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Narrative Discourse in Adults with High-Functioning Autism or Asperger Syndrome

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Abstract   We report a study comparing the narrative abilities of 12 adults with high-functioning autism (HFA) or Asperger Syndrome (AS) versus 12 matched controls. The study focuses on the use of referential expressions (temporal expressions and anaphoric pronouns) during a story-telling task. The aim was to assess pragmatics skills in people with HFA/AS in whom linguistic impairments are more subtle than in classic autism. We predicted no significant differences in *general* narrative abilities between the two groups, but *specific* pragmatic deficits in people with AS. We predicted they use fewer personal pronouns, temporal expressions and referential expressions, which require theory of mind abilities. Results confirmed both predictions. These findings provide initial evidence of how social impairments can produce mild linguistic impairments.

Keywords   Narrative abilities · Adults with HFA/AS · Temporal expressions · Anaphoric pronouns · Theory of mind

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Introduction

The development of narrative discourse has been studied across different cultures (Slobin & Berman, 1994), and in neurodevelopmental conditions such as specific language impairment (SLI) (van der Lely, 1997) and autism (Loveland, McEvoy, Tunali, & Kelley, 1990; Tager-Flusberg & Sullivan, 1995). Such studies are of interest because the ability to tell a story reveals both linguistic and social-cognitive skills. Studies of narratives produced by children with autism have focused on the role of a theory of mind (ToM). A large number of studies reveal ToM deficits (or degrees of 'mindblindness') in people with autism (Baron-Cohen, 1995; Frith, 2003). ToM is the ability to attribute mental states to another person and to infer their underlying intentions, thoughts, emotions and motivation. This ability is needed to make sense of the actions of characters in a story. To use narrative successfully, the speaker has to organise information for the listener by selecting what is *relevant* (Sperber & Wilson, 1986), based on taking account of the listener's knowledge and perspective (Astington, 1991). The narrator has to keep in mind what information the listener already has, what information is new for them, and what information the listener needs to know. Failure to do this could risk confusing the listener, or boring them with irrelevant detail. The story-telling task therefore gives us an important window into how well a speaker can keep track of information *for a listener*, how well they can edit information for a listener,—in short, how skilled the speaker is employing a ToM.

To better understand the relationship between language and theory of mind abilities, in the study reported below we analyze narrative ability in adults

with high-functioning autism (HFA) or Asperger Syndrome (AS). Such individuals are of interest because they afford the opportunity to test if social deficits affect linguistic abilities even in the presence of intact cognitive functioning in other domains (such as general intelligence). Here we use the terms HFA and AS interchangeably, though we recognize that some researchers have suggested there may be differences between the two diagnoses (Klin, Jones, Shultz, Volkmar, & Cohen, 2001). People with AS do not show marked language impairments (unlike those seen in classic autism), but they do show social difficulties. We can therefore exclude the possibility that difficulties traceable in the narrative skills of people with AS are due to any linguistic delay or major language impairment. Our study is also of value in that this population has hardly been studied, in terms of their narrative abilities.

Narrative Abilities in the Autistic Spectrum

Studies of narrative development in children with autism confirm difficulties in using pragmatic markers of time and space (Bruner & Feldman, 1993; Loveland & Tunali, 1993), reduced expressions of mental states (Baron-Cohen, 1988a; Baron-Cohen, Leslie, & Frith, 1986), use of inappropriate utterances and idiosyncratic gestures whilst telling a story (Loveland et al., 1990), and reduced complexity and number of causal statements (Tager-Flusberg & Sullivan, 1995). Generally, individuals on the autistic spectrum may not adapt their speech to the listener (Baron-Cohen, 1988a). For example, they may speak in the same way to a friend or a stranger, they may make irrelevant comments, and they may have difficulty interpreting indirect expressions (Baltaxe & Simmons, 1983; Ozonoff & Miller, 1996).

Loveland et al. (1990) compared the narrative storytelling ability of high-functioning verbal children and adolescents with autism with children with Down's syndrome, who were language-matched. The results showed that people with autism were able to interpret the meaningful events of a story, and the two groups did not differ in length of narrative. However, the children with autism produced more 'bizarre' utterances, and fewer communicative gestures. The analysis of inappropriate utterances appeared as instances of pragmatic violations (e.g., speaker shifts focus from the story to himself with inappropriate comments). In general these findings of narrative deficits in autism have been interpreted as reflecting a deficit of ToM (Baron-Cohen, 1988b; Bruner & Feldman, 1993). One

study has directly explored the relationship between narrative and ToM performance (Tager-Flusberg & Sullivan, 1995). Using another wordless picture book, narratives were produced by adolescents with autism, and IQ-matched controls. In this study, people with autism did not produce impoverished narratives (i.e., shorter and less complex sentences), and nor were their narratives limited in the use of lexical cohesive devices (adverbial phrases, causal connectives, subordination). However, in the people with autism alone, ToM performance significantly correlated with narrative measure such as number of connectives, emotion and cognitive terms, and length of the story. These problems have been closely linked to the capacity to understand other minds (both the listener's and those of the characters within the story).

