To what extent can children with autism understand desire?

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Abstract
Previous studies of theory of mind abilities in young people with autism have found that their understanding of false belief is specifically impaired, but that simple aspects of desire are understood in line with mental age. We explored the possibility that more complex aspects of desire (in which comparison of goals with outcomes is not a sufficient strategy) are not understood by children with autism. In two experiments, we found that these children were specifically impaired in understanding desire satisfaction and desire change, when compared with children with mental handicap and normal 4-6-year-olds. Although there was some evidence that understanding of desires may be easier for individuals with autism than understanding false belief, it would appear that they have difficulties in understanding both epistemic and volitional mental states.

Autism is a developmental disorder of organic origin that is characterized by impairments in reciprocal social interaction and communication, together with a restricted, repetitive repertoire of behaviors and a lack of imaginative activity. It is frequently (although not always) associated with mental retardation, and is thought to involve basic cognitive deficits that have implications for social functioning (Rutter, 1983). One striking aspect of the social impairment in autism is the failure to appreciate the inner world of subjective experience, such as people's thoughts and feelings. This is apparent in the failure to show empathy or to demonstrate embarrassment, shame and pride. These three emotions are thought to be a consequence of appreciating what others might think (Harris, 1989). A conspicuous feature of the communication impairment, among those individuals with good language development, is the pragmatic failure to adapt utterances to the knowledge or interests of the hearer (Baron-Cohen, 1988; Tager-Flusberg, 1993).

In recent years, considerable evidence has been reported suggesting that the failure to take account of the world of mental experience constitutes a core, primary deficit in autism. It has been proposed that there is an impairment in the cognitive mechanism dedicated to interpreting human action in terms of underlying beliefs, intentions, desires, and feelings. In the terminology widely used, individuals with autism fail to develop a "theory of mind" (Baron-Cohen, Leslie, & Frith, 1985). For example, most
children and young people with autism with verbal mental ages in excess of 4 years fail tests of understanding their own or others' beliefs (Baron-Cohen, 1993; Happé, 1993). Furthermore, of the minority who pass belief tests set at the normal preschool level, most fail tasks designed for 7-year-olds (Baron-Cohen, 1989). This evidence suggests that understanding epistemic mental states (belief, knowledge) is specifically impaired in autism. Questions about the origins of this theory of mind impairment are the subject of current debate (Baron-Cohen, Tager-Flusberg, & Cohen, 1993).

A second main class of mental state is volition. This class includes the mental states of intention, goal, and desire. Philosophical accounts of understanding behavior have consistently stressed the importance of reasoning about both beliefs and desires in making sense of and predicting action ( Dennett, 1978). Unlike emotions, both desires and beliefs are unobservable states that have no bodily manifestations. However, unlike beliefs, desires are rarely emotionally neutral. Rather, they are usually affectively charged: their satisfaction leads to positive emotions and their frustration leads to negative affect. The purpose of this paper is to examine the extent to which children with autism are able to understand desire, which although it is a volitional mental state, would appear also to involve the realm of affect.

Three previous studies have indicated that, in autism, understanding of desire may be in line with mental age. First, Baron-Cohen (1991a) found that children with autism did not differ from a group of children with mental handicap in their ability to predict how a story character would feel, according to whether the character's desire was fulfilled or unfulfilled. However, children with autism were specifically impaired in a similar condition in which they had to take account of the character's desire and mistaken belief in predicting her emotion. Second, Tan and Harris (1991) found that children with autism were able to recall their own previously stated desires. Whether this is evidence of understanding desire or simply of having consistent preferences is unclear, because the desire still existed at the time of questioning. Finally, Baron-Cohen (1991b) tested whether or not children with autism could recall a past, noncurrent desire. He offered subjects two boxes, and invited them to choose one to open. After they had seen the contents, he closed up that box and then asked them which box they would now like to open. Of course, they selected the other one. Before this new box was opened (and the desire satisfied), the subject was asked which box he or she had wanted to open at the beginning. The children with autism were as accurate as a mentally handicapped control group and a group of 3-4-year-old normally developing children in recalling their earlier desire. One earlier unpublished investigation suggested that children with autism may be impaired in understanding that a single object or event can be either desirable or undesirable. Harris and Muncer (1988) found that children with autism were impaired (relative to normal children of similar mental age) in the ability to understand that, when two protagonists want incompatible but equally pleasant things, only one will be satisfied with the outcome. Unfortunately, this study did not control for the influence of mental handicap, because only a normal control group was tested. Therefore it cannot be concluded that the observed deficit was necessarily autism-specific.

