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Central coherence and theory of mind in autism: Reading homographs in context

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The hypothesis that people with autism have a specific deficit in 'theory of mind' has been successful in explaining the characteristic triad of social, communication and imagination impairments. It cannot, however, explain the non-social impairments and skills shown by people with autism. Frith (1989) and Frith & Happé (1994*a*) have suggested that these aspects of autism can, instead, be understood as manifestations of a characteristic of general information processing in autism: 'weak central coherence'. The relationship between theory of mind deficits and weak coherence is examined in the present paper. Sixteen relatively able participants with autism, who differed in their theory of mind task performance, were tested with a homograph reading task, in which pronunciation of target words is determined by integration of whole sentence context (e.g. pronouncing tear in 'In her eye/dress there was a big tear'). The results suggest that people with autism at all levels of theory of mind performance show a relative failure to process information for context-dependent meaning in this task. The implications of these findings for current theories of autism are discussed.

The central coherence hypothesis put forward by Frith (1989) can be seen as flowing from two sources: a collection of symptoms and features of autism which remain unexplained by the theory of mind account, and a body of research centering around the relative failure to extract and use global meaning in autism. The first source includes features of autism such as the high incidence of savant skills, the motor stereotypies, insistence on sameness (a diagnostic criterion) and special interests (Wing, 1988). It is interesting to note Kanner's (1943, reprinted in Kanner, 1973) original observations of a tendency to fragmentary processing in his cases: 'a situation, a performance, a sentence is not regarded as complete if it is not made up of exactly the same elements that were present at the time the child was first confronted with it' (p. 37–38). Kanner saw as a central feature of autism 'The inability to experience wholes without full attention to the constituent parts' (p. 38).

The second source includes work begun by Hermelin & O'Connor (1967), and by Frith herself, exploring the use of meaning and pattern in autistic memory and problem solving. For example, testing immediate serial recall of sentences versus word strings, Hermelin & O'Connor (1967) found that, unlike mentally handicapped controls, participants with autism did not benefit significantly from the effect of meaning. In addition, with supra-span materials, controls showed significantly more clustering of related items in free recall than children with autism. While this work has been

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overshadowed by recent theories focusing on autistic social impairments, it has been neither superseded nor invalidated. More recently, for example, Tager-Flusberg (1991) showed that, in free recall, participants with autism were not significantly better at remembering lists of related versus unrelated nouns, while VMA-matched (young normal and learning disabled) controls benefited significantly from the semantic relation.

Frith (1989) proposed a new and tentative theory of autism, which pinpointed as the underlying cognitive deficit a failure of the 'normal operation of central coherence [which] compels us human beings to give priority to understanding meaning' (p. 101). For Frith, the surprising abilities and striking deficits seen in autism have the same cause, the individual's failure to process information for meaning in context. Shah & Frith (1993) tested the hypothesis that people with autism find the Block Design subtest of the Wechsler intelligence scales unusually easy because they are able to resist the overall pattern and perceive it instead in terms of the constituent cubes. For normal individuals the constituent cubes are hard to recognize in the context of the complex pattern. They found that, as predicted, pre-segmentation of the pattern (i.e. drawing in the separate cubes, isolating them from and dismantling the Gestalt context) aided normal participants but not participants with autims. Shah and Frith (1983) also demonstrated that individuals with autism excel on the Embedded Figures Test—which similarly requires that the parts of a pattern be attended to in preference to the whole figure.

The notion of central coherence has not yet been systematically developed and is at present only loosely defined and conceptualized. In particular, it is as yet unclear what is the appropriate level for pinpointing the inability to use context in autism; while success on the Embedded Figures Test suggests a peculiarity even at the level of perception, other features of autism (e.g. failure to benefit from semantic relations in memory tasks; Tager-Flusberg, 1991) are better explained by a failure of coherence only at higher, conceptual levels. One clear prediction of the theory, however, would be that people with autism, of all ages and abilities, should be impaired at extracting context-dependent meaning. The present study aimed to test this prediction with able participants with autism and to relate performance on a coherence task to performance on tests of theory of mind.

