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Children's inferences from 'knowing' to 'pretending' and 'believing'

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Three studies investigated children's ability to draw inferences from the properties of one mental state to the properties of another. Inferences from knowledge/ignorance to the possible contents of pretends and beliefs are crucial to developing a representational theory of mental states. In Experiment 1, we replicated Lillard's (1993) finding that 4- and 6-year-olds fail to appreciate that a character who does not know about an entity cannot pretend to be that entity. We show that these children also fail a similar task in which the inference to be made is from not knowing to thinking (false belief). Lillard's inference tasks may be difficult because of their performance demands—specifically, children are not offered a plausible alternative content for the agent's pretence or belief state. In a second experiment, children were presented with know–pretend and know–think inference tasks which offered two options for the content of a character's mental state. One option was consistent with that character's knowledge state, while the other was not. Under these conditions, 4- and 6-year-old children's performance improved significantly on both pretend and think. A third experiment investigated the role of the salience of the character's ignorance and the possible use of an association strategy in producing successful performance in Experiment 2. When the salience of the character's ignorance was reduced, children still succeeded on know–pretend inferences but failed on know–think inferences. These results suggest that children do not really grasp the theory of mental representation. The results better support the ToMM-SP model of 'theory of mind' development. According to this model, concept possession is prior to, and therefore does not depend upon, knowledge of theories, and task success depends upon the control of salience.

The function of 'theory of mind' ability is to provide interpretations of the behaviour of agents in terms of their cognitive properties (Leslie, 1994b). It is widely agreed that this ability requires possession of mental state concepts such as 'belief', 'desire' and 'pretend'. A major topic of debate over the last 15 years has been how to account for the acquisition of these concepts. Where do these highly abstract concepts come from and

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what is the relation between concepts of mental states and knowledge about mental states? Since Leslie (1987) introduced the idea that pretence is part of the child's 'theory of mind,' much discussion has focused on the early capacity for pretend play, which emerges between 18 and 24 months of age in the normally developing child. Under Leslie's model of 'theory of mind' development, the ability to engage in pretence together with the ability to recognize pretence in other people depends upon the mental state concept 'pretend' (Leslie, 1987, 1988, 1994a, 2000). Accordingly, this concept must be available very early. An alternative view is that children's earliest interpretation of pretence does not involve the attribution of mental states; instead, pretence is interpreted only as a special kind of action, namely, 'acting as if' something were the case when it is not (Lillard, 1993, 1996, 1998; Perner, 1991).[1]

Concepts and the theory-theory

The contrasting views presented above reflect differences concerning the nature of abstract concepts. According to the Lillard–Perner view, abstract concepts depend crucially upon knowledge, in particular upon knowledge of common-sense 'theories'; such a view is often called the 'theory-theory' of concepts. To the theory-theorist, early possession of the mature concept 'pretend' seems highly dubious. The reasons for this are as follows. Theory-theory argues that possession of the 'pretend' concept is really possession of special knowledge, namely, knowledge of the representational theory of mind. In order to possess the 'pretend' concept by their second birthday, children would already have to have knowledge of that theory. However, knowledge of the representational theory will also yield the concept 'belief'. Extensive evidence shows that children do not consistently solve false belief tasks until 4 years of age (see e.g. Wellman, Cross, & Watson, 2001). According to current theory-theory, this is critical evidence, showing that the representational theory of mind only develops around 4 years of age. Therefore, children younger than this, because they do not grasp the representational theory, must lack any and all the concepts that depend upon it, including 'pretend'.

It is important to realize that the problem that early pretence poses for theory-theory is not that it implies concept innateness. Leading theory-theorists often concede that some highly abstract concepts are probably innate and even that some highly abstract concepts must be innate (e.g. Gopnik & Meltzoff, 1997; see also Carey, 1985), Why, for the theory-theorist, couldn't 'pretend' simply be different from 'believe' in that the former is innate and the latter acquired? The answer is again because, according to theory-theory, the possession of abstract concepts depends critically upon possession of knowledge of theories. The only way that 'pretend' could be innate is if knowledge of the theory it depends upon—the representational theory—is innate. But that is ruled out by the evidence on 'believe'. The only remaining alternative is that younger children have a quite different theory of pretence and consequently have a quite different concept than 'pretend'. Therefore, even though younger children engage in pretence and recognize pretence in other people, they cannot really possess the concept 'pretend'. That

[1] More recently, Perner (e.g. Perner, 1995; Perner, Baker, & Hutton, 1994) has argued that pretence *is* initially understood as a mental state, specifically, as an undifferentiated pretence-belief state which he calls 'prelief'. In certain respects, this moves Perner's position much closer to Leslie's.

is, despite appearances, they do not have the concept that adults have because they do not really understand pretence as a representational mental state. And so, following Perner (1991), Lillard proposes that, instead, younger children only understand pretence behaviourally as a type of action. And, again for that reason, they lack the adult concept, 'pretend'.