Taken together, these studies suggest that understanding volitional mental states such as desire may be relatively unimpaired in autism, whereas comprehension of epistemic states seems to be severely limited. This is consistent with the finding that young normal children understand desire before belief (Dunn, 1991; Flavell, Flavell, Green, & Moses, 1990; Hadwin & Perner, 1991; Wellman, 1990). However, it is not obvious why desires should be understood by children with autism when beliefs are not. One difference between belief and desire understanding is that judging when desires are satisfied can be achieved often by simply comparing a person's goal with the outcome — where these match, a person is
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deeed to be satisfied. Several authors have suggested that this understanding of goals and outcomes requires a less mature understanding of mental states. According to Leslie (in press), representation of the relationships between goals and outcomes may be the responsibility of one cognitive sub-system (system, of the “Theory of Mind Mechanism”) that may be relatively unimpaired in autism. In Baron-Cohen's (in press) model, simple volitional states (desire and goal) are represented by a separate cognitive mechanism (ID, the “Intentionality Detector”) that may be relatively unimpaired in autism. This system is based on Premack's (1990) proposal. According to Perner (1991), comparison of goal and outcome may not require a concept of desire as a representation of the world. However, in his view, a representational concept of mind is necessary for understanding that desires can be changed and manipulated and are subject to self-control. Furthermore, according to Astington (1991, 1994), a representational concept of desire and intention is needed also to understand how the mind causes events in the world, because actions are directly caused by mental representations—that is, intentions. Thus, one possibility is that an understanding of desire that goes beyond a simple comparison of explicit information about goals and outcomes may be beyond the abilities of children with autism.

The two experiments reported here were designed to explore the ability of high-functioning children with autism to understand volition. In keeping with the analyses by Perner (1991) and Astington (1991, 1994), a separation will be maintained between understanding desire satisfaction and understanding other aspects of volition, such as desire change, desirability, and intentional causation. We addressed the following issues. First, can children with autism understand the satisfaction conditions of desire when the information needed for matching goal and outcome is not explicit? Second, do they understand that people can change their minds about what they want or intend, so that desires are neither satisfied nor unsatisfied, but are simply changed?

In the experiments below, the test questions involve use of the terms “meant to” and “gonna,” but we wish to point out that this does not signify that an understanding of the mental state of intention is being tested. Astington (1994) proposed that the language of desire (want) and the language of intention (mean to, try to, gonna) appear not to be differentiated by normal children under 4-5 years—they seem to have an undifferentiated concept of desire/intention. In many situations, such a concept is adequate to understand volition, because people normally intend to do what will satisfy their desires. Phillips (1993) has argued that a test may only claim to tap intention specifically where intentions are not confounded with desires. An example of such a situation would be when a particular outcome is wanted, but no intention is formed to accomplish this. Similarly, when a desire is satisfied, but not as a consequence of an intention being carried out, then desires and intentions are not confounded. In the experiments that follow, desires and intentions are always consistent with one another, which means that the test question can be answered correctly on the basis of either intention or desire. In the interests of parsimony, therefore, we describe these two experiments as tests of understanding desire.¹ Empirical work using “true” tests of understanding intention are reported in Phillips et al. (1995).

Experiment 1: The Accidents Test

This experiment was based on a study carried out with young normal children by Astington and Lee (1991). The focus of the experiment was understanding of the satisfaction conditions of desire. This was tested under two different conditions. In the Explicit condition, goal information was given verbally and visually. In the Implicit condi-

¹ Searle (1983) has argued that the satisfaction conditions of intention are more stringent than those of desire, in that intentions are only fulfilled if intended outcomes are brought about by the intended act, and not by some other cause.
tion, goal information was not supplied overtly, although it could be inferred from the context. The purpose of the test was to find out whether children with autism find it more difficult to judge desire satisfaction when they do not have access to explicit information on goals and outcomes.

Previous studies of desire understanding in normal children involved comparing information about a person's goal with facts about outcome (Hadwin & Perner, 1991; Yuill, 1984). Where these match, desires can be said to be satisfied. If such data are explicitly given, a simple visual (or verbal) matching strategy might lead to a correct solution without reference to mental states. Astington and Lee (1991) found, using this test, that children younger than 4 years of age could judge desire-satisfaction when information about goals was made explicit, but had considerable difficulty understanding desire when they could not simply read off and compare goals and outcomes. If, as earlier studies implied, children with autism understood the satisfaction conditions of desire, we would expect them to perform well in both conditions. If, however, the relative competence shown in earlier studies was based on a simple matching strategy only, then we would expect them to be impaired in the Implicit condition, relative to control groups of equivalent mental age.

Method

Participants

Four groups of participants were tested. Children and adolescents with autism; children and adolescents with mental handicap; normally developing 4-year-old children; normally developing 5- and 6-year-olds. The clinical groups were equivalent in verbal mental age (VMA), as measured by the Test of Reception of Grammar (TROG; Bishop, 1989). All participants in these two groups had a verbal MA in excess of 4½ years. Nonverbal mental age (NVMA) was assessed using Raven's Coloured Progressive Matrices (Raven, Court, & Raven, 1990). As is frequently found, individuals with autism were somewhat more able on the test of nonverbal ability than in the language comprehension measure. For the two groups of normal children, it was assumed that MA was, on average, the same as chronological age (CA). The 4-year-old normal group was chosen because that is the age at which many existing tests of understanding mental states are first passed. The older normal children were equivalent in mean VMA to the autism and mental handicap groups. Age and mental age data are summarized in Table 1.