While the majority of individuals with autism have been shown to fail tasks where a false belief must be attributed to another person, some older and more verbal individuals with autism are able to pass these first-order theory of mind tasks (Baron-Cohen, 1989; Baron-Cohen, Leslie & Frith, 1985; Frith, Morton & Leslie, 1991). Indeed, recent studies suggest that some people with autism may even pass more advanced, second-order theory of mind tests, understanding that one story character may have a false belief about another character's mental state (Bowler, 1992; Happé, 1993, 1994*a*; Ozonoff, Rogers & Pennington, 1991). These individuals still show social and communication handicaps in everyday life, although they are less impaired than individuals with autism who fail theory of mind tasks (Frith, Happé & Siddons, 1994). These continuing real-life problems may be due to delay in acquiring mentalizing ability, but could also be the result of additional and continuing cognitive characteristics. A weakness in central coherence, for example, would limit the individual's ability to apply even intact theory of mind appropriately in everyday life—where information from many sources must be integrated in context to provide the necessary input for mental state attributions.

In Frith's (1989) original formulation of the central coherence theory, she postulated that the theory of mind deficits shown by most individuals with autism might be just one manifestation of weak coherence, understanding social interactions being the ultimate challenge to our powers of central coherence. More recently, however, Frith & Happé (1994*a*) have suggested that these two cognitive features of autism may be distinct. The basic ability to attribute mental states appears to be a cognitive process of great evolutionary significance, which all normally developing children possess by 5 years and across cultures (Avis & Harris, 1991), with relatively little individual variation in age of acquisition. By contrast, the tendency to process information in context, and to pay attention to wholes versus parts, may vary in the normal population—as reflected in individual differences in scores on Block Design or Embedded Figures tests. In this respect people with autism may be at the extreme end of a normal continuum. Weak central coherence (like its opposite, strong coherence), then, has both advantages and disadvantages, and may be seen as akin to a cognitive style—although its relation to, for example, field-dependence/independence (Bertini, Pizzamiglio & Wapner, 1986; Witkin, Dyk, Faterson, Goodenough & Karp, 1962) is by no means straightforward. In the present study, the aim was to test the hypothesis that weak central coherence is a feature of all individuals with autism, regardless of their level of theory of mind test performance.

According to the central coherence hypothesis, people with autism should show an inability to use context, for example to disambiguate linguistic material. Clearly, much of utterance interpretation is disambiguated by reference to the context of speakers' mental states—and here demands upon central coherence and demands upon theory of mind are confounded. One task which tests the use of linguistic context to derive context-dependent meaning, without making demands on theory of mind, has been devised by Frith & Snowling (1983). They asked participants to read aloud sentences containing homographs, i.e. words with one spelling but two meanings (e.g. 'lead', the metal or the dog's accessory). The homographs used by Frith & Snowling (1983) have two pronunciations, disambiguating the word's meaning (i.e. they are not homophones). Correct pronunciation of the word therefore depended on sentence context, and pronunciation indicated the participant's processing of the target word for meaning in context. In a comprehensive series of experiments, these researchers explored the reading skills of hyperlexic children, with and without autism. At the end of seven experiments, Frith & Snowling (1983) concluded that while the hyperlexic readers with autism showed normal phonological and syntactic processing, these readers showed specific impairments (relative to reading age matched dyslexics and young normals) in 'reading for meaning'. This emerged in their significantly lower comprehension than accuracy scores on the Neale Analysis of Reading Test, in their inability to choose the story-appropriate word to fill in gaps and in their failure to use sentence context to inform pronunciation of homographs.

The homograph task used by Frith & Snowling (1983) included five homographs in 10 sentences, presented in a story format, with no prior warning that some words had two possible meanings and pronunciations. This task was extended and modified in Snowling & Frith's 1986 study, where 20 sentences presented five homograph words in four conditions; rare or frequent pronunciation, and before or after sentence context. The authors looked for an effect of position of target in sentence; if participants use context

to determine pronunciation, then targets appearing after sentence context should be easier to pronounce appropriately than those appearing early in the sentence, before disambiguating context is given. In this second study the procedure was also changed, to include explicit training in a pre-test session, in which participants were alerted to the special status of the target words. Following this procedure, highlighting the double pronunciation of each homograph, participants with autism performed as well as non-autism controls. Participants with autism, normally developing participants and those with learning difficulties with VMA above seven years used context, and those of lower ability in all three groups showed relative insensitivity to sentence context.

