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The theory of mind deficit in autism: How specific is it?*

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Abnormalities in the social and communicative development of children with autism have recently been related to an impairment in their ability to attribute mental states to others, that is, in the development of their 'theory of mind'. The present paper investigates if this deficit is *specific* to understanding mental states, or if it extends to domains of social cognition in autism which do not involve a theory of mind. This is tested in three areas: (1) relationship recognition, (2) interpersonal reciprocity, and (3) understanding the animate–inanimate distinction. Results from experiments in these three areas show that subjects with autism are unimpaired in all three domains, relative to non-autistic mentally handicapped or normal control groups. This suggests that the deficits in their theory of mind may well be highly specific.

Recent studies of social cognition in autism suggest that the ability to attribute propositional mental states (such as beliefs and knowledge) to other people is severely impaired, even relative to control groups of a lower mental age (Baron-Cohen, 1989*a*,*b*, 1991*a*; Baron-Cohen, Leslie & Frith, 1985, 1986; Dawson & Fernald, 1987; Harris & Muncer, 1988; Leekam & Perner, in press; Leslie & Frith, 1988; Mitchell, 1989; Perner, Frith, Leslie & Leekam, 1989; Reed & Patterson, in press; Russell, Sharpe, Mauthner & Tidswell, 1991; Shaw, 1989; Sodian & Frith, 1990; Swettenham, 1990). This finding appears to be highly robust, in that despite wide variations in techniques used to assess it, comparable results are still obtained. Thus, studies to test if children with autism understand false beliefs have used a range of stimuli that include dolls (Baron-Cohen *et al.*, 1985; Leekam & Perner, in press; Mitchell, 1990; Reed & Patterson, in press), picture stories (Baron-Cohen *et al.*, 1986), people (Leslie & Frith, 1988; Perner *et al.*, 1989; Russell *et al.*, in press), and even computer-graphic images of people (Swettenham, 1990). In addition, although most of these experiments have been administered by psychologists, similar results are still obtained if the tests are administered by the child's mother (Shaw, 1989).

Three questions arise concerning the *specificity* of this deficit. First, is it confined to people with autism? To date, the only other clinical groups that have been tested are

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subjects with Down's syndrome (Baron-Cohen, 1989*a*; Baron-Cohen *et al.*, 1985, 1986), specific language impairments (Leslie & Frith, 1988; Perner *et al.*, 1989), deafness (Leslie & Sellars, forthcoming), and mental handicap of mixed aetiology (Baron-Cohen, 1989*b*) all of whom perform normally on the tests. Whilst this does not exhaust the set of clinical populations that need to be tested using such techniques, the deficit so far does seem to be specific to autism.

Secondly, is the deficit in autism confined to understanding propositional mental states, or does it apply generally to their understanding of all mental states? Evidence so far suggests that understanding the propositional mental states believe (Baron-Cohen *et al.*, 1985, 1986), know (Leslie & Frith, 1988), think and dream (Baron-Cohen, 1989*b*) are all impaired in people with autism, whilst their understanding of non-propositional mental states such as 'simple' emotions (e.g. happiness and sadness as outcomes of situations) is unimpaired* (Baron-Cohen, in press; Harris, 1991). Thus, the deficit may well be confined to (or at least most severe in) their understanding of propositional mental states.

Finally, is the deficit in autism confined to understanding mental states (propositional or otherwise), or does it extend to other domains of their social cognition? The term social cognition is used here to refer to those aspects of the cognitive system that are used in understanding the social world. The evidence to date shows that people with autism are relatively 'intact' in a number of domains of social cognition. These include person permanence (Sigman & Mundy, 1989), visual perspective taking (Baron-Cohen, 1989*c*; Hobson, 1984), mirror self-recognition (Baron-Cohen, 1985; Dawson & McKissick, 1984; Ferrari & Matthews, 1983; Flannery, 1976; Neumann & Hill, 1978; Spiker & Ricks, 1984) and gender recognition (Abelson, 1981; Weeks & Hobson, 1987). Similarly, children with autism pass tests of face recognition, although they may use unusual strategies (Goode, 1985; Hobson, Ouston & Lee, 1988; Langdell, 1978; Volkmar, Sparrow, Rende & Cohen, 1989).

However, there are many other domains within social cognition which do not involve a theory of mind and which have not yet been systematically investigated in autism. The possibility remains, therefore, that there may well be a 'lower level' social cognitive deficit in autism. This article attempts to fill a gap in our knowledge by reporting on three areas of social cognition which do not involve a theory of mind and which have not been previously tested in autism. These abilities are relationship recognition, interpersonal reciprocity and understanding the animate–inanimate distinction. The rationale for testing each of these is outlined below.

