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Understanding intention in normal development and in autism

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This study aimed to establish whether or not young children and young people with autism can understand the mental state of intention. Participants were exposed to personal experience of unintended outcomes, to test if they could distinguish intended vs. unintended actions. Recognizing accidental outcomes was more difficult for normal 4-year-olds than 5-year-olds, and more difficult for young people with autism, compared with comparison groups. Such findings suggest that the theory of mind deficit observed in people with autism is not restricted to understanding epistemic states, but also extends to understanding intention. The results are also compatible with an action-monitoring deficit. Future research needs to test these two accounts against each other.

A large amount of research has been carried out to investigate children's developing understanding of mental states, because this is thought to have major implications for social development and communication (Astington, 1994; Astington, Harris & Olson, 1988; Whiten, 1991). Most studies have focused on beliefs, and it is now clear that children develop an understanding of belief and knowledge during the pre-school years. The 'acid test' for this concept involves understanding a belief that is different from the individual's own (Dennett, 1978*a*), and this is easily passed by children at around 4–5 years of age. It is also well established that most children with autism fail this critical test and many other tests of understanding minds (Baron-Cohen, 1995). The cause of the theory of mind deficit is still debated (see Baron-Cohen, Tager-Flusberg & Cohen, 1993).

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The focus of this paper is on understanding of volitional mental states, and specifically intention. Philosophical accounts of understanding behaviour have stressed the importance of beliefs and desires and intentions in reasoning about action (e.g. Dennett, 1978*b*). Desires and intentions are usually believed to be understood earlier in development than beliefs (e.g. Wellman, 1990). Most of the research into understanding volition has emphasized desire, and the findings suggest that this is normally understood by the age of 3 years. Children with autism seem less impaired in the area of desire, as many individuals with the disorder have been found to pass simple desire tests (e.g. Baron-Cohen, 1991). However, a recent study showed that more complex aspects of desire are not understood by pre-school children and many people with autism (Phillips, Baron-Cohen & Rutter, 1995).

In this paper, we concentrate on the other major volitional state, intention. This has not been investigated in individuals with autism. It is of interest to know whether the difficulties they have with mental states extend to this important concept. The work of Shultz and co-workers in the 1980s showed that normally developing children as young as 3–4 years old can say whether or not they 'meant to' produce an outcome, by distinguishing between deliberate and accidental outcomes (Shultz & Wells, 1985; Shultz, Wells & Sarda, 1980). These authors proposed that this demonstrates an understanding of intention. More recently, this conclusion has been called into question and the issue of when children come to understand intention has been reopened (Astington, 1991, 1994; Perner, 1991).

One difficulty with previous tests of understanding intention is that they do not separate out desire and intention, and it can be argued that they can be passed on the basis of understanding either desire or intention. There is no doubt that 3-year-olds, and even younger children, are aware of making mistakes or achieving their goals (Bullock & Lutkenhaus, 1988). But it is questionable whether such awareness constitutes a concept of intention. It may be simply that they know what they want and whether they get it or not. Shultz *et al.*, (1980) exposed young children to accidental and deliberate outcomes in real-life situations. For example, they induced them to reach out for a target object whilst wearing laterally distorting lenses that disrupt visually guided reaching. As a result, the children connected with the wrong object. Even the 3–4-year-olds were able to say that they had not 'meant to' do this. However, tests like these can be passed by using a simple strategy of matching goals and outcomes. Perner and Astington have argued that this may not require understanding of intention. According to Astington (1994), young children may not differentiate between desire and intention in such situations. Indeed, they do not need to, because most of the time, people intend what they desire.

