Do People with Autism Understand What Causes Emotion?

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BARON-COHEN, SIMON. *Do People with Autism Understand What Causes Emotion?* CHILD DEVELOPMENT, 1991, **62**, 385-395. An experiment is described that tests whether people with autism understand some causes of 2 basic emotions (happiness and sadness). The causes of emotion tested were *situations, desires,* and *beliefs.* Results showed that, relative to normal and mentally handicapped subjects of an equivalent mental age, people with autism alone showed severe deficits in comprehension of emotion caused by beliefs. Their understanding of emotion caused by situations and desires was no different than the nonautistic mentally handicapped group. Thus, difficulties in understanding emotion by people with autism are most apparent when emotion interacts with false belief. The implications of these results for the affective and meta-representation theories of autism are discussed.

As long as autism has been recognized, the idea has existed that the main difficulty for people with autism is an inability to enter into *emotional* relationships. Thus Leo Kanner, the psychiatrist who first described autism as a distinct clinical syndrome, in 1943 wrote that "these children have come into the world with innate inability to form the usual, biologically provided affective contact with other people, just as other children come into the world with innate physical or intellectual handicaps" (p. 250). And, more recently, Peter Hobson (1986a, 1986b) and his colleagues (Hobson, Ouston, & Lee, 1988) have tested the hypothesis that people with autism are unable to enter into emotional relationships with others because they cannot understand emotional expressions. Hobson's (1986a, 1986b) experiments found that subjects with autism performed significantly worse than nonautistic normal or mentally handicapped control groups on emotion-matching tasks. Similar findings have been reported by Tantam, Monaghan, Nicholson, and Stirling (1989).

When the emotion-recognition test is simplified, performance by subjects with autism improves considerably (Hertzig, Snow, & Sherman, 1989; Hobson, 1986b; Langdell, 1981). People with autism show their most severe deficits when matching photographed or drawn facial expressions of emotion with either videotapes of emotion-related gestures or audiotapes of emotion-related vocalizations (Hobson, 1986a). When the task is simplified so that the subject is asked to match a drawn emotion-related gesture to a videotape of an emotion-related gesture, subjects with autism perform better (Hobson, 1986b). They are also less impaired when the task is simply one of recognizing the emotion in photographs of faces alone (Hertzig et al., 1989; Langdell, 1981). Indeed, their performance on such tasks does not differ significantly from that of mentally handicapped or normal control groups either for emotion recognition in faces or voices (Hobson, Ouston, & Lee, 1989). Verbal MA may also play an important role in these deficits (Braverman, Fein, Lucci, & Waterhouse, 1989; Hobson et al., 1988, 1989; Ozonoff, Pennington, & Rogers, 1990).

Understanding emotional expressions aside, few studies have investigated the more fundamental question of whether peo-

This paper was first presented in the symposium on Children's Theories of Emotion at the BPS Developmental Psychology Conference, University of Surrey, UK, September 1989. It was also presented in part in invited seminars at the universities of Sussex, Oxford, St. Andrew's, Southampton, and Warwick, and Hatfield Polytechnic (1989/1990). I am especially grateful to Paul Harris for his suggestion to use this paradigm to study autism. I am also indebted to the staff and children at the following London schools: St. Luke's and Rosemary Schools, Islington, and the Sybil Elgar School, Ealing. Finally, I would like to thank Michael Rutter, Helen Tager-Flusberg, Wendy Phillips, Sally Ozonoff, Sue Leekam, Peter Hobson, and the anonymous reviewers for their valuable comments on the first draft of this paper. Correspondence should be addressed to the author at the Department of Psychology, University of London, De Crespigny Park, London, England SE5 8AF.

[*Child Development*, 1991, **62**, 385–395. 0009-3920/91/6202-0002$01.00]

ple with autism understand what *causes* emotion. We know from studies of normal development (reviewed in Harris, 1989) that children of 3–4 years old understand that emotion can be caused by *situations* (Borke, 1971; Trabasso, Stein, & Johnson, 1981) and by *desires* (Wellman & Bartsch, 1988; Wellman & Woolley, 1990; Yuill, 1984), and that 4–6-year-olds understand that *beliefs* can affect emotion (Harris, Johnson, Hutton, Andrews, & Cooke, 1989). Hadwin and Perner (in press) report a similar developmental trend.

The question of whether people with autism understand desires as a cause of emotion has been tested by Harris and Muncer (1988). In their test, two story characters were described, one of whom wanted X and got X (match condition), and the other of whom wanted X but got Y (mismatch condition). The subject was asked how the character felt and to justify their judgment. Harris and Muncer found that the match condition was easier than the mismatch for all subjects, but that subjects with autism performed significantly worse on this test overall than normal children matched for verbal mental age (MA).