For the autism group, participants were attending specialist schools for pupils with autism. All had a formal diagnosis of autism, using established criteria (Rutter, 1978). Any potential participant with an equivocal diagnosis, such as “autistic features,” was not included in the sample. For the mental handicap group, participants were drawn from schools for pupils with severe or moderate levels of learning disability (mental retardation). Seven individuals had Down syndrome, one had spina bifida, one had cerebral palsy, and the remainder had mental handicap of unspecified etiology. Some investigators (e.g., Cicchetti & Pogge-Hesse, 1982) have recommended that research with atypical children should employ groups that are etiologically homogeneous, to be able to tease apart developmental issues. There are clear advantages to this approach, and indeed some “theory of mind” studies have used control groups consisting of children with Down syndrome (e.g., Baron-Cohen et al., 1985). Our choice of a heterogeneous control group was made for two reasons, both related to the need to obtain a reasonable comparison with regard to level of functioning. First, the autism group included several young people with relatively high verbal MA. In the schools in which we recruited subjects, there were no students with Down syndrome who had comparable verbal ability. Second, there is some indication that children with Down syndrome have pragmatic language abilities that are in advance of
Table 1. Subjects' chronological and mental ages

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Chronological Age</th>
<th>Verbal Mental Age</th>
<th>Nonverbal Mental Age</th>
</tr>
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<tbody>
<tr>
<td>Autism</td>
<td>24</td>
<td>13.39 ± 2.95</td>
<td>6.19 ± 2.03</td>
<td>8.21 ± 2.45</td>
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<tr>
<td>Range</td>
<td></td>
<td>7.8-18.2</td>
<td>4.5-11</td>
<td>4-11.5</td>
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<tr>
<td>Mental handicap</td>
<td>24</td>
<td>14.10 ± 2.64</td>
<td>6.26 ± 1.96</td>
<td>6.98 ± 2.22</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>7.2-17.5</td>
<td>4.25-11</td>
<td>3.5-11.5</td>
</tr>
<tr>
<td>Normal (4 years)</td>
<td>23</td>
<td>4.55 ± 0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>4.1-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal (5/6 years)</td>
<td>30</td>
<td>6.10 ± 0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>5.5-6.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are in years.

their syntactic development (Beeghly, Weiss-Perry, & Cicchetti, 1990). This is a reversal of the typical pattern in autism (Tager-Flusberg, 1993), yet our matching variable was a measure of syntax comprehension. Furthermore, children with Down syndrome are frequently described as being very outgoing and sociable. It has been shown that this perception has some basis in fact (Gibbs & Thorpe, 1983). We felt that a more conservative comparison would be with a group of young people with a broader range of pragmatic ability and “sociability.”

In the autism group, 19 participants were male and 5 were female, reflecting the large predominance of males in autism (Lord, Schopler, & Revicki, 1982). In the mental handicap group, there were 16 males and 8 females. The gender ratio for each of the normal groups was almost exactly 1:1.

Task and materials

Four pairs of very simple stories were used, each story illustrated by three line drawings. In the two explicit pairs, both goals and outcomes were specifically mentioned and clearly depicted (by means of a “think bubble”). In the two implicit pairs, outcome information was given, but there was no mention of the characters’ goals. In each story, a character was shown in a familiar context, an action took place, and an outcome arose. In one story within a pair, the character got what s/he wanted. In the other, the character got the same thing—by mistake—but it was not what was wanted. Participants had to judge which of the two characters was satisfied. In each pair, the outcomes were the same, but the characters’ goals differed. One Explicit and one Implicit pair are shown in Figure 1. The original pictures were 15-cm square and in color, to highlight the critical features.

In the other explicit pair, two girls are trying to throw balls into colored buckets. One throws the ball into the desired bucket (red), the other gets hers in the same bucket, but that was not what she wanted to happen. In the other implicit pair, a girl has some bread. She takes it outside to eat it. Some crumbs drop behind her. The birds peck them up. Another girl takes some bread outside and throws crumbs on the floor, and then some birds come and eat them. Participants were asked “Which girl meant the birds to get the crumbs?”

Participants in the autism, mental handicap, and 4-year-old groups were also given a composite standard false-belief task. This included the Sally–Anne task (Baron-Co-
Figure 1. The accidents test: (a) Explicit condition: “Here are some stories about two boys at school. (1) This boy is thirsty. He wants some milk at break time. (2) He goes to break. This is him thinking that he wants milk. (3) He picks up the right glass. He gets milk. (1) The other boy is thirsty too. He wants some orange juice at break time. (2) He goes to break. This is him thinking that he wants orange juice. (3) He picks up the wrong glass. He gets milk. We have this boy and this boy (Experimenter points to the two “outcome” pictures). One boy is happy, one boy is not happy. Test question: Which boy is happy?”
Figure 1. The accidents test. (b) *Implicit condition:* 
"(1) This boy is standing by the swimming pool. (2) The boy jumps in the water. (3) He is wet. 
(1) This other boy is standing by the swimming pool. (2) The boy falls in the water. (3) He is wet. 
We have this boy and this boy (Experimenter points to the two "outcome" pictures). 
Test question: Which boy meant to get wet?"
hen et al., 1985) and the Teddy task [a version of the “unexpected contents” task (Perner, Frith, Leslie, & Leekam, 1989) that used a little teddy in a Band-aid tin]. The tests were carried out exactly as described in the original studies.

Procedure

Participants were tested individually in a quiet, familiar room in school. The order of stories within pairs was counterbalanced, so that the desire-satisfied version always came first in one pair and second in the other. This was done for both explicit and implicit conditions. The order of story pairs within conditions was also systematically varied. Furthermore, the order of presentation of the two conditions was counterbalanced across subjects. To pass a condition, participants had to answer the test question correctly for both pairs of stories. The test question was a forced choice between two alternatives, and therefore the probability of getting both questions correct by chance alone was .25.