In the present study the extended materials from Snowling & Frith (1986) were used, but the open-ended procedure (without pre-test teaching) from the earlier study (Frith & Snowling, 1983) was followed. The homograph reading task in this form has a number of advantages as a method for exploring processing of context-specific meaning by individuals with autism. It is an open-ended task, where the participant is free to process the stimuli in a number of ways. It seems clear that able individuals with autism are capable of comprehending meaning in text—as, for example, in the 'Strange Stories' (Happé, 1994*a*) where understanding of the text was demonstrated by good performance on the control questions. In the stories task, however, the participants were explicitly required by the experimenter to work out the meaning of the text. By contrast, in the homograph task two quite different processing strategies are available, and no instruction or feedback is given to direct the participant in his/her choice of strategy. The participant can choose either to process the homograph in isolation, in which case the most frequent or default pronunciation is the 'correct' one, or she/he can process the homograph as one element of the sentence context, in which case the context-specified pronunciation will be given. In this respect it is important that the homograph task is a non-intrusive task where little instruction has to be given and where—since being asked to read aloud is a fairly ordinary request—the demand characteristics of the situation (to which people with autism might by expected to be less sensitive) are minimized. Lastly, the task has advantages as an on-line task, which does not require meta-knowledge or the making of reflective judgments—abilities which may make demands on the metarepresentational system thought to be deficient in most individuals with autism (Leslie, 1987).

This paper reports the results of the homograph task with individuals with autism who had previously been tested on two levels of theory of mind tasks. Central coherence was measured through the effect of context position; participants who use sentence context to derive appropriate homograph pronunciation should be sensitive to the position of the target word relative to the sentence context. The prediction, that even those participants with autism who pass all theory of mind tasks will show a deficit in central coherence on this simple task, is a bold one, as is appropriate for the early stages of exploration and definition of the central coherence hypothesis.

Method

Design

The experiment had a repeated measures design. The independent variables were pronunciation type (rare versus frequent), and position of target word relative to context (before versus after context). The 20 sentences were thus of four types: rare pronunciation and target word before sentence context; rare

pronunciation and target word after sentence context; frequent pronunciation and target word before sentence context; and frequent pronunciation and target word after sentence context. The dependent variable was number of context-appropriate pronunciations.

Participants

The individuals with autism in this experiment came from a range of special schools, or were contacted through clinicians working with high functioning adults with autism. All had received a diagnosis of autism, by the criteria of DSM-III or DSM-III-R (APA, 1987). Participants were assessed with WISC–R or WAIS (Wechsler, 1974, 1981) according to age.

The participants had previously taken part in a study of theory of mind ability, and some had been tested on communication tasks reported in Happé (1993, 1994*a*). They were divided into three groups according to their performance on a battery of theory of mind tasks (Happé, 1991), and previous studies had demonstrated that performance on this battery was a significant predictor of performance on other social and communication tasks (Happé, 1993, 1994*a*). The battery consisted of false belief and deception tasks at two levels of difficulty: first-order tasks which required attribution of false beliefs about the world (e.g. 'Mary thinks the marble is still in the basket') and second-order tasks requiring attribution of false beliefs about beliefs ('Mary thinks John believes the marble is still in the basket'). Participants with autism tested on the theory of mind battery were selected to form two groups: six participants who passed all and only first-order tasks (referred to as the 'first-order theory of mind' autism group) and six who performed most successfully on second-order tasks ('second-order theory of mind' group). In addition, six of the most able participants with autism who failed first-order false belief tasks were also included ('no-theory of mind' group). Two of the participants with autism (one from the first-order and one from the no-theory of mind group) were not able to read the experimental materials and so were excluded from the study. Characteristics for the three autism groups are shown in Table 1.