Three hypotheses

One possibility is that the social difficulties in autism stem from an inability to recognize social relationships, that is, an inability to perceive how people are related to each other, *independent* of the mental states people possess. A failure to recognize social relationships would, one imagines, leave a person seriously confused by the

* Hobson and his colleagues (see Hobson, 1989, for a review) have found emotion recognition for people with autism is impaired relative to recognition of non-emotion stimuli, when compared to matched controls. How such recognition skills relate to comprehension remains to be investigated (see also Ozonoff, Pennington & Rogers, 1990).

social world. Some evidence that this occurs was reported by Dewey & Everard (1984) who noted that social relationships such as social class might go unrecognized by people with autism, since they often fail to modify their language according to their listener's social status.

Social relationships are, at the simplest level, defined by the physical characteristics of the particular individuals. For example, a mother–child relationship is defined by a relative age gap and by the gender of the adult, although the absolute age or physical appearance of that mother or her child, and the absolute gender of her child, are irrelevant to the definition. Naturally, relationships can be defined on more subtle levels, such as in terms of the ways in which the two people behave ('relate') towards each other. Thus, in the case of a mother–child relationship, nurturing behaviour might be thought of as important to the definition of the relationship. In the first of our experiments, however, we investigated judgements about relationships simply in terms of the physical attributes of the relative age difference between the adult and child, plus the adult's female gender.

The capacity for relationship recognition, also known as non-egocentric discrimination of kin association,* has been demonstrated in the higher primates (Dasser, 1988). This ability has not, as far as I know, been tested in normal children. It is conservatively estimated here that normal children of 3.5 years old would possess such an ability, using Premack's (1988, p. 173) rule of thumb that 'capacities that do not appear in the 3.5-year-old child will not be found in the ape'. Can people with autism also identify such relationships? Experiment 1 tested this question.

A second possibility is that the social difficulties in autism arise from a general inability to understand anything about interpersonal reciprocity (Rutter, 1983), that is, that relationships have a symmetry, again independent of the mental states people possess. Again, such a deficit could be expected to have a profoundly disruptive effect on their attempts at social interaction, leaving them oddly one-sided and 'egocentric'. In Expt 2 we tested this in two ways, by asking (*a*) Do people with autism appreciate that, if we are sitting opposite each other, their left and right is my right and left?† (*b*) Can they demonstrate simple reciprocity in a turn-taking ball game, such that their turn alternates with mine, and mine with theirs?

These are tests of interpersonal reciprocity to the extent that they involve people in symmetrical relationships. But this type of simple reciprocity is unlikely to involve a theory of mind. For example, left–right reciprocity could be solved simply by 180° mental rotation of one's own left and right, whilst the ball-rolling reciprocity could be solved by employing a simple schema in which direction and repetition of movement are specified. In this sense, these tasks could be solved without any awareness of people with their own mental states.

The third and final hypothesis is that the social difficulties in autism might arise from an early incapacity to distinguish between animate and inanimate objects, again

* Dasser (1988, p. 91) makes the point that non-egocentric discrimination of kin association is different to simple kin recognition. The latter involves differentiating if an individual is a genetically close relation to oneself or not, and this ability is widespread in animals. The discrimination of kin-associations between others can be thought of as ***non-egocentric*** when it entails judging the relationship between any two individuals, even if they are completely unrelated to oneself.

† I am grateful to Cathy Peng for suggesting this non-mentalistic control task.

independent of whether those objects possess mental states. Imagine a human being who was 'blind' to such a distinction. Such a person would not only find the world confusing, but might attempt to communicate with entirely the wrong class of objects. Indeed, Kanner, the psychiatrist who first described autism in 1943, suggested such a deficit might exist:

> He never looked up at people's faces. When he had any dealings with persons at all, he treated them, or rather parts of them, as if they were objects. He would use a hand to lead him. He would, in playing, butt his head against his mother as at other times he did against a pillow. He allowed his boarding mother's hand to dress him, paying not the slightest attention to *her* . . . People, so long as they left the child alone, figured in about the same manner as did the desk, the bookshelf, or the filing cabinet. (Kanner, 1943, reprinted in 1973, pp. 15, 38).

Although Piaget (1929) believed young normal children were confused about the distinction between animate and inanimate objects, recent work shows he considerably underestimated young children in this regard (Carey, 1985). In Expt 3, we tested if children with autism had the ability to distinguish animate and inanimate objects.

Experiment 1: Recognizing social relationships

Subjects

The experiments were administered in random order, and all subjects took part in all three experiments. Each subject was tested in a quiet room in his or her school, alone with the experimenter. There were 17 subjects with autism, all of whom had been diagnosed according to established criteria (DSM III–R, 1987) and were attending a special school for autism. In addition, there were 16 subjects with mental handicap, to control for mental age (MA) and chronological age (CA), and 19 clinically normal children, included to provide some normative data for the abilities tested. The sex ratio in the normal group and the group with mental handicap was approximately 1:1, whilst in the group with autism it was 3:1 (M:F). Details of the subjects are summarized in Table 1.