These ToM deficits have been related to the pragmatics competence of people with AS. Standard diagnostic criteria define AS as involving similar social impairment and unusually narrow interests or repetitive behaviour, but with no history of language delay or delay in cognitive development (APA, 1994; ICD-10, 1994). They may however still manifest subtle communication abnormalities. For example, word choice is often pedantic or overly formal (Ghaziuddin & Gerstein, 1996), and they can appear oblivious to the listener's interest or the listener's affective states (for example, inattention to gestural and facial feedback from the listener). This results in communication being one-sided, the speaker with AS holding forth in a monologue, often with undue intensity as if to persuade the listener of their point of view, but in the process showing a relative insensitivity to the existence of other points of view (Attwood, 1997). The intensity of the single focus on one narrow topic of conversation may also reflect their cognitive style of strong 'systemizing' (Baron-Cohen, 2002, 2006), needing to focus on the small details of an argument and pursue it to its logical conclusions in order to achieve an understanding of the topic as a web or system of facts. Again, in not being able to judge the inappropriateness of staying on one topic for too long, or going into such minutiae for too long, the speaker with AS reveals their difficulties with ToM, or what is today seen as part of a wider difficulty with empathy (Baron-Cohen, 2002). An apparently opposite problem is seen in people with AS showing difficulties *maintaining* an ongoing topic of discourse, instead introducing irrelevant comments, or failing to extend the topic by adding new relevant information (Tager-Flusberg & Anderson, 1991). Again, such problems may reflect ToM deficits in being able to judge when the listener wants to stay on topic, or when they are hinting they want to

shift topic. Subtle ToM difficulties have also been revealed on tests of understanding 'faux pas' (Baron-Cohen, O'Riordan, Jones, Stone, & Plaisted, 1999) and in inferring complex mental states such as bluff and ironic states in story characters (Happé, 1994). However, there are few studies that have directly measured narrative skills in this population. The aim of the present study is therefore to extend narrative analysis to people with HFA or AS. We predicted that their difficulties in ToM would lead to incorrect use of subtle pragmatic markers.

Language and ToM

There is still debate concerning the relationship between language and ToM during development. Studies suggest a strong correlation between these. For example, correlations are found between standard false-belief tasks and general language ability in 3–5 year olds (Astington & Jenkins, 1999; de Villiers & de Villiers, 2000). Typically developing children also show better performance on the false belief test when the task is verbally simpler (Chandler, Fritz, & Hala, 1989). However the direction this relationship is still unclear. Some theorists have made a strong claim, that ToM depends on a minimum level of *syntactic* development (de Villiers & de Villiers, 2000; Tager-Flusberg, 1992). This claim has some plausibility because the classic false belief test involves the question ''Where does Sally think the marble is?'' (or ''Where will Sally look for her marble?''). These authors claim that what is crucial is the syntax of *complementation*, in which a sentence takes a full clause as its object complement. They argue that this specific aspect of syntax provides children with a necessary representational format for understanding false beliefs. De Villiers (2000) has also suggested that mastery of the syntax of complementation correlates with children's later performance on ToM tasks (de Villiers & de Villiers, 2000). In children with autism a similar correlation has been found, with those who pass ToM tasks having a higher verbal mental age (Happé, 1995). Tager-Flusberg and Sullivan (1994) also found that syntactic comprehension in children with autism and mental retardation was the strongest predictor of performance in ToM tasks.

A rival hypothesis is that precursors of ToM such as joint attention (Baron-Cohen, 1989) or mutual imitation (Meltzoff, & Gopnik, 1993) are the basis for vocabulary acquisition (Baron-Cohen, Baldwin, & Crowson, 1997) and communicative skills. Both vocabulary acquisition and conversational skills

involve mind-reading, particularly the inferential attribution of intentions. Pragmatics is usually discussed in terms of communication as an inferential process (Grice, 1975; Sperber & Wilson, 1986). Communication is achieved by the reciprocal recognition of informative intentions. As such, pragmatics requires ToM. In line with this hypothesis many studies suggest that the communicative difficulties that even individuals with HFA or AS share with others on the autistic spectrum derive from an initial ToM deficit (Baron-Cohen, 1988a; Tager-Flusberg & Anderson, 1991).

To test the link between linguistic skills and ToM in autism, several authors have looked at specific linguistic aspects such as grammar, narrative, pragmatics phenomena, and ToM performance. Happé (1993), for example, investigated the link between grasping irony and metaphors and false belief skills. She found a correlation on both these tasks. Ziatas, Durkin, and Pratt (1998) also found a correlation between expressions referring to mental states and the ability to pass classic ToM tests in people with autism. However, neither of these approaches are able to tell us about the direction of the relationship between ToM and the pragmatics deficit, or can demonstrate whether these two skills are independent or aspects of a single cognitive skill.

In the study reported below, we make the assumption that pragmatics and ToM cannot be separated. We test, even in the case of people with HFA or AS who have no history of language impairment, if the quality of their narrative is nevertheless still affected by their known problems in mindreading. We evaluate the different component of their narratives: length of the stories, mental states expressions, linguistic cohesion devices. In particular we examine the referential nature of two aspects of language: anaphoric personal pronouns, and temporal expressions. We focus on these linguistic devices because they require the use of a ToM. Referential expressions, in a narrative discourse, refer the listener back to earlier points in the narration. Both aspects are referential since they are used to encode a particular perspective on events.