Results

The order of presentation within and between conditions did not influence performance (Yates’s chi-square or Fisher’s exact tests, all $p > .05$). Performance by all groups was greater than expected by chance in the explicit condition (binomial tests, all $p < .05$). However, in the implicit condition, only the mental handicap and 5-6-year groups exceeded chance performance (binomial tests, $p < .001$).

The results are summarized in Table 2 and presented graphically in Figure 2. As expected, more participants passed the explicit condition than the implicit one. In the explicit condition, group differences were not statistically significant (chi-square test, $\chi^2 = 6.99, 3 \ df, p = .07$). In the implicit condition, there were large differences between groups ($\chi^2 = 18.65, 3 \ df, p < .001$). Specific pair-wise comparisons, using Tukey-like range tests on the proportions of groups who passed (Collis, 1992), showed that the autism group differed significantly from both the mental handicap and 5-6-year-old groups ($p < .01$). No other significant group differences emerged. Within groups, the autism group was more successful in the explicit than the implicit condition ($\chi^2 = 7.59, 1 \ df, p = .006$), but for the other groups, differences were in the same direction but did not reach statistical significance.

Analysis of errors

An analysis of errors revealed that, within conditions, both story pairs were equally difficult for the autism group. However, for the other groups the two stories within the explicit condition were not equally difficult. When errors for all control subjects were pooled, more subjects passed the drink story and failed the ball-in-the-bucket story than the other way around (McNemar's test, $\chi^2 = 11.13, p < .001$). No difference in difficulty was found for the implicit stories.

Relationship with understanding false belief

In the false-belief composite test, the percentages of subjects who passed the test questions for both subtests was as follows: autism 22%; mental handicap 71%; normal 4-year-olds 77%. This result was similar to previous tests of false-belief understanding.
in autism (Baron-Cohen et al., 1985; Leslie & Frith, 1988; Perner et al., 1989). The children with autism were significantly less successful than other groups ($\chi^2 = 17.18, 2\, df, p < .001$). The relationship between the accidents test and the false-belief composite test was explored by means of comparing numbers of subjects who passed one test and failed the other. For the two clinical groups, there was no evidence that the implicit task was easier or more difficult than false belief (McNemar's tests not significant). For the normal 4-year-olds, nine participants passed false belief and failed the implicit task, but only one showed the opposite pattern (McNemar’s test, $\chi^2 = 4.90, p < .005$). To summarize, judging desire satisfaction seemed easier for the autism group than did understanding false belief, but only when this could be done by reading off explicit goal information.

An interesting finding of this study was that the normal 4-year-olds performed less well on the task than a similar group of Canadian children in Astington and Lee's (1991) investigation. In the explicit condition, 98% of the Canadian 4-year-olds passed, compared with only 48% in the present study. In the implicit version, 48% of the Canadian group passed, compared with only 35% of the 4-year-olds in this research. In an attempt to reconcile these findings, the performance of the Canadian 5-year-olds in the Astington and Lee study was compared with that of a “new” group of 5-year-old British children. This new group consisted of the 5-year-olds from the original 5–6-year group, together with 9 younger 5-year-olds from the same school (total 24,
mean age 5.7). As with our younger group, performances in this new group were also low compared with the Canadian 5-year-olds: 63% passed the explicit version (compared with 98% of the Canadian group), and 50% passed the implicit (compared with 77%). It is unclear why our subjects showed a depressed performance, but Astington (personal communication, July, 1992) has also found problems in replicating the strong performances found in the original study.

Discussion

The accidents test is a test of understanding unfulfilled desires. Performance of children with autism differed significantly from that of children with mental handicap and normal 5–6-year-olds children only in the implicit version of the task. In this condition, information about the goals of the actors had to be inferred from the story context, before a strategy of matching goals and outcomes could be employed to judge whether or not desires were satisfied. Although all subjects found this version of the task more difficult than one in which goals and outcomes could be compared easily (presumably because they were not overtly specified and saliently depicted), the children with autism were more severely affected by the absence of explicit goal information. This implies that the theory of mind impairment in autism extends to the ability to understand the relation between goals and outcomes when a simple matching strategy is prevented. It should be noted that, in previous studies reporting unimpaired understanding of desire by children with autism, goals were overtly stated (Baron-Cohen, 1991a; Tan & Harris, 1991).

The difficulty for normal 4-year-olds on the simple explicit test is quite surprising, because other studies have reported that goal-outcome matching can be done by children as young as 3 years old (Astington, Gopnik, & O'Neill, 1989; Shultz, Wells, & Sarda, 1980; Wellman & Woolley, 1990; Yuill, 1984). Examination of the errors provides one possible explanation: the ball story seemed more difficult than the drink story, for control subjects but not for those with autism. Where errors occurred, they were more likely to be in this story. It may be that, although young children can readily understand that some people prefer milk and others orange juice, they cannot comprehend that people might be more pleased when successfully throwing a ball into one bucket than when getting it into another, very similar, bucket. Because only the control groups made more errors in this story than in the other, this may also be why the tendency for children with autism to perform less well than other groups in this condition did not reach significance. That is, this relatively poor performance by control groups in the Explicit task might be disguising a true autism-specific deficit in this straightforward desire-satisfaction task.