Their experiment suggests that even this elementary relation between desire and emotion may be poorly understood by the majority of people with autism. However, it is unclear exactly what the role of MA in this is, since (*a*) the group with autism in Harris and Muncer's study included subjects with a verbal MA as low as 3 years 7 months, whereas the lowest verbal MA in the normal group was 4 years 9 months; (*b*) their study did not include a nonautistic mentally handicapped control group; and (*c*) a later extension of this study (Tan & Harris, 1990) showed that among those subjects with autism who had a higher verbal MA, impairments in understanding desire as a cause of emotion were not as severe.

Apart from these studies into their understanding of desires as a cause of emotion, no studies have tested whether people with autism can understand either situations or beliefs as causes of emotion. The present article reports an attempt to fill these gaps. In the experiment described here, methods used by Harris et al. (1989) in their study of normal 4–6-year-olds were adapted for use with subjects with autism and with mental handicap.

In Harris et al.'s (1989) procedure, children listen to stories about animal characters who only like certain types of food or drink. For example, they are introduced to a toy elephant, Ellie, and told either that Ellie likes milk to drink and nothing else, or that she likes Coke to drink and nothing else. In the next part of the story, a mischievous monkey called Mickey tricks Ellie by substituting the contents of one container for another. For example, Mickey might pour all the Coke out of the coke can, replace it with milk, and then offer the Coke can to Ellie. Children are asked how Ellie will feel when she finds out the real contents by taking a drink from the can. The children are also asked how Ellie felt *before* opening the container. To answer this latter question correctly, the children needed to bear in mind not only what Ellie *wants* to drink—Coke or milk—but also what she mistakenly *thinks* is in the Coke can.

Harris et al.'s (1989) paradigm can be adapted to test whether people with autism can understand not only situations and desires as causes of emotion but also beliefs as a cause of emotion. The latter is sometimes referred to as "cognitive emotion" (Perner, 1991; Wellman, 1990). This makes it particularly valuable, since whereas the Tan and Harris (1990) study suggests that understanding of situations and desires as causes of emotion by people with autism may be related to MA, there are good reasons to predict that their understanding of beliefs as a cause of emotion will be very poor, irrespective of MA. This prediction derives from other studies that have found that understanding of belief by people with autism is severely impaired (Baron-Cohen, 1989a, 1989b; Baron-Cohen, Leslie, & Frith, 1985, 1986; Charman & Baron-Cohen, 1990; Dawson & Fernald, 1987; Harris & Muncer, 1988; Leekam & Perner, in press; Leslie & Frith, 1988; Mitchell, 1990; Perner, Frith, Leslie, & Leekam, 1989; Russell, Sharpe, Mauthner, & Tidswell, in press; Shaw, 1989; Sodian & Frith, in press; Swettenham, 1990).

Method

Subjects

We tested 17 subjects with autism, all of whom had been diagnosed according to established criteria (DSM-IIIR; American Psychiatric Association, 1987) and were attending a special school for autism. In addition, there were 16 subjects with mental handicap and 19 clinically normal children, to control for MA and CA, respectively. The sex ratio in the normal and the mentally

TABLE 1

SUBJECT VARIABLES: MEANS, STANDARD DEVIATIONS, AND RANGES OF CHRONOLOGICAL AGE (CA) AND MENTAL AGE (MA)

Diagnostic Groups	CA	Nonverbal MA[a]	Verbal MA[b]
Autism (n = 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 (n = 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 (n = 19):			
Mean	5.3	. . .	. . .
SD	.87		
Range	4.1–6.8		

[a] Raven's matrices.
[b] BPVS.

handicapped group was approximately 1:1, while in the group with autism it was 3:1 (m:f). Details of the subjects are summarized in Table 1.

The clinical subjects had a verbal MA of at least 4 years old, this being the age at which normal children begin to pass the tests used by Harris et al. (1989). Nonverbal MA was higher than verbal MA for both clinical groups, markedly so in the case of the subjects with autism. Using a minimum verbal MA of 4 years as an inclusion criterion was therefore a conservative precaution against the risk that the clinical groups might be developmentally disadvantaged in comparison to the normal control group.

The verbal MA of the clinical groups was assessed using the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton, & Pintilie, 1982). Their nonverbal MA was assessed using the Raven's Colored Progressive Matrices (Raven, 1956). As can be seen, the two clinical groups were not significantly different on verbal MA (t = 0.76, 31df, N.S.), and in this respect are matched on this. We assumed that for the normal group, MA would roughly correspond to CA. The group with autism had a higher nonverbal MA than the group with mental handicap, thus making it unlikely that any impairment that might emerge in the group with autism could be due to general developmental delay.

PROCEDURE

Each child was tested individually, in a quiet room in the school. The experimenter told the story described below, interspersing two questions testing understanding of situations as a cause of emotion (the Situation Test), two questions testing understanding of desires as a cause of emotion (the First Desire Test), and two questions testing understanding of beliefs as a cause of emotion (the Belief Test). Finally, two more desire questions were given in order to control for order effects (the Second Desire Test). Each test question was followed by a justification question. The whole procedure was then repeated (Trial 2) with minor variations, described later.

