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Competence and performance in false belief understanding: A comparison of autistic and normal 3-year-old children.

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Using a standard prediction of action task, we find that normally developing 3-year-old children successfully take into account a protagonist's false belief when asked a 'look first' question. When asked this same question in a true belief scenario, 3-year-olds also correctly predict a protagonist's action even though in this case the correct answer is the second (full) location rather than the first (empty) location. This rules out the use of a low-level response strategy. In a second experiment, children aged 3.5 years who failed a standard 'think' question passed a 'look first' question. A control group of older children with autism, who performed at the 3.5-year-old level on the 'think' question, showed no improvement in performance on the 'look first' question. Taken together, the two studies confirm that a minimal modification to the standard false belief task helps normally developing preschoolers to calculate the content of a false belief. Current neuropsychological models of 'theory of mind' development typically contrast autistic children with normally developing 4-year-olds who pass standard false belief tasks. Our present results extend current models by comparing autistic children with 3-year-olds who also fail standard tasks. Apparently, the two groups do not fail for the same reasons. Whereas 3-year-olds' difficulties on theory of mind tasks appear to be due to performance factors, autistic children's difficulties appear to be caused by a deeper metarepresentational impairment.

Despite almost 15 years of research on preschoolers' understanding of false belief, the reasons for the shift in performance between the ages of 3 and 4 years remains controversial. Currently there are two major theoretical positions on the question. According to one view, children construct a succession of 'theories' about behaviour that come to implicate a theoretical construct—mental states. This process is thought to culminate in a major discontinuity in development: namely, a 'theory-shift' at around 4 years of age in which the child makes the discovery that mental states are really representations. For example, Perner claims that 'what young children cannot do is to

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represent that a proposition can be given a different truth value than the one it has (as assigned by children themselves)' (Perner, 1991, p. 243). The theory-shift view is shared by a number of different models and theoretical proposals which may differ substantially on other respects such as the relative emphasis given to specific mechanisms of change and developmental precursors (e.g. Perner, 1991; Gopnik, 1993; Wellman, 1990). The key finding for the theory-shift view is that 3- (but not 4-) year-old children fail on tasks that test for the understanding of false belief.

Another major view assumes more conceptual continuity in preschool development and postulates an early emerging, domain specific, innate competence (e.g. Baron-Cohen, 1995; Fodor, 1992; Leslie, 1987; Leslie & Thaiss, 1992). For example, the early emerging abilities to pretend and to understand pretense-in-others have been explained in terms of the maturation of a specialized 'theory of mind mechanism' (ToMM). According to the theory of ToMM, an early competence is embodied in a pre-structured representational system that provides the child with a domain-specific and probably modular learning device. The existence of such a specialized learning device explains how a preschool child is able to attend to and thus learn about mental states and their causes (Leslie, 1994). For 'continuity theories' such as ToMM, the failure of 3-year-olds on false belief tasks is to be understood in terms of performance limitations of various kinds which prevent or attenuate the deployment of an inherent competence. This pinpoints one major area of disagreement between these two positions: whether the failure of 3-year-old children on false belief tasks is the result of conceptual deficit or the result of a performance squeeze.

Just as 3-year-old failure on some varieties of false belief task is a key finding for theory-shift views, so 3-year-old success on other varieties of false belief task is an important finding for continuity theories. A number of false belief task formats have now been devised in which 3-year-olds show heightened success compared with the 'standard' scenarios (e.g. Freeman & Lacohée, 1995; Mitchell & Lacohée, 1991; Roth & Leslie, 1991, 1998; Wellman & Bartsch, 1988; Zaitchik, 1991). Such findings strengthen the hypothesis, derived from learnability arguments and from evidence of early understanding of pretending and desiring, that 3-year-olds have a basic conceptual competence in regard to the concept 'believing'.

Proponents of the theory-shift view seek to explain 3-year-old false belief successes on a variety of grounds, including being the result of experimental artefacts, of the child employing *ad hoc* 'processing strategies', or of the child patching his inappropriate theory with 'auxiliary hypotheses' (e.g. Perner, 1989, 1991; Gopnik, 1993; Gopnik & Wellman, 1995). For the theory-shift view, 3-year-old's greater success on non-standard false belief tasks are false positives. In contrast, continuity theories claim that, with respect to conceptual competence, 3-year-old's failures represent false negatives. To make empirical progress on this issue, we need to be able to understand how the children's competence interacts with their available general processing resources. This interaction will in turn be affected by the variations in general problem solving demands made by different task formats. In short, we need to develop a task analysis (Leslie, 1994; Leslie & Polizzi, 1998; Roth & Leslie, 1998).

If we had a map of the cognitive architecture of the child at, say, 3 years old, we could attempt to specify precisely what the various loads placed on the processing components are in the course of cognizing a particular task. This would give us a theoretically motivated analysis of the general problem solving requirements of that task. We could then study a given task structure in relation to various conceptual contents. This, in turn, would lead to a deeper understanding of cognitive architecture in relation to conceptual development. Regardless of which theoretical position one wishes to defend, such theoretical models are badly needed, because, even if the child does develop and employ 'theories', the child is still required to process information.