In Experiment 1, the two conditions differed not only in terms of whether goal information was implicit or explicit, but also in the test question ("Which boy is happy?" vs. "Which boy meant to...?"). We know from previous studies that children with autism can make judgments of satisfaction (e.g., Which one is happy? See Baron-Cohen, 1991a). It is possible that their poor performance in the implicit condition of this experiment occurred because of a lack of understanding of the phrase "meant to." If this was a purely linguistic deficit, then use of an alternative form of wording (such as "What's he gonna do?") should overcome the problem. However, if the difficulty with the implicit condition reflects a cognitive deficit, as we believe, then such a change in wording should not affect the relative performance of the groups, and an autism-specific deficit should still be found. This was tested as part of Experiment 2.

Experiment 2: The Changed Plans Test

Perner (1991) and Astington (1991) have argued that understanding the representational nature of desires may be more difficult than simply identifying whether or not a desire is satisfied. The same entity (object, event, situation) can appear desirable to one
person, while at the same time being undesirable to another. According to Astington and Gopnik (1991), to understand this fact requires a concept of desire that includes its personal, subjective nature. One needs to understand that desirability is not a property of the object, but of the person's mental representation of the object. Not only can an object be desirable to one person and not another, but also it can be desirable to one person at one time and not at a later time. Again, understanding this may require a concept of the representational nature of desire. In this experiment, we attempted to test understanding of desire in situations in which it is not a matter of satisfaction but of desire change, and in which the answer cannot be derived from a comparison of goals and outcomes.

In this experiment, we asked subjects about the planned but unrealized actions of a character who has changed his or her plan as a result of a change in external circumstances. That is, subjects had to understand a character who has changed his or her mind. Perner (1991) argued that a representational concept of mind is needed to understand such a situation. To illustrate this point, Perner related an anecdote in which his 4-year-old daughter refused the peas she had previously asked for. When challenged, she said, “I don't want them. I changed my mind when you didn't look” (1991, p. 225). The basis of the experiment was a narrative consisting of the following four elements: (1) a protagonist desires an outcome and plans an action to achieve it; but (2) before the act can be performed, an event occurs that; (3) causes the protagonist to change his or her mind, and (4) produce some other action, toward a different goal. The task required the subject to diagnose what the character was going to do, before he or she changed his or her mind.

In one sense, this task relates to the aspect of intention that Searle (1983) described as “prior intention.” That is, it seems to involve the temporal separation between a plan and its enactment. However, it is true to say that the character not only planned to perform the action, but also wanted to achieve the outcome. That is, his desire and his intention were, as is usual, in accord. Although the test question asks about his intended action (what he was “going to do”), a correct answer may be given by judging what he wanted to achieve as easily as by inferring what he planned to do. For reasons of parsimony, the test is therefore considered to be one of understanding desires. In contrast to “satisfaction” tests of understanding desire, this method does not allow solution on the basis of goals and outcomes. In the present study, not only were subjects not supplied with the goal in an explicit form, but furthermore they could not use the outcome as a clue to the original mental state of the character, as outcomes did not relate to the original desires.

Method

Subjects

The same children with autism, children with mental handicap and normally-developing 4-year-olds who had participated in Experiment 1 also took part in Experiment 2. One subject in the autism group failed a pretest (described below) and was dropped from the sample. This left 23 children with autism, 24 with mental handicap, and 23 normal children. Older normal children were not tested because pilot studies showed that 4-year-olds performed well in this test.

Task and materials

Five oral narratives were given in random order, each one illustrated by a series of four colored drawings. One of the stories is shown in Figure 3—a burglar wants to steal a clock, but when he sees a policeman appear he strokes a cat instead. The test question asks about the burglar’s initial desire, before he changed his mind.

Note that the narrative did not contain the verb phrase specifying the character's initial intention or desire. Note also the inclusion of a control action question. This was to check story comprehension, the ability to extract information from the narra-
Figure 3. The changed-plans test: burglar story. (1) Here is Burglar Bill. He sees the window is open. (2) Just then, a policeman comes along. (3) The burglar sees the cat. (4) He strokes the cat. Action question: What did Burglar Bill do here? (Picture 4) Desire question: What's Burglar Bill gonna do here? (Picture 1) Naming questions (if desire question failed): What's this? . . . What's this? etc" (Experimenter points to each item in Pictures 1 and 2.)

tive, and the ability to respond verbally to an open question. The naming questions, which were only given if the desire question was failed, controlled for the possibility that failure was due to an inability to supply the appropriate vocabulary. Briefly, the other four narratives were as follows: a boy wants to give a dog a biscuit, but eats it himself when the dog growls; a girl wants to ride her bicycle, but decides to do a jigsaw because it rains; a boy wants to help his sister, but goes back to bed when he sees his mother come to help; a boy wants to pick an apple, but goes off with his football when he notices a gardener watching him.

In two stories, the actor's desire was to help someone, in two it was a moral transgression (stealing) and in the other it was neutral. The outcomes were neither good nor bad.