The Story (Trial 1)

The experimenter introduced the doll to the child by saying "This is Jane," and then asked Naming Question 1: "Now can you tell me her name?" (correct answer: Jane).

Situation Test

"Jane is having a birthday party." Situation Question 1: "How does she feel?" (correct answer: happy). Justification Question: "Why?" (correct justification: because birthdays are nice, you get presents, etc.). "After the party, Jane was walking home and she fell down and cut her knee." Situation Question 2: "How did she feel?" (correct answer: sad). Justification Question: "Why?" (correct justification: because she hurt herself, it's not nice to hurt yourself, etc.).

First Desire Test

"The next day, Jane has her breakfast. Jane likes Rice Crispies. Here are some Rice Crispies" (shows box, unopened). "Jane doesn't like Coco-Pops. Here are some Coco-Pops" (shows another box, unopened).

"She wants some Rice Crispies." Desire Question 1: "If we give her THIS box, how will she feel?" (indicate closed Rice Crispies box; correct answer: happy). Justification Question: "Why?" (correct justification: because she likes Rice Crispies, etc.). Desire Question 2: "If we give her THIS box, how will she feel?" (indicate closed Coco-Pops box; correct answer: sad). Justification Question: "Why?" (correct justification: because she doesn't like Coco-Pops, etc.).

Belief Test

"Now Jane goes for a walk" (Exit Jane). "Let's open the Rice Crispies box. Look! There's nothing inside! Now, let's open up the Coco-Pops box. Look! There are Rice Crispies inside! OK, let's close up the boxes again. Now, here comes Jane, back from her walk." Belief Question 1: "If we give her THIS box, how will she feel?" (indicate closed Rice Crispies box; correct answer: happy). Justification Question: "Why?" (correct justification: because she thinks there are Rice Crispies in the box, and she likes/wants some Rice Crispies, etc.). Belief Question 2: "If we give her THIS box, how will she feel?" (indicate closed Coco-Pops box; correct answer: sad). Justification Question: "Why?" (correct justification: because she thinks there are Coco-Pops in the box, and she doesn't like/want any Coco-Pops, etc.).

Second Desire Test

"Now let's give Jane THIS box" (indicate Rice Crispies box). "She opens the box." Desire Question 3: "How does she feel?" (correct answer: sad). Justification Question: "Why?" (correct justification: because she likes Rice Crispies, but there aren't any/it's empty, etc.). "Now let's give Jane THIS box" (indicate Coco-Pops box). "She opens the box." Desire Question 4: "How does she feel?" (correct answer: happy). Justification Question: "Why?" (correct justification: because there are Rice Crispies in it, and she likes Rice Crispies, etc.).

Rationale behind the Test Questions

The two situation questions test understanding of emotion caused by a nice situation and an unpleasant situation, respectively. Desire Question 1 tests understanding of a fulfilled desire as a cause of emotion, while Desire Question 2 tests understanding of an unfulfilled desire as a cause of emotion. The belief questions test understanding of a belief as a cause of emotion in that the subject knows the actual contents of the box but the doll does not. For Belief Question 1, the actual content is negative (no food), but the doll thinks it is positive, and for Belief Question 2 the actual content is positive (preferred food), but the doll thinks it is negative (unpreferred food). Notice that the wording of the questions in the First Desire Test and in the Belief Test is identical. All that changes in the Belief Test is the knowledge state of the subject.

In the Belief Test, we dispensed with Harris et al.'s (1989) ploy of Mickey the mischievous monkey who changed the contents of the container because our pilot studies using subjects with autism suggested that, irrespective of whether such a deceptive character was included, the results stayed the same. Our impression is that deception is beyond their comprehension. This is consistent with findings from Sodian and Frith (in press) and Russell et al. (in press).

Desire Questions 3 and 4 are more complicated. Respectively, they again test understanding of an unfulfilled or fulfilled desire as a cause of emotion, but in circumstances when the actual content of the box is different to its apparent content. Finally, there are three memory questions and two naming questions to control for the possibility that failure on the other questions might be due to memory or recognition problems. Naming Question 1 was mentioned in the story earlier. The other control questions are explained below.

Control Questions

Memory Question 1: "What does Jane like? Rice Crispies or Coco-Pops?" (correct answer: Rice Crispies). Memory Question 2: "What's in the Rice Crispies box?" (correct answer: nothing). Memory Question 3: "What's in the Coco-Pops box?" (correct answer: Rice Crispies). Naming Question 2: "What are these called?" (correct answer: Rice Crispies).

Design

In each trial, the First Desire Test was always followed by the Belief Test, and then by the Second Desire Test. This ensured that the wording of questions in the First Desire Test and the Belief Test would be as similar as possible. The Situation Test was given before the First Desire Test in one trial or after the Second Desire Test in the other trial. This allowed us to check for either fatigue or practice effects. Within the four tests, questions were randomized. This allowed us to check for any order effect of subjects preferring to respond in terms of happy before sad, or vice versa.