Table 1. Subject variables: Means, SDs and ranges of chronological age (CA) and mental age (MA)

Diagnostic groups	*N*	CA	Non-verbal MA	Verbal MA
Autism	17			
	Mean	13.78	8.48	6.91
	SD	2.8	1.81	1.77
	Range	9.7–19.8	5.6–11.2	4.0–9.9
Mental handicap	16			
	Mean	15.44	6.03	6.47
	SD	2.13	1.0	1.5
	Range	9.3–18.3	5.0–8.5	4.0–10.0
Normal	19			
	Mean	5.3	—	
	SD	0.87	—	—
	Range	4.1–6.8	—	—

Note. Non-verbal MA measured by Raven's Matrices; verbal MA by the BPVS.

The inclusion criterion for the clinical subjects was a verbal MA of at least 4 years old, representing the age at which normal children comfortably passed our pilot tests. Non-verbal MA was higher than verbal MA for both clinical groups, markedly so in the case of the subjects with autism, reflecting typical discrepancies in the IQ profile (De Myer, 1976). Using a minimum verbal MA as an inclusion criterion was therefore a conservative precaution against the risk that the clinical groups might be developmentally disadvantaged in comparison with the normal control group. Our normal control group had a mean CA of 5.3 years, ranging from 4.1 to 6.8. We assumed that, for the normal group, MA would roughly correspond to CA. Verbal MA was assessed using the British Picture Vocabulary Scale (BPVS, Dunn, Dunn, Whetton & Pintilie, 1982). Non-verbal MA was assessed using the Raven's Coloured Progressive Matrices (Raven, 1956).

Procedure

Four sample pictures were put on the table in front of the subject. Each picture was taken from one of the four categories of relationship tested, namely (*a*) mother–child, (*b*) father–child, (*c*) peer, and (*d*) husband–wife. These categories were selected on the basis that subjects in all three groups would have had direct or indirect experience of all four types of relationship. The experimenter first named the four sample pictures for the subject ('Here is a picture of a mother and a child', etc.). The subject was then given 20 further pictures, in random order, containing five further examples from each category, and was asked to place each one next to one of the four sample pictures. With each picture the subject was reminded 'Look at these [sample pictures]' and was then asked 'Where does this one go?'*. All subjects seemed to grasp the nature of the matching to sample task without any warm-up, training or additional explanation being necessary.

Materials. The 24 pictures were colour photographs taken from popular magazines, mounted on card measuring 3 × 3 in. In each category, care was taken to ensure that the models differed in terms of age, and in categories *a*, *b* and *c*, the child's sex was in some instances male, others female. Schematic examples of the sample picture in each of the four categories and a randomly selected token of each category are shown in Fig. 1.

Scoring. After the subject had sorted the 20 pictures, incorrect classifications were noted, and these were then deducted from a possible total score of 20. The probability of correctly sorting any one picture by chance alone was assumed to be .25, since there were four piles of pictures. Therefore, using the binomial test at $p < .05$, an overall score of 9 or more was taken as above chance performance.

Results and discussion

The results of Expt 1 are shown in Table 2. As can be seen, all three groups performed clearly above chance. A one-way analysis of variance revealed that the groups differed significantly ($F = 4.894$, $p < .01$), and a Scheffé *post hoc* test showed that this difference was due to the group with autism scoring significantly higher than the group with mental handicap (Scheffé test, $p < .05$). The same Scheffé test showed that the group with autism and the normal group did not differ from one another on this task ($p > .05$).

The relatively poorer performance of the subjects with mental handicap was not predicted prior to the experiment, but one possible reason for this may have been their tendency to be more impulsive than the other groups. They frequently put a picture down on to one of the four piles without any delay. It seems likely that, in

* A pilot version of this task required the child to place the pictures *over* the targets. This was considered less satisfactory than the present procedure because it introduced unnecessary memory factors. In the final form of this experiment, the target pictures were therefore visible at all times, eliminating additional memory factors from the task.