Pretest screening for future tense understanding

Because the critical desire question within the main test involved asking about future events, it was necessary to ensure that all subjects could understand questions in dif-
ferent tenses. Although there is evidence that, in general, the acquisition of syntax follows a similar pattern in children with autism to that seen in other children (Tager-Flusberg, 1989, 1991; Tager-Flusberg et al., 1990), some studies have found that children with autism are less likely than others to use past tense morphemes correctly in talking about past events (Howlin, 1984). Comprehension of past tense terms has not been well studied in autism. With regard to future tense, there is little specific information on whether this is problematic for children with autism. A screening task was therefore devised, to ensure that no subject was disadvantaged in the main task by an inability to understand the tense of the questions. The exact form of the future tense question (and in the main test, the desire question) was "gonna." Pilot studies showed that 3- and 4-year-old normal children found this easier to understand than forms such as "will." The following story was acted out with a small boy doll and brightly colored wooden models of a house and a school:

This is a house. This is school. Here is the boy who lives in the house. [Which is the school? Which is the house?] It's morning. The boy comes downstairs. He eats his breakfast. He goes out of the house. (Doll placed in a central location between the buildings, facing neither.) Future Question 1: What's he gonna do? Filler Item: Is he wearing a red jumper or blue jumper? Now it's 3 o'clock. The bell goes. He goes out of school. Future Question 2: Where's he gonna go?

It might be objected that the pretest and main test were both tapping the same concepts. However, because the house/school situation was highly familiar, action should have been easily predictable on the basis of the "script" (Schank & Abelson, 1977) that all these school children could be assumed to have. That is, in contrast to the desire question in the main test, there was no need to refer to the specific desires or intentions of the protagonist to predict the next action.

Procedure

Subjects were tested individually, in a quiet but familiar room at school. The future tense pretest was given first. Both future questions had to be answered correctly for the subject to proceed to the changed plans task. The five narratives were given in random order. One point was awarded for each correct answer on the action and desire questions. For both types of question, the subject's answer had to include both an appropriate verb and the relevant object. In the example given above, a correct answer to the action question was "stroke the cat," or a similar phrase. The desire question required the answer "steal the clock" or something similar. Simply saying "clock" did not constitute a satisfactory response.

Results

One participant with autism failed the pretest by failing to reply to Future Question 2. He was among the least verbally able, having a VMA of 4.5 years. He was excluded from further retesting in this experiment. In the other groups, no participant failed the pretest. All the remaining children passed the action questions in all five stories. Because there was no variance on this measure, it was not included in further analysis. Those subjects who (having failed a desire question) were given the naming questions were, without exception, able to name the objects in the pictures.

Results for the desire questions are summarized in Table 3. Scores for the three groups were somewhat dissimilar in variance, as can be seen from the standard deviations, largely because of the excellent performance of the normal and mental
Table 3. Scores for the Changed Plans Test (out of 5; means and standard deviations)

<table>
<thead>
<tr>
<th></th>
<th>Autism</th>
<th>Mental Handicap</th>
<th>4 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.83*</td>
<td>4.79</td>
<td>4.91</td>
</tr>
<tr>
<td>SD</td>
<td>1.27</td>
<td>0.51</td>
<td>0.29</td>
</tr>
</tbody>
</table>

*Autism versus mental handicap, \( p < .05 \); autism versus 4 years, \( p < .01 \).

handicap groups. Indeed, the normal children scored almost at ceiling on this task. In view of this lack of homogeneity of variance, nonparametric tests were used to analyze group differences. A Kruskal–Wallis one-way ANOVA showed that the differences between groups were highly significant \( (\chi^2 = 17.52, p < .001) \). Post hoc testing of mean ranks, by Nemenyi’s procedure (a version of Tukey’s HSD test for ranked data; Hochberg & Tamhaye, 1987), demonstrated that the autism group differed from the normal 4-year group \( (p < .01) \) and also from the mental handicap group \( (p < .05) \). These two control groups did not differ from one another.

Analysis of errors

Within the autism group, the number of errors on desire questions was similar (approximately six) for each of the five stories. In other groups, errors were too few to analyze. Thus, there was no evidence that any of the stories were more difficult to understand than others. In addition, the task was no more difficult for stories involving “bad” desires than for those with prosocial or neutral desires, as might have been expected from work with normal preschool children, which found antisocial motives were understood later than prosocial ones (Yuill, 1984).

Analysis of error types showed that, for the autism group, two varieties of error were most frequent. First, a large proportion of errors (11 out of 30) appeared to be perseverative, in that the subject referred to the same object as in the control question. For example, subjects often said “stroke the cat” or simply “cat.” It should be noted though, that a simple echoing of the control question responses is not the only explanation for this error, because both the correct object and the other one were depicted in pictures 1, 3, and 4. Secondly, many errors (13 out of 30) consisted of being unable to give a definitive response (i.e., “don’t know” or no reply). Occasionally, errors took the form of an inappropriate verb (e.g., “look at the clock”) or irrelevant phase. There was only one example of giving the appropriate noun (“clock”) but no verb. Among the children with mental handicap, errors were very few, but almost all came into the “don’t know” category. A similar analysis was not carried out for the normal children, as they performed almost at ceiling.

Relationship with understanding false belief

Although the false-belief composite was scored on a criterion basis and the changed-plans task involved actual scores, making direct comparisons difficult, changed plans seemed easier than false-belief. The percentage of the normal 4-year group who obtained a maximum score (5) on changed plans was 91%, compared with 77% who passed both false-belief tasks. Among the mental handicap group, more subjects obtained maximum scores in changed plans (88%) than passed false belief (71%). Children with autism also seemed to fare better on changed plans than false belief (43% vs. 22%).