Table 1. Participant characteristics

Group	*N*	Means (ranges)			
		Age	VIQ	PIQ	FIQ
Normal control	13	7.7 (7.2–8.2)	—	—	—
Autism (all)	16	17.7 (8.9–28.2)	79.6 (52–100)	88.4 (55–123)	82.0 (51–112)
Autism group divided by theory of mind performance					
'No-ToM autism'	5	18.9 (13–28.2)	64.4* (52–76)	85.0 (55–112)	72.0 (51–90)
'1st-ToM autism'	5	16.6 (8.9–24.6)	84.8 (64–100)	86.0 (64–106)	83.8 (60–102)
'2nd-ToM autism'	6	17.5 (11.5–25.5)	89.5* (58–101)	94.3 (79–123)	90.2 (69–112)

* VIQ of 'second-order theory of mind' group is significantly greater than that of 'no-theory of mind' group (ANOVA, $F(2,13) = 4.47$, $p < .033$; Tukey's test $p < .05$).

Every attempt was made to equate the three theory of mind groups for age and ability, and the groups did not differ on performance IQ (ANOVA, $F(2,16) = 1.01$, $p < .39$) or full-scale IQ ($F(2,16) = 3.2$, $p < .07$). However, as can be seen from Table 1, the groups were not matched for verbal IQ. The no-theory of mind group was significantly less able than the second-order group in terms of VIQ only.

Previous studies, too, have found a verbal advantage in those participants with autism who pass false belief tasks (reviewed by Happé, 1995). Frith & Happé (1994*b*) have suggested that this may reflect the role of mental state attribution in language acquisition, and Happé (1993, 1995) has outlined the importance of understanding mental states in communicative competence. In addition, the verbal subtests of the WAIS and WISC–R may make greater pragmatic demands on the participant than do the performance subtests, and it may be this superior pragmatic competence that is reflected in the higher VIQ scores of those participants with autism who pass theory of mind tasks.

Controls for this experiment were young normally developing children, from an outer London comprehensive school. While it had been intended to use as controls a group of learning disabled (mentally handicapped) individuals, who had previously succeeded on the theory of mind battery (Happé, 1991, 1993), only one of the 14 participants previously identified as IQ-matched to the autism group was able to read the experimental materials sufficiently fluently to take part. Participant characteristics, for the autism and young normal groups, can be seen in Table 1. Young normal children of 7 and 8 years were chosen to form a conservative control group for the youngest and least able of the participants with autism; the lowest CA in the autism group was 8.9 and the lowest VMA 7.7 years. Theory of mind performance was not tested in the control group, since a number of studies suggest that normally developing children of 7 years routinely pass both first- and second-order false belief tasks (Happé, 1993; Perner & Wimmer, 1985; Sullivan, Zaitchik & Tager-Flusberg, 1994).

Materials

First-order theory of mind tasks included the Sally-Ann task (Baron-Cohen, Leslie & Frith, 1985; Wimmer & Perner, 1983) and Smarties task (Perner, Frith, Leslie & Leekam, 1989), as well as two deception tasks modelled on tests reported in Wimmer & Perner (1983). Second-order tasks included the ice cream van task used by Baron-Cohen (1989) and Bowler (1992), as well as higher order deception tasks (based on Perner & Wimmer, 1985, described in Happé, 1991, 1993; see Appendix for an example).

The homograph materials (including frequency norms) were taken from Snowling & Frith (1986). Materials were identical except for two sentences, which were felt to involve social factors which might put the participants with autism at a disadvantage for comprehension (a sentence about a dog 'knowing' that it was going to be taken for a walk, and a sentence about two boys 'pretending' to be cowboys and Indians). These were replaced by similar sentences without these directly 'mental' aspects. Examples of the four sentence types are as follows:

Rare pronunciation, before context. 'There was a big tear in her dress'. 'I always read a lot when I was younger'.

Rare pronunciation, after context. 'The girls were climbing over the hedge. Mary's dress remained spotless, but in Lucy's dress there was a big tear'. 'Yesterday I read a new story'.

Frequent pronunciation, before context. 'There was a big tear in her eye'. 'I read a story now and then I do some maths'.

Frequent pronunciation, after context. 'Molly was very happy, but in Lilian's eye there was a big tear'. 'First I tidy up and then I read a story'.

The sentences were presented on plain white cards. In addition, a list of single words, including the five homographs, was presented to the participants to check reading ability and familiarity with the target words.

Procedure

Participants were tested alone in a quiet room. Each was first asked to read aloud the pre-test list of words and was then presented with the 20 sentences. The cards containing the sentences were shuffled thoroughly before each testing session began, and sentences were presented in pseudo-random order.