Astington and colleagues have devised tasks that require more than a simple matching of goals and outcomes, in order to test children's understanding of intention as a mental representation of action. Astington & Lee (1991) used stories that contrasted accidental and deliberate events, but did not overtly specify goals. They asked normal young children which of two actors 'meant to' produce the outcome. They could not simply look for goal and outcome information to compare, as both outcomes were the same and goals were not clearly stated. Although the test question asked about intentionality, it seems possible that the correct answer could be arrived at by reference to the characters' desires, because the intentional outcome was in accord with what the actor wanted to achieve. Even though the actor's desires were not made explicit in the stories, they were implicit

and could be inferred from both language and pictures. Therefore, even this carefully designed test may not have disentangled intentions from desires. Given that people normally intend to produce what will satisfy their desires, it is not an easy matter to separate out these two mental states. In order to be able to consider how one might avoid confounding them, it is necessary to examine the concept of intention itself.

Intention is not reducible to desire, and differs from it in at least three ways. Firstly, it is possible to hold conflicting desires, but not to have conflicting intentions. (Example: I can want to spend next Christmas in England and on a beach at Acapulco, but I cannot intend both of these.) Secondly, I can desire the impossible, but cannot intend what I know to be impossible. (Example: I can wish I had wings, but not intend to have wings.) Finally, desire is satisfied if the desired situation comes to pass by any means, but intentions can only be fulfilled if the outcome is brought about by the precise means specified in the propositional content of the intention. (Example: If I want carrots, it is irrelevant whether I grow my own or whether someone else gives them to me. If I intend to grow carrots, my intention is not fulfilled by my getting carrots as a gift, but only by my action to cultivate them.) Putting this another way, desires can be satisfied either deliberately or fortuitously (accidentally), but intentions can only be fulfilled deliberately.

To summarize, a test of understanding intention should avoid the possibility of solution by a simple matching of goals and outcomes. The test should disentangle intention from desire, to ensure that it cannot be passed spuriously by taking account of desires. It is our contention that previous studies of understanding intention in normally developing children have not succeeded in doing this, but have allowed for desire-based solutions (Astington & Lee, 1991; Moses, 1993; Shultz *et al.*, 1980; Smith, 1978).

In the study described below, children were given first-hand experience of intentional and accidental outcomes. The rationale for adopting this approach, first used by Thomas Shultz and colleagues, is that real-life events with personal significance may have more impact than hypothetical situations in stories, and may help children to articulate their understanding of intention. In addition, in this test there was no need to take account of a belief that is contrary to reality.

The task was based on an electronic target-shooting game used by Shultz and Wells (Shultz & Wells, 1985). In that study, the task involved firing a 'ray gun' to hit one of several coloured targets, and participants either hit the chosen target or accidentally hit a different colour. Shultz and Wells showed that young children could match goals and outcomes to judge whether or not they 'meant' to hit a particular colour. We were not convinced that the task required understanding of intention, as distinct from desire, because the children intended to achieve what they wanted to happen. Matching goal and outcome was equivalent, therefore, to matching desire and outcome. In the new version of the task, we introduced an important modification, designed to partially disentangle intention and desire. In Shultz and Wells's test, hitting the chosen target was the sole aim, and was an end in itself. In our version, there was an additional element. The aim of the game was to win tangible prizes, and the shooting of the target was simply the means to get the prizes. Participants wanted the prizes, and intended to shoot specific targets in order to get what they wanted. This extra dimension enabled us to manipulate the value, or desirability, of some outcomes, to make them intentional but not desirable, or desirable but accidental. This ensured that we were tapping understanding of intention, as it would

be misleading to use desire information to judge intentionality in these situations.

We predicted (*a*) that understanding the accidental–deliberate distinction would show a developmental progression in young children from 4–6 years old; and (*b*) that young people with autism would find this distinction difficult to understand, compared with children with mental handicap with similar general levels of ability.

Method

Participants

Three groups of normally developing children were tested, aged 4, 5 and 6 years. There were approximately equal numbers of girls and boys in each group. They were mostly white and from lower middle-class and upper working-class backgrounds. To test for intact or impaired performance in autism, we investigated two more groups—children and adolescents with autism, and those with mental retardation but without autism. The two clinical groups were equivalent in verbal mental age (VMA), as estimated by the Test of Reception of Grammar (TROG), an assessment of understanding of syntax, (Bishop, 1983). Non-verbal mental age (NVMA) was assessed using Raven's Coloured Progressive Matrices (Raven, 1956). As is frequently found, individuals with autism were more able on the non-verbal test than the language measure. Age and mental age data are summarized in Table 1 below.

