LISTENER VS. SPEAKER-ORIENTED SPEECH

LISTENER VS. SPEAKER-ORIENTED SPEECH:

STUDYING THE SPEECH OF INDIVIDUALS WITH AUTISM

By

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Listener vs. speaker-oriented speech: Studying the language of individuals with autism

There are many mechanisms speakers utilize in conversation that aid a listener's understanding. However, there are also many characteristics of speech where it is unclear whether they serve listener or speaker-oriented functions. For example, speakers frequently produce disfluencies such as "um or "uh," which are helpful to listeners, indicating that the speaker is not finished speaking yet. We do not know, however, if these are used intentionally to aid listeners. In addition, the tendency to place animate items as sentential subjects may benefit either speaker or listener. Since individuals with autism engage in minimal listener-oriented behaviour, they are a useful group to differentiate these functions. Results showed that individuals with autism used fewer ums and uhs, and more silent pauses than controls, but used animacy similarly. This suggests that the use of ums and uhs is for the benefit of listeners, but the bias toward animate subjects is not.

Key words: Autism; Pragmatics; Disfluencies; Word order; Animacy; Language production

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The mechanisms underlying language production and comprehension during a conversation are highly complex and intricately coordinated, yet they are largely effortless processes. One question that arises is to what extent this ease of communication is due to the work being done by the speaker or by the listener, the latter often in spite of a speaker's failure to be helpful. The goal here is to identify what aspects of a speaker's behaviour can be identified as cooperative, or otherwise. In the past, some approaches to this problem have involved referential communication tasks where eye-tracking, naming experiments, and object identification tasks have been used to better understand the roles of the speaker and listener in communicative exchanges (see Girbau, 2001; Mangold & Pobel, 1988). Results of this research have succeeded in determining which aspects of speech are helpful for a listener, but it remains unclear to what extent this is being done by the speaker for the benefit of the listener (i.e., is listener-oriented), or whether it is merely a regularity in the speaker's behaviour that a listener can exploit, and is not performed by the speaker with the listener's needs in mind (speaker-oriented) (see Bock, 1996; Brennan & Clark, 1996; Fox Tree & Schrock, 1999). Hand gestures, head nods, and even ums and uhs in everyday conversation convey important information to the listener. These communicative events tell us that the listener has understood what was said and also enable the speaker to express themselves (Pérez-Quiñones & Sibert, 1996). The present experiment tests a group of individuals with autism to help tease apart what discourse behaviour is actually being done by the speaker for the listener's benefit, regardless of whether listeners are able to use it to aid comprehension. Specifically, we make the assumption (detailed further below) that individuals with autism spectrum disorders will not tend to display elements of speech that are listener-oriented.

The present study examines two phenomena – the role of disfluencies in speech, including ums and uhs, and the role of animacy. Recent research has suggested that disfluencies or filled-pause words may not be as useless as we often think they are – they can actually be quite helpful in conversations as they can indicate that the speaker is not finished speaking yet and is trying to put together their next thought or find the correct word (Fox Tree, 2001). The current experiment will extend this research and examine the use of filled-pause words in the conversation of control subjects and subjects with autism to determine whether these words are utilized by a speaker for the benefit of a listener. Secondly, this experiment will study the tendency of native English speakers to make word order choices that result in the subject of a sentence being animate entities (Bock, Loebell & Morey, 1992) and establish if this bias is also observed in individuals with autism. Again, this allows us to ascertain whether these structures are produced by speakers for the benefit of a listener, or is simply a bias of the speaker's own language production system. In addition, we compare the role of animacy in the world-view and in the language production system of individuals with autism.

