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Are Children with Autism Deaf to Gricean Maxims?

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High-functioning children with autism show a severe deficit in the development of pragmatics whereas their knowledge of syntax and morphology is relatively intact. In this study we investigated further their selective communication impairment by comparing them with children with specific language impairment (SLI) and normally developing children. We used a pragmatic task that involved the detection of utterances that violate conversational maxims (avoid redundancy, be informative, truthful, relevant, and polite). Most children with autism performed at chance on this task, whereas all children with SLI and all normal controls performed above chance. In addition, the success of children with autism on the pragmatics task was related to their ability to attribute false beliefs. These results are consistent with the idea that communication deficits in autism result from a selective impairment in representing propositional attitudes. Their implications for domain-specific views of cognitive development are discussed.

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INTRODUCTION

Abnormal communication is a key symptom of autism (DSM-IV; APA, 1994). It is seen in all children with autism and has received considerable attention since the first description of the syndrome (Kanner, 1943). Previous studies on the development of pragmatics in children with autism have reported egocentric speech (Cunningham, 1968); failure to recognise speaker's intended meaning (Eales, 1993; Happé, 1993; Hurtig, Ensrud, & Tomblin, 1982); incorrect use of personal pronouns and prosody (Baltaxe, 1977, 1984); a failure to take into account the distinction between given and new information and conform to conversational rules (Ball, 1978; Baltaxe, 1977; Fine, Bartolucci, Szatmari, & Ginsberg, 1994); a failure to signal turn-taking (Bernard-Optiz, 1982); and abnormal use of requests (e.g. asking questions for which they already know the answer; Wetherby & Prutting, 1984; see Baron-Cohen, 1988; Frith, 1989; and Tager-Flusberg, 1989 for reviews). Most children with autism also show severe deficits in other areas of language development (e.g. morphology, lexical semantics, and syntax). However, although the acquisition of syntactic and morphological knowledge appear to be delayed and, in many cases, development seems to follow the sequence observed in normal children (Tager-Flusberg, 1981, 1989), the acquisition of pragmatics reveals deviant development and a persistent deficit.

What might be causing this pragmatics deficit? Baron-Cohen, Leslie, and Frith (1985) proposed that the characteristic triad of deficits found in children with autism (abnormal communication, social interaction, and imagination) results from a developmental impairment in their theory of mind. Leslie (1987) and Baron-Cohen (1994) discuss this in terms of a dysfunction of a specific mechanism dedicated to forming representations of propositional attitudes. As predicted by this theory, studies have shown that high-functioning individuals with autism are impaired in the attribution of mental states (such as belief). Moreover, their difficulties in attributing mental states cannot be explained by mental handicap, by an executive function deficit, or by a general problem in understanding representation (Charman & Baron-Cohen, 1992, 1995; Happé, 1994; Leekam & Perner, 1991; Leslie & Thaiss, 1992). Nor is the deficit in mental state attribution explained by general difficulties in logical reasoning (Scott & Baron-Cohen, 1994; Scott, Baron-Cohen, & Leslie, 1994; Surian & Leslie, 1995). Rather, the selective pattern of deficit suggests the existence of a discrete ''mindreading system'' (Baron-Cohen, 1994) or Theory of Mind Mechanism (Leslie, 1994) that may be damaged in autism. Such studies highlight the potential importance of autism for asking questions about the core architecture of human cognition (Baron-Cohen, 1995; Frith, Morton, & Leslie, 1991; Leslie, 1994). Research on language and communication in autism may also provide a test for theories of human communication (Baltaxe, 1977; Happé, 1993).

In studying human communication it is crucial to distinguish between ''inferential'' and ''code'' processes. This contrast has been outlined with elegance by Sperber and Wilson (1986). Code processes exploit the shared knowledge of a conventional code and mapping rules that associate representations in a given domain or representational system to representations in another domain or system. An example of a code process is the parsing of sentences of a natural language that associates a semantic description to each sentence in that language. A core feature of code processes is the representational constraint on what can or cannot be coded. Inferential processes are different in nature from code processes in two important respects. First, they do not exploit any shared knowledge of a coding system but rely instead on general reasoning abilities and heuristics. Secondly, there are no constraints on what information may in principle be used in an inferential process. The inferential processes used in human communication can exploit virtually any information as a cue to the speaker's *intended meaning*. Sperber and Wilson pointed out that code models cannot go very far in accounting for human communication. In most communication events it is necessary to use inferences to disambiguate lexical terms, interpret deictic terms, integrate contextual information, and recover propositional attitudes, thereby compute implicit meaning. Thus, in interpreting a phrase like ''Shall we?'', the listener cannot rely solely on mapping rules because the input is so impoverished. For example, if the phrase is uttered in a dance hall, the listener might interpret the question as an invitation to dance; if it is uttered at a crowded party, while nodding toward the door, the listener might infer that the speaker would like to leave, etc.