Table 1. Participants, chronological age and mental age-equivalent in years (mean and standard deviation)

Group	Number	Age	TROG Age-equiv	Raven's Age-equiv
Autism	24	13.39 (2.95)	6.19 (2.03)	8.21 (2.45)
Mental retardation	24	14.1 (2.6)	6.26 (1.96)	6.98 (2.22)
4-year-olds	23	4.54 (0.26)	–	–
5-year-olds	23	5.58 (0.25)	–	–
6-year-olds	23	6.56 (0.26)	–	–

Participants with autism were attending specialist schools, and all had a formal diagnosis of autism, using established criteria (APA, 1994; Rutter, 1978). Any potential participant with an equivocal diagnosis (e.g., 'autistic features') was not included in the sample. For the mental retardation group, participants were drawn from schools for pupils with severe or moderate levels of learning disability (mental retardation). This was a heterogeneous group, including several children with Down syndrome. Five of the young people with autism were of Afro-Caribbean origin, and one was Asian. One child with mental retardation was Asian. All of the other clinical participants were white.

Apparatus

The game consisted of a set of six coloured targets (opaque plastic canisters) balanced on a 'wall' and a plastic water pistol mounted on a pivot at a distance of 60 cm from the wall. The water pistol was

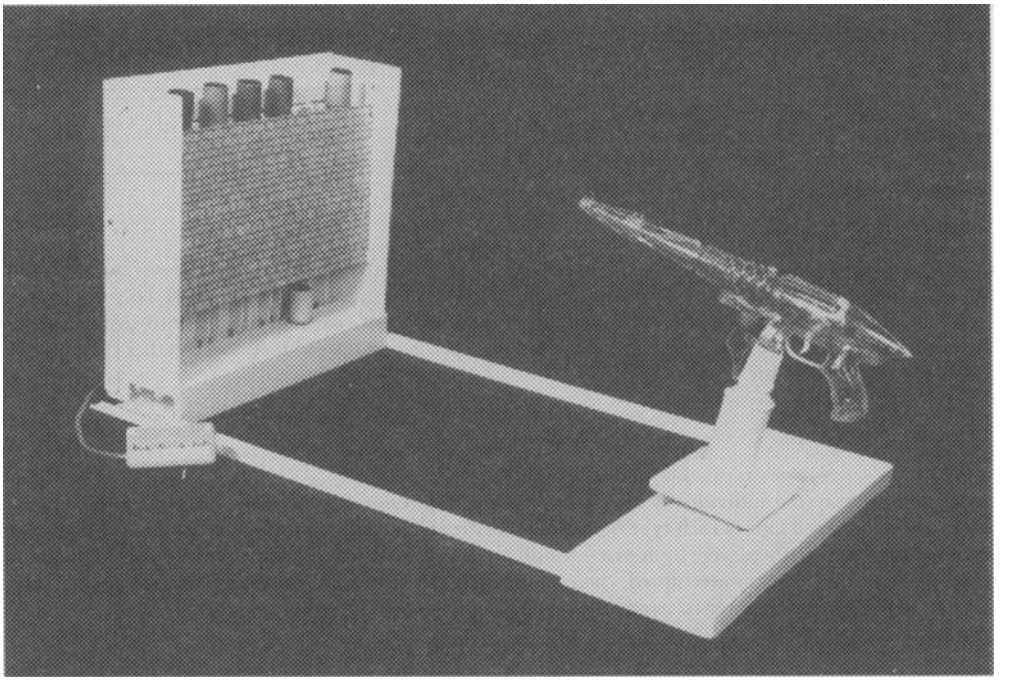

Figure 1. Apparatus.