The participant was given one card at a time and asked to read aloud the sentence written there. Breaks were allowed if participants seemed fatigued, and positive comments only were made throughout. All participants completed the test in one session.

As in Frith & Snowling's (1983) study, but unlike Snowling & Frith's (1986), the participants in this experiment were not alerted to the special status of the homographs. No teaching was given, and it was assumed from the reading ability and vocabulary level of the participants that both uses of the target words were known. This assumption, although questionable, was necessary, since the experimenter aimed to avoid directing the participants in any way. Nothing occurred during testing to suggest that the assumption was incorrect. None of the participants remarked on the special status of the homographs at pre-test, and comments during testing suggested that the experimenter's lack of intervention was largely successful, and that participants treated the task as an open-ended one where the request to read aloud was not seen as unnatural. Reading errors other than on homograph targets were corrected on-line by the experimenter to facilitate comprehension of the text. Such assistance was necessary for only one of the participants with autism, who mispronounced 'Lucy' as 'lucky'. Most of the normal children, by contrast, required correction on at least one word. Thus, although reading age was not assessed in this study, the occurrence of reading errors and the rate of reading appeared to the experimenter to indicate that the participants with autism were more fluent readers than the normal children.

Pronunciation of the homographs was marked by the experimenter on a standard scoring sheet. Participants who corrected themselves were scored on their corrected attempt, although all attempts were recorded. A score out of 20 resulted, that is, out of five for each of the four conditions.

Results

The results of the homograph task can be seen in Table 2. The first analysis compared the controls with all the participants with autism, grouped together regardless of theory of mind performance. A two-way repeated measures ANOVA (with frequency and context position as within-subjects factors) was performed. The results showed that the autism group and the controls were matched on total score, since there was no main effect of group ($F(1,27) = 0.01, p = .93$). Frequency of the correct pronunciation (frequent versus

Table 2. Number of homographs pronounced context appropriately (Group means (SD) max. = 5)

Target: Position:	Frequent Before context	Rare Before context	Frequent After context	Rare After context	Total (max = 20)
Group					
Control (N = (13)	3.77 (1.09)	1.92 (1.32)	5.00 (0.0)	4.77 (0.44)	15.46 (1.81)
Autism (N = 16)	4.5 (0.73)	2.75 (1.65)	4.63 (0.72)	3.38 (1.50)	15.25 (3.66)
Autism group divided by theory of mind performance					
'No-ToM'	4.40 (0.55)	2.00 (1.87)	5.00 (0.0)	2.80 (1.30)	13.0 (2.78)
'1st-ToM'	4.00 (1.0)	3.00 (1.58)	4.00 (1.0)	3.60 (1.52)	15.2 (4.78)
'2nd-ToM'	5.00 (0.0)	3.17 (1.60)	4.83 (0.41)	3.67 (1.75)	16.7 (3.44)

Note. Context × group interaction significant; no-ToM autism versus control group ($F(1,16) = 12.89; p < .002$); 1st-order ToM autism versus control ($F(1,16) = 20.47; p < .000$); 2nd-order ToM autism versus control ($F(1,17) = 26.98; p < .000$).

rare) had a significant main effect ($F(1,27) = 27.59$, $p < .00$), as did position of target homograph relative to sentence context ($F(1,27) = 102.73$, $p < .00$). In addition, the effect of position of context showed a significant interaction with group ($F(1,27) = 48.80$, $p < .00$).

Very striking in the performance of the autism group compared with the controls was the difference in degree of self-correction. While (across the four conditions) 73 per cent of normal children who made any errors self-corrected at least once, only 50.5 per cent of the participants with autism who performed below ceiling, and so could have corrected themselves, did so. However, the results were not altered when participants were scored on first attempt only; taking a 'strict' score (that is, not allowing self-corrections) still led to a significant group by context interaction ($F(1,27) = 5.69$, $p < .024$).

The second analysis divided the participants with autism into their three groups according to theory of mind performance. As can be seen graphically in Fig. 1, all three groups with autism showed significantly less benefit from preceding context than did the young normal controls. This was true even for the participants with autism who passed second-order theory of mind tasks.