Anaphoric Pronouns

An anaphor is an item with little or no intrinsic meaning or reference that takes its interpretation from another item in the same sentence or discourse, its antecedent. For example, in 'I asked Johnny to come with me and *he* came'. (Here, the anaphor is italicised). Pronouns are the most familiar anaphor, but verbs or

whole sentences can also be used as anaphor. Another type of anaphor exists called zero anaphor. In this case a null element (or the absence of a linguistic item) is the anaphor. For example, 'Lisa came in and * sat down'. (Here, the zero anaphor is shown with an asterisk).

The speaker not only has to represent the relationship between the pronouns at the local (sentence) level, but also represent what context is already known by the listener, and what new information they need to be provided with. The speaker should use the indefinite article (e.g., a) and a noun phrase [NP] (e.g., *boy, man*)—as in 'a man'—to initially introduce a character to the story. Or the speaker should use a definite article (e.g., the, or that) and a NP (e.g., *man*)—as in 'that man'—to re-introduce the character after another protagonist has become the topic of the discourse. However, the speaker should use a personal pronoun (or zero anaphora) to refer to a character only if he or she has already appeared in a particular episode in the topic position, since this is sufficient to disambiguate the reference of the pronoun. The sequence of referring expressions is based on how the storyteller and their interlocutor build and revise a narrative. Information already supplied is encoded in definite referring expressions (e.g., *the boy*) whilst indefinite and less explicit expressions (e.g., *a boy*) are commonly used to provide new information.

Investigations into children's narrative abilities show that use of appropriate anaphoric referential expressions develops at a relatively late stage of language acquisition. Qualitative changes are seen from three to 10-years-old, long after the child has developed basic syntax. Karmiloff-Smith (1985) proposed a three-phase model for the development of the use of anaphora. In her view, only at around 10 years of age do children have cohesive narrative discourse using appropriately anaphoric referential expressions.

Temporal Devices

Temporal devices are linguistic forms that contribute to the establishment of narrative cohesion, since they give an insight into the perspective from which narrative events are being organized. When expressing temporal relations the narrator is faced with the problem of how to order the protagonist's different activities. The narrator has to set the scene and then continually refer to it whilst events are advancing. At the same time, the narrator has to continually keep in mind any background information relating to the current circumstances and organise them coherently for the listener. Typically, in story-telling, a referent time is established, which is usually not the time of speaking (e.g., "last Tuesday", "yesterday", etc). Further temporal markers are also used in relation to this established overall referent time. Thus, temporal expressions often involve complex, embedded time relations (Enc, 1987).

For these reasons, temporal adverbs (such as 'now', 'tomorrow', 'meanwhile', etc), like pronouns, are considered referential words. Such grammatical elements sign-post the speaker's perspective of an event. The meaning of such terms are also dependent on who uses them, on the context in which are used. For these reasons, the speaker needs to keep track of the listener's knowledge, to avoid the risk of confusion. A narrator needs to keep in mind what the listener has been told and what they may still need to be told for the narrative to be "informative" (following Grice's maxims governing communication), without supplying too little or too much information (Grice, 1975). Impairments identified in the narrative abilities of children with autism include the inability to narrate events incorporating pragmatic markers of time and place (Bruner & Feldman, 1993).

Predictions

By definition, people with AS have at least average language ability and can sometimes have unusually sophisticated vocabulary. Given this, we predict no difference in the *length* of their narrative or the choice of *vocabulary*. According to the current literature we also predict no significant differences in the frequency of theory of mind expressions in people with or without AS. However, we predict subtle impairments will be found in the use of grammatical devices that require taking the listener point of view. In particular we expected that deficits will be found in *referential use of personal pronouns* and in production of *temporal expressions*. We predicted that people with AS may overlook that the listener may need information about which event the speaker is referring to. For this reason we expect inappropriate use of anaphoric expressions. We expect that people with AS, who have difficulties recognizing violations of Gricean maxims, such as being truthful, relevant, concise and polite in conversation (Surian, Baron-Cohen, & van der Lely, 1996), will also show resulting difficulties in their use

of temporal expressions. In particular, we predict fewer temporal devices, such as 'then', 'yesterday', and 'later'. Such devices serve to build the plot of a story, and overcome a description of isolated events.

Experiment

Method

To test story-telling skills, we employed the well-known wordless picture book: *Frog where are you?* (Mayer, 1965). We used the coding scheme devised by Van der Lely (1997) in her study of children with grammatical Specific Language Impairment (G-SLI). We applied her methods to analyse referential expressions (NP, personal pronouns, and zero anaphor references). Additionally, we included an analysis of theory of mind expressions and two other pragmatic markers of narrative discourse: casual expressions, and temporal expressions.

Participants

Two groups of volunteers participated in the experiment: Group 1 comprised 10 adults with diagnosis of AS and 2 with (HFA). They were diagnosed by qualified clinicians, using DSM-IV criteria (1994), and on the basis of ADI and ADOS (Lord et al., 1999). Group 2 comprised 12 adults who were recruited from the general population as volunteers via an advert, with no history of any psychiatric diagnosis, and who served as a control group. We excluded any adults with a history of language delay or learning disability by means of a preliminary clinical interview. The people with AS were recruited via adverts on AS web-pages, or through specialist clinics in the UK. None of them was receiving specific treatment or were on medication. The control group were recruited via an advert in a local newspaper in Cambridge, and comprised people from the local community. The participants in the two groups were all native English speakers.