It is widely accepted that individiuals with autism display a variety of impairments in many areas including social skills, symbolic play, and language development. However, little is known with regard to its cause. Do these symptoms reflect a specific language deficit, a social deficit, or a more general cognitive deficit? One of the most profound characteristics of individuals with autism is a failure to develop social relationships, often resulting from an inablity to engage in cooperative group play (Dawson & Fernald, 1987). Individuals with autism have particular difficulty with social interactions involving joint attention behaviours including eye contact, affect, and gestures aimed at sharing experiences with others. It has been suggested by some researchers that these deficits may be a reflection of problems in taking the perspective of another person, a key component of social development. This notion has translated into a "theory of mind" hypothesis, describing how children with autism are unable to form representation of another's mental state (Baron-Cohen, 1995). Theory of mind, and consequently, the ability to understand and acknowledge the perspective of another is also a critical aspect of language development and use, specifically with regard to pragmatics. Pragmatics in language is defined as the use of speech and gesture in a communicative way appropriate to the social context (Baron-Cohen, 1988). In order to use pragmatics effectively, a person must possess the ability to recognize the listener's perspective and knowledge, a task that is often referred to as establishing 'common ground' (Clark & Fox Tree, 2002). Common ground involves understanding the speaker's intention and beliefs such that a shared understanding of mental state is developed (Ziatas, Durkin, & Pratt, 2003). Typical speakers are generally very good at using this knowledge and carry on conversations with little effort (e.g. Brennan & Clark, 1996). In contrast, individuals with autism have difficulty understanding the thoughts, knowledege, and beliefs of other people which can make conversing with others challenging. Baltaxe (1977) conducted a study examining the role of given and new information in the conversation of five adolescents with autism. In dialogue, given information provides the required 'background' against which new information is foregrounded. New information eventually becomes given when the speaker and listener have established what is being discussed and the the syntatic devices used to discuss new and given information typically differ. In her study, Baltaxe discovered that autistic participants failed to foreground and background their utterances such that listeners were unable to differentiate between new and given information. In addition, when referring to a previous conversation, autistic participants were unable to distinguish between utterances they had spoken and utterances someone else had spoken (Baltaxe, 1977). Wetherby and Prutting (1984) conducted a similar study examining the use of pragmatics in the language of children with autism. Results of their research determined that compared to the language of typically-developing children, children with autism showed higher frequencies of requesting objects and actions, protesting, and non-focused utterances. Furthermore, unlike the typically-developing children, those with autism were not observed to request information, acknowledge others, show off, comment, or label, and they generally exhibited a narrower range of communicative abilities (Wetherby & Prutting, 1984). To further investigate the language capabilities of children with autism, Ziatas, Durkin, and Pratt (2003) conducted a study examining whether theory of mind ability was related to communicative competence. As predicted, the majority of children with autism in this experiment failed the theory of mind task and rarely referred to the mental landscape of the shared communicative context. Participants with autism also employed significantly fewer explanations, descriptions, and reports of internal states. Finally, children with autism rarely referred to their own or another's thoughts or beliefs

(Ziatas, Durkin, & Pratt, 2003). The language of children with autism therefore appears to be more self-focused and directed at obtaining desired objects, whereas typically developing children are more likely to engage in reciprocal conversation involving the listener.

Overall, we see that even very high functioning individuals with autism, who are not judged to be language impaired by usual measures, nonetheless use language from a more egocentric viewpoint; they do not tend to take listener's knowledge, points of view, or comprehension needs into consideration. Therefore, this group presents an excellent opportunity to explore which functions of language are produced by a speaker for the benefit of the listener, and which are independent of the perceived needs of the listener. Specifically, we predict that if high-functioning individuals with autism are seen to produce specific pragmatic aspects of speech at a rate comparable to that of controls without autism, that feature is likely the result of speaker-oriented processes, and is not being done for the benefit of the listener. Conversely, for those pragmatic aspects of speech that are relatively absent in an individual with autism, this constitutes some evidence that this feature may be listener-oriented in normal speech.