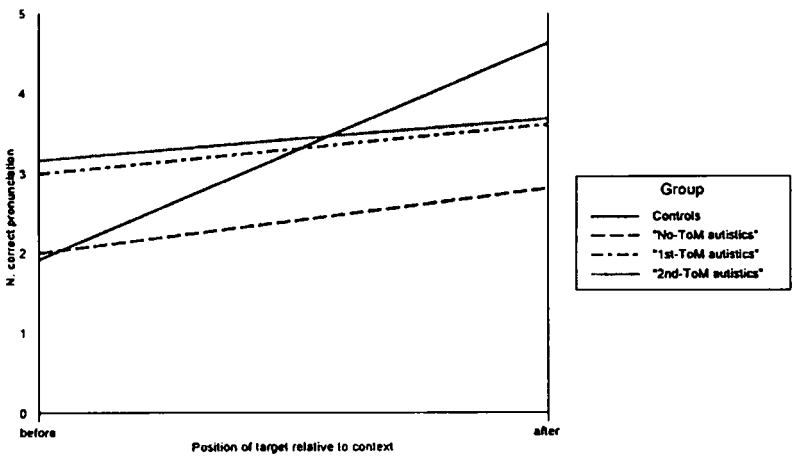

Figure 1. Results of the homograph task: effect of target position on correct pronunciation of rare target words.

So what was true of the autism group as a whole was also true for each of the three subgroups divided by theory of mind performance; participants with autism were less facilitated than young normals by preceding context in the homograph pronunciation task.

Discussion

The finding that most of the participants with autism, including those who passed theory of mind tasks, made relatively little use of preceding sentence context in pronouncing the homographs is very striking. While reading rate was not measured, the

experimenter's impression was that most of the participants with autism read fluently and over all more easily than the normal young controls. Despite this, they did not seem to integrate the sentence context to arrive at the correct interpretation of the homographs.

The relative lack of self-correction might be interpreted as indicating that the autism group's problems with this task spring from a lack of theory of mind, and hence a failure to monitor output to make the sentence comprehensible for the listener. However, the finding that even the 'second-order theory of mind' group (who perform well on a number of other social and communication tasks; Happé, 1993, 1994*a*) showed characteristic failure to use context, suggests that their poor performance results from a separate cognitive characteristic. In addition, monitoring problems from some other source (e.g. executive function deficits; Hughes, Russell & Robbins, 1994) could not explain the present findings; taking a'strict' score (that is, scoring on first attempt and not allowing self-corrections) still led to a significant group by context interaction. Thus the difference between the participants with autism and the normal children in the use of context is not due solely to differing degrees of self-correction.

The findings in the experiment reported here are in accord with Frith & Snowling's (1983) finding that hyperlexic subjects with autism fail to read for meaning. In contrast to the results from the explicitly taught version of the task (Snowling & Frith, 1986), the present study demonstrated that even people with autism who have near normal verbal IQ (and VMA well above 7 years) fail to use context to extract meaning. The results reported here also echo Kanner's comment, that in children with autism 'reading skill is acquired quickly, but the children read monotonously and a story or moving picture is experienced as unrelated portions rather than in its coherent totality' (Kanner, 1943; reprinted in Kanner, 1973 p. 42).

A number of limitations exist in the present study, however, and the conclusions must be considered somewhat tentative. It remains important to establish whether failure to use context in this open-ended task is a truly autism-specific phenomenon; the results should be replicated with a control group of non-autistic learning disabled participants. The present study used rather small numbers of participants, especially in the autism subgroups; and testing with larger samples is underway to seek replication of the present results. The present normal controls were not reading ability-matched with the autism group, and it remains a possibility that better decoding ability in some way hampered the integration of meaning in the autism group (although this would be a somewhat surprising effect). In the present study order of presentation was randomized, and the responses in the autism group were not examined for perseveration—although this is unlikely to explain the specific pattern of results. In particular, it is interesting to note that the participants with autism did not simply 'perseverate' on the more frequent pronunciation of each homograph. Their use of the rare pronunciation may have been due to chance fluctuation, or may reflect local priming which was possible in certain sentences (e.g. eye—tear). Work is underway to address this question, using sentences without such local cues, where whole sentence meaning must be used for disambiguation of homograph meaning/pronunciation. Lastly, comprehension of the homographs and of the whole sentences was not tested directly; future studies might include a post-test asking subjects to paraphrase each sentence.