TABLE 2

RESULTS FROM THOSE SUBJECTS PERFORMING CONSISTENTLY ON BOTH TRIALS ON THE DESIRE TESTS

DIAGNOSTIC GROUPS	PASSING				MEAN DQ[a]
	DQ1	DQ2	DQ3	DQ4	
Autism (n = 17)	11	10	9	9	9.75 (57.4)
Mental handicap (n = 16)	11	10	9	8	9.5 (59.4)
Normal (n = 19)	19	17	17	17	17.5 (92.1)

[a] Mean number of each group passing the Desire Tests (with mean percentage in parentheses).

In Trial 2 (given on the same day as Trial 1), the subject was introduced to a different puppet, Mary, who had the opposite set of desires to Jane (i.e., she liked Coco-Pops and didn't like Rice Crispies). In this trial, the Coco-Pops box was actually empty, and the Rice Crispies box contained Coco-Pops. The two situation questions (SQs) in this trial were, "Now Mary is going to the zoo. How will she feel?" and "At the zoo, Mary loses her mother. She can't see her anywhere. How will she feel?" Finally, half the subjects heard the story about Jane before the story about Mary, and for the other half the order was reversed.

MATERIALS

The materials used included small cardboard cereal boxes (4 × 3 inches) that are commercially available and two female dolls, clearly distinguishable from each other by their hair color and clothes. The dolls stood about 7 inches high.

PREDICTIONS AND SCORING

We predicted that if the subjects with autism only had difficulty in understanding beliefs as a cause of emotion, they would score poorly on the Belief Test alone. If, on the other hand, they had difficulty in understanding all causes of emotion, they would score poorly on the Situation and Desire Tests too. Passing a question was scored if the correct emotion judgment was made on both trials: inconsistent performance across the two trials was therefore conservatively scored as a fail. Passing a test was scored if both questions were answered correctly on both trials. Subjects passing the Desire Tests were defined as those who passed all four desire questions on both trials. Subjects passing the belief questions were defined as those who passed both belief questions on both trials, and who had also passed the Desire Tests. This is explained more fully in the Results section.

RESULTS

All subjects passed the control questions and the Situation Test on both trials. On the Desire and Belief Tests, two subjects with autism and three with mental handicap performed inconsistently across the two trials, giving the impression from their justifications that they were guessing. Their inconsistency occurred on both the desire and belief questions. These five subjects were therefore conservatively scored as failing these tests overall. The remainder of the subjects performed identically on both trials on these tests. In Table 2, we report the results of these subjects' performance on the Desire Tests.

From Table 2 it is clear that for all groups, slightly more subjects passed the First Desire Test than the Second, but this was not statistically significant for any group ([DQ1 + DQ2]/2 × [DQ3 + DQ4]/2, Fisher's Exact Probability Test, N.S., for all three groups). Desire Questions 1 and 2 did not differ from each other significantly, nor did Desire Questions 3 and 4, for any of the groups (Fisher's Test, N.S., for all three groups). The normal group showed a trend toward performing better overall than either of the other two groups, although this difference did not reach significance (normal × mental handicap, Fisher's Test, N.S.). The two clinical groups did not differ from each other (autism × mental handicap, Fisher's Test, N.S.). Overall, 57.4% of the subjects with autism and 59.4% of those with mental handicap passed on both Desire Tests, as opposed to 92.1% of the normal children.

Table 3 shows the results from the Belief Test. We only analyzed responses on the Belief Test for those subjects who had also

TABLE 3

RESULTS FROM THOSE SUBJECTS PERFORMING CONSISTENTLY ON BOTH TRIALS ON THE BELIEF TEST

DIAGNOSTIC GROUPS	n[a]	PASSING BQ1	PASSING BQ2	MEAN BQ[b]
Autism (n = 17)[c]	9	3	3	3 (33.3)[d]
Mental handicap (n = 16)	8	8	8	8 (100)
Normal (n = 19)	17	15	13	14 (77.7)

[a] Number of subjects who passed the Desire Tests.
[b] Mean number of each group passing the Belief Test (and, in parentheses, expressed as a percentage of those who also passed the Desire Tests).
[c] Total number of subjects in each group.
[d] $p < .02$, autism × mental handicap.

passed the Desire Tests in order to make the most generous comparison. Overall, 33.3% of the subjects with autism who passed the Desire Tests also passed both Belief Tests, as opposed to 100% of the mentally handicapped and 77.7% of the normal subjects. Statistically, the subjects with autism performed significantly worse than either of the other two groups (autism × normal, Fisher's Test, $p < .02$), who did not differ from each other (mental handicap × normal, Fisher's Test, N.S.). Analyzing group differences from all subjects produced a similar significant difference, with 17.6% of the whole autism group passing the Belief Test, as opposed to 56.3% of the whole mentally handicapped group and 73.7% of the whole normal group (autism × mental handicap, Fisher's Test, $p < .02$; mental handicap × normal, Fisher's Test, N.S.). None of the groups differed in the proportions passing BQ1 versus BQ2 (Fisher's Tests, N.S., for all three groups).