It has been suggested that the use of filled-pause words or disfluencies in normal speech, such as um and uh, may represent an important role in conversation and establishing common ground. Fox Tree (2001) examined the effect of ums and uhs during on-line processing of speech. Results of this research suggest that um and uh may be utilized by a listener to facilitate conversations. Uh appeared to signal an upcoming short delay, while um an upcoming longer delay. The use of uh was found to increase the speed at which listeners were able to recognize words in upcoming speech, however, um had no effect on listeners' speech recognition (Fox Tree, 2001, 2002). Fox Tree suggests that ums and uhs help listeners by alerting them that the speaker is still speaking (that it is not the listener's turn yet) and indicating the length of the upcoming delay in speech. However, we do not know if speakers are intentionally using this function of speech to aid the listener or if this is merely a regularity in the speaker's behaviour that listeners are able to take advantage of. By studying the speech of individuals with autism, who by definition are unlikely to engage in listener-oriented functions of speech, we can determine whether these types of disfluences are a speaker- or listener-oriented function of language production.

The other aspect of speech investigated here is the role of animacy in sentence formation. Native English speakers have a strong preference to form active sentences where the subject is the agent and the object is the patient, e.g., [The boy]$_{SUBJ}$ [hit$_{VERB}$ [the ball]$_{OBJ}$], rather than passives, e.g. [The ball]$_{SUBJ}$ [[was hit]$_{VERB}$ by [the boy]$_{OBJ}$] (Goldman-Eisler & Cohen, 1970). However, when the agent is nonliving/inanimate and the patient is living/animate, English speakers reverse this, and demonstrate a strong preference to form passive sentences e.g. "[The boy]$_{SUBJ}$ [[was hit]$_{VERB}$ by [the ball]$_{OBJ}$], instead of the active version, here "[The ball]$_{SUBJ}$ [hit$_{VERB}$ [the boy]$_{OBJ}$] (Bock, Loebell & Morey, 1992). McDonald, Bock, and Kelly (1993) examined the effects of animacy, word length, and prosody on word order to further investigate this bias. Results of their research indicate that while animate nouns have a tendency to appear as subjects, this preference does not occur in the case of conjunctions within sentences. Therefore, the observed bias toward animate subjects appears to be a consequence of grammatical role assignment and not word ordering (McDonald, Bock, & Kelly, 1993). It has been hypothesized that faster activation of animate subjects over inanimate subjects may serve as one explanation of this phenomenon (Altmann & Kemper, 2006). Bock and Warren (1985) further suggest that the speed of activation is dependent upon conceptual accessibility. Conceptual accessibility refers to the ease with which the mental representation of something can be activated or retrieved from memory (Bock & Warren, 1985). Given that there is a strong tendency to learn animate nouns early in life and that in typically developing children knowledge of animate nouns exceeds knowledge of inanimates (Altmann & Kemper, 2006), it follows that these concepts would be more accessible and retrieved faster.

To investigate the development of children's vocabulary, Tomasello and Farrar (1986) conducted a study which examined the relationship between the attentional focus of a mother and child on an object and the ensuing utterances produced. Results of this experiment demonstrated that "words referring to objects on which the child's attention was already focused were learned better than words presented in an attempt to redirect the child's attentional focus" (Tomasello & Farrar, 1986, p.1454). For typically developing children, animate objects are the focus of attention more often than inanimate objects. Since these children are attending to animate items more frequently their learning of these concepts is also greater.

Although we know that native English speakers have a strong tendency to use animate subjects when speaking, there does remain some ambiguity as to why it occurs. It could be that using an animate subject is the result of a speaker oriented cognitive shortcut whereby the activation of animate objects is more readily available, and it is therefore most efficient for the speaker to place items as soon as they are activated into a sentence that is being constructed incrementally. However, it may also be that the use of animate subjects serves the purpose of a discourse function employed for the benefit of the listener, similar to the foregrounding and background of information, or the placement of given and new information, which individuals with autism do not seem to do (Baltaxe, 1977). If this discourse function is in fact for the benefit of the listener, we would predict that individuals with autism would not show this same preference for animate sentential subjects, but if it is simply a speaker-oriented behaviour, we would predict no difference between groups.