The two groups were matched on chronological age [CA] (AS = 27.5 years, sd = 11.8; control = 27.2 years, sd = 11.23), a t test confirming that their ages were not significantly different ($t(22) = 0.375$, $p < 0.96$). In addition, both groups were matched on a short form of the WAIS-R (Wechsler, 1981) (AS = 110.7 IQ, sd = 13.8; control = 110.9, sd = 10.9). Again, a t test confirmed no differences between the IQs of both groups ($t(22) = 1.11$, $p < 0.97$). Finally all the participants were male.

Material

We chose the picture book *Frog where are you*? to elicit the narrative because this does not require any prior descriptions of the story by the experimenter. Moreover, it was likely to elicit numerous temporal and causal expressions to describe the main characters' actions. It also requires the narrator to shift constantly from one protagonist to the other when telling the story, thereby allowing us to assess the subjects' flexibility in their use of referential expressions. The 'Frog book' has been used in previous studies with both normally developing children (Slobin & Berman, 1994) and children with developmental disabilities (Reilly, Klima, & Belligi, 1990; Tager-Flusberg, 1995; Van der Lely, 1997), against which the results of this study can be compared. The story in this book involves the search by a young boy and his dog for a lost pet frog. The search involves the two protagonists (the boy and the dog) in numerous adventures, along with secondary characters. Their actions are shown in 24 pictures, in each of which the two protagonists are engaged in different actions. We choose this easy story in order to ensure that any difficulties found were not due to either levels of comprehension, memory load, or unfamiliar concepts or vocabulary.

Procedure

Each person was tested individually in a quiet room in the presence of the experimenter alone. They were presented with a copy of *Frog where are you*? and were asked to look at the pictures and tell the story. We adopted the procedure used by Van der Lely (1997), with some minor changes to make the task more appropriate for adult volunteers. For example, we did not ask the volunteer to choose between five envelopes containing a copy of the story, as we assumed our adult volunteers would all be naive to the one story offered. However, the experimenter checked that each participant had no prior knowledge of the story, and the experimenter explicitly said that he/she had not seen that particular story book. The participant was instructed to be as clear as possible in their narration. This allowed us to assess if the participant's use of reference was sensitive to the experimenter's state of knowledge. The participant looked at the pictures and turned over the pages whilst telling the story, without the experimenter being able to see the pictures. This procedure thus eliminated memory demands, and served to highlight the listener's informational needs.

The experimenter did not intervene during the narration. Each narration was recorded using a digital

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audio tape recorder (Sony DAT), with a microphone positioned close to the subject. The stories were later transcribed orthographically by two independent transcribers, transcribing not only what was said, but also pauses, hesitations or changes during the narration. Coding was carried out by the first author who was blind to each person's identity and diagnosis. A second, independent coder, blind to diagnosis, scored 25% of the narrative samples, selected at random. Inter-rater reliability for all measures exceeded .85 (Cohen's Kappa coefficient). The coding scheme for analysis of the narrations is described below (and see Appendix 1 for an extended description).

Coding Scheme

Length and Episodes

There were three measures of length: (i) *total number of words*, (ii) *total number of episodes*, and (iii) *total number of boy/dog episodes*. An episode was defined as a description where the focus is a single protagonist (Van der Lely, 1997). The number of episodes also provided an evaluation of the complexity of the story. An example of two consecutive episodes is given in 1:

1) [The little boy searched everywhere in the tree] and [the dog was chased by bees]

In order to compare the syntactic complexity of the narrative we also analysed the number of coordinated and subordinated sentences presented in each episode. An example of coordinated and subordinated is given in 2 and 3 respectively.

2) The boy falls out of the tree and lands on his back
3) the dog was feeling a bit sorry for himself after having been attacked by the bees

We excluded from the analysis of syntactic complexity sentences that were used to start a new episode, as in the example 4.

4) [the boy woke up in the morning] and [the frog is gone]

Reference Analysis

To analyse referential expressions in the story, each episode was identified using brackets (as in the example above). Then, in each episode, we identified the episodes where only *one* protagonist was mentioned. Occurrences in which *both* protagonists, were mentioned together as part of a plural NP (i.e., the boy

and the dog, they) were excluded, except for the first occurrence in the story where they were first introduced (e.g., ''There was a boy and his dog''). We decided to exclude plural expressions from the coding, to focus specifically on the references to each main protagonist and to reproduce the coding system proposed by the original study (Van der Lely, 1997). We then coded the episodes according to whether a reference was used (i) to *introduce* a characters when they first appeared; (ii) to *re-introduce* a character in a new episode when a different character had been interposed between a previous reference of him and a later one (e.g., as in the third sentence of example 5, below); or (iii) to *maintain* reference to the actions carried out by the same protagonist. Example 5 below shows how these three referential functions are identified:

5) [The boy$_1$ is in his$_2$ room. He$_3$ is watching the frog in the jar] [His$_1$ dog is leaning over the frog in the jar] [the boy$_1$ is in his$_2$ pyjamas]

Referent 1 (indicated by the subscript) in episode 1 represents a *re-introduction* of the main protagonist, with referents 2 and 3 *maintaining* reference to the protagonist in the same episode. Referent 1 in episode 2 again *maintains* reference to the boy, as does referent 2 in episode 3. The full noun phrase ''*the boy*'' is used to *re-introduce* the boy at the beginning of episode 3 as the dog had previously been in the focus position in the narrative. Thus the boy is unambiguously and appropriately re-established as the focus of the episode.