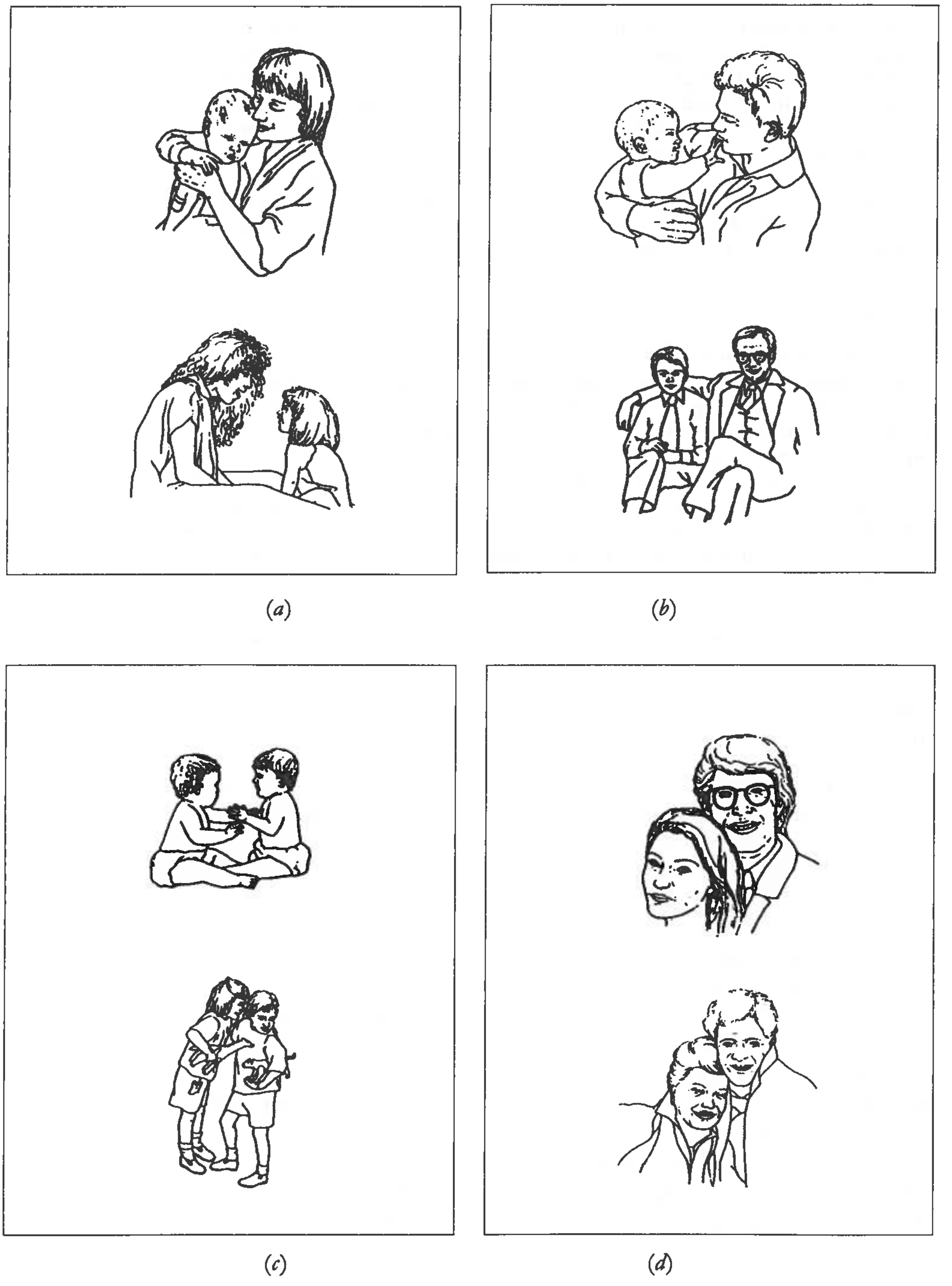

Figure 1. Schematic examples of the sample illustration in the four categories of relationship, and a schematic token of a match for each. Category names: (*a*) mother–child; (*b*) father–child; (*c*) peer; (*d*) husband–wife.

These drawings are by Cathy Clench, St Bartholomew's Hospital Medical Illustration Department, London.

Table 2. Results on the relationships test

		Score (max. = 20)	
Diagnostic group	*N*	*M*	SD
Autism	17	17.7	2.25
Mental handicap	16	14.5*	3.85
Normal	19	17.0	3.02

* $p < .05$.

their case alone, some pre-training might have improved their score. In contrast, the subjects with autism and the normal subjects were virtually at ceiling on this task.

These results suggest that the detection of mother–child, father–child, husband–wife, and peer relationships in unfamiliar and unrelated individuals poses no special difficulty for subjects with autism. This kind of social perception can be carried out purely in terms of relative age and gender cues, without necessarily involving attribution of mental states. Naturally, more subtle aspects of relationship perception, not tested here, may entail mental state attribution, but the present data are consistent with the notion that the social-cognitive deficit in autism is specific to the development of a theory of mind. This was tested further in Expt 2.

Experiment 2: Demonstrating 'reciprocity'

Procedure

We used two tests of reciprocity: (i) distinguishing own left–right from other left–right, when sitting opposite another person, and (ii) maintaining a ball-rolling game. These two tests were administered in random order. The instructions for the left–right test were as follows. The experimenter said 'Which is your left hand? And which is your right hand? OK, now, which is my left hand? And which is my right hand?' The order of hands and of self–other in the questions was randomized. Then, after the experimenter and the subject had switched sides of the table, this was repeated in order to control for position effects. Correct performance was credited if the subject passed on both trials of own left–right and other left–right.

The instructions for the ball game were as follows. The experimenter said 'Look! Here's a little ball. Would you like to play ball with me? OK, let's roll the ball to each other'. The experimenter then rolled the ball to the subject, and waited to see if the subject rolled it back. If the subject did not, the experimenter said, 'Now it's your turn. Can you roll it back to me?' This was the only time a prompt was given. If the subject did roll it back, the experimenter silently rolled it back to the subject, and then counted to establish if the subject could maintain the alternate turn taking for five to-and-fro turns.