Siegal & Beattie (1991) proposed that the failure by the 3-year-old on standard false belief tasks was related to limitations in their pragmatic skills. In essence, the 3-year-old fails to 'get the point' when the experimenter asks the crucial test questions. They found that when the prediction question, 'Where will Sally look for her marble?', was made more explicit by the inclusion of the single word 'first,' 'Where will Sally look *first* for her marble?', 3-year-olds performed significantly better. This is an interesting finding because if this minimal difference in a standard false belief task can impact on 3-year-old performance, then it supports the assumptions of continuity theories. In order to succeed in this way, 3-year-olds would have to have access to the concept 'belief'. We would of course still have to understand why 3-year-olds require this extra 'pragmatic' help and 4-year-olds do not, and we would still have to understand how processing a standard false belief task changes developmentally such that 4-year-olds do not need the word 'first' in order to succeed.

However, before concluding that children's successes with the 'look first' version of the test question are in fact true positives we need to rule out the use of *ad hoc* strategies that do not access the concept 'belief'. One possibility, for example, is that children may simply hear 'Where marble first?' and point to the first location the marble occupied. In this case, the children will be scored as correct without ever considering Sally's belief. A second possible strategy that younger children may use is more sophisticated but still does not require calculating Sally's belief. Perhaps children's attention is drawn to the idea that there will be a *first* look and therefore presumably a second or later look too. Why should there be later looks unless the first look fails? Where can Sally make a failing look? In the empty location, of course. Following this strategy, children will again point to the correct location but for the wrong reasons—they will 'pass' the task without ever considering Sally's belief.

There have been puzzling failures to replicate this finding using slightly different questioning (e.g. Clements & Perner, 1994; see Siegal, 1996 for discussion), so in our first experiment we simply wished to see if we could replicate Siegal & Beattie (1991) by using a standard Sally and Anne type task (Baron-Cohen, Leslie & Frith, 1985). Siegal & Beattie used Wellman & Bartsch's (1988) Explicit False Belief task framed in short vignettes such as the following: 'Jane wants to find her kitten. Jane's kitten is really in the playroom. Jane thinks the kitten is the kitchen.' They then asked the modified question: 'Where will she look first for her kitten?' It is important to guard against false positives in this task, and Siegal & Beattie (1991) did so in their second experiment by presenting a true belief control task such as: 'Jane wants to find her kitten. The kitten lives in two rooms: the garage and the lounge. Jane thinks her kitten is in the garage and now it really is in the garage. Where will Jane look first for her kitten?' If children interpret the 'look first' question as generically implying that they should give an answer different from the real location then they should have responded correctly to the false belief task but not to the true belief task. They instead had comparable rates of success in both tasks.

In order to guard against false positives, we included a control group of children who heard a story in which Sally does not leave before Anne changes the location of the object but instead remains and watches throughout and then leaves. So now Sally has a true belief regarding the location of the object. If children follow the strategy of answering where the object was first, they will indicate the empty location in both conditions, a response which is correct in the false belief version but wrong in the true belief version. Likewise, if children follow the strategy of answering where a look will fail, they will indicate the empty location in both conditions, again a response which is correct in the false belief version but wrong in the true belief version. The pattern of responding on the true belief version then can give us an estimate of the rate of false positive responding in the false belief version. We also included two groups of children who were tested under similar conditions on the same false belief and true belief tasks, minus the crucial word 'first'. These groups allowed us to compare performance of similar aged children on both tasks in standard form.

To summarize, in Expt 1 we manipulated both the type of instructions (look first test question versus standard test question) and the agent's exposure to the critical change in location of the desired object (see condition vs. not see condition). The first manipulation was aimed at checking for false negatives in the responses to a standard false belief test question. The second manipulation allowed us to check for false positives in children's correct responses to the look first question.

EXPERIMENT 1

Method

Subjects

Seventy 3-year-olds participated (mean age, 3 years 9 months; range, 3 years 5 months to 4 years 0 months). They attended nursery schools serving working- and middle-class communities in northern London. They were tested individually in a quiet room of their school and randomly assigned to one of four conditions. In the 'see' condition we tested 18 children on the standard question (mean age, 3 year 10 months) and 14 children on the look first question (mean age, 3 years 9 months); in the not see condition we examined 20 subjects on the standard question (mean age, 3 years 9 months) and 18 on the look first question (mean age, 3 years 10 months). The mean ages in the four groups were similar ($F(3,66) < 1.0$).

Procedure

The standard 'Sally/Anne story' introduced by Baron-Cohen, Leslie & Frith (1985) was used as the false belief task in this experiment. In the original version, Sally places her marble in her basket and then she leaves the scene. Anne transfers the marble from the basket to a box. At this point the story differed slightly for children assigned to the see condition and those assigned to the not see condition.