Happé (1993) proposed that the communicative deficit in autism may be restricted to *inferential communication*, leaving the ability to use *code communication* relatively intact. This is consistent with the core deficit being in attributing mental states. According to Sperber and Wilson, inferential processes in human communication are based on a Principle of Relevance: Every act of inferential communication communicates the presumption of its optimal relevance (i.e. it creates the expectation that the cognitive effects the listener will achieve by interpreting the communicative act are worth while the cognitive resources required by the interpretation process). The listener exploits such a presumption to reach a correct interpretation of an utterance in real time. This is not to say that speakers are always relevant, as we all know. Speakers may fail to achieve optimal relevance either intentionally (an example would be the speeches given by filibusters in parliament) or accidentally (as it is often the case in the speech of very young children). However, part of what makes us competent communicators is our ability to distinguish when the speaker is being relevant or irrelevant, and when irrelevance is intentional (i.e. meaningful) or accidental (i.e. meaningless).

In the present study we employed a new task in which children were asked to identify utterances that failed to achieve relevance. To put it in Gricean terms,

they were asked to identify utterances that violated a conversational maxim. Grice (1975) proposed that speakers in conversation implicitly follow a Co-operative Principle: They co-operate towards an accepted purpose. To do that they conform to nine conversational maxims, divided into four groups, labelled (after Kant) Quantity, Quality, Relation, and Manner:

Maxims of Quantity:
1. Make your contribution as informative as is required.
2. Do not make your contribution more informative than is required.

Maxims of Quality:
1. Do not say what you believe to be false.
2. Do not say that for which you lack adequate evidence.

Maxim of Relation:
Be relevant.

Maxims of Manner:
1. Avoid obscurity of expression.
2. Avoid ambiguity.
3. Be brief (avoid unnecessary prolixity).
4. Be orderly.

The Gricean view of human communication as a rational activity that conforms to a set of maxims proved to be very fruitful in guiding empirical investigations of pragmatic phenomena and processes of utterance interpretation in adults (e.g. Brown & Levinson, 1978), in normally developing children (e.g. Ackerman, 1981; Conti & Camras, 1984; Surian, 1991; Surian & Job, 1987), and in persons with communicative disorders (e.g. Baltaxe, 1977; Bernard-Optiz, 1982; Bishop & Adams, 1989). Note, that to conform to the maxims, or to exploit them in interpretation, entails ascribing mental states (beliefs, knowledge, and communicative intentions) to the participants in the conversation. If children with autism have deficits in ascribing mental states, and particularly ascribing intentions, then they should fail to recognise when such Gricean maxims are being violated.

Grice acknowledged that his list of maxims was compiled having in mind a conversation mainly aimed at an efficient exchange of information, rather than at influencing the addressee's actions. Clearly, one might need other maxims, and Grice himself added a tenth ''off-the-list'' maxim: ''Be polite''. The open-ended character of such a list is a weakness, as for every regularity found in conversation one might be tempted to add a new, *ad-hoc* maxim. Another problem is the vagueness of the definition of the maxims. Grice's Maxim of Relation refers to relevance, but he admittedly gave a very intuitive and vague account of what he meant by relevance. Relevance theory is an attempt to overcome these problems by trying to be more explicit about the cognitive factors that make an utterance more or less relevant to a listener and how such

factors guide the interpretation process. Although retaining the general Gricean conception of communication as an inferential process and a rational activity, Sperber and Wilson replaced the list of different maxims with the Principle of Relevance. Accordingly, we should view the classification of utterances by violation type as a descriptive classification. It is an open question the extent to which that classification is meaningful also at the functional level (i.e. the level of cognitive mechanisms). All target utterances in our pragmatics task—possibly with the exception of politeness violations—failed to be optimally relevant in the given context and might not differ qualitatively at the functional level.