There is also a secondary reason for investigating the role of animacy in speech production among individuals with autism. It is well known that individuals with autism do not attend to social stimuli as much as typically developing children (Dawson & Fernald, 1987). Furthermore, individuals with autism frequently exhibit deficits in discriminating animate and inanimate objects, possibly as a result of their inexperience with animacy (Rutherford, Pennington, & Rogers, 2004). Taken together, children with autism are less likely to orient toward social or animate stimuli, and we predict that therefore their vocabulary and or conceptual accessibility for these concepts should also be lower. Since adult individuals with autism may neither have had the same experience as typically developing children with animate or social objects, nor a currently existing attentional bias towards animate objects, they may not possess the same preference toward animate subjects when forming sentences.

There are therefore two potential reasons why autistic participants might fail to show an animacy effect on grammatical role assignment – either due to a lack of listener-oriented perspective, or a more basic lack of orientation towards animate objects. However, if autistic participants do in fact demonstrate the same animacy effect, as controls, we can still conclude that the animacy effect must not be a listener-oriented phenomenon.

In summary, the goal of the present experiment is to investigate the role of listener and speaker-oriented aspects of speech. Specifically, we will examine the tendency to utilize animate subjects when speaking as well as the role of disfluencies in conversation, and discern whether these features of speech serve listener or speaker-oriented functions by looking at their occurrence, (or lack of occurrence) in the speech of autistic participants, who by definition should not show listener-oriented tendencies.

Method

Participants

Participants with autism were recruited from a facility in Hamilton providing services and support to high-functioning individuals with autism and Asperger's syndrome. Fourteen native English speaking individuals with autism (thirteen male and one female) took part in the experiment, all of whom had been diagnosed with autism by an outside agency. The mean age of participants with autism was 27 years, with a range of 19-35. Wechsler Adult Intelligence (WAIS) scores were obtained for participants with autism with an average full scale IQ of 93 and a range of 75 to 112. For the purpose of comparison, fourteen age- and gender-matched control participants also took part in the experiment. Control participants were native English speaking students of McMaster University and members of the community who volunteered to participate in the study. It is important to note that the groups were not matched on the basis of IQ. IQ information was not obtained for control participants, nor were the participants matched in terms of education level. What limitations this may present for the current study will be addressed in the discussion.

Materials

A binder containing 24 simple line drawings and 11 printed filler sentences, each on a separate page, was presented to all participants. Each picture portrayed an entity (thematically, the agent) doing an action to a second entity (the patient), that could be described with either an active or a passive sentence. Six of the pictures depicted an animate agent and an inanimate patient, and six of the pictures depicted an inanimate agent and an animate patient (refer to Table 1). The remaining twelve pictures displayed an agent and patient of matching animacy. The items in each picture were of similar phonological difficulty and familiarity.

Participants were instructed to describe aloud in one sentence what was happening in each picture without using any adjectives or pronouns. No instruction was given with regard to form or content of descriptions and participants were told there was no wrong answer. For the printed filler sentences, participants were instructed to read the sentences aloud. Of the eleven sentences, nine of them were intransitive and two of them were passive. One sentence appeared after every two or three pictures.

A spontaneous language sample was also obtained by means of a 5-10 minute recorded conversation. Participants were asked a variety of general questions related to their interests and hobbies. Following each question, participants were given 5 seconds to respond before the experimenter used further prompting to achieve a reply. The timing was not measured exactly, it was estimated by the trained experimenters. The same set of questions was used for both groups and all conversations were recorded by a digital recording device. Two experimenters listened to these recordings and transcribed the conversations using S.A.L.T. computer software (Systematic Analysis of Language Transcripts) (Miller & Chapman, 1983). Transcriptions were completed independently and then compared, with discrepancies resolved by one of the original transcribers. As per S.A.L.T. conventions, the first 49 utterances produced by each participant were analyzed using S.A.L.T. guidelines with regard to syntactic, phonological, semantic, and pragmatic properties. Utterances were further categorized according to the number of revisions, repetitions, filled-pauses (ums and uhs) and silent pauses (greater than two seconds).