converted to operate electronically. The whole device was erected on a tabletop, and measured 50 cm wide by 90 cm long by 40 cm high. The apparatus is illustrated in Fig. 1. The game was electronically controlled, so that the operation of the gun's trigger closed a switch that caused one canister to fall from its position and roll towards the participant. The experimenter discreetly held a set of toggle switches that allowed her to select which of the six cans was to fall when the gun was fired. The participant, therefore, was in control of when the canister fell, but the experimenter covertly determined *which* canister fell. The result of this was a very convincing game, in which even normal adults were unable to detect that the outcome was rigged. Six small pieces of coloured card acted as visual reminders of the intended target. The prizes, which were contained inside some of the canisters, were Smarties (M&Ms) and raisins.

Task

In Shultz & Wells' task, for each trial, participants selected a target, took aim, and then fired. They were then asked 'Did you mean to hit that one?'. In the present study, participants were told the aim of the game was to get as many prizes as possible, by shooting down the cans with the prizes hidden inside. They knew that not all the cans had a prize in. So for each trial, there was a desire for a prize, an intention to shoot a particular target, and then an action. The outcome of the intention was either a HIT or a MISS. (A 'miss' was when the wrong colour canister fell. Participants never missed completely.) Whether or not there was a prize was independent of the outcome of the shot. For example, some intended outcomes were not rewarded with a prize, and some accidental outcomes did contain a prize. (Note that the latter is broadly equivalent to the fortuitous satisfaction of desires, as described earlier.) So, sometimes the outcome fulfilled the intention and satisfied the desire for a prize, sometimes it frustrated both, but sometimes only one of these two mental states was satisfied. The four possible outcomes are summarized in Table 2. From Shultz's work, we predicted that the younger children would have no difficulty with the straightforward cases

Table 2. Four possible outcomes within the target game

	Prize	No prize
Hit	HP (1)	HN (2)[a]
'Miss'	MP (4)[a]	MN (3)

[a] Discrepant outcomes.

(1 and 3), which can be answered correctly on the basis of either desire or intention. However, we expected that they might have difficulty with the discrepant conditions (2 and 4), in which a HIT fails to produce a prize or a MISS is unexpectedly rewarded. In these conditions, participants have to disregard the unexpected satisfaction or frustration of their desire for a prize, and instead focus on whether they hit the target they intended to hit.

Procedure

Participants were tested individually at school or playgroup. Outcomes were controlled by the experimenter, who contrived four of each type (see Table 2). After each trial, the can was replaced on the wall of the apparatus. Because there were light prize-winning trials, some reloading of prizes was needed. In order that the game could flow uninterrupted, there were two more identical sets of cans concealed behind the wall, to allow the experimenter to reload the game discreetly with minimum disruption.

Instructions 'In this game, you have to shoot the little cans off to win some prizes, but only some of the cans have got a prize in. Some of them are empty. Let's see how many prizes you can win! When we start the game, you choose a colour and point the gun at it. When I say "Shoot," then you can pull the trigger. If you hit the can, it will fall down, and we can see if you've won a prize. Okay? Now, which colour are you going to choose? Let's put this card here to remind you which one to shoot.' (Places the corresponding coloured card on the gun-mounting in front of the participant.) 'Okay, this is the colour you are going to shoot at. Ready . . . SHOOT!' (A can falls down, and the participant opens the lid.) 'Oh look, you won a prize!' (or, 'Oh look, that's an empty one. No prize this time.') Test question: 'Which colour did you mean to shoot? The (red) one, or the (yellow) one?' 'Let's do it again. Which colour are you going to shoot down this time?' (etc.)

The correct answer was the first alternative in half the trials and the second in the remaining half. Thus, the first alternative in the test question was always the one in the hand, regardless of whether or not it was the intended colour. The selected colour card remained in full view throughout the trial, and was therefore available for comparison.

Parametric analysis

One point was given for each trial in which the participant correctly identified the intended colour. That is, there was a score out of four for each of the four conditions. Four sets of planned contrasts were tested, using two-way analyses of variance. HITS and MISSES were analysed separately. For each analysis, one factor was group (either clinical group or age group) and the other, which was repeated measures, was type of outcome (either discrepant or consistent).