We predicted that children with autism would find the pragmatics task particularly difficult and we expected a close relationship between success on such a task and mindreading abilities, as assessed by a theory of mind test (Baron-Cohen, 1988). Moreover, if a difficulty in identifying irrelevant utterances is specific to children with autism, and does not result simply from their general language delay, their performance should be poor relative to language-matched control groups. This pattern of selective impairments would be further evidence that the processes underlying mental states attribution are domain-specific and ''modular *to some interesting extent*'' (Fodor, 1983, p. 37, emphasis added).

This prediction was therefore tested by comparing children with autism with both a group of normal children and a group of children with specific language impairment (SLI) of equivalent mental age. In making this comparison, this allowed us to investigate not only the nature of cognition in autism, but also an additional question concerning the deficit in some children with SLI: Is their deficit restricted to aspects of syntactic knowledge, as Van der Lely (1994) suggests, or is it a more general problem affecting aspects of pragmatics too? We predicted that children with SLI would have no difficulty in identifying violations of Gricean maxims. If this prediction were confirmed, this would support the notion that syntactic processing and utterance interpretation rely on separate cognitive subsystems (Chomsky, 1986; Pinker, 1994; Sperber & Wilson, 1986).

METHOD

Subjects

The details about the chronological (CA) and mental ages (MA) of the children participating in this study are summarised in Table 1. The children with autism (one girl and seven boys) attended a special school for autism in London, England and had all received a diagnosis of autism according to established criteria (DSM-IV; APA, 1994). Verbal MA was assessed using the Test for the Reception of Grammar (TROG) (Bishop, 1983). The TROG is a multiple-choice test that assesses knowledge of morphology, syntax, and semantics in a comprehension task involving noun phrases and sentences of different

TABLE 1
Characteristics of the Participants

	Chronological Age	*Verbal MA (TROG)*
Autistic		
Mean	12;11	5;7
SD	2;4	1;11
SLI		
Mean	11;10	5;9
SD	1;3	0;3
Normal		
Mean	6;7	5;8
SD	0;3	0;3

grammatical complexity. The choice of TROG was motivated by the need to match children with autism and children with SLI on their development in number of domains of language knowledge other than pragmatics. Nonverbal MA was assessed using the Raven's Coloured Matrices (Raven, 1956). Nonverbal MA turned out significantly higher than Verbal MA (mean NVMA = 10.0, SD = 1.0), and this characteristic profile has been widely reported (Frith, 1989).

The children with SLI (one girl and seven boys) all attended a school in Nottingham, England, that specialised in education of children with language disorders. These children had been diagnosed by speech and language therapists and educational psychologists as having severe and persistent difficulties with language development as measured by standardised tests of language abilities. The children who participated in this study are a subgroup of the children classified as SLI. This group is characterised by a persistent and disproportionate deficit in grammatical abilities. In a previous study, these children showed more difficulties in tests involving syntactic and morphological knowledge than in the tests tapping primarily lexical-semantic and ''information content'' (Van der Lely, 1994). In that study, they were tested on the TROG (Bishop, 1983), the British Picture Vocabulary Scale (a single-word comprehension test; Dunn, Dunn, Whetton, & Pintilie, 1982), the Grammatical Closure subtest of the Illinois Test of Psycholinguistic Abilities (a test of production of morphology; Kirk, McCarthy, & Kirk, 1968), and the Naming Vocabulary subtest from the British Vocabulary Scales (a picture-naming test; Elliott, Murray, & Pearson, 1978). In the TROG, their performance was equal or less than –1.5 (z-scores). On the Grammatical Closure subtest of the Illinois Test of Psycholinguistic Abilities, children had an equivalent age score of at least three years below their chronological age. Children with SLI performed in the low average range on a Nonverbal MA test (i.e. the performance subtests of the British Ability Scale;

Elliott et al., 1978). For further details on the selection procedure for the children with SLI see Van der Lely (1994).

Finally, children in the normal control group (two girls and six boys) attended a mainstream school in London. Their first language was English and they were described by their teachers as not showing any delay in their linguistic, social, and cognitive development.

Materials

Twenty-seven short conversational exchanges were staged and tape-recorded by three speakers, one male and two females (see the Appendix for the complete transcript of the conversations). In each episode, one of the female speakers asked a question and the other two speakers gave a short answer. In each episode, one of the answers violated a conversational maxim. The utterances violated the first or the second maxim of Quantity, the first maxim of Quality, the maxim of Relation, and the maxim of Politeness. As for the First Maxim of Quantity trials, the target utterances failed to provide an informative answer, as in the following:

Question: ''How would you like your tea?''
Answer: ''In a cup''.