We included in the analysis *nominal expressions* such as the noun phase (NP) (definite and indefinite), *personal pronouns* and *zero anaphors*. The use of possessive and relative pronouns were only used for the total count. We also noted whether the narrator introduced the protagonist with or without taking into account the listener's knowledge of the protagonist's existence (using an indefinite NP (*a boy*), or an NP with a possessive, e.g., his dog).

In order to evaluate the participant's ability to maintain the focus on the protagonist we coded whether the narrator employed pronominal expressions (the pronouns 'he' or 'it', or zero anaphor) to refer back to a character once their existence had already been established in the story (e.g., in 5 above, episode 1). We also made a distinction between two different kinds of inappropriate referential expressions: ungrammatical and ambiguous. These were both included in the total count. We defined as *ungrammatical* the omission of the article of the NP or the incorrect use of a zero anaphor (the absence of the subject) such as in 6 below

6) [" 0 didn't look happy"]

We defined an *ambiguous* expression to be any reference where the pragmatic context was not sufficiently clear to determine the referent for a pronoun or a zero anaphor expression. For example:

7) [the little boy went downstairs to check if he* was all right]

Here there is no immediate mention of the dog, Thus the context is insufficient to determine the referent for "*he*".

When the name to which the pronoun referred to could not be found in a previous sentence, we considered this an ambiguous expression. For example:

7) [And the boy opens the window, and he yells for the frog but the frog does not reply. The little boy went downstairs to check if he* was all right]

We did not consider as an ambiguous expression when the character was mentioned in the previous sentence and therefore the pronouns was easily referred to him/it. To keep to the same example, we would not consider ambiguous the pronoun referring to the dog in:

8) [Then the boy went to the window to call for the frog. The dog fell on the ground and the jar smashed. The little boy went downstairs to check if he was all right]

We calculated the number of ambiguous references of pronouns or possessive determiners referred to a character out of the total number of pronouns used for that character.

Using the above coding criteria, we calculated the following percentages:

1) The percentage of nominal expressions used to refer to the boy and the dog. The percentage was taken from the total number of nominal and pronominal expressions for each protagonist.
2) The percentage of definite NP's used to maintain reference to a protagonist (boy or dog). This was calculated from the total number of definitive NP's and pronominal expressions used to maintain reference to the protagonist.
3) The percentage of pronominal and zero expressions used to refer to the boy and the dog, taken from the total number of nominal and pronominal expressions.
4) The percentage of ambiguous pronouns used. This was measured from the total number of pronouns used to refer to the boy and to the dog.

5) The percentage of episodes where a nominal expression was used to initially introduce a protagonist (indefinite NP or NP with a possessive e.g., his dog) and to reintroduce the protagonist. This was taken from the total number of nominal and pronominal expressions that first occurred in each episode with the boy or the dog as the main focus. An analysis of the remaining characters in the story was carried out (e.g., the pet frog, the swarm of bees, an owl, a deer and a rodent). This included the boy and the dog as a plural expression (this measure was left out from the protagonists' coding). In particular, we marked:

(i) ambiguous and ungrammatical expressions;
(ii) the percentage of nominal expressions, taken from the total number of nominal and pronominal expressions;
(iii) the percentage of ambiguous pronouns from the total number of pronouns used.

Temporal Relations

The total number of temporal expressions was counted to test if people with AS could give sequential events a temporal organisation. This included temporal adverbs and conjunctions ('*after*', '*meanwhile*') and temporal expressions ('*It was night*'). We excluded from our analysis any tense marking on the verb.

Mental State Expressions

We included in this category any mention of the emotional state of a character in the story ('the boy was really *upset* with the dog') and any reference to a mental state, such as might be inside information about desires, beliefs, thoughts and intentions of a character in the story, (e.g., 'The boy *thought* the frog might be inside the tree hole'). The frequency of these expressions was summed into a single score.

Results

The adults with AS showed no difficulty with using appropriate phonology and syntax. Nor did the two groups differ in their ability to comprehend and extract the plot. However, their two groups' narratives did differ in the use of some of the referential devices we measured. The group with AS produced less cohesive and less well organised stories than did the control group. Parametric statistical tests were not appropriate

since variables were not normally distributed. The results were therefore analysed using one-tailed Mann–Whitney tests, corrected for multiple comparisons. To retain the maximum statistical power in our small sample, we applied the Bonferroni correction only to the three comparison predicted to be significant (temporal expressions; NP for maintaining and ambiguous pronouns). This requires each critical comparison to reach a significance level of p = (.05/3) = .017

Length and Episodes

Table 1 presents the means and standard deviations for the three measure of length of each narrative. Analysis did not reveal any significant group difference for: words count; number of episodes involving the boy (mean = 10.5 episodes for AS, 10.9 for Controls); or for the number of episodes involving the dog (mean = 8.1 episodes for AS, 6.1 for Controls). The AS group made slightly fewer references to the dog than the control group, but this was not statistically significant and was accounted for by one subject with AS who did not mention the dog at all. The analysis of the syntactic devices used in the narrative also did not reveal any significant group difference for number of coordinated and number of subordinated.