Results

Picture Descriptions

Both groups of participants demonstrated a strong preference to form sentences with an animate subject, whether it resulted in an active or passive structure (see Figures 1). When the agent was animate and the patient inanimate, as in the example of the dinosaur stepping on the house, 97.4% of utterances from participants with autism and 96.6% of utterances from control participants described the picture using an active sentence (which therefore has an animate subject). In the case of the agent being inanimate and the patient being animate, as in the example of the boy being hit by the ball, 20% of the time participants with autism, and 13% of the time, control participants described the picture using an active structure making the inanimate agent the subject. Conversely, this meant that these pictures were described with passive structures (with an animate subject) 80% and 87% of the time, respectively. All calculations are based on the formula of number of active sentences divided by number of active plus passive sentences, excluding utterances that were of other structures, primarily sentence fragments. To test for significance, a one-way analysis of variance was conducted to examine the effects of group (autistic vs. control participant) and animacy (agent vs. patient animacy), with the proportion of active sentences produced as the dependent measure. There was a large main effect of animacy, with 97% active sentences when the agent was animate, and 14% when the patient was animate, $F(1, 20) = 86.82, p < .0001$. There was also a small but significant main effect of group, where the autistic participants produced 56% actives overall, and controls produced 54% actives, $F(1, 20) = 4.75, p = .04$. Finally, there was also a significant interaction between animacy and group, $F(1, 20) = 7.35, p = .013$. Although the interaction was significant, both groups exhibited a striking bias toward placing the animate entity in the subject position, even when it meant reversing the language-general preference for active sentences. However, on one item individuals with autism displayed the opposite trend, a strong tendency to form active sentences when the subject was inanimate. This item involved a picture of an alarm clock and a boy. In this case, individuals with autism frequently produced the active utterance "the alarm clock woke up the boy." After this item was taken out of the analysis for both groups, there was no significant interaction between animacy and group $F(1, 20) = .521, p = .479$, or main effect of group $F(1, 20) = 1.082, p = .311$.

Conversation Sample

S.A.L.T. analysis yielded a mean length of utterance (MLU) for control participants of 9.12 words, and for participants with autism, 5.92 words. Participants with autism tended to answer questions with shorter responses, particularly one-word replies. However, even when one-word utterances were excluded from the analysis, the MLU for control participants was still larger, ranging from 7.65 to 11.45 compared to 4.55 to 8.76 for participants with autism. An informal analysis of the conversation samples of participants with autism revealed no obvious deficits, and semantic and syntactic aspects of speech were comparable between the two groups.

Throughout the conversation samples, subjects with autism reponded to 84.5% of questions, compared to 99% for control participants. It should be noted that the experimenter frequently had to pose and re-phrase the questions several times before obtaining a response from participants with autism. Disfluencies were coded into four categories: repetitions, revisions, silent pauses, and filled pauses. Table 2 gives examples of each of these types of disfluencies within an utterance. A series of independent samples t-tests revealed significant differences between the control group and individuals with autism with respect to disfluencies (see Figure 2). All comparisons reported below were significant at or below the alpha level of .0125, which was set using the conservative bonferroni correction procedure to deal with multiple comparisons. Participants with autism produced fewer filled-pause words (ums and uhs) than control participants, $t(26) = 7.74$ (4.0 vs. 21.0). Conversely, the participants with autism produced more silent-pauses than control participants $t(26) = 12.72$ (with means of 10.0 and zero respectively). Of the silent pauses produced by individuals with autism, 68% occurred at the beginning of an utterance, and 32% within utterances. Participants with autism produced significantly more repetitions $t(26) = 11.88$ than controls (13.0 vs 3.0), but fewer revisions $t(26) = 7.74$ (7.0 vs. 16.5).