In the Second Maxim of Quantity trials, utterances provided redundant information, thus demanding the expenditure of extra processing effort without producing any additional cognitive benefit. For example:

Question: ''What would you like for breakfast?''
Answer: ''A hard boiled egg cooked in hot water in a sauce pan.''

Violations of the First Maxim of Quality consisted of utterances that were obviously false:

Question: ''Where do you live?''
Answer: ''I live on the moon.''

Violations of the Maxim of Relation were presented by using utterances that did not bear any obvious topical relation with the context question:

Question: ''What is your favourite programme on telly?''
Answer: ''My favourite is sandwiches.''

The Maxim of Politeness was violated in rude replies, as in the following:

Question: ''Would you like some of my cake?''
Answer: ''No, it's disgusting.''

All conversational exchanges were kept very short to avoid any failures that might result from memory demands or other processing factors irrelevant to the

present study. Utterances that violated or conformed to the maxims were of roughly the same length and syntactic complexity. The items used were well within children's language comprehension skills and knowledge base, given their performance on the TROG and the Nonverbal MA tests. Children's sensitivity to violations of the Maxims of Manner and the Second Maxim of Quality was not tested because of difficulty in generating items appropriate to their knowledge base and because of the need to keep the experimental task reasonably short. Trials were presented in the same random order to all participants.

A second set of audio-taped conversations was used in a Control Task aimed at checking that the subject could understand the instructions used in the Pragmatics Task. In the Control Task the questions and the correct answers were the same as in the pragmatics task, but the target answers (i.e. the utterances violating a maxim) were replaced by strings of words that consisted of the same words found in the correct answers, but arranged in the reverse order. For example:

Question: ''Where do you live?''
Correct Answer: ''I live in London.''
Target Answer: ''London in live I.''

Procedure

Children were presented with three dolls and were told that one of them, Lucy, was going to ask questions to the other two dolls, Tom and Jane. They were told that Tom and Jane would always answer Lucy, but each time one of them would say something funny or silly. It was said also that sometimes Tom would say something silly, and sometimes it would be Jane who said something silly. Children were first familiarised with the names of the dolls and their voices recorded on tape. Then they were asked to listen carefully to the tape and after each episode the tape was stopped and the child was asked to ''point to the doll that said something silly''. Two practice trials were presented before starting with the experimental trials. Subjects were encouraged to say whether they did not understand what had been said by the dolls and at any sign of uncertainty the trials were played again. Similar tasks have been employed previously in investigations on the development of pragmatics in normal children (Ackerman, 1981; Conti & Camras, 1984).

Children who performed at chance on the pragmatics task were given the control task to test if their failure in the pragmatics task was due to a failure to understand the task instructions. In order to minimise interference between the two tasks, the control task was given about a month after children had performed the pragmatics task. As explained earlier, in this Control Task children received identical instructions as those given in the Pragmatics Task (''point to the doll that said something silly or funny''), but the target utterances involved not only

pragmatic violations, but also violations of grammatical rules and semantic restrictions on word selection.

Finally, all children with autism were given a standard false belief task (Baron-Cohen et al., 1985), as a probe test of their ''theory of mind'', or ability to attribute complex mental states. Children were told a short story involving two characters, Sally and Ann, a marble and two salient hiding places, a box and a basket. The story was staged using suitable materials. Sally hides her marble in a box and then goes out for a walk. While she is out Ann moves the marble from the box to the basket. Then Sally comes back and the child is asked to predict where she will look for her marble. The ability to predict correctly that she will look in the box reveals that the child can attribute a false belief to others and use such attribution to anticipate their actions.

RESULTS

In the Pragmatics Task, three children with autism (out of eight), all children with SLI, and all normal controls performed significantly above chance (i.e. scoring at least 17/25 correct, Binomial Test, $P = 0.05$). The three children with autism who passed the Pragmatics Task also passed the standard False Belief Task, whereas the others failed both tasks. The association between the performance in the two tasks was significant (Fisher's Exact Probability Test, $P = 0.006$). Also, all children with autism performed significantly above chance in the Control Task (lowest score = 20, mean = 23.3). The children with autism who were above chance on the Pragmatics Task were on average younger than the other children with autism (mean CA: 11;6 vs. 13.8, respectively) and had a lower Verbal MA (mean VMA: 5;2 vs. 5;8, respectively). This indicates that their success on the Pragmatics Task was not due to higher general intellectual development.

