, communication, and the brain* (pp. 57-75). New York, NY: Raven Press.

Russell, J. (1997). *Autism as an executive disorder*. Oxford: Oxford

University Press.Russell, J., Jarrold, C. & Henry, L. (1996). Working memory in children with autism and with moderate learning difficulties. *Journal of Child Psychology and Psychiatry*, 37, 673-686.

Rutherford, M.D., Baron-Cohen, S., & Wheelwright, S. (2002). Reading the mind in the voice: A study with normal adults and adults with asperger syndrome and high funcitoning autism. *Journal of Autism and Developmental Disorders, 32,* 189-194.

Rutter, M., LeCouteur, A., & Lord, C. (2003). *Autism Diagnostic Interview-Revised*. Los Angeles: Western Psychological Services.

Siegman, A. W. (1979). Cognition and hesitation in speech. In A. W. Siegman, & S. Feldstein (Eds.), *Of speech and time: Temporal speech patterns in interpersonal contexts* (pp. 151-178). Hillsdale, NJ: L. Erlbaum Associates.

Stevenson, R. J., Crawley, R. A., & Kleinman, D. (1994). Thematic roles, focus and the representation of events. *Language and Cognitive Processes, 9,* 473-592.

Tager-Flusberg, H. (1995). 'Once upon a ribbit': Stories narrated by autistic children. *British Journal of Developmental Psychology*, *13*, 45-59.

Tager-Flusberg, H. (1999). A psychological approach to understanding the social and language impairments of autism. *International Review of Psychiatry, 11*, 325-334.

Tager-Flusberg, H. (2001a). Understanding language and communication impairments in autism. *International Review of Research in Mental Retardation*, *23*, 185-205.

Tager-Flusberg, H. (2001b). A re-examination of the theory of mind hypothesis of autism. In J. Burack, T. Charman, N. Yirmiya, & P. Zelazo (Eds.), *The development of autism: Perspectives from theory and research* (pp. 173-193). Mahwah, NJ: Lawrence Erlbaum Associates.

Tager-Flusberg, H., & Anderson, M. (1991). The development of contingent discourse ability in autistic children. *Journal of Child Psychology and Psychiatry*, *32*, 1123-1134.

Tager-Flusberg, H., & Joseph, R. (2003). Identifying neurocognitive phenotypes in autism. Philosophical Transactions of the Royal Society, Series B, *358*, 303-314.

Tager-Flusberg, H., Paul, R., & Lord, C. (2005). Language and communication in autism. In F.R. Volkmar, A. Klin, & D.J. Cohen (Eds.), *Handbook of autism and pervasive developmental disorders: Diagnosis, development, neurobiology, and behavior* (Vol. I, pp 335-364). Hoboken, N.J.: John Wiley and Sons, Inc.

Townsend, J., Harris, N. S., & Courchesne, E. (1996) Visual attention abnormalities in autism: Delayed orienting to location. Journal of the International Neuropsychological Society, 2, 541-50.

Turner, M. (1997). Towards an executive dysfunction account of repetitive behavior in autism. In J. Russell (Ed.), *Autism as an executive disorder* (pp. 57-100). New York: Oxford University Press.

Van der Meulen, F. F., Meyer, A. S., & Levelt, M. J. M. (2001). Eye movements during the production of nouns and pronouns. *Memory and Cognition*, *29*, 512-521.

Watson, D. G., Arnold, J. E., & Tanenhaus, M. K. (in press). Tic tac TOE: Effects of predictability and importance on acoustic prominence in language production. *Cognition.*

Watson, D., & Gibson, E. (2004). The relationship between intonational phrasing and syntactic structure in language production. *Language and Cognitive Processes*, *19*, 713–755.

Weber, E. G. (2003). Nominal information flow in the talk of two boys with autism. In J. W. Du Bois, L. E. Kumpf, & W. J. Ashby (Eds.), *Preferred argument structure: Grammar as architecture for function*. Philadelphia: John Benjamins.

Wechsler, D. (1991). *Wechsler Intelligence Scale for Children-Third Edition*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale-Third Edition.* San Antonio, TX: The Psychological Corporation.

Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: Bradford Books/MIT Press.

Wellman, H. M., & Liu, D. (2004). Scaling of theory-of-mind tasks. *Child Dvelopment, 75,* 523-541.

Winer, B. J., Brown, D. R., & Michels, K. M. (1991). *Statistical principles in experimental design (3rd ed.)*. New York: McGraw-Hill.

Wing, L. (1981). Asperger's syndrome: A clinical account.*Psychological Medicine, 11*, 115–129.

Young, E.C., Diehl, J.J., Morris, D., Hyman, S.L., & Bennetto, L. (2005). The use of two language tests to distinguish pragmatic language problems in children with autism spectrum disorders. *Language, Speech, and Hearing Services in Schools, 36*, 62-72.