Discussion

There are several aspects of speech that occur in conversation which could be listener or speaker-oriented. The use of filled pauses during disfluencies, including ums and uhs appear to help listeners, but it is unclear whether these are produced for the benefit of the listener. Also, native English speakers show a strong tendency to place animate actors in the subject of sentences when speaking, but again, we don't know if this is primarily for the benefit of speakers or listeners. Challenges in understanding the perspective of another – theory of mind deficits –make participants with autism less likely to engage in listener-oriented behaviour. Therefore if individuals with autism employed certain aspects of speech, we argue that this feature must be primarily speaker-oriented and if they do not employ it, this is at least some evidence that it may be listener-oriented.

According to the research of Fox Tree (2001), the use of filled-pause words alerts the listener to important conversational cues. However, it is unclear whether these ums and uhs are being employed intentionally by speakers for the benefit of the listener. Results of the present experiment demonstrated that participants with autism produced significantly fewer filled-pause words than controls. Interestingly, participants with autism appeared to be using silent pauses in the place of filled-pauses. Participants with autism used significantly more silent pauses than controls and engaged in these silent pauses at virtually the same rate as control participants used ums and uhs. However, unlike filled-pauses, silent pauses made it difficult for the speaker to know when the listener was finished speaking. In this sense, silent-pauses may reflect the same speaker-originating disfluencies in production, but do not attempt to remediate the potential confusion they cause to an interlocutor.

Results demonstrated a significantly higher number of repetitions in the conversations of participants with autism compared to control participants. Repetitions could be indicative of difficulties formulating speech, particularly as the length of an utterance increases (Shriberg et al., 2001). A particularly interesting possibility is that they could be a more rudimentary form of maintaining one's turn in conversation. This kind of repetitive speech is often found in the communication of typically-developing children. Children between the ages of 3 and 6 years are often observed to repeat words or phrases as a means of 'holding the floor,' or sustaining their turn in the conversation (Keane & Conger, 1981). Given that semantic and syntactic aspects of speech were comparable between the two groups, and the autistic participants tested here did not appear to experience an overall greater rate of planning difficulties (as evidenced by overall number of disfluencies of any time) the increased number of repetitions observed in the conversation of the participants with autism is more likely a pragmatic issue than a specific language production deficit.

Finally, participants with autism were found to revise their speech significantly less often than controls. Revising speech involves self-repair, whereby an individual detects a problem and formulates a revision or replacement to correct it (Levelt, 1983). Given this information, one could conclude that participants with autism don't detect problems in their own speech the same way as controls do. Alternatively, we suggest that they may be able to detect their own formulation problems perfectly well, but may be less aware of the problems this may have caused a listener, and are therefore less likely to attempt to clarify and revise their utterance to aid a listener. They may instead simply insert a pause and begin a new utterance.

In comparison to the conversational data, results of the animacy experiment demonstrated that individuals with autism exhibited the same preference to form sentences with animate subjects as controls do. These results tell us two important pieces of information. Firstly, the notion that individuals with autism are less sensitive to animacy may have some limitations. Secondly, the bias to use animate subjects is not a listener-oriented feature of speech, unlike other word order preferences in discourse such as background and foregrounding, and the differential treatment of given and new information (Baltaxe, 1977).

The only exception to the observed bias was the item displaying the boy and the alarm clock where participants with autism placed the inanimate clock as the subject and control participants the boy. Clinical literature in this area has suggested that individuals with autism often display intense fascination with electric machinery and clocks in particular (Baron-Cohen & Wheelwright, 1999). It appears therefore that participants with autism in this experiment chose to put the (to them) more salient inanimate clock as the subject over the animate boy. This further supports the theory that overall, speakers tend to place the most highly salient item in a sentence in subject position, but shows how salience can vary between individuals, or groups.