Results and discussion

The results of this experiment are shown in Table 3. Taking the left–right test first, it is evident that the majority of subjects in all three groups passed this without any difficulty. Furthermore, statistically the three groups did not differ from each other (autism × mental handicap, and mental handicap × normal, both $\chi^2(1) = .25$; $p < .62$). And again, on the ball-rolling task, all three groups functioned at a similar

Table 3. Results from the reciprocity tasks

Diagnostic group	N	Left–right test		Ball-rolling test	
		Pass	Fail	Pass	Fail
Autism	17	14 (82)	3	15 (88)	2
Mental handicap	16	11 (69)	5	13 (81)	3
Normal	19	11 (59)	8	18 (95)	1

Note. Numbers in parentheses indicate percentage of whole group passing each test.

level, close to ceiling (autism × mental handicap, $\chi^2(1) = .01$, $p < .94$; autism × normal, $\chi^2(1) = .01$, $p > .91$).

Thus, the majority of our subjects with autism showed no deficit in their ability to demonstrate reciprocity at this simple level, revealing their awareness of the basic symmetrical structure of reciprocal social relationships. As with Expt 1, this result is also consistent with the impaired theory of mind model of autism, as reciprocity at this level does not necessarily entail attribution of mental states. Of course, more complex forms of social reciprocity (e.g. sharing, helping) are likely to entail mental state attribution, and these would be expected to be impaired in autism. Such complex forms were not tested here. We shall return to this point in the General Discussion section. Before this, the final experiment is described, which tested understanding of the animate–inanimate distinction in autism.

Experiment 3: Understanding the animate–inanimate distinction

Method

The experimenter said, 'I've got some more pictures to show you. Would you like to see them? OK, now can you tell me what this is? Good. Is this alive or not alive?' The experimenter then proceeded to ask the same two questions (naming and alive questions) for the subsequent 29 pictures (total = 30). The pictures are described below. With each response, the experimenter put the picture into the pile identified by the subject as alive or not alive. At the end of the task, the experimenter spread out the pictures on the table in front of the subject, retaining the two piles the subject had made, and said, 'OK. Now let's look at all of these' (here, he indicated all the pictures the subject had classified as alive). He then said, 'Why are all these alive?' (the Why question).

Materials. The pictures comprised colour photographs obtained from popular magazines, each picture containing one object. The objects fell into six categories (three animate and three inanimate), and the five examples of each are listed here:

(*a*) animals (bird, cat, fox, dog, otter)
(*b*) plants (four types of flower and a tree)
(*c*) people (boy, baby, man, girl, woman)
(*d*) domestic objects (table, cup and saucer, camera, television, hammer)
(*e*) mobile objects (tricycle, wheel-barrow, car, lawn-mower, vacuum cleaner)
(*f*) toy creatures (a furry duck, a furry Mickey Mouse, a teddy bear, a soft clown, a plastic female doll).

These categories were chosen in order to facilitate investigation of the kinds of errors that subjects might make, based on the criteria they might use to define being alive. Thus, if they used the criterion of movement, category (*e*) would be wrongly sorted as alive whilst category (*b*) might be wrongly sorted as not alive. In contrast, if they used the criterion of having eyes, again category (*b*) would be wrongly sorted as not alive, but this time category (*f*) would be wrongly sorted as alive. Or, to give a final example, if they used the criterion of being able to talk, categories (*b*) and (*c*) would both be wrongly sorted as not alive.

Scoring. There were 15 pictures that could be categorized correctly as alive [namely the five pictures in each of categories (*a*), (*b*) and (*c*)] and 15 that could be categorized correctly as not being alive [namely the five pictures in each of categories (*d*), (*e*) and (*f*)]. Each subject was therefore allocated an animate score out of 15, depending on how many of (*a*), (*b*) and (*c*) had been classified as alive, and an inanimate score out of 15, depending on how many of (*d*), (*e*) and (*f*) had been classified as not being alive. Subsequently, errors were classified by type and criteria used in response to the why question. Since the probability of correctly classifying any one picture by chance alone was .5, an animate or inanimate score of equal to or more than 9 out of 15 was considered to be non-random responding (binomial test, $p < .05$).

Results

The correct animate and inanimate scores for each group are shown in Table 4. The group with autism scored well above chance on both, whilst the group with mental handicap and the normal group, although well above chance on their inanimate scores, were only just above chance on their animate scores. However, a one-way ANOVA showed that the correct animate score did not differ significantly between groups ($F=2.26$, $p>.11$). A similar ANOVA of the correct inanimate scores also showed that the groups did not differ ($F=1.53$, $p>.22$). However, when the group with autism and the normal group were compared by a further *t* test, the difference in performance approached significance ($t(34)=1.91$, $p=.06$). This suggests that the normal group tended to find it *more* difficult to define correctly what was not alive compared to the group with autism.

Table 4. Correct classification of animate objects (and number of errors) on the animate–inanimate test

		Correct animate score[a]		Correct inanimate score[a]	
Diagnostic groups	*N*	*M*	*SD*	*M*	*SD*
Autism	17	11.4	2.96	13.41	2.67
Mental handicap	16	9.6	3.3	12.06	3.68
Normal	19	9.1	3.46	11.2	4.02

[a] Max. score = 15.