A comparison of Tables 2 and 3 suggests that a significant minority of both clinical groups had some difficulty with the Desire Tests relative to the normal controls, but no autism-specific deficit appeared here. On the Belief Test, however, the performance of the group with autism was significantly worse than the other two groups. Table 4 shows the overall number of subjects in each group passing the Desire and Belief Tests, information that is not available in Table 3, as the analysis of the Belief Test there considered only those children who had also passed the Desire Tests. It is clear from this that for the normal group and the group with autism, the Desire Tests were easier than the Belief Test, while for the group with mental handicap they were roughly equivalent. Furthermore, across all three groups, only two subjects (one with mental handicap and one normal) passed the Belief Test but failed the Desire Tests, while nine subjects showed the opposite pattern. This is entirely as one should expect, given the dependence of the Belief Test on the Desire Tests.

In an earlier version of this experiment, using the same subjects but carried out approximately 9 months before the experiment reported above, the Second Desire Test was given before the Belief Test. This meant that the belief questions took the form, "How did Jane feel *before* she opened the box?" We found that this order of questions made no

TABLE 4

NUMBER OF SUBJECTS PASSING THE DESIRE AND BELIEF TESTS

DIAGNOSTIC GROUPS	PASSING Desire Tests	PASSING Belief Test
Autism (n = 17)	9 (52.9)	3 (17.6)[a]
Mental handicap (n = 16)	8 (50.0)	9 (56.3)
Normal (n = 19)	17 (89.5)	14 (73.7)

NOTE.—Numbers in parentheses = percentage of each group passing each test.
[a] $p < .02$, autism × mental handicap.

difference at all to the results obtained. This suggests that the findings have high test-retest reliability.

Emotion Justifications

Subjects' justifications fell into three categories—correct, incorrect, and uninformative. (The latter comprised either bizarre responses, or "don't know" responses.) Examples of some correct justifications that actually occurred are given in the Procedure section. Incorrect justifications were those that backed up a wrong prediction.

In addition, where a child passed a question, they also gave a correct justification, and where a child failed a question, they gave an incorrect justification. The exceptions to this were four subjects with autism who said nothing to any of the justification questions (i.e., gave uninformative justifications) and three subjects with mental handicap who said "don't know" on most justification questions (also rated as uninformative). Thus, on the Belief Test, those subjects who judged the character's emotion correctly and who provided justifications referred to the doll's belief about the *apparent* content of the container (e.g., "She'll be sad, cuz she thinks it's got Coco-Pops in it"), while those who failed the belief questions tended to give justifications referring to its *actual* content (e.g., "She'll be happy, cuz it's got Rice Crispies in it").

Influence of MA, CA, and Gender

In the group with autism, those subjects who passed the Desire Tests did not differ from those who failed them in terms of either CA (t = 0.71), BPVS (t = 1.46), or Raven's Matrices (t = 1.30, all 15 df, all N.S.). Nor did those subjects with autism who failed the Belief Test but passed the Desire Tests differ from those who passed both in terms of either BPVS (t = 1.14) or Raven's Matrices (t = 0.23, both 7 df, both N.S.). However, they did differ significantly in their CA (t = 5.61, 7 df, $p < .001$). This suggests that within the group with autism, CA but not MA had some effect on passing the Belief Test.

In the group with mental handicap, those subjects passing the Desire and Belief Tests did not differ from those who failed them in terms of either CA (t = 0.81), BPVS (t = 0.44), or Raven's Matrices (t = 1.74, all 14 df, all N.S.). In the group with mental handicap, then, neither CA nor MA seemed to affect performance. In the normal group, those children who passed the Desire Tests did not differ from those who failed in terms of CA (t = 0.81, 17 df, N.S.). Similarly, those normal children who passed the Desire Tests but failed the Belief Test did not differ from those who passed both in terms of their CA (t = 0.59, 15 df, N.S.). The failure to find age affecting performance on these questions in the normal group may be due to the small numbers of normal children failing these tests. Finally, in none of the groups did gender differences in performance emerge.

Discussion

The present study tested whether people with autism can understand three different causes of emotions, namely, situations, desires, and beliefs. The results indicate that their understanding of situations as a cause of emotion is at ceiling on this task, and therefore shows no impairment at this level. Their understanding of desires as a cause of emotion was no different to nonautistic mentally handicapped subjects of equivalent MA, although both of these groups made more errors than a normal control group. These results from the subjects with autism confirm findings by Harris and Muncer (1988) and Tan and Harris (1990) and underscore the importance of inclusion of a nonautistic mentally handicapped control group. This is critical in comparing the present results with those studies (Braverman et al., 1989; Hobson et al., 1988; Ozonoff et al., 1990) that have found that verbal MA is associated with tests of emotion understanding in autism. This documents new areas of relatively intact social understanding in autism that have not been previously reported. (For a review of other intact areas of social cognition in autism, see Baron-Cohen, in press.)