One limitation of this study is the fact that while the autistic participants were high functioning, and had good verbal skills, the control participants were not matched to them on IQ or education, only on age and gender. While we do not have IQ information on our control participants, it seems likely that their scores would have been markedly higher than those of the autistic participants. However, it seems unlikely that a difference in IQ or education could account for the pattern of results that we see here – no difference on animacy preferences, and a greater number of ums and uhs for participants with presumably greater verbal skills.

The results obtained from this study tell us important information about listener and speaker-oriented features of speech. Filled-pause words appear to be employed by speakers for the benefit of listeners and are therefore listener-oriented features of speech. The tendency to use animate actors in the subject position, however, does not appear to be a listener-oriented feature of speech. Both groups displayed this bias, regardless of the resulting structure. Participants with autism did, however, produce significantly more repetitions and silent pauses than controls, suggesting not that their speech has any particular problems of formulation, but that the main differences were pragmatic in nature, at least for these very high functioning speakers with autism. As well as the information this provides us about the basic communicative functions of language, it also has implications for therapeutic applications. Individuals with Asperger's or autism may be able to improve their social interactions by being taught to use discourse functions as seemingly unimportant as using ums and uhs in conversation.

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Table I

Example: Picture Descriptions

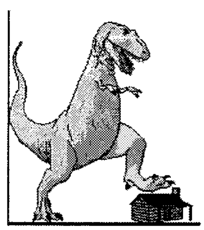
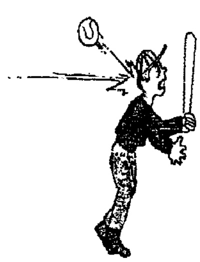
Picture	Animacy	Type of Sentence	Example Utterance
	Animate agent Inanimate patient	Active (preferred)	“The dinosaur is stepping on the house.”
		Passive	“The house is being stepped on by the dinosaur.”
	Inanimate agent Animate patient	Active	“The ball hits the boy”
		Passive (preferred)	“The boy is being hit by the ball”

Table II

Examples of Disfluencies

Disfluency category	Example utterance
Repetition	"My fav...fav...favourite...favourite animal is a cat...my favourite animal is a cat"
Revision	"My fat...favourite...best animal is a dog...my favourite animal is a cat"
Filled pause	"My favourite...um...animal...uh...is an um...cat"
Silent pause >2s	"My favourite...(>2 s silence) animal is a ...(>2 s silence) cat"

Figure Caption

Figure 1. The y axis represents the percentage of active sentences, calculated as the number of active sentences out of active plus passive sentences. Error bars depict the standard error of the mean.

Figure 2. Mean number of disfluencies for control participants and participants with autism. The error bars show the standard error of the mean.

Figure 1. Percentage of active sentences across animacy (participants with autism vs. control participants)