About one-half of the children ($N = 38$) received the story in the original version (not see condition) and the remaining children received the story in the control version (see condition), identical to the previous one except for the fact that Sally witnessed the change in location of the marble before leaving the scene. The child was finally asked where Sally will look for her marble on her return. The question was either in the standard form: 'Where will Sally look for her marble?', or in the explicit form: 'Where will Sally look *first* for her marble?'. In each condition, about one-half of the children were asked the look first question ($N = 36$) and the others were asked the standard question.

Results

All children tested completed the task and their answers were included in the analyses. In the not see (i.e. false belief) condition 15 out of 18 children (83%) passed the look first question, but only 6 out of 20 (30%) passed the standard question (Upton's $\chi^2 = 10.61$, $p < .01$, two-tailed). By contrast, in the see condition, 15 children out of 18 (83%) passed the look first question and 14 out of 14 (100%) passed the standard test question (Fisher exact, n.s.). Thus, whereas results in the see (i.e. true belief) condition showed similar rates of success following the two types of questions, in the not see (false belief) condition the results showed a significantly higher success rate with the look first question compared to the standard think question.

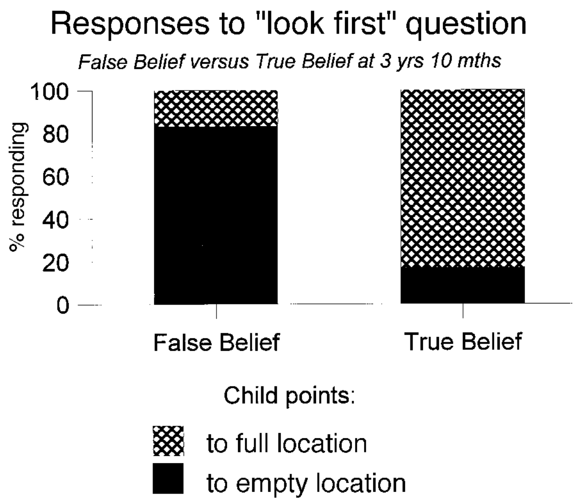

Figure 1. When asked to predict where the protagonist will look *first*, 3-year-old children respond differently depending upon whether the protagonist's belief is true or false. Only in the case of the false belief, do children indicate the first and now empty location, ruling out low-level strategic responding.

When looked at *by response*, instead of pass/fail, most subjects pointed to the empty location when asked a look first question in the false belief condition. In the true belief condition, most subjects pointed to the full location (Upton's $\chi^2 = 15.56$, $p < .002$, two-tailed). This is shown graphically in Fig. 1.

Discussion

The rates of success found in the present study replicate the results reported by Siegal & Beattie (1991). In their Expt 1, which included only a false belief task, they reported 71% correct responses with the look first question and only 30% correct responses with the standard question. In their Expt 2, which compared a false belief task with a true belief task, correct performance was as follows: in the false belief task, 83% with the look first question, and 41% with the standard question; in the true belief task, 83% with the look first question and 92% with the standard question (for a replication see Siegal & Peterson, 1994).

It is unlikely that by asking a look first question we pushed our subjects into an *ad hoc* response strategy which did not consult the protagonist's belief. We found virtually opposite responses depending upon whether the protagonist had seen the switching of the object's location or not. The child's response to the look first question was sensitive to the belief status of the protagonist.

In Expt 1 we examined children only toward the end of their third year. Although only 30% of these children passed our standard task, it is possible that these children were on the cusp of passing and that the look first question will only help children who are on the cusp. In Expt 2 therefore we studied a group of younger children. We also incorporated two further design changes to which we now turn.

Because of the possibility of perseveration effects with young children (see, for example, Freeman, Lewis & Doherty, 1991; Expt 1), it is unwise to give to the same child both the explicit and the implicit versions of the action prediction question. Yet it would be ideal to test the benefits of a look first question using a within-subjects design, so that we could be sure that a given individual both fails the standard question and passes the look first question. To achieve this end, we adopted the following method. We presented a standard Sally and Anne task using the 'think' question (Where does Sally *think* the object is?). Following the think question, we asked the reality and memory control questions. Finally, we asked the look first prediction question. At the time that we ask the think question, the task is entirely standard. We are then able to change the nature of the task by asking a look first question right at the end. We interpose the two control questions to avoid or reduce the possibility of perseverative responding or hostile questioning. This allows us to compare a standard and a look first task using a within-subjects design.

The second design change made was to investigate the performance of a group of autistic children. Following Baron-Cohen *et al.* (1985), numerous studies have demonstrated a selective 'theory of mind' impairment in children with autism relative to other clinical groups matched for general intellectual ability and relative to normally developing 4-year-olds (for reviews see Baron-Cohen, 1995, Happé, 1995*a*, and Leslie & Roth, 1993). These results have been used as support for theories that postulate specialized neurocognitive machinery for 'theory of mind' abilities.