A similar number of participants in each group passed one test and failed the other. Data were therefore pooled in order to test the hypothesis that passing the false-belief task was more difficult than obtaining maximum score in the changed-plans test.

4. Note that using “maximum score” as a pass criterion is very stringent, because five “open” questions need to be answered correctly. Therefore, it is even more striking that, using this criterion, subjects tended to find this task easier than false belief.
Across all groups, 12 subjects “passed” changed plans but failed false belief, compared with only one subject who showed the opposite pattern (McNemar’s test, $\chi^2 = 7.69$, $p < .01$). Thus, the changed-plans test appeared to be less difficult than standard tests of false belief.

Discussion

The changed-plans test is a test of understanding a previous desire, when that desire remained unobservable and was not translated into action. On this test, children with autism were significantly impaired, relative to children with mental handicap with equivalent verbal ability and relative to normal 4-year-old children, over whom they had a substantial verbal and nonverbal MA advantage. The young normal children and those with mental handicap found this task very easy, despite the lack of specific information about goals and outcomes. The actor’s goal was not specified in the narrative and there was no information about outcome, because the test question asked what the protagonist was going to do prior to an event that prevented the outcome. The only basis for “predicting” the action was the mental state (desire or intention) of the actor, which could be inferred from the context alone.

In this experiment, it was not the satisfaction conditions of desire that needed to be understood. Because the desires in question were changed (rather than being fulfilled or not fulfilled), the test may have involved understanding the representational nature of desire. It required participants to realize that desires exist at the mental level, representing aspects of the world as desirable or not desirable. It would appear that children with autism are impaired in the ability to understand this aspect of desire, compared with children with mental handicap and normal children. Although there was some indication that the task is less difficult than understanding false belief, an autism-specific deficit was still apparent. However, before concluding that children with autism are specifically impaired in the ability to understand that desires may change, and therefore show evidence of the lack of a representational concept of mind, it is necessary to consider alternative explanations for the poor performance of the autism group in this task.

First, it may be that these children are unfamiliar with the cultural meaning of the events in the narratives (Loveland, McEvoy, Kelley, & Tunali, 1990). For example, they might have little knowledge about the habits of burglars and policemen, or about taking things that do not belong to one. However, the other four stories were about more ordinary situations, such as wanting to play on a new bicycle, and three stories involved good or neutral desires rather than moral transgressions. The subjects with autism performed no better in these less sensational stories.

Second, the syntax of the desire question could have been too difficult. This does not seem likely because the groups were matched on a measure of understanding grammar, the desire question employed the simplest grammatical structure (avoiding conditional terms), and a pretest established understanding of the precise form of tense of the desire question. (One possibility, however, is that the future task itself could be done without understanding the future question: The house and school were the only possible objects that the subjects could refer to. In any replication of this study, it would be desirable to include one or more “distractor” objects in the future task, such as a tree.)

Third, the possibility remains that the children with autism failed because of an inability to create a novel utterance, because the desire question required construction of a novel verb phrase, whereas the action question could be answered by repeating a phrase from the narrative. However, this seems unlikely when one considers the error patterns of the children with autism. All the children had the appropriate nouns within their expressive vocabulary (naming questions), but only one error involved the use of the noun alone, without the verb. If the problem was with producing a novel verb
phrase, one would have expected more sub-
jects to produce the correct noun by itself. Instead, children who failed appeared even to misunderstand which object was in-

Fourth, we can rule out the possibility that the children with autism failed the de-
sire question because they did not under-
stand sabotage (the desired action was sabo-
taged by, for example, the arrival of the 
policeman). This is because Sodian and Frith (1992) have shown that understanding sabotage is within the understanding of children with autism.

Finally, we can exclude the possibility that the children with autism were unable to extract information from pictures. The action question required this ability, as did the TROG language test. Furthermore, other studies have shown that action sequences can be understood in picture form (Baron-
Cohen, Leslie, & Frith, 1986). However, it 
may be that the desire question requires us-
ing context to make inferences, rather than just to read off the information in picture form. Making inferences from context may be beyond the inferential abilities of children with autism. For example, in the Bur-
glar story, the subject needed to infer from 
the pictures alone that burglars usually steal things, that gold clocks are worth stealing, and that policemen prevent theft (the wider context). Furthermore, the pictures are the only source of information about the nar-
row context, that is, the mental state of the actor. For example, the burglar was "acting suspiciously," by looking at the open win-
dow in a furtive manner. In the other sto-
ries, the protagonist's intentions towards the desired object were indicated by his or her gaze direction. Thus, the problem for the children with autism might have been in making inferences from contextual infor-
mation that was not specifically mentioned in the narrative, rather than in making men-
tal state inferences per se (Frith, 1989). A test of this possibility would be to devise a control task involving physical causal events, in which participants must construct nonmental state information from context alone. In sum, however, the results from Experiment 2 suggest that children with au-
tism have difficulty in understanding the changeable nature of desire.