References

The mean total number of references made to the boy and the dog can be seen in Table 2. This shows that the two groups made a similar number of references overall. Table 2 also shows the percentage of nominal and pronominal references to the boy and to the dog produced by the two groups. Some differences in using pronominal expressions can be see in Table 2, with the control group using more pronominal expressions than the AS groups. However, the groups did not differ significantly either in the percentage of nominal and pronominal reference for the boy, or nominal and pronominal references for the dog. In summary, the number of references made did not differ significantly between the two groups. In addition, they composed

Table 2 Types of expression used in the narrative discourse by adults with AS adults versus controls

BOY	AS		Control	
	M	SD	M	SD
Reference-total	28.03	12.05	29.02	10.28
Nominal %	51.7	20.25	39.3	13.22
Pronominal %	48.3	20.25	60.7	13.22
DOG	AS		Control	
	M	SD	M	SD
Reference-total	16.6	10.01	16.08	3.56
Nominal %	64.2	10.92	62.3	10.05
Pronominal %	35.8	10.92	37.7	10.05

stories of similar length. Thus any differences in performance on the task cannot be accounted for by either of these factors.

We report next how the referential devices were used by the narrators, as a means of introducing, re-introducing, or maintaining reference.

Introduction Devices

The results of the initial introduction of one of the two protagonists are shown in Table 3. Both groups showed a preference for introducing the protagonists with an indefinite article + N. The percentage of subjects who used an indefinite article + N and definite article + N to introduce the boy and the dog were calculated. Although the AS group used more definite NPs to introduce the boy and the dog, no significant differences between the groups were found for the boy's introduction, or the dog's.

Re-introductory Devices

The percentage of NPs (indefinite + definite NPs) and pronominals used to reintroduce the boy and the dog in a new episode are shown in Table 4. As predicted, the use of the reference to reintroduce the character did not prove difficult for either group. They both showed a significant preference for full NPs to start a new episode and to re-introduce the boy or the dog. No significant difference between the groups was revealed for references to the boy, or to the dog.

Table 1 Mean narrative discourse length produced by adults with Asperger syndrome (AS) versus controls

	AS		Controls	
	M	SD	M	SD
Word count	410	151.39	418	96.50
Coordinated sentences	16.42	5.47	18.17	4.53
Subordinated sentences	4.67	2.27	5.83	2.17

Table 3 Type of expression used to introduce the boy and the dog by adults with AS versus controls

BOY	AS		Control	
	M	SD	M	SD
Indefinite NP	83.33	24.62	91.67	19.46
Definite NP	16.67	24.62	8.33	19.46
DOG	AS		Control	
	M	SD	M	SD
Indefinite NP	70.35	12.54	86.67	17.26
Definite NP	29.65	12.54	13.33	17.26

Table 4 Types of expression used to reintroduce the protagonists by adults with AS versus controls

BOY	AS		Control	
	M	SD	M	SD
Nominal %	93.68	7.61	87.26	14.19
Pronominal %	6.32	7.61	12.47	14.19
DOG	AS		Control	
	M	SD	M	SD
Nominal %	100	.001	98.33	5.77
Pronominal %	0		1.67	5.77

Maintaining Devices

The percentage of referential expressions used to maintain reference to the two main protagonists is shown in two different ways (see Table 5). First, the percentage of nominal versus pronominals used to maintain reference to the boy and the dog was calculated. Second, the percentage of nominals and pronominals as a proportion of *all* nominals and pronominals used in the narrative to the boy and the dog was calculated. This percentage has been used in the statistical analysis, and provides a measure of the proportional of pronominals used for the maintenance function, rather than for introduction or re-introduction. Therefore, it provides a subtle, global measure of the use of pronouns for maintaining reference. We predicted that for people with pragmatics problems the overall proportion of pronouns used for maintaining reference would be lower than those without pragmatics problems.

As predicted, the control group maintained reference to a character in focus by using pronominal expressions more often, the effect of which was to make the narrative move 'faster' and more cohesively, than if full NPs had been used. Also as predicted, this pattern of reference used by the control group was the opposite of how they re-introduced a character. The AS group showed less use of pronominal expressions and conversely more full NPs to maintain focus on a protagonist. The total number of maintain references

(pronouns and NPs) used by the two groups to refer to the boy did not differ. However, the AS group used significantly fewer pronominal expressions and more full NPs than the control group, to maintain reference to the boy ($Z(24) = -2.345$, $p < .017$). The proportion of pronominal expressions used to maintain reference to the dog revealed a similar pattern, with more nominal expression and fewer pronominal being used by the AS group. However, this difference was not significant. The difference remains significant analysing boy and dog maintaining reference pooled together ($Z(24) = -2.427$, $p < .017$).

The percentage of nominal and pronominal used for maintaining reference as a proportion of all nominals and pronominals used in the narrative to refer to the boy and to the dog was also calculated. Although analysis revealed no significant differences between the groups for the maintaining references to the boy, the difference between the groups was significant for the maintaining references to the dog ($Z(24) = -2.064$, $p < .05$). The AS subjects used 32% of the total nominals to maintain reference to the dog whereas the control group used only the 7% of the total nominals to maintain reference to the dog.