In Expt 2, we have two specific aims in studying autistic children. First, it allows us to examine further the question of false positives on look first tasks. Any *ad hoc* strategies available to normally developing 3-year-olds should also be available to older autistic children. Therefore, if non-belief calculation strategies underlie 3-year-olds' success on look first tasks, then autistic children should also achieve success by the same means. Secondly and more importantly, the majority of both 3-year-olds and children with autism fail standard false belief tasks. But do they fail for the same reasons? To date there is but a single published study (Roth & Leslie, 1991) suggesting that autistic children are also impaired on understanding of false belief when compared with 3-year-olds. The comparison of normal 3-year-olds and children with autism on look first false belief tasks is of great theoretical interest and impacts on both our understanding of normal development and our success in identifying the core psychological deficits in autism.

If children with autism and normal 3-year-olds fail standard false belief tasks for similar reasons, then we should expect facilitation in both groups when they are given the look first question. Alternatively, if, as claimed by the metarepresentational theory (Baron-Cohen *et al.*, 1985; Leslie, 1987), children with autism have a conceptual impairment while normal 3-year-olds do not, then, unlike the 3-year-olds, the autistic children will *not* benefit from the look first question.

The comparison of normal 3-year-old children and children with autism addresses the issue of the cognitive mechanisms underlying both successes and failures in theory of mind tasks. We compared the performance of children with autism on the false belief look first question with (a) their own performance on the standard think question and (b) with normally developing 3-year-olds' performance on think and look first questions. If the look first effect is artifactual, increased success should be found in both groups of children. Alternatively, if success reflects availability of the concept belief, then young normal children will show a benefit while older autistic children will not. We can thus test the claim that, although children with autism and 3-year-olds both fail standard false belief tasks, they do so for different reasons.

EXPERIMENT 2

Method

Participants

Forty normally developing 3.5-year-olds participated. An additional seven normally developing children were rejected for failing to answer control questions correctly. Twenty-one children and adolescents who attended special schools for autistic disorder were also tested and who, according to medical records, had received a diagnosis of autism from a qualified clinician according to standard DSM-IIIR criteria (American Psychiatric Association, 1987; Rutter, 1978). The current status of the autistic children was confirmed informally with their teachers using a checklist derived from DSM-IIIR. These children would also have met DSM-IV (American Psychiatric Association, 1994) criteria for autism. The level of intellectual functioning of the autistic subjects was assessed by the British Picture Vocabulary Test (BPVT). Three of the autistic children had age equivalence scores between 3 : 8 and 4 : 0, the rest had verbal mental ages of 4 : 0 or above. All of the autistic children completed the study and passed controlled questions. Table 1 shows the background variables of subjects.

Table 1. Participants' background variables

	Chronological age (years:months)	Verbal Mental Age (BPVS)
Normal (N = 40)	Mean 3:4 Range 3:0–3:8	
Autistic (N = 21)	Mean 13:8 Range 7:10–18:7	7:4 3:8–18:11

Procedure

Children were tested individually in a quiet room of their school. We used the false belief story previously used with autistic subjects by Leslie & Thaiss (1992; Expt 1) but modified by the addition of a look first question. The child is shown a male doll, Billy, a ball and three pieces of toy furniture: a bed, a dressing-table and a toy-box. The child is told that Billy has a ball, which he puts on the dressing-table. Billy then goes downstairs for breakfast. While Billy is away his mother comes into the room, picks up the ball and puts it in the toy-box. The child was then asked a series of questions in fixed order:

Know question:	'Does Billy know where the ball is?'
Think question:	'Where does Billy think the ball is?'
Memory question:	'Where did Billy put the ball in the beginning?'
Reality question:	'Where is the ball now?'
Look first question:	'When he comes back, where is the *first* place Billy will look for his ball?'

Results

The pattern of results in normal children follows the pattern found in Expt 1. Thirteen children out of 40 (32.5%) passed the standard think question, whereas 23 (57.5%) passed the look first question. McNemar's change test revealed that normal children were significantly more likely to pass the look first question while failing the standard think question than the reverse (Binomial, p = .006, one-tailed) (see Table 2). The results for the autistic children on the standard think question were highly similar to the results for normally developing children around 3 years 4 months of age. Despite this, their results on look first were strikingly different. Eight out of 21 autistic children (38%) passed the standard think question and only six (28.6%) passed the look first question; no child with autism passed the look first question and failed the think question. Unlike young normal children, children with autism did not find look first easier than think. On the think question, autistic children performed like the young 3-year-olds (Upton's $\chi^2 = 0.19$, n.s.), whereas on the look first question, autistic performance was significantly poorer (Upton's $\chi^2 = 4.55$, $p = .017$, one-tailed).