The present results may be taken as an indication of the autistic impairment in extracting meaning in context. In this way, the results on this homograph task can be related to earlier experiments on meaning and memory (e.g. Hermelin & O'Connor, 1967) and to studies by Shah & Frith (1983, 1993) which demonstrate weak central coherence in participants with autism. The new contribution of the present findings is in suggesting that weak coherence is a characteristic of all individuals with autism, regardless of theory of mind status. Since some participants tested performed well on even second-order theory of mind tests, and showed similar success in understanding the intentions behind metaphorical and ironic utterances (Happé, 1993), yet failed to use context in this homograph task, the results would appear to suggest that a deficit in central coherence can coexist with a degree of theory of mind task competence. This makes it unlikely that the theory of mind deficit is merely a manifestation of a failure in coherence at high levels, either on-line or developmentally (as suggested in Frith, 1989). The possible relations between theory of mind and central coherence remain to be explored empirically. In particular, it will be important to know whether degree of central coherence varies among people with autism, and how this measure relates to real life (as opposed to theory of mind test) social understanding.

The conclusion that weak coherence may be characteristic of all individuals with autism, regardless of theory of mind test ability, is also supported by an analysis of the often reported spiky intelligence test profile of people with autism. Happé (1994*b*) found, in an independent sample of 51 participants with autism, that peaks of performance on WISC–R and WAIS attributable to weak central coherence—such as on Block Design—were shown by the majority of participants regardless of false belief task performance. Tasks hypothesized to be sensitive to pragmatic and theory of mind abilities, however—such as the Comprehension subtest—were poorly performed only by those participants with autism who failed false belief tasks.

Other studies, too, suggest that weak coherence may be a persisting feature of even those individuals with autism who have (perhaps delayed) theory of mind ability. Lack of cohesion appears to characterize the narratives of children with autism, compared with other groups with learning difficulties (Loveland, McEvoy, Kelley & Tunali, 1990). Bruner & Feldman (1993) report, however, that even high functioning adolescents with autism give relatively fragmented narratives in a story telling task. They report that 'the story telling task seemed to evoke, in lieu of narration, a genre of description, for its more frequent words were mainly of specific elements in the story drawings—beach, castle, clouds, flower, girl, plants, pool, rain . . .' (p. 281). In one study quoted, four adolescents with autism and above average IQ were told fables about trickery and deceit and asked to tell them back in their own words. Bruner & Feldman report that the boys seemed to grasp the meaning of the story, recognizing the psychological motivations behind the salient episodes, such as attempts to mislead. However, when telling the story back to the experimenter, the boys did not 'organise their retelling' around the salient episode; 'their retellings report a sequence of actions or events seen in a story rather than composing something that is a story itself' (p. 283). Bruner & Feldman conclude from these findings that individuals with autism have a specific problem with constructing narratives (and that their theory of mind problems are only one manifestation of this). Such an impairment can be seen as one aspect of a more general failure to search for meaning, in terms of global versus local coherence.

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Appendix: Higher order deception task

The Burglar Bill story test

Using a village scene, the following story is narrated and acted out:

'This is Burglar Bill. He has just robbed a shop and he's making his get-away. He's running away from the police. He's running away as fast as he can when he meets his brother. This is Burglar Bill's brother, Bob. He says to Bob, "Don't let the police find me, don't let them find me!" Then he runs and hides in the church. Remember, he's hiding in the church.

Just then the police arrive. They have looked everywhere for Burglar Bill; everywhere except the church and the park. They are going to ask Bob, "Where's Burglar Bill? Is he in the church or in the park [order counterbalanced]?" But the police recognize Bob and they know he will try to save his brother, Burglar Bill. They expect him to lie, and wherever he tells them, they will look in the other place. But Bob is very very clever, and he wants to save his brother. He knows they do not trust him'.

Deception question. 'Where will Bob tell the police to look for Burglar Bill? In the church or in the park' [order counterbalanced].

Comprehension question. 'Where will the police look if he says that?'

Justification question. 'Why will Bob tell them that?'