In contrast, in response to questions testing understanding of beliefs as a cause of emotion, performance by subjects with autism was significantly worse than either of the two control groups. The control questions rule out that this was due to memory or recognition deficits. This confirms other studies showing that people with autism have difficulties that are more severe than would be expected for their MA in attributing different beliefs to other people (Baron-Cohen, 1989a, 1989b; Baron-Cohen et al., 1985, 1986; Charman & Baron-Cohen, 1990; Dawson & Fernald, 1987; Harris & Muncer, 1988; Leekam & Perner, in press; Leslie & Frith, 1988; Mitchell, 1990; Perner et al., 1989; Russell et al., in press; Shaw, 1989;

Sodian & Frith, in press; Swettenham, 1990). The results from the Belief Test reported here also broadly replicate Harris et al.'s (1989) results for the normal group.

Thus, people with autism show their most profound deficits in understanding emotions caused by beliefs, rather than emotions caused by situations and desires. In this respect, we predict that their understanding of other emotions caused by beliefs, such as surprise, embarrassment, curiosity, or boredom, should also be particularly poor (Baron-Cohen, 1985). The conclusion that can be drawn from the present results is that for people with autism, difficulty in understanding emotions emerges most clearly when the task involves understanding how emotion interacts with different beliefs.

What implications do these results have for the metarepresentation theory of autism (Leslie, 1987, 1988), that is, the conjecture that in autism there is a specific deficit in the child's capacity for forming and employing metarepresentations? Insofar as people with autism show specific deficits in understanding beliefs as a cause of emotion, the present results are consistent with this theory, as understanding belief requires metarepresentation (Leslie, 1987; Pylyshyn, 1978). Their appreciation of the existence of basic emotions such as happiness and sadness is also consistent with the metarepresentation theory, as these mental states do not necessarily require metarepresentation for their comprehension since they are not intentional or propositional states (see Dennett, 1978; Fodor, 1987).

But what are we to make of the fact that 57.4% of the subjects with autism passed the Desire Tests? Is this not evidence against the metarepresentation theory of autism? After all, desires are Intentional, propositional states (Dennett, 1978; Fodor, 1987) and therefore should require metarepresentation for a person to understand them. There are at least two possibilities here. On the one hand, we might interpret this evidence as a sign that a significant proportion of people with autism have developed to the stage of understanding desires, but not to the point of understanding beliefs. Such a developmental sequence would parallel what is seen in normal development (Wellman & Woolley, 1990). Under this interpretation, we might consider that those people with autism who understand desires have indeed reached an early step in the development of a metarepresentation capacity, albeit after a severe delay, as has been postulated to exist in autism (Baron-Cohen, 1989a, 1991). Some tentative support for this is that those subjects with autism who passed the Belief Test had a significantly higher CA than those who failed it. This pattern has also been reported in our earlier studies (see Baron-Cohen, 1989a, 1989b, for example).

On the other hand, Wellman and Woolley (1990) have argued that desires could be understood not as Intentional, propositional states, indeed, not even as mental states, but rather as simple internal "drives" that guide a person toward certain objects and away from others. Perner (1991) also argues that young normal children initially treat desires simply as relations to desired situations, and only later understand them as mental representations of situations. Yuill's (1984) data support such a developmental sequence. Under this second interpretation, understanding of desires would not require a metarepresentation capacity, and the present results on the Desire Tests would therefore present no difficulty for the metarepresentation theory of autism. Future research is needed to test between these two interpretations.

The present study has revealed that some of the knowledge that people with autism possess in the domain of emotion is appropriate to their mental age. They are, for example, aware of the existence of emotion and of situations and desires as simple causes of this, and they demonstrate a close similarity in their understanding of this to people without autism. For example, in answer to Situation Question 2 in Trial 2 ("Mary loses her mother. She can't see her anywhere. How will she feel?"), all subjects with autism correctly judged that Mary would feel sad. Most also went on to justify their emotion judgment in such terms as, "She doesn't like being alone" or "She's frightened cuz she can't find her way home," or even, in the case of two subjects with autism, "She wants her mummy."

Such justifications indicate that children with autism may themselves have emotional attachments to their caregivers, supporting results from other studies (Dissanayake & Crossley, 1989; Shapiro, Sherman, Calamari, & Koch, 1987; Sigman & Mundy, 1984, 1989). These data also suggest that people with autism learn the conventions governing which situations give rise to different emotions in a similar fashion to other people.

Thus, birthday parties are represented as causing happiness, even though many children with autism may themselves not enjoy social situations such as birthday parties.