Table 2. Performance on standard think question versus look first question in Expt 2

Group	Pass think and look first	Pass only think	Pass only look first	Fail think and look first
Normal young 3-year-olds (N = 40)	11 (27.5%)	2 (5.0%)*	12 (30.0%)*	15 (37.5%)
Autistic children (N = 21)	6 (28.6%)	2 (9.5%)	0	13 (61.9%)

[a] McNemar Binomial, N = 14, x = 2, p = .006, one-tailed

Twenty-two normal children (55%) passed the know question; 11 of them passed the know question and failed the think question whereas only 2 showed the reversed pattern. Thus, the know question proved easier than the standard think question (McNemar Binomial, $p = .011$, one-tailed). Considering only children who passed the know question, we found that eight of them passed the look first question but failed the think question and one showed the reversed pattern (McNemar Binomial, $p = .02$, one-tailed). Thus, the greater difficulty of the standard think question compared with the look first question remained even when only children that responded correctly to the know question were considered. Among the autistic subjects, 11 (52%) passed the know question, a similar result to Leslie & Frith (1988). Of these know passers, eight passed think and six passed look first; two autistic children passed think only, none showed the opposite pattern (n.s.). There was no evidence among know-passing autistic subjects that look first was easier than think.

Discussion

Normally developing subjects changed their answers from the think to the look first questions. It is unlikely that this was due simply to repeated questioning. First, the forms of the questions were different. Secondly, the children all passed two interposed control questions that required different answers. Thirdly, in a recent study, task order effects were examined in children performing both a standard appearance/reality task and the 'trick' task, a facilitated false belief task framed as a deceptive game (Rice, Koinis, Sullivan, Tager-Flusberg & Winner, 1997). Rice *et al.* reported a task order effect impacting the standard task, such that children gave more correct responses to the standard task when it was performed after the trick task. By contrast, there was no impact on the trick task when the standard task was given first. This result suggests that performing correctly in a simplified task can improve subsequent performance on a standard task, but performing a standard task has no significant subsequent effect on a simplified task.

Our autistic subjects' performance on understanding know and think was similar to that of our young 3-year-olds. Despite this, they showed a different pattern in their responses to look first. Whereas the look first question helped the normally developing children, it had no impact on the autistic subjects. This suggests that normally developing 3-year-olds and older autistic children fail false belief tasks for different reasons.

GENERAL DISCUSSION

In two experiments, we found that asking a look first question heightened the success rate of children who were otherwise too young to pass a standard false belief task. We controlled for possible false positives in two ways. First, we employed a control task in which the protagonist has full knowledge of the location of the object. The children show that they are sensitive to the epistemic status of the protagonist by responding differently to the look first question when the protagonist's belief is true than they do when the protagonist's belief is false. Secondly, we tested a group of children with autism. The children with autism failed to benefit from the look first question, suggesting that when autistic children fail false belief tasks they do so for different reasons from normally developing 3-year-olds. Taken together, our results support the idea that the look first modification results in a task which better measures genuine false belief competence in normally developing 3-year-olds than does the standard task.

There are a large number of studies which have demonstrated a specific 'theory of mind' impairment in childhood autism when compared to normally developing 4-year-olds. An important theoretical question which has hitherto hardly been addressed is whether or not autistic children are impaired relative to 3-year-olds (Leslie & Roth, 1993). The question arises because, of course, normally developing 3-year-olds and older children with autism both fail standard 'theory of mind' tasks. Do they fail for the same underlying reasons? The answer to this question has implications for understanding both the neuropsychology of autism and the neuropsychology of normal 'theory of mind' development. Until recently, there has been only a single published study which has addressed this question, namely, Roth & Leslie (1991) who found striking differences between the performance of 3-year-olds and older autistic subjects on a modified false belief task. Roth & Leslie (1998) have recently presented data showing further differences between 3-year-olds and autistic subjects on 'theory of mind' tasks. Our present results extend these findings and suggest that, despite many similarities with young preschoolers on 'theory of mind' performance, nevertheless important differences in 'theory of mind' abilities exist between autistic children and normally developing children of *any* age.

Three-year-old competence: Fact or fiction?

There is, at present, one published failure to find higher success on the look first question as compared to the standard question (Clements & Perner, 1994). The procedure in that study differed in a number of important aspects from Siegal & Beattie's study. Children were told a story featuring a mouse that, because of lack of exposure to a critical event, was holding a false belief about the location of a piece of cheese. Then they were given an anticipation prompt ('I wonder where he's going to look?') followed by the action prediction question in either the standard form ('Which box will he open?') or the look first form ('Which box will he open first?'). They found no significant difference in the success rates: 36% and 32%, respectively.

Clements & Perner (1994) pointed out that while Siegal & Beattie (1991) used an explicit false belief task (Wellman & Bartsch, 1988), in which the child was explicitly informed about the false belief of the agent, they used an inferred false belief task, consisting of a story about events that lead the protagonist to hold a false belief. In the latter case, according to Clements & Perner, the child is given a less demanding task because he is presented with information concerning how the mental state of the character came about. By contrast, in the explicit false belief task, no justification was given for the protagonist's confused state. They argued that children can benefit from the look first question only in the explicit false belief tasks because then the look first question helps them to construct the experimenter's interpretation of the vignettes. In our Expt 1, however, we used an inferred false belief task and found a significant improvement with the look first question. Our results therefore cast doubt on the explanation proposed by Clements & Perner.