An examination of the types of error made (shown in Table 5) revealed first that when errors occurred, they tended to be consistent within a discrete category (e.g. if a subject excluded any plants, then he or she excluded all examples of plants, not just one or two examples of them). This meant that errors tended to occur in groups of five points, corresponding to the category wrongly classified. Secondly, although fewer subjects with autism showed random errors (guessing) than the other two groups, and although more normal children excluded animals from the alive category than the other two groups, neither these nor any other differences in Table 5 were

Table 5. Number of subjects in each group making different error types in the animate–inanimate distinction

Error type	Diagnostic groups Autism	Mental handicap	Normal
Animate			
Plants excluded	10	9	12
Animals excluded	0	1	4
People excluded	0	0	1
Inanimate			
Mobile objs excluded	1	0	2
Toy creatures excluded	2	2	2
Domestic objects excluded	0	0	0
Random errors	2	4	4
No errors	5	3	2

statistically significant (Fisher's exact test, $p > .05$). The most common error for all three groups was excluding plants as being alive, and the least common errors for all groups were excluding people, or including domestic objects, as being alive.

There were also a number of similarities between the three groups in the criteria they used to define being alive (see Table 6). First, for all three groups the most commonly used criteria were movement, followed by reference to a biological function (eating, growing, or dying), followed by sight. Two subjects in the normal group used an additional criterion of familiarity (any object seen or owned) which no subjects in the other two groups used. This strengthens the statistically non-significant trend that the normal subjects seemed the most unclear about the animate–inanimate distinction. Indeed, it was the normal group which contained the highest number of bizarre criteria (e.g. familiarity). This contrast with the group with autism replicates an earlier unpublished study (Donald Cohen, personal communication).

Table 6. Number of subjects in each group using the various criteria in the animate–inanimate distinction

	Diagnostic groups Autism	Mental handicap	Normal
Criteria used			
Moves	6	5	6
Biological function[a]	5	6	4
Sight (has eyes)	2	2	4
Familiarity[b]	0	0	2
'Don't know'	4	4	3

[a](Grows, can die, or eats).
[b](Seen or has one).

Indeed, the only subject with autism who produced a really bizarre response in his sorting was a bright, teenage boy who said that things that are alive can 'swallow'. He explained that it was on this basis that he had classified the picture of the vacuum cleaner and the lawn-mower as alive. In our coding this subject's criterion was scored as biological (eats). But apart from him, the surprising level of development of this distinction in autism demonstrates yet another intact area of their social cognition, and underlines the real possibility of the specificity of their deficit in understanding mental states.

Influence of MA and CA on performance in all three experiments

It is worth noting briefly that although few significant differences emerged between groups in any of the experiments, there was nevertheless a trend within groups for performance to be related to both CA and MA, that is, the older and higher functioning subjects in both clinical groups tended to make fewer errors on any of the tasks, relative to both younger and lower functioning subjects. The same was true for the normal group with respect to CA. (MA was not assessed in the normal group.) Thus, correct performance steadily increased with age for the normal children, on all three tasks.

General discussion

The question behind the three experiments described here is whether the previously reported deficit in the development of a theory of mind in people with autism is *specific* to that aspect of their social cognition, or whether there is a lower level deficit in other domains of their social cognition that do not involve a theory of mind. The results of these three experiments produced a clear answer to this question, in relation to three such social cognitive abilities. Subjects with autism are neither impaired in their ability to recognize simple relationships, nor in their ability to show simple reciprocity, nor in their understanding of the animate–inanimate distinction, relative to normal subjects and subjects with mental handicap. I argued at the outset of this article that none of these skills, at this basic level, require mental state attribution. On this assumption, the present results are therefore consistent with the hypothesis that the deficit in the development of a theory of mind in autism is highly specific.

However, although good performance was observed in all three areas, the tests used here were of such a simple level that deficits in each of these areas might still exist at higher levels. Nevertheless, both I and others (Baron-Cohen, 1988, 1990, in press; Baron-Cohen *et al.*, 1985, 1986; Leslie & Frith, 1990) have made the claim that the complexity such higher-level tests would require is likely to be of a kind which entailed using a theory of mind. For example, some evidence suggests that people with autism are unaware or only dimly aware of certain complex types of relationship, such as deception (Russell *et al.*, in press; Sodian & Frith, 1990), or embarrassment. Similarly, there are certain kinds of reciprocity which people with autism are incapable of demonstrating, such as pragmatic competence in language (Baltaxe, 1977; Baron-Cohen, 1988; Perner *et al.*, 1989) or complex social games. Given the role of mental state attribution in the normal functioning of these skills

(Dennett, 1978; Grice, 1975), failure at all of these levels may well be related to deficits in their use of a theory of mind.