In Table 2 we report the results from the Pragmatics Task split into different types of violations. As a group, children with autism did not differ from chance on any of the violation types {First Maxim of Quantity: $t(7) = 0.782$; Second Maxim of Quantity: $t(7) = 0.935$; Maxim of Quality: $t(7) = 0.386$; Maxim of Relation: $t(7) = 0.2$; and Maxim of Politeness: $t(7) = 2.26$, all $P > 0.05$}. The score of children with SLI was not above chance with utterances that violated the First Maxim of Quantity {$t(7) = 1.57$}, but they were above chance in all the other types {Second Maxim of Quantity: $t(7) = 2.39$; Maxim of Politeness: $t(7) = 19$, both $P < 0.001$; performance on the Maxims of Quality and Relation was at ceiling}. A similar pattern was found in normal children. They too were at chance with the utterances violating the First Maxim of Quantity {$t(7) = 1.07$, $P = 0.32$}, but above chance on all the others {Second Maxim of Quantity: $t(7) = 3.92$; Maxim of Politeness: $t(7) = 8.078$, both Ps < 0.001; their performance on the other two maxims was at ceiling}.

TABLE 2
Mean Percentage of Correct Responses in the Pragmatics Task

Diagnostic Group	Conversational Maxim					Total
	Quantity 1	*Quantity 2*	*Quality*	*Relation*	*Politeness*	
Autism						
Mean	58	60	55	53	73	60
SD	26	26	30	36	36	32
SLI						
Mean	63	65	100	100	98	85
SD	22	18	0	0	8	8
Normal						
Mean	58	78	100	100	93	86
SD	20	20	0	0	14	10

Note: Chance level = 50

We compared the performance of the three groups by means of a 3_6 5 (Group$_6$ Maxim) MANOVA, entering the number of correct trials as the dependent variable. The analysis revealed significant main effects for Group $\{F(1) = 7.34,\ P = 0.0038\}$ and for Maxim $\{F(4) = 13.818,\ P < 0.001\}$ and a significant Group$_6$ Maxim interaction $\{F(8) = 2.931, P < 0.001\}$. Because of the small sample size, results of this statistical analysis should be considered with caution. *Post-hoc* pairwise comparison (Newman-Keuls method, $_a = 0.05$) showed no significant difference in the scores of the three groups for items violating the first Maxim of Quantity, but higher success of children with SLI and normal controls as compared with children with autism in all other types of violations. Children with SLI did not differ significantly from normal controls in any violation type.

DISCUSSION

In this study we found that children with autism were impaired at detecting pragmatic violations, compared to both normal children and children with specific language impairment matched on linguistic development. Most of the children with autism performed at chance, and this was despite their being able to perform well on a control task involving grammatical violations. We also found an association between success of children with autism on the false belief reasoning task and their performance on the pragmatics task. These findings are consistent with previous studies relating communicative competence and false belief understanding in autism (Eisenmajer & Prior, 1991; Happé, 1993). Equally, as previous studies have shown, these results suggest that some high-

functioning children and adolescents with autism possess an ability to attribute mental states. Their persistent deficit in every-day communication indicates that attributing mental states is certainly not the only process required for developing a normal conversational competence.

Without the ability to represent propositional attitudes one cannot exploit the presumption of relevance in interpreting an utterance or in evaluating its adequacy. Thus, the theory of mind hypothesis of autism (Baron-Cohen et al., 1985), combined with Relevance theory (Sperber & Wilson, 1986), can account for why children with autism failed to assess whether an utterance had not achieved relevance.

Could a nontheory of mind explanation account for the findings of this study? We can rule out an explanation in terms of level of language development or IQ because children with autism and with SLI were matched on this. Equally, working memory demands are not likely to have been significantly greater in the pragmatics task than in the control task, on which the children with autism were unimpaired. Finally, the pattern of results cannot be easily explained, in our view, by a deficit in executive function. Why would a child with autism be sensitive to grammatical but not pragmatic violations, if the underlying deficit was solely an executive one? The executive dysfunction account predicts that the child should be drawn by the more salient of the pair of stimuli (Hughes & Russell, 1993). However, it is not at all clear that the target utterances in the pragmatics and control tasks in the present study differ in terms of salience. The executive dysfunction theory would therefore make no prediction as to how children with autism would perform on this task, whereas the theory of mind hypothesis makes specific predictions that were clearly confirmed.