An alternative explanation for Clements & Perner's failure to replicate the 'look first effect' is that their procedure included repeated questioning with very similar questions

(Siegal, 1996). The child was presented first with an anticipation prompt ('I wonder where he's going to look?'), and then with an action prediction question ('Where will she look first?'). This sequence of questions may suggest that the answer to the second question should be different from the answer given to the first question. Given that 3-year-olds' reactions to the first question (as revealed by the direction of their gazes) were predominantly correct, they may have been induced to give a different, and thus incorrect answer to the second question. However, the experimental design did not vary question order and therefore we cannot empirically evaluate this possibility.

The results of Expt 1 provide further evidence that the look first effect is not artifactual and that the correct answers to the look first question are likely to be true positives. Such results agree with those of a number of previous studies showing that 3-year-olds' competence on mental states concepts are underestimated by standard false belief tasks (Appleton & Reddy, 1996; Freeman, Lewis & Doherty, 1991; Freeman & Lacohée, 1995; Lewis, 1994; Mitchell & Lacohée, 1991; Roth & Leslie, 1991, 1998; Saltmarsh, Mitchell & Robinson, 1995; Sullivan & Winner, 1991; Zaitchik, 1991).

Freeman *et al.* (1991) found that most 3-year-olds pass a false belief test when this is framed in a familiar hide-and-seek script. Lewis (1994) showed that most 3-year-olds pass a false belief task provided that the story is told to them twice before asking the test question. A related facilitation was also reported by Appleton & Reddy (1996) who reported that talking through some videotapes showing false belief tasks helped 3-year-olds to achieve success in theory of mind tasks. Mitchell & Lacohée (1991) demonstrated the significant effect of giving young children a concrete representation (a picture) of the content of past situations that were critical to calculate false beliefs in the test question.

High success rates in 3-year-olds have also been obtained by framing the false belief tasks in deceptive games (e.g. Sullivan & Winner, 1993; Chandler & Hala, 1994; but see Sodian, 1994 for a critical perspective). Most 3-year-olds succeed also on tasks strictly related to false belief tasks, such as appearance reality tasks, when they are presented as deceptive games (Rice *et al.*, 1997) and correctly distinguish lies from mistakes (Siegal & Peterson, 1996). Roth & Leslie (1991) showed that, unlike children with autism, 3-year-olds readily attributed false beliefs to participants in a deceptive conversation (see also Zaitchik, 1991). Roth & Leslie (1998) show further differences between normally developing 3-year-olds and autistic children, with the 3-year-olds showing both greater and qualitatively different competence on modified false belief tasks.

Our results join a growing body of evidence that 3-year-olds in fact possess the concept 'belief', though the restricted circumstances under which they can successfully demonstrate their competence shows the fragility of their use of this concept, a fragility that most certainly requires explanation. With regard to the present results, it is hard to see why the concept of 'prelief', as described by Perner (1995), should be sensitive to the epistemic status of the protagonist, and if it be insisted that it is, then belief and prelief appear to be a distinction without a difference.

Why are 3-year-olds and children with autism limited in different ways?

Ascribing 3-year-olds' difficulties in theory of mind tasks to limitations in conversational skills is theoretically important because it is in contrast with a prediction derived from the 'theory-shift' view, namely, that the concept belief can only become available to the child via his construction of the 'representational theory' of belief.[1] However, it does not provide us with an account of the cognitive mechanisms that underlie the child's behaviour, and therefore it is not a sufficient psychological explanation. What are the cognitive processes underlying conversational skills? What develops when conversational skills develop? Pointing out a limitation in conversational skills leaves unspecified which cognitive processes or representational competencies are the source of children's limitations. There are important benefits from trying to provide a more explicit cognitive account of limitations in communicative skills (Surian, 1995; Surian, Baron-Cohen & Van der Lely, 1996). For example, suppose that a significant source of pragmatic difficulties is the effective deployment of attentional or executive function resources. If this is the case, then it makes little sense to pit an attention or executive function deficit hypothesis against a pragmatic deficit hypothesis.

Ozonoff, Pennington and Rogers (1991) reported an association between executive functions deficits and theory of mind performance in children with autism, which can suggest that impairment of one skill may be secondary to impairment of an other. To say that the deficit in mental state attribution is not functionally primary, but is secondary to a deficit in executive functions implies that performance factors rather than limitations on metarepresentational competence are responsible for failures on theory of mind tests (Hughes & Russell, 1993). The present study suggests that this may be the case for the failure of normal 3-year-olds, but not for children with autism (Leslie & Roth, 1993; Leslie & Thaiss, 1992).