False belief tasks

Participants in the 4-year-old group, the autism group and the mental retardation group also received a composite false belief (FB) test. This was made up of two standard FB tasks: the Sally-Ann and Smarties tasks. (See Baron-Cohen, Leslie & Frith, 1985; Perner, Frith, Leslie & Leekam, 1989).

Results

Most groups had a mean score of over 3 in each condition. (A score of 2 out of 4 can be obtained by guessing.) Means scores are shown in Table 3.

Table 3. Mean scores and standard deviations

Group	HP		HN		MP		MN	
Autism	3.63	(1.05)	3.50	(1.14)	2.67	(1.81)	3.04	(1.57)
MR	3.83	(0.82)	3.41	(1.28)	3.88	(0.61)	3.96	(0.20)
4 years	3.87	(0.46)	2.83	(1.50)	3.35	(1.19)	3.43	(1.04)
5 years	3.96	(0.21)	3.74	(0.69)	3.78	(0.52)	3.96	(0.21)

Key. HP = hit, with prize; HN = hit, no prize; MP = miss, with prize; MN = miss, no prize.

Normal 4-year group vs. 5-year group

These contrasts are shown in Fig. 2. Within HIT conditions (in which the intended can was hit), there was an overall age effect: 5-year-olds were more accurate than 4-year-olds ($F(1,44) = 6.68, p < .02$). There was also a large effect of type of outcome, in which the HN (discrepant) condition was more difficult than the HP (consistent) condition ($F(1,44) = 14.66, p < .001$). However, the interaction of age condition was significant also ($F(1,44) = 6.29, p < .02$). A simple main effects analysis confirmed that the age effect was confined to the discrepant trials, in which intention was fulfilled but the desire for a prize was unsatisfied ($F(1,44) = 7.06, p < .02$). For the consistent trials (HP), there was no effect of age ($F(1,44) = 0.69, p > .05$). That is, the 4-year-olds were rather poor in the discrepant (HN) condition, but as competent as 5-year-olds in the HP condition.

Within the MISS conditions (in which a different can was hit by accident), 5-year-olds were better than 4-year-olds, as before ($F(1,44) = 4.87, p < .04$). However, this time

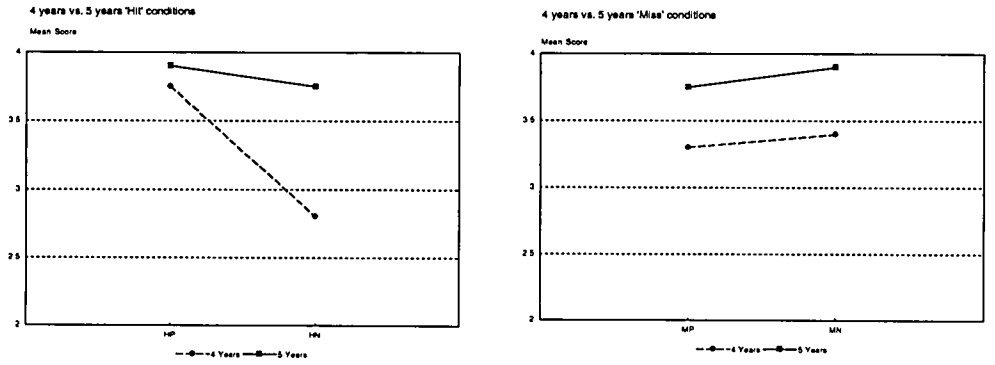

Figure 2. Mean scores for normal children.

there was no effect of condition ($F(1,44) = 2.64, p > .05$), and the age effect was similar in both MP and MN conditions ($F(1,44) = 0.49, p > .05$).