Ambiguous Pronominal Reference

Table 6 presents the mean percentage of ambiguous pronominals for the boy and the dog and the ambiguous pronominals used to refer to the other characters in the story. This analysis was calculated based on the total number of pronominal expressions used for each protagonist. The overall analysis, which included references to the boy and to the dog pooled together, showed a significant difference between the groups ($Z(24) -1,945$, $p < .017$). No difference in ambiguous references was found when refers to the main character, the boy. However, analysis revealed that the AS group used significantly more ambiguous expressions than the controls when they referred to the dog

Table 5 Types of expression used to maintain reference to the protagonists by adults with AS versus controls

BOY	AS		Control	
	M	SD	M	SD
Nominals: % maintaining devices	17.54	15.81	5.13	6.41
Pronominals: % maintaining devices	82.46	15.81	94.87	6.41
Nominals: % of total nominals	6.47	6.9	3.27	5.59
Pronominals: % of total pronominals	43.38	21.36	45.82	16.20
DOG	AS		Control	
	M	SD	M	SD
Nominals: % maintaining devices	37.7	31.13	26.52	31.80
Pronominals: % maintaining devices	62.3	31.13	73.48	31.80
Nominals: % of total nominals	32.7	19.15	7.13	8.37
Pronominals: % of total pronominals	12.6	15.7	23.51	16.52

(Z(24) = –2.515, p < .017), and when refers to other characters in the story (the boy and dog together or other animals) (Z(22) = –2.55, p < .017).

Temporal and ToM Expressions

The total number of causal, temporal and theory of mind expressions is given in Table 6. Analysis did not reveal a significant difference for the groups in theory of mind expressions. However the AS group used fewer temporal expressions than control group; the difference in this case appear significant (Z(24) = –2.119, p < .017).

Discussion

In the study reported here, we extended the research into narrative abilities in autism, to individuals with HFA or AS. As in the case of autism (Capps, Losh, & Thurber, 2000; Tager-Flusberg, 1995; Tager-Flisberg & Sullivan, 1995) , we expected some aspects of narrative performance to be impaired due to their ability to understand other people's mental states being impaired. In order to test for subtle social difficulties in individuals with AS we carried out a more detailed linguistic analysis. We highlighted some referential features in language, which are affected by social competence, specifically, the use of personal pronouns and zero anaphors and temporal expressions. These features are more dependent on the narrative context and the listener's states of knowledge, and therefore on the social knowledge of the narrator.

Pronominal Expressions

The results were consistent with our predictions. In particular, regarding the use of the pronoun, people

Table 6 Percentage of ambiguous pronominal expressions, temporal and ToM expressions used by adults with AS versus controls

	AS		Control	
	M	SD	M	SD
Ambiguous pronouns BOY: % total pronouns	9	7.87	20.21	30.14
Ambiguous pronouns DOG: % total pronouns	30.3	33.25	1.04	3.61
Ambiguous pronouns OTHERS: % total pronouns	22.69	18.73	7.77	7.76
Temporal expressions	5	3.74	7.67	2.87
Tom expressions	4.7	2.80	5.6	3.26

with HFA/AS produced a similar amount of pronominal expressions as the control group, but they often referred to the protagonist with a noun expression when maintaining reference, which made the narrative less fluent and in some cases pedantic. Although this difference was significant only when referring to the boy, the same pattern was evinced when referring to the dog. As the boy was the character who occurred most frequently in the story, there were clearly more opportunities for people with HFA/AS to make references to this character and to use nouns for maintaining reference to him. In addition, compared to the control group, subjects with HFA/AS were also significantly different in the number of ambiguous pronouns used. They were more likely to refer to a character who had not been mentioned for a while, using pronouns instead of full NPs. This tendency can explain the number of ambiguous references produced by the HFA/AS group. The major use of ambiguous references was evident for both the main protagonists and the other characters in the story, reaching the significance level for the dog, and the other characters in the story, but not the boy. It should be noted that ambiguous pronoun use for the boy was also very high in the control group.

One possible reason for the pragmatics deficits we have found is that when the cues of a situation were not sufficiently transparent, a person with AS was more likely to make mistakes. We suggest that in the case of the boy the human character was taken to be the protagonist by default, and thus reference to this character was less likely to be ambiguous. In an analysis of ambiguous occurrences, it is worth noticing that the pronoun was more likely to be produced ambiguously when the protagonist changed in the middle of a scene. According to Karmiloff-Smith's developmental phase model, in Phase 1 the extra-linguistic aspects mostly trigger the referential use of pronouns (deictic use). The results from the individuals with AS may reflect a pattern common to young children in Karmiloff-Smith Phase 1, although in other ways their narrative were clearly more mature.

Temporal Expressions

The second referential device we highlighted was the use of temporal expressions. Consistent with our hypothesis, people with AS preferentially used simple and unlinked sentences, without taking into account the relation between a specific event with what had happened before. Our results showed a limited use of temporal expressions by the AS group. Further, the range of temporal expressions used was less in the AS
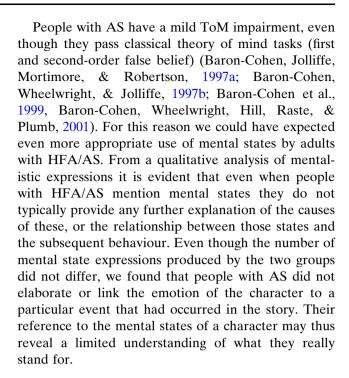
group compared with the control group. These results suggest an impairment in the ability to establish links between particular episodes with more global themes, highlighting difficulties in referential ability.