The exception to this qualification may be in the understanding that people with autism have of the animate–inanimate distinction, which the present results suggest is highly advanced, and which may even be free of deficits at higher levels. For example, on questioning those subjects who produced biological explanations for the distinction, I found their understanding of biology was no weaker than that of either of the control groups. Thus, some referred to growth, or to the existence of bones and blood, to the need to eat, and to the inevitability of death. In another study (Baron-Cohen, 1989*b*), I found a surprisingly normal understanding of the location and function of the heart and the brain, relative to control groups. However, consistent with the theory of mind deficit in autism, many subjects with autism believed the brain's main function was solely in generating and controlling *movement*, whilst most normal subjects, as well as those with mental handicap and with the same MA believed its main function was to generate and control *thought*.

In conclusion, social cognition that is independent of a theory of mind seems to be spared of any damage in autism. In contrast, as more replications of their deficits in theory of mind are attempted, the specificity of this deficit becomes all the clearer. One clinical implication of this is that, if social skills that do not involve a theory of mind are taught in schools for autism, these are likely to be successfully acquired, without necessarily affecting the crucial deficits in the person's theory of mind. It will be important for future studies of the theory of mind deficit in autism to establish further the respective roles played by emotion (Hobson, 1990) and cognition (Leslie & Frith, 1990), as well as investigating whether this highly specific deficit is amenable to treatment.

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References

Abelson, A. G. (1981). The development of gender identity in the autistic child. *Child: Care, Health, and Development*, **7**, 347–356.

Baltaxe, C. (1977). Pragmatic deficits in the language of autistic adolescents. *Journal of Paediatric Psychology*, **2**, 176–180.

Baron-Cohen, S. (1985). Social cognition and pretend play in autism. Unpublished PhD thesis, University College, University of London.

Baron-Cohen, S. (1988). Social and pragmatic deficits in autism: Cognitive or affective? *Journal of Autism and Developmental Disorders*, **18**, 379–402.

Baron-Cohen, S. (1989*a*). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, **30**, 285–298.

Baron-Cohen, S. (1989*b*). Are autistic children behaviourists? An examination of their mental–physical and appearance–reality distinctions. *Journal of Autism and Developmental Disorders*, **19**, 579–600.

Baron-Cohen, S. (1989*c*). Perceptual role taking and protodeclarative pointing in autism. *British Journal of Developmental Psychology*, **7**, 113–127.

Baron-Cohen, S. (1990). Autism: A specific cognitive disorder of 'mind-blindness'. *International Review of Psychiatry*, **2**, 79–88.

Baron-Cohen, S. (1991*a*). The development of a theory of mind in autism: Deviance and delay? *Psychiatric Clinics of North America*.

Baron-Cohen, S. (1991*b*). Precursors to a theory of mind: Understanding attention in others. In A. Whiten (Ed.), *Natural Theories of Mind*. Oxford: Blackwell.

Baron-Cohen, S. (in press). Autistic children's understanding of some causes of emotions. *Child Development*.

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

Baron-Cohen, S., Leslie, A. M. & Frith, U. (1986). Mechanical, behavioural and intentional understanding of picture stories in autistic children. *British Journal of Developmental Psychology*, **4**, 113–125.

Carey, S. (1985). *Conceptual Change in Childhood*. Cambridge, MA: MIT Press/Bradford.

Dasser, V. (1988). Mapping social concepts in monkeys. In R. Byrne & A. Whiten (Eds), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes and Humans*. Oxford: Oxford University Press.

Dawson, G. & Fernald, M. (1987). Perspective-taking ability and its relationship to the social behaviour of autistic children. *Journal of Autism and Developmental Disorders*, **17**, 487–498.

Dawson, G. & McKissick, F. C. (1984). Self-recognition in autistic children. *Journal of Autism and Developmental Disorders*. **14**. 383–394.

De Myer, M. K. (1976). Motor, perceptual–motor and intellectual disabilities of autistic children. In L. Wing (Ed.), *Early Childhood Autism*. Oxford: Pergamon.

Dennett, D. (1978). *Brainstorms: Philosophical Essays on Mind and Psychology*. Hemel Hempstead: Harvester Press.

Dewey, M. & Everard, P. (1984). The near normal autistic adolescent. *Journal of Autism and Developmental Disorders*, **4**, 348–356.

DSM III–R (1987). *Diagnostic and Statistical Manual of Mental Disorders*, rev. 3rd ed. Washington, DC: American Psychiatric Association.

Dunn, L., Dunn, L., Whetton, C. & Pintilie, D. (1982). *British Picture Vocabulary Scale*. Windsor, Berks: NFER–NELSON.

Ferrari, M. & Matthews, W. S. (1983). Self-recognition deficits in autism: Syndrome-specific or general developmental delay? *Journal of Autism and Developmental Disorders*, **13**, 317–324.

Flannery, C. N. (1976). Self-recognition and stimulus complexity preference in autistic children. Unpublished Masters thesis, University of Orleans.

Goode, S. (1985). Recognition accuracy for faces presented in the photographic negative: A study with autistic adults. Unpublished MPhil thesis, Institute of Psychiatry, University of London.