Autism group vs. mental retardation group

These contrasts are shown in Fig. 3. Within HIT conditions, there was no significant group difference ($F(1,46) = 0.05, p > .05$). The HP condition was somewhat easier than the HN (discrepant) condition, as expected ($F(1,46) = 5.32, p < .03$), but the effect was not large. There was no interaction effect, so the condition effect was similar for both groups ($F(1,46) = 1.54, p > .05$).

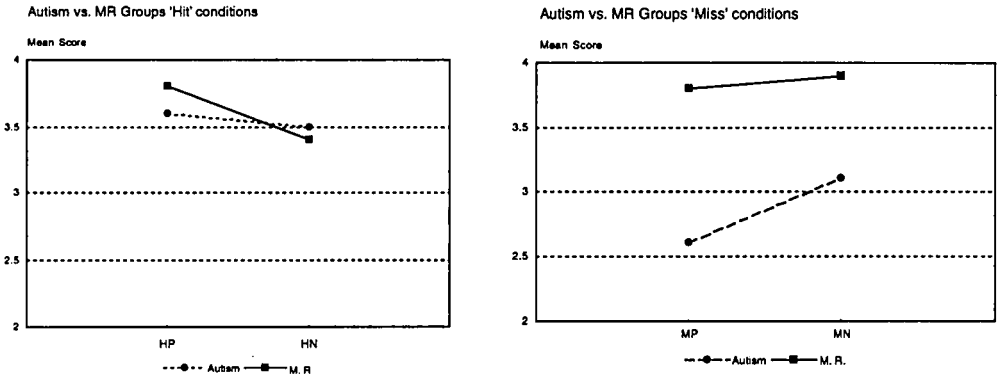

Figure 3. Mean scores for autism and mental retardation groups

Within MISS conditions, there was a strong effect of group, with the autism group doing less well than controls ($F(1,46) = 10.29, p < .01$). Although the trend was for the discrepant condition (MP) to be harder, this effect was not significant ($F(1,46) = 2.8, p > .05$). Again, there was no interaction of group and type of outcome ($F(1,46) = 1.13, p > .05$). That is, the group difference was common to both conditions.

As expected, 77 per cent of 4-year-olds passed the composite FB test (17 out of 22 participants who passed all control questions. One participant who failed a control question was excluded from the FB analysis). This performance is in strong contrast with the intention result—only 17 per cent passed this. Out of the 17 participants who passed the false belief composite, 14 failed intention. No participant passed intention but failed false belief.

The two clinical groups also had the false belief composite test. Only 22 per cent (5 out of the 23 participants who passed control questions) of the autism group passed this, compared with 71 per cent of the mental retardation group.

Non-parametric analysis

The above comparisons were repeated using Fisher exact probability tests, comparing passers and failers, since the distributions were non-normative and might therefore violate assumptions underlying ANOVA. Using a criterion of passing defined as scoring equal to or more than three out of four, all group differences identified using parametric tests

(above) remained significant at the $p < .05$ level, and no additional group differences were found.

Discussion

In this test, children had to judge intentionality simply by comparing goal and outcome. In general, both 4- and 5-year-olds performed relatively well, although some age effects were apparent. To make sure that participants were not able to rely on a simple understanding of desire, we made some intentional outcomes produce no experience of desire satisfaction and some accidental outcomes lead to the experience of satisfaction. Thus, the two consistent conditions could be passed by reference to desires or intentions, but the two discrepant conditions required understanding of intention, as distinct from desire. Given that children's understanding of desire is thought to be in place before 4 years (Wellman, 1990), we expected that any age effect in the normal children would appear only in the two discrepant conditions (HN and MP). In fact, the 5-year-olds were better than the 4-year-olds in the consistent MN condition also. The older children's better performance in both Miss conditions may be due to a greater ability to recognize unintentional outcomes, and therefore avoiding overattributing intentionality.

The explanation for the more striking age effect in the HN condition may be of a different nature. In this condition, in which the can was unexpectedly empty, the 4-year-old children tended to say that they meant to get the other colour. This was despite having the intended colour in their hand and the matching coloured 'reminder' card within inches of their hand. Perhaps some children said the other colour hoping that the experimenter would simply hand this one over to them, thus giving them a second chance to find the prize in that trial.