Story Length and Structure

Consistent with our other predictions, people with AS were able to sustain a story structure (for example, using narrative devices) and were generally able to keep track of the main plot: both groups mentioned all the relevant events in the story. The quantity of information provided in their narration was also similar in the two groups, as measured by word count, numbers of episode and number of references to the boy and dog. These findings allow us to exclude possible deficits in the AS group being due to an overall impairment in producing narrative discourse. Considering the high linguistic skills of individuals with AS, it was not surprising that there was no significant difference in the measure of length. In the linguistic analysis of the complexity of syntactic devices measured by coordinate and subordinated sentences, the AS group did not show any problems. This result confirms that adults with AS have no difficulties with morpho-syntactic aspects of language per se.

Reference to Mental States

In line with our predictions, the results did not show any significant difference in the use of causal devices and in mental states expressions. These findings are consistent with some of the results from narrative abilities of those with autism. Tager-Flusberg (1995) for example showed that children with autism produced a limited number of causal expressions but that the frequency did not differ from the normal population. She noted that, although the frequency did not differ between the two groups, children with autism were more likely to use emotional and mental states with a limited understanding of intentions and internal states of a character in a story. In other words, they were able to label emotions but did not fully understand the mental states to which they referred. Our results are in line also with recent findings (Dennis, Lazenby, &Lockyer, 2001) in which high-functioning children with autism, despite average verbal intelligence, showed difficulties in inferential aspects of language (such as understanding metaphor, to infer what mental state verbs implied in context, to produce the intentional inference involved in speech acts).

People with AS have a mild ToM impairment, even though they pass classical theory of mind tasks (first and second-order false belief) (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997a; Baron-Cohen, Wheelwright, & Jolliffe, 1997b; Baron-Cohen et al., 1999, Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001). For this reason we could have expected even more appropriate use of mental states by adults with HFA/AS. From a qualitative analysis of mentalistic expressions it is evident that even when people with HFA/AS mention mental states they do not typically provide any further explanation of the causes of these, or the relationship between those states and the subsequent behaviour. Even though the number of mental state expressions produced by the two groups did not differ, we found that people with AS did not elaborate or link the emotion of the character to a particular event that had occurred in the story. Their reference to the mental states of a character may thus reveal a limited understanding of what they really stand for.

Language Pragmatics and ToM

These results are relevant to the current debate about the relationship between language and ToM. We acknowledge that these are normally intertwined. Severe language delay, such as may occur in deaf children or some children with autism, may affect performance on ToM tasks (de Villiers & de Villiers, 2000; Peterson & Siegal, 2000). On the other hand, ToM difficulties may explain difficulties in pragmatics both in comprehension and production. Our study of a sample of adults with HFA/AS was of particular interest since this clinical group do not exhibit linguistic impairment or language delay in development, but they continue to show some difficulties in ToM. AS predicted, people with AS performed within the typical range when grammatical knowledge was sufficient to determine the linguistic-lexical reference. However, when linguistic abilities rely on pragmatics knowledge, these individuals were not able to use linguistic devises correctly, as evinced by their deficit in the referential use of pronouns and temporal marks in narrative.

Thus, when the narrator needed to engage the listener in their narrative perspective, individuals with AS showed difficulties. We found for example that adults with HFA/AS had no impairment in processing syntactic information required for understanding pronominal reference, but presented less flexibility in their knowledge of pronouns when their use required pragmatics inferences. Thus, the HFA/AS group

performed appropriately in introducing and reintroducing a character in the narrative, using an indefinite and definite NP respectively, but showed a subtle but significant deficit when the listener's needs determined the use of pronouns, to maintain reference to a character, and in their use of temporal expressions. This resulted in the use of pronouns whose referents were ambiguous. More investigation is needed to explore such subtle linguistic deficits in HFA/AS. We conclude that such clinical studies afford the opportunity to reveal the independence of ToM from some aspects of language function.

Appendix 1

Analysis of the references to the two main protagonists
   The following counts were made:
Type of NPs:

– indef. NPs
– def. NPs
– pronouns
– zero anaphors
– total number of references (indef. NPs + def. NPs + pronouns + zeros + relative pronouns + possessive determiners)

Episodes and expressions used for maintaining reference:

– total number of episodes
– Episodes with at least one maintenance of reference
– Episodes with one or more pronouns and/or zero referring back to an expression in that episode
– Number of pronouns and zeros referring back to a previous expression

Ambiguous references:

– Number of ambiguous references for (i) pronouns; (ii) possessive pronouns

Inappropriate indef. NPs:

– number of indef. NPs used inappropriately

Theory of mind expressions:

– number of verbs and adjective that describes any characters' affective and cognitive states (e.g., "the boy was sad", "he believed it was a bush")

Temporal expressions:

– number of adverbs, across the episodes, which relate temporally two sentences (e.g., "when he was in the pound, he hear...")

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