General Discussion
At the beginning of this paper, we asked two questions about understanding voli-
tional mental states. First, can children with autism understand desire satisfaction? An earlier study by Baron-Cohen (1991a) sug-
gested that they can, because they could predict emotions based on the satisfaction or frustration of a person's expressed de-
sire. However, we found that this under-
standing of the satisfaction conditions of desire is fragile, and does not extend to situ-
ations in which information about goals is only implicit in the context. In such situa-
tions, the children with autism were pro-
foundly impaired relative to MA-matched children without autism. Second, do chil-
dren with autism understand that desires are mental representations of situations, and can be changed "at will"? This concept seems to be different from understanding when desires are satisfied, and we suggested that it requires understanding of the repre-
sentational nature of desires (Perner, 1991). Unlike children with mental handicap and young normal children (with a distinct MA disadvantage), who found the task almost trivially easy, children with autism were rel-
atively impaired in this test. Thus, in both experiments, children with autism were found to show impairments relative to other children of equivalent or lower mental age.

The conclusion to be drawn from these two tests of understanding desires is that the theory of mind impairment in children with autism is not restricted to epistemic mental states such as belief, but also extends to vo-
lition. This deficit is unlikely to be a purely linguistic one because it appeared despite varying the wording of test questions. This finding suggests that the deficit is cognitive in nature. These two experiments suggest that children with autism may be less im-
paired in understanding desires than they are in taking into account beliefs, but their comprehension of desire may stem from
only a very limited concept: knowing that people like different things and are happy when they get them, and so on. A full understanding of when desires are satisfied and when they are not seems beyond their grasp. Furthermore, they have incomplete understanding of desire/change. The implication is that the representational or subjective nature of desire is not comprehended.

One issue to be dealt with is why the implicit condition of the accidents test (Experiment 1) was so very difficult. This task was harder than the changed-plans test, and indeed, for normal 4-year-olds, it was harder than false belief. The implicit task involved using (inferred) data about goals to compare goals and outcomes for each story of the pair. Thus, a substantial amount of information had to be handled. In contrast, each trial in the changed-plans task involved only one story. It seems possible that the extreme difficulty of the implicit test for 4-year-olds might have been partly to do with information-processing demands of a general nature, not simply the theory of mind aspect. It would be interesting to see if the task is easier if presented as single stories, rather than as a forced-choice between two similar alternatives. It should be remembered that many of the children with autism in this study, who were profoundly impaired in this task, had mental ages (verbal and nonverbal) that were much higher than the normal 4-year-olds.

Could the autism-specific deficits found in these two experiments be explained in terms of a more general cognitive deficit? For example, could it be a deficit in executive function, or the high-level ability to plan and control behavior, rather than impairment in the social domain specifically? More specifically, could the autism results have arisen from an inability to inhibit an incorrect, but irresistibly salient response (Hughes & Russell, 1993)? In the changed-plans experiment, many errors involved repetition of the answer to the action question—that is, a type of “reality error.” It is possible that this error resulted from an inability to inhibit the more salient “reality” response, and shift attention to the appropriate object. However, the fact that an even more common error was to say “don't know” makes this explanation seem less likely—more than 40% of errors were not of the “reality” type. For the accidents test, it is difficult to see how a domain-general problem with cognitive flexibility or response inhibition could account for the difficulties of the children with autism. First, the incorrect (unintentional) story within each pair did not contain more salient information. Second, there was no habitual response to be inhibited. Finally, it was not the case that children with autism made the incorrect choice systematically—rather, they appeared to make their selections randomly.

Another alternative to the theory of mind explanation for these results is that a more general deficit is present in autism, connected with the processing of contextual information. Frith (1989) has suggested that a weak drive for central coherence may be the underlying difficulty for people with autism, and that impairments in interpreting behavior in terms of mental states may be part of a more general problem with use of context to derive high-level meaning. It is true that both the implicit condition of the accidents test and the changed-plans experiment involved using context to obtain critical information. Comparable tests now need to be devised that tap the ability to use context both with and without specifically mental-state material. It is possible, however, that deficits in understanding mental states may be additional to and independent of a tendency to process information in a “piecemeal” fashion (Frith & Happé, 1994).

In summary, previous studies of understanding volition by children with autism have only investigated very simple aspects of desire, and found that these were not specifically impaired. The two experiments reported in this paper suggest that understanding more complex levels of volition is in fact impaired in many individuals with autism. This means that both aspects of belief-desire reasoning are difficult for people with this disorder. Naturally, a comprehensive impairment in such reasoning capacity
has profound consequences for understanding the social world. One effect may be a relative insensitivity to others' wishes and emotions. There is a paradox in the evidence related to emotion comprehension in autism. On one hand, there are many reports of lack of empathy and insensitivity to others' expressions of emotion. Furthermore, there is some evidence that facial expressions of affect may hold less significance for individuals with autism (Weeks & Hobson, 1987). On the other hand, in experimental settings, children with autism can sometimes understand emotions as well as other children with equivalent verbal ability (Baron-Cohen, 1991a; Hobson, Ouston, & Lee, 1989). One explanation for this apparent contradiction may be that predicting simple emotions (e.g., happiness, sadness) on the basis of goals and outcomes can be done "intellectually," by observing contingencies between events and behavior (emotional expression). In contrast, a sophisticated conceptual framework of the causes of emotion (that is, the beliefs and desires of the person) may be required in order for the significance of affect to be fully appreciated (Harris, 1989).

References