Within the clinical groups, there was a marked tendency for the young people with autism to do less well in the Miss conditions—that is, they were more likely to overattribute intentionality. This suggests that their understanding of intention was not in keeping with their overall developmental level. However, it is worth considering other possible explanations for this pattern of results. Firstly, it is unlikely that the poorer performance in Miss conditions was due to the individuals with autism echoing part of the test question. The correct response in these conditions was to refer to the second alternative in the test question. An echolalic response would be more likely to lead to a bias in the correct direction, by repeating the end of the utterance. A second, and perhaps more feasible alternative, is a failure to suppress a more immediately compelling response. The correct response in Miss trials was to say the colour that was not in the hand. The young people with autism may have been unable to resist referring to the can that was in their hand at the time of the question. The 'executive dysfunction' account of autism would suggest that inhibiting such a prepotent (but incorrect) response would be difficult for people with autism. Such a difficulty is one predicted consequence of impaired executive function (Hughes & Russell, 1993). However, it could be argued that the coloured 'reminder' card was highly salient, so the executive dysfunction theory makes no clear prediction as to whether individuals with autism will be drawn by the reminder card or the can. In contrast, the theory of mind hypothesis predicts that the difficulty will lie in a failure to understand unintentional outcomes, and this was strongly confirmed. It is, of course, possible to test the executive dysfunction explanation further by, or for example,

reducing the salience of the can in the hand by replacing it on the wall before asking the test question.

It is also possible that the present results are evidence of an action-monitoring deficit in autism, previously only reported in schizophrenia (Frith & Done, 1989) but recently also extended to children with autism (Russell & Jarrold, in press *a,b*). The action-monitoring account holds that at a subpersonal, a-'theoretical' level, children with autism do not lay down a sufficiently strong record of what they intend, even though they can understand what an intention is and what another person's intention might be. In contrast, the theory of mind (TOM) account does not make any special discrimination between the child with autism being able to monitor their own mental states or those of someone else.[1] This contrast leads to opposite, testable predictions from the two accounts: if the same experiment was run again, but this time in the third person—having the child make judgments about another person's real intentions—then the TOM predicts deficits will persist, whereas the action-monitoring account predicts no deficit for third-person judgments.[2] Such a test clearly needs to be done.

We should add that the action-monitoring account raises another question: presumably, if children with autism had difficulty in this area, or with awareness of themselves as agents (Russell, 1996), then it should be easy to shift them from one activity to another. They would simply not have an adequate record of what they wanted. Yet children with autism can insist tenaciously on continuing an activity, despite all attempts by parents and teachers to shift them to something else. The child's characteristically difficult tantrums may be an outward sign that they *can* monitor their own actions, agency and desires. The action-monitoring account will need to answer this question about its validity.

To summarize, the generally high scores among the normal children suggest that understanding intentional and accidental outcomes is emerging by 4 years, and is well established by 5 years of age. The young people with autism, while not performing as well as would be expected from their mental age level, seemed less impaired in this test than in tests of false belief. One very positive aspect of this study was the high level of interest that the people with autism showed in playing the game. Any relatively poor performance was not, therefore, due to failure to fully engage in the test.

The implication is that the theory of mind impairment in autism extends well beyond belief understanding, and includes difficulties with desires and intentions. Although the magnitude of their difficulty may vary between tests and between mental states, the impairment in understanding minds is apparent in many young people with autism, and seems to apply at both late-developing, 'complex' levels (Baron-Cohen, Jolliffe, Mortimore & Robertson, 1997) and at earlier, simpler stages (Baron-Cohen *et al.*, 1996; Phillips, Baron-Cohen & Rutter, 1992).

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[1] If anything, the TOM account would predict that judging third-person intentions would be harder than first-person intentions, for a person with autism, since first-person intentions usually have increased salience.

[2] We are grateful to Jim Russell for this suggestion.

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