Whereas children with autism found it difficult to evaluate all types of pragmatic violations, normal children and children with SLI only found it difficult to evaluate the violations of the two Maxims of Quantity. One possible explanation of these findings is that at a certain age children know about some maxims but not about all of them. Alternatively, such a pattern of results may be due to more or less extreme departures from optimal relevance of the different items. We could not control the degree with which different items failed to be relevant, but it is quite plausible that the Maxim of Quality and Maxim of Relation utterances failed to achieve relevance to a greater degree than the ones violating the Maxims of Quantity and Politeness. In the latter cases, the addressee can draw an interpretation at the cost of some extra effort which decreases the relevance of the utterance (Sperber & Wilson, 1986). In contrast, for the items violating the Maxims of Quality or Relation the addressee cannot draw any plausible interpretation. This explanation is more attractive than the first one because it does not require postulating that the maxims are explicitly represented in the cognitive system. The effect of item type found in the nonautistic groups suggests that the communicative development in normal children and children with SLI may take place in the first place because of a

gradual increase of access to computational resources and encyclopaedic knowledge (Surian, 1995). This highlights the role of performance limitations rather than competence deficits and is consistent with a theoretical perspective that assumes continuity in conceptual development. In contrast, the difficulties found in some children with autism are domain-specific (Baron-Cohen, 1993, 1995), concern all types of items regardless of their level of difficulty, and are not found in other children with comparable mental age. These findings may be better explained as the result of a domain-specific representational deficit. Thus, quite different kinds of cognitive factors are likely to underlie the pragmatic failures in children with autism and in young normal children. Whereas in young normal children limitations in access to computational resources appear to be the main source of difficulties, in children with autism the problem may be at the level of representations made available by a specialised component of the core cognitive architecture (Leslie, 1994).

Children with autism failed to distinguish a rude response from a polite one. This suggests that when rude or awkward utterances are produced by children with autism, these are due to a competence deficit in the domain of politeness, rather than to motivational factors, as suggested by Baltaxe (1977). The theory of mind hypothesis for autism offers an explanation for such a knowledge deficit. Because of their representational deficit, children with autism cannot solve the acquisition problem in this domain in the way it is solved by normal children. In conversation, one needs an understanding of the rationale underlying politeness, namely its aim to avoid ''face''-threatening acts (Brown & Levinson, 1978). Because working out what constitutes a face-threatening act involves the attribution of beliefs and complex ''cognitive emotions'' (e.g. shame and pride), a deficit in the mindreading system would prevent the development of a normal understanding of politeness.

Although the results of the present study were predicted using Relevance Theory (Sperber & Wilson, 1986), alternative theories, such as the Mutual Knowledge Theory (Clark & Marshall, 1981; Shiffer, 1972) and the Gricean account of non-natural meaning (Grice, 1957) make similar predictions. Recovering the non-natural meaning of an utterance involves the attribution of an informative intention (the intention to inform) and a communicative intention (the intention to have the informative intention recognised). Such intentions would be computed by a cognitive system that cannot represent propositional attitudes. Further research is needed to test between these alternative theories. Happé (1993) has made a first step in this direction. She studied the performance of children with autism in a task that required the understanding of metaphors, similes, and ironic utterances. The difficulties found in the interpretation of irony, metaphors, and similes nicely follow from the functional account of these forms of figurative speech given in Sperber and Wilson's Relevance Theory. Her findings indicate a greater explanatory power of Relevance Theory over the Gricean account.

These findings have interesting implications for the problem of modularity and domain-specificity in human cognition (Hirshfeld & Gelman, 1994). They suggest that language disorders in some children with SLI and children with autism may derive from impairments in different components of the cognitive system. Whereas language disorders in *some* children with SLI derive from a selective impairment in the ''grammar module'' (Pinker, 1994; Van der Lely, 1994), those found in *some* children with autism derive from an impairment in the Mindreading System (Baron-Cohen, 1994, 1995) or in the Theory of Mind Mechanism (Leslie, 1987, 1994).