This unimpaired understanding of situations and desires as causes of simple emotions is consistent with recent psycholinguistic studies by Tager-Flusberg (1989). She found that if children with autism spontaneously produced *any* mental state terms in their speech, these tended to refer to basic emotions such as happiness and fear, and to desires, seen in the use of the terms *want*, *love*, and *like*, and even to perception terms (*see*, *look*), but never to cognitions or to beliefs affecting emotion. The justification data from the present study confirm Tager-Flusberg's findings.

Some attention should be paid to the subjects with autism who passed the Desire Tests. Of these, 33.3% had no difficulty even on the Belief Test. Analysis of the available background variables suggested that high chronological age, in conjunction with a high mental age, distinguished these subjects from those who failed the Belief Test. This furnishes new evidence for the notion that in autism there may be a considerable delay in the development of a theory of mind, in that it seems to appear in those people with autism who are of higher intelligence, and even then years later than its first appearance in normal development (Baron-Cohen, 1989a, 1991). These findings resemble those reported by Eisenmajer and Prior (1990). Longitudinal data (Humphries & Baron-Cohen, 1990) may be able to clarify the size of this delay more precisely.

The present study needs to be considered against the backdrop of the debate in autism over whether cognitive or affective deficits are primary (Baron-Cohen, 1988; Hobson, 1989, 1990; Leslie & Frith, 1990). If some emotion is within the understanding of people with autism, does this imply that affective factors do not play a primary role in autism? There are some reasons for doubting such a conclusion, in that other studies into the *expression* of emotion by children with autism show marked abnormalities (Dawson, Galpert, Hill, & Spencer, 1988; Snow, Hertzig, & Shapiro, 1987; Yirmiya, Kasari, Sigman, & Mundy, 1989). Such abnormalities could simply be signs of more pervasive communicative deficits, but they may represent a primary affective disturbance. Furthermore, the tasks reported here are, for theoretical reasons, controlled laboratory tasks. Naturalistic studies to determine whether people with autism can understand emotion (which so far have not been tried) are needed to establish if there is an affective deficit. Disentangling the role of cognitive and affective deficits in autism is an important goal for future research.

References

American Psychiatric Association. (1987). *Diagnostic and statistical manual of mental disorders* (3d ed.). Washington, DC: Author.

Baron-Cohen, S. (1985). *Social cognition and pretend play in autism.* Unpublished doctoral dissertation, 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. (1989a). The austic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, **30**, 285–298.

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

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

Baron-Cohen, S. (in press). The theory of mind deficit in autism: How specific is it? *British Journal of Developmental Psychology.*

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.

Borke, H. (1971). Interpersonal perception of young children: Egocentrism or empathy? *Developmental Psychology*, **5**, 263–269.

Braverman, M., Fein, D., Lucci, D., & Waterhouse, L. (1989). Affect comprehension in children with pervasive developmental disorders. *Journal of Autism and Developmental Disorders*, **19**, 301–316.

Charman, T., & Baron-Cohen, S. (1990). *Testing the metarepresentation theory of autism.* Unpublished manuscript, University of London, Institute of Psychiatry, London.

Dawson, G., & Fernald, M. (1987). Perspective-taking ability and its relationship to the social behavior of autistic children. *Journal of*

Autism and Developmental Disorders, **17**, 487–498.

Dawson, G., Galpert, L., Hill, D., & Spencer, A. (1988). *Affective exchanges between young autistic children and their mothers.* Paper presented at the meeting of the International Conference on Infant Studies, Washington, DC.

Dennett, D. (1978). *Brainstorms: Philosophical essays on mind and psychology.* Sussex: Harvester.

Dissanayake, A. C., & Crossley, A. (1989). Behavior in children with early infantile autism: Responsiveness to people. In P. Lovibond & P. Wilson (Eds.), *Clinical and abnormal psychology.* Holland: Elsevier Science Publishers.

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

Eisenmajer, R., & Prior, M. (1990). *Cognitive linguistic correlates of "theory of mind" ability in autistic children.* Unpublished manuscript, La Trobe University, Department of Psychology, Bundoora, Australia.

Fodor, J. A. (1987). *Psychosemantics: The problem of meaning in the philosophy of mind.* Cambridge, MA: MIT Press.

Hadwin, J., & Perner, J. (in press). Pleased and surprised: Children's cognitive theory of emotions. *British Journal of Developmental Psychology.*

Harris, P. (1989). *Children and emotion.* Oxford: Basil Blackwell.

Harris, P., Johnson, C. N., Hutton, D., Andrews, G., & Cooke, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion*, **3**, 379–400.

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

Hertzig, M. E., Snow, M. E., & Sherman, M. (1989). Affect and cognition in autism. *Journal of the American Academy of Child and Adolescent Psychiatry*, **28**, 195–199.

Hobson, R. P. (1986a). The autistic child's appraisal of expressions of emotion. *Journal of Child Psychology and Psychiatry*, **27**, 321–342.

Hobson, R. P. (1986b). The autistic child's appraisal of expressions of emotion: A further study. *Journal of Child Psychology and Psychiatry*, **27**, 671–680.