Consistent with the present study are the findings of Prior, Dahlstrom & Squires (1990) who presented children with autism with two action prediction tasks (the 'Sally/Anne task' and an equivalent task with people rather than dolls) and an unexpected content false belief task similar to the familiar 'smarties task'. In the action prediction task, children were asked the look first question, whereas in the unexpected content task, they were asked a standard false belief question about what another person will think there is in the box. Children with autism performed somewhat better than is usually reported in the literature in all tasks (about 50% of them gave correct answers), probably due to sampling effects (see Happé, 1995*b*). Note however that, as in the present study, no advantage was found for performance on the look first question as compared with the standard questions. Unlike normal 3-year-olds (and brain damaged patients, see Siegal, Carrington & Radel, 1996), the performance of children with autism in theory of mind tasks is not improved by using explicit test questions.

Our results support a two-factor model, such as the ToMM-SP model (Leslie, 1994; Leslie & Polizzi, 1998; Leslie & Roth, 1993; Leslie & Thaiss, 1992; Roth & Leslie, 1998; see also Saltmarsh, Mitchell & Robinson, 1995, and Carlson, Moses, & Hix, 1998, for related ideas). In this model, one set of mechanisms (ToMM) is primarily responsible for the conceptual competence that is specific to theory of mind, namely, the attitude concepts, while another set of mechanisms (the selection processor) provides the processing resources required for solving tasks with the particular problem structure found in

[1] For this reason, we find it hard to reconcile the view of Clements & Perner (1994) that children around the third birthday have an 'implicit' concept of belief with Perner's (1991, 1995) view that belief can *only* be understood by grasping an explicit representational theory of mind. The Clements & Perner finding suggests, in line with the assumptions of the ToMM model, that such theorizing on the part of the child is not in fact necessary for concept possession.

standard 'theory of mind' tasks. According to the model, normally developing 3-year-olds have an intact conceptual competence but are limited in their processing resources, whereas children with autism have sufficient processing resources but an impaired conceptual competence.

The essential idea behind 'selection processing' is that, in belief attribution, belief contents that are true are attributed *by default*. In a false belief task, the default true-content is highly salient but gives the wrong answer and therefore needs to be *inhibited*. Only if the true-belief content can be successfully inhibited can the correct non-factual content be selected. Leslie & Polizzi (1998) offer a detailed model with some supporting evidence. According to the model, younger children are less able to maintain the necessary inhibition. Task manipulations which render the true-belief and false-belief contents more nearly equal in salience will demand correspondingly less powerful inhibition and will aid the young child. We hypothesize that the look first question does exactly this, perhaps by calling attention to the first location or to the possibility of a failing look to the first location. Directing attention in this way has an effect (on the belief attribution) that is sensitive to the protagonist's knowledge, as our first experiment showed. Thus, the look first question seems to increase the salience of one possible content for the protagonist's belief, namely, one which refers to the first location. If this is so, there will be a correspondingly reduced need for inhibition, making the task easier for younger children. This, in turn, may be the mechanism whereby the young child better grasps what the questioner is 'getting at'. Further research will be required to substantiate the possible link between the effect of the look first question and selection processing.

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References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders*, 4th ed. Washington DC: APA.

Appleton, M. & Reddy, V. (1996). Teaching three-year-olds to pass false belief tests: A conversational approach. *Social Development*, 5, 275–291.

Baron-Cohen, S. (1995). *Mindblindness: An essay on autism and theory of mind*. Cambridge, MA: MIT Press.

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

Carlson, S.M., Moses, L.J. & Hix, H.R. (1998). The role of inhibitory processes in young children's difficulties with deception and false belief. *Child Development*, 69, 672–691.

Chandler, M. & Hala, S. (1994). The role of personal involvement in the assessment of early false belief skills. In C. Lewis & P. Mitchell (Eds), *Children's early understanding of mind: Origins and development*, pp. 403–425. Hove: Lawrence Erlbaum.

Clements, W.A. & Perner, J. (1994). Implicit understanding of belief. *Cognitive Development*, 9, 377–395.

Fodor, J.A. (1992). A theory of the child's theory of mind. *Cognition*, 44, 283–296.

Freeman, N.H & Lacohée, H. (1995). Making explicit 3-year-olds' implicit competence with their own false beliefs. *Cognition*, 56, 31–60.

Freeman, N.H., Lewis, C.N. & Doherty, M. (1991). Preschoolers' grasp of a desire for knowledge in false belief prediction: Practical intelligence and verbal report. *British Journal of Developmental Psychology*, **9**, 139–158.

Gopnik, A. (1993). How we know our minds: The illusion of first-person knowledge of intentionality. *Behavioral and Brain Sciences*, **16**, 1–14.

Gopnik, A. & Wellman, H.M. (1995). Why the child's theory of mind really *is* a theory. In M. Davies & T. Stone, (Eds), *Folk psychology: The theory of mind debate*, pp. 232–258. Oxford: Blackwell.

Happé, F.G. (1995*a*). *Autism: An introduction to psychological theory*. Cambridge, MA: Harvard University Press.

Happé, F.G. (1995*b*). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development*, **66**, 843–855.