This does not imply that all developmental disorders involving deficits of pragmatics derive from an impairment of the mindreading system. Rapin and Allen (1983) have proposed the existence of a language disorder, the ''semantic-pragmatic syndrome'', which appears to share with the autistic syndrome the pragmatics deficit, but not the other communicative and social problems. The main symptom of such a syndrome is a difficulty in the encoding of meaning relevant to the conversational situation. In a detailed analysis of spontaneous speech of children diagnosed as having semantic-pragmatic disorder, Bishop and Adams (1989) found a persistent tendency to provide too much or too little information (i.e. a tendency to violate both Maxims of Quantity). A challenge for future research will be to determine to what extent the communicative impairments in autism and semantic-pragmatic disorder are different at the cognitive level. Equally, this applies to the differentiation of these from Asperger syndrome.

In conclusion, the present study suggests that most children with autism are ''deaf'' to violations of Gricean maxims. Such a deficit is itself likely to be the result of an impairment in mindreading. A further level of explanation for the communicative and cognitive deficits in children with autism will need to relate these deficits to neurobiological factors, for which there are several candidates (Baron-Cohen & Ring, 1994; Rutter & Bailey, 1993). Whatever the neural basis of these deficits, this pattern suggests a specific abnormality, and serves to highlight the plausibility of a fractionation of central cognitive processes.

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APPENDIX

Conversations used in the Pragmatics Task (target items are marked by (*))

1. First Maxim of Quantity (''Be informative'')
   1.1 Lucy: What would you like to buy in this shoe-shop?
   *Tom: A pair of shoes.
   Jane: A pair of trainers.
   1.2 L.: How would you like your tea?
   T.: With milk.
   *J.: In a cup.
   1.3 L.: What did you eat for lunch?
   *T.: Some food.
   J.: Pizza.
   1.4.: What did you see at the cinema last night?
   T.: Snow-white.
   *J.: A film.
   1.5 L.: What did you get for your birthday?
   *T.: A present.
   J.: A bike.

2. Second Maxim of Quantity (''Avoid redundant information'')
   2.1 L.: What did you have for breakfast?
   T.: I had cornflakes, and then a boiled egg and toast.
   *J.: A hard boiled egg cooked in hot water in a sauce pan.
   2.2 L.: Who is your best friend?
   *T.: My best friend is Peter. He wears clothes.
   J.: My best friend is John. He goes to my school.
   2.3 L.: What pets do you like?
   T.: I like puppies and kittens.
   * J.: I like rabbits which are animals.
   2.4 L.: Where did you go this morning?
   T.: I went to dance class and I had a great time.
   *J.: I went to school and I didn't stay at home.
   2.5 L.: What is your favourite colour?
   *T.: Brown which is a colour.
   J.: Blue like the sea.

3. First Maxim of Quality (''Be truthful'')
   3.1 L.: Where do you live?
   *T.: I live on the moon.
   J.: I live in London.
   3.2 L.: Do you have any brothers?
   *T.: Yes, I have 500 brothers.
   J.: Yes, I have two brothers.
   3.3 L.: Have you seen my dog?
   T.: Yes, he is in the clouds.
   3.4 L.: Why don't you play with me?
   T.: Because I have to go home for tea.
   *J.: Because I am playing in the sky.
   3.5 L.: Is there any more chocolate?
   *T.: Yes, I am made of chocolate.
   J.: Yes, I saved you a piece.

4. Maxim of Relation (''Be relevant'')
   4.1 L.: What did you do on holiday?
   T.: I cycled every day.
   *J.: My trousers were blue.
   4.2 What did you do at school?
   *T.: We had a bath.
   J.: We did some writing.
   4.3 L.: What do you like to eat?
   *T.: I like London.
   J.: I like ice-cream.
   4.4 L.: What is your favourite programme on television?
   T.: My favourite is cartoons.
   *J.: My favourite is sandwiches.
   4.5 L.: What games do you know?
   T.: I know how to play football.
   *J.: I know your name.

5. Maxim of Politeness (''Be polite'')
   5.1 L.: Do you like my dress?
   T.: It's pretty.
   *J.: I hate it.
   5.2 L.: Would you like some of my cake?
   T.: No, thanks.
   *J.: No, it's disgusting.
   5.3 L.: May I use your pencils?
   *T.: No, you cannot draw.
   J.: No, I left them at home.
   5.4 L.: Do you want to play with me?
   *T.: No, you are too stupid.
   J.: No, it's too cold to play outside.
   5.5 L.: Could you help me in tidying up my room?
   *T.: Do it yourself.
   J,: In a little while.