Grice, H. P. (1975). Logic and conversation. In R. Cole & J. Morgan (Eds), *Syntax and Semantics: Speech Acts*. New York: Academic Press. (Originally published in 1967.)

Harris, P. (1991). Reasoning in and about possible worlds. In A. Whiten (Ed.), *Natural Theories of Mind*. Oxford: Blackwell.

Harris, P. & Muncer, A. (1988). The autistic child's understanding of beliefs and desires. Paper presented at the BPS Developmental Psychology Conference, Harlech, September.

Hobson, R. P. (1984). Early childhood autism and the question of egocentrism. *Journal of Autism and Developmental Disorders*, **14**, 85–104.

Hobson, R. P. (1989). Beyond cognition: A theory of autism. In G. Dawson (Ed.), *Autism: Nature, Diagnosis, and Treatment*. New York: Guilford Press.

Hobson, R. P. (1990). On acquiring knowledge about people, and the capacity to pretend: A response to Leslie. *Psychological Review*, **97**, 114–121.

Hobson, R. P., Ouston, J. & Lee, A. (1988). What's in a face? The case of autism. *British Journal of Psychology*, **79**, 441–453.

Kanner, L. (1943). Autistic disturbance of affective contact. *Nervous Child*, **2**, 217–250. Reprinted in L. Kanner (1973), *Childhood Psychosis: Initial Studies and New Insights*. New York: Wiley.

Langdell, T. (1978). Recognition of faces: An approach to the study of autism. *Journal of Child Psychology and Psychiatry*, **19**, 225–238.

Leekam, S. & Perner, J. (in press). Does the autistic child have a metarepresentational deficit? *Cognition*.

Leslie, A. M. & Frith, U. (1988). Autistic children's understanding of seeing, knowing, and believing. *British Journal of Developmental Psychology*, **6**, 315–324.

Leslie, A. M. & Frith, U. (1990). Prospects for a cognitive neuropsychology of autism: Hobson's choice. *Psychological Review*, **97**, 122–131.

Leslie, A. M. & Sellars, C. (forthcoming). The deaf child's theory of mind. Unpublished MS, MRC Cognitive Development Unit, 17 Gordon St, London, WC1.

Mitchell, S. (1989). Exploring the autistic child's impaired theory of mind. Unpublished manuscript, Department of Experimental Psychology, University of Oxford.

Ozonoff, S., Pennington, B. & Rogers, B. (1990). Are there emotion perception deficits in young autistic children? *Journal of Child Psychology and Psychiatry*, **31**, 343–363.

Neuman, C. J. & Hill, S. D. (1978). Self-recognition and stimulus preference in autistic children. *Developmental Psychobiology*, **11**, 571–578.

Perner, J., Frith, U., Leslie, A. M. & Leekam, S. (1989). Exploration of the autistic child's theory of mind: Knowledge, belief, and communication. *Child Development*, **60**, 689–700.

Piaget, J. (1929). *The Child's Conception of the World*. London: Routledge & Kegan Paul.

Premack, D. (1988). 'Does the chimpanzee have a theory of mind?' revisited. In R. Byrne & A. Whiten (Eds), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans*. Oxford: Oxford University Press.

Raven, J. C. (1956). *Coloured Progressive Matrices*. London: H. K. Lewis.

Reed, T. & Patterson, C. (in press). A comparative study of autistic subjects' performance at two levels of visual and cognitive perspective taking. *Journal of Autism and Developmental Disorders*.

Russell, J., Sharpe, S., Mauthner, N. & Tidswell, T. (1991). The 'windows task' as a measure of strategic deception in preschoolers and autistic subjects. *British Journal of Developmental Psychology*, **9**, 331–349.

Rutter, M. (1983). Cognitive deficits in the pathogenesis of autism. *Journal of Child Psychology and Psychiatry*, **24**, 513–531.

Sigman, M. & Mundy, P. (1989). Social attachments in autistic children. *Journal of the American Academy of Child and Adolescent Psychiatry*, **28**, 74–81.

Sodian, B. & Frith, U. (1990). Can autistic children lie? Paper presented at the European Conference of Developmental Psychology, Stirling University, August.

Spiker, D. & Ricks, M. (1984). Visual self-recognition in autistic children: Developmental relationships. *Child Development*, **55**, 214–225.

Swettenham, J. (1990). The autistic child's theory of mind: A computer-based investigation. Unpublished PhD thesis, Psychology Department, University of York.

Volkmar, F. R., Sparrow, S., Rende, R. D. & Cohen, D. J. (1989). Facial perception in autism. *Journal of Child Psychology and Psychiatry*, **30**, 591–598.

Weeks, S. J. & Hobson, R. P. (1987). The salience of facial expression for autistic children. *Journal of Child Psychology and Psychiatry*, **28**, 137–152.

Wellman, H. (1990). *Children's Theories of Mind*. Cambridge, MA: Bradford/MIT Press.

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