Hobson, R. P. (1989). Beyond cognition: A theory of autism. In G. Dawson (Ed.), *Autism: Nature, diagnosis, and treatment* (pp. 22–48). New York: Guilford.

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, T. (1988). Emotion recognition in autism: Coordinating faces and voices. *Psychological Medicine*, **18**, 911–923.

Hobson, R. P., Ouston, J., & Lee, T. (1989). Naming emotion in faces and voices: Abilities and disabilities in autism and mental retardation. *British Journal of Developmental Psychology*, **7**, 237–250.

Humphries, S., & Baron-Cohen, S. (1990). *How far can people with autism go in developing a theory of mind?* Unpublished manuscript, University of London, Institute of Psychiatry, London.

Kanner, L. (1943). Autistic disturbance of affective contact. *Nervous Child*, **2**, 217–250.

Kasari, C., Sigman, M., Yirmiya, N., & Mundy, P. (in press). Affective characteristics of autistic children. In B. M. Prizant & B. Schaechter (Eds.), *Autism: The emotional and social dimensions.* Boston: Exceptional Parent Press.

Langdell, T. (1981). *Face perception: An approach to the study of autism.* Unpublished doctoral dissertation, University of London.

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

Leslie, A. M. (1987). Pretence and representation: The origins of "theory of mind." *Psychological Review*, **94**, 412–426.

Leslie, A. M. (1988). Some implications of pretence for mechanisms underlying the child's theory of mind. In J. Astington, P. Harris, & D. Olson (Eds.), *Developing theories of mind* (pp. 19–46). Cambridge: Cambridge University Press.

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.

Mitchell, S. (1990). *Exploring the autistic child's impaired theory of mind.* Unpublished manuscript, University of Oxford, Department of Experimental Psychology, Oxford, England.

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

Perner, J. (1991). *Understanding the representational mind.* Cambridge, MA: Bradford Books, MIT Press.

Perner, J., Frith, U., Leslie, A. M., & Leekam, S. (1989). Exploration of the autistic child's the-

ory of mind: Knowledge, belief, and communication. *Child Development*, **60**, 689–700.

Pylyshyn, Z. (1978). When is attribution of beliefs justified? *Behaviour and Brain Sciences*, **4**, 492–593.

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

Russell, J., Sharpe, S., Mauthner, N., & Tidswell, T. (in press). The windows task as a measure of strategic deception. *British Journal of Developmental Psychology*.

Shapiro, T., Sherman, M., Calamari, G., & Koch, D. (1987). Attachment in autism and other developmental disorders. *Journal of the American Academy of Child and Adolescent Psychiatry*, **26**, 480–484.

Shaw, P. (1989). *Is the deficit in autistic children's theory of mind an artifact?* Unpublished manuscript, Oxford University, Department of Experimental Psychology, Oxford, England.

Sigman, M., & Mundy, P. (1984). Attachment behaviors in autistic children. *Journal of Autism and Developmental Disorders*, 14, 231–244.

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

Snow, M. E., Hertzig, M. E., & Shapiro, T. (1987). Expression of emotion in young autistic children. *Journal of the American Academy of Child and Adolescent Psychiatry*, **26**, 836–838.

Sodian, B., & Frith, U. (in press). Can autistic children lie? *Journal of Child Psychology and Psychiatry*.

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

Tager-Flusberg, H. (1989). *An analysis of discourse ability and internal state lexicons in a longitudinal study of autistic children.* Paper presented at the meeting of the Society for Research in Child Development, Kansas City.

Tan, J., & Harris P. L. (1990). *Autistic children understand seeing and wanting.* Unpublished manuscript, University of Oxford, Department of Experimental Psychology, Oxford, England.

Tantam, D., Monaghan, L., Nicholson, H., & Stirling, J. (1989). Autistic children's ability to interpret faces: A research note. *Journal of Child Psychology and Psychiatry*, **30**, 623–630.

Trabasso, R., Stein, N. L., & Johnson, L. (1981). Children's knowledge of events: A causal analysis of story structure. In G. Bower (Ed.), *Learning and motivation* (Vol. **15**, pp. 237–282). New York: Academic Press.

Wellman, H. (1990). *Children's theories of mind.* Cambridge, MA: Bradford Books, MIT Press.

Wellman, H., & Bartsch, K. (1988). Young children's reasoning about beliefs. *Cognition*, **30**, 239–277.

Wellman, H., & Woolley, J. (1990). From simple desires to ordinary beliefs: The early development of everyday psychology. *Cognition*, **35**, 245–275.

Yirmiya, N., Kasari, C., Sigman, M., & Mundy, P. (1989). Facial expressions of affect in autistic, mentally retarded, and normal children. *Journal of Child Psychology and Psychiatry*, **30**, 725–735.

Yuill, N. (1984). Young children's coordination of motive and outcome in judgments of satisfaction and morality. *British Journal of Developmental Psychology*, **2**, 73–81.