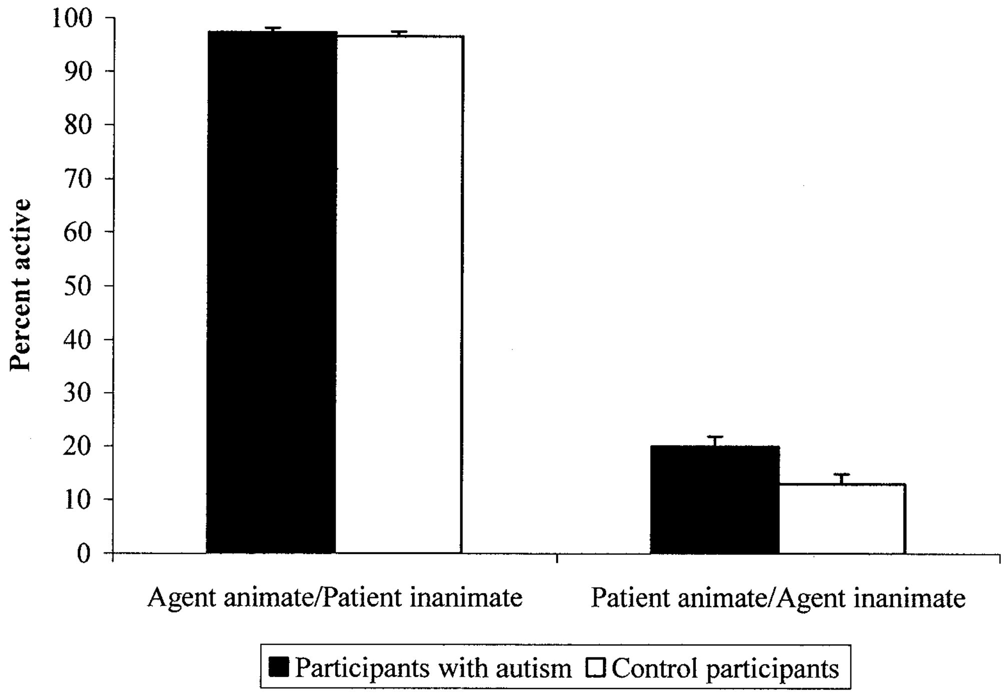
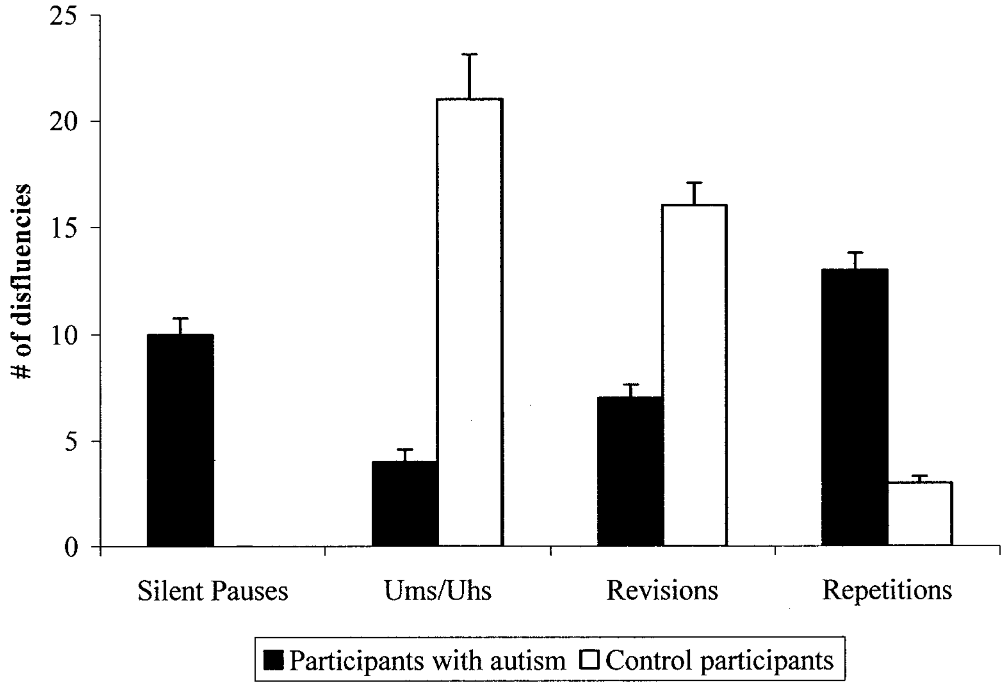

Percent active
100
90
80
70
60
50
40
30
20
10
0
Agent animate/Patient inanimate
Patient animate/Agent inanimate
Participants with autism
Control participants

Figure 2. Mean number of disfluencies (control vs. autism)


25
20
15
10
5
0
# of disfluencies
Silent Pauses
Ums/Uhs
Revisions
Repetitions
Participants with autism
Control participants