Hughes, C. & Russell, J. (1993). Autistic children's difficulty with mental disengagement from an object: Its implications for theories of autism. *Developmental Psychology*, **29**, 498–510.

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

Leslie, A.M. (1994). Pretending and believing: Issues in the theory of ToMM. *Cognition*, **50**, 211–238.

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

Leslie, A.M. & Polizzi, P. (1998). Inhibitory processing in the false belief task: Two conjectures. *Developmental Science*, **1**, 247–254.

Leslie, A.M. & Roth, D. (1993). What autism teaches us about metarepresentation. In S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds), *Understanding other minds: Perspectives from autism*, pp. 83–111. Oxford: Oxford University Press.

Leslie, A.M. & Thaiss, L. (1992). Domain specificity in conceptual development: Neuropsychological evidence from autism. *Cognition*, **43**, 225–251.

Lewis, C. (1994). Episodes, events, and narratives in the child's understanding of mind. In C. Lewis & P. Mitchell (Eds), *Children's early understanding of mind: Origins and development*, pp. 457–480. Hove: Lawrence Erlbaum.

Mitchell, P. & Lacohée, H. (1991). Children's early understanding of false belief. *Cognition*, **39**, 107–127.

Ozonoff, S., Pennington, B.F. & Rogers, S.J. (1991). Executive function deficits in high-functioning autistic individuals: Relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, **32**, 1081–1105.

Perner, J. (1989). Is "thinking" belief? Reply to Wellman and Bartsch. *Cognition*, **33**, 315–319.

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

Perner, J. (1995). The many faces of belief: Reflections on Fodor's and the child's theory of mind. *Cognition*, **57**, 241–269.

Perner, J., Baker, S. & Hutton, D. (1995). Prelief: The conceptual origins of belief and pretense. In C. Lewis and P. Mitchell (Eds), *Children's early understanding of mind: Origins and development*. Hove: Lawrence Erlbaum.

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

Prior, M., Dahlstrom, B. & Squires, T. (1990). Autistic children's knowledge of thinking and feeling states in other people. *Journal of Child Psychology and Psychiatry*, **31**, 587–601.

Rice, C., Koinis, D., Sullivan, K., Tager-Flusberg, H. & Winner, E. (1997). When 3-year-olds pass the appearance-reality test. *Developmental Psychology*, **33**, 54–61.

Roth, D & Leslie, A.M. (1991). The recognition of attitude conveyed by utterance: A study of preschool and autistic children. *British Journal of Developmental Psychology*, **9**, 315–330.

Roth, D. & Leslie, A.M. (1998). Solving belief problems: Toward a task analysis. *Cognition*, **66**, 1–31.

Rutter, M. (1978). Language disorder and infantile autism. In M. Rutter and E. Schopler (Eds), *Autism: A reappraisal of concepts and treatment*, pp. 85–104. New York: Plenum.

Saltmarsh, R., Mitchell, P. & Robinson, E. (1995). Realism and children's early grasp of mental representation: Belief-based judgements in the state change task. *Cognition*, **57**, 297–325.

Siegal, M. (1996). Conversation and cognition. In R. Gelman & T. Au (Eds), E.C. Carterette & P. Friedman

(Gen. Eds), *Handbook of perception and cognition: Volume 13. Perceptual and cognitive development*. San Diego: Academic Press.

Siegal, M. & Beattie, K. (1991). Where to look first for children's knowledge of false beliefs. *Cognition*, **38**, 1–12.

Siegal, M., Carrington, J. & Radel, M. (1996). Theory of mind and pragmatic understanding following right hemisphere damage. *Brain and Language*, **53**, 40–50.

Siegal, M. & Peterson, C.C. (1994). Children's theory of mind and the conversational territory of cognitive development. In C. Lewis and P. Mitchell (Eds), *Children's early understanding of mind: Origins and development*, pp. 427–455. Hove: Lawrence Erlbaum.

Sodian, B. (1994). Early deception and the conceptual continuity claim. In C. Lewis & P. Mitchell (Eds), *Children's early understanding of mind: Origins and development*, pp. 385–401. Hove: Lawrence Erlbaum.

Sullivan, K. & Winner, E. (1991). When 3-year-olds understand ignorance, false belief and representational change. *British Journal of Developmental Psychology*, **9**, 159–172.

Sullivan, K. & Winner, E. (1993). Three-year-olds' understanding of mental states: The influence of trickery. *Journal of Experimental Child Psychology*, **56**, 135–148.

Surian, L. (1995). Children's ambiguous utterances: A re-examination of processing limitations on production. *Journal of Child Language*, **22**, 151–169.

Surian, L., Baron-Cohen, S. & Van der Lely, H. (1996). Are children with autism deaf to Gricean maxims? *Cognitive Neuropsychiatry*, **1**, 55–71.

Wellman, H.M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.

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

Zaitchik, D. (1991). Is only seeing really believing? Sources of true belief in the false belief task. *Cognitive Development*, **6**, 91–103.

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