Each step of the theory-theorist's argument depends on the assumption that concept possession depends upon knowledge and, specifically, on the assumption that the concepts 'pretend' and 'believe' each depend upon knowledge of the representational theory. If these assumptions are rejected, or even questioned, it is possible to agree on much of the current developmental data and yet reach quite different conclusions.

Concepts and the ToMM model

Leslie's model of pretence assumes a radically different view of concepts. In this view, rather than depending upon knowledge, concepts may exist prior to knowledge. This may be particularly useful for the early developing abstract concepts. A concept, e.g. 'cause' (Leslie & Keeble, 1987) or 'pretend' (Leslie, 1987), serves principally to pick out and designate a specific property in the environment, allowing attention selectively to that property. Rather than always depending upon knowledge, concepts can depend upon mechanism. Specialized cognitive mechanisms can allow attention to go to specific properties or sets of properties. For example, the mechanisms of colour vision allow colours to be attended and thus allow colour concepts to be grounded without knowledge of a theory of colour. According to Leslie's approach, this general idea can be extended to non-sensory concepts, and even to highly abstract concepts. For example, the 'Michotte module' allows young infants to attend to causes and effects, grounding the concept 'cause' without infants knowing anything about what causes really are (Leslie & Keeble, 1987). But once the child can selectively attend to the property in question, the child can have thoughts about that property, make observations about that property and, most importantly, can begin to learn things about that property.

The principal developmental role of a concept in Leslie's view, then, is to allow the child to attend to a specific property in the environment so that it becomes possible to learn things specifically about that property—under what circumstances it occurs, its typical consequences and accompaniments, and so forth. What is necessary for concept possession within this framework is not having a prior theory concerning the nature of that property but simply a mechanism that allows the relevant property to be specifically and reliably dealt with. In the case of mental state concepts, Leslie and colleagues (Baron-Cohen, 1995; Frith & Frith, 1999; German & Leslie, 2000; Leslie, 1987, 1991, 1994a, 1994b, 2000; Leslie & German, 1995; Leslie & Roth, 1993; Leslie & Thaiss, 1992; Roth & Leslie, 1998) have developed the idea of a specialized 'Theory of Mind Mechanism' (ToMM) which has the job of attending to other people's mental states. If anything, a representational theory of mind is a consequence of possessing concepts like 'pretend' and 'believe' not a prerequisite. In short, according to this view of concepts, theory-theory puts the cart before the horse. For more extensive discussion, see Leslie (in press).

The ToMM model postulates the existence of a specialized neurocognitive mechanism that begins to mature during the second year of life (but see Leslie, 1994b, for earlier

manifestations). On present knowledge, the normal development and maturation of neural systems appears to require a mixture of genetic specification plus certain kinds of inputs both endogenously generated and external (Crowley & Katz, 1999; Katz & Shatz, 1996). Though nothing is known in this regard, ToMM is probably no exception to this rule. Leslie (1987, 1994a, 1994b, 2000) has proposed that a chief psychological function of ToMM is to allow the young brain to attend to the mental states of agents. In this service, ToMM makes available a set of specialized concepts, the 'informational relations'. It seems likely that the initial size of the conceptual space is limited to 'want', 'pretend', 'know' and 'believe', plus some others having to do with perceiving and saying.

Of these early-appearing mental state concepts, 'pretend' and 'believe' have attracted the most controversy. In the context of the studies to be reported, we highlight below two aspects of the ToMM model of how these concepts develop.[2]

First, as we have seen, concepts are not assumed to depend inherently upon knowledge. Therefore, attributing a concept to a child does not entail attributing a particular piece of knowledge to the child. This has been a continuing source of confusion for theory-theorists when discussing the ToMM model. For example, Hickling, Wellman, and Gottfried (1997) write,

> Consider Leslie's ... position that young children *view* pretence not only as mentalistic and subjective ... but also as representational ... [A] representational understanding of pretence requires recognizing that pretenders mentally depict the world in a particular fashion ... [and] [t]hus, with a representational understanding, children would *know* that pretence aims at a fictional depiction not intended to capture reality at all faithfully, whereas belief aims to depict faithfully ... (p. 350; italics added).

However, Leslie's position is not, and never was, that young children possess knowledge of the theory that pretence is a 'mentalistic, subjective, representational' state. Fortunately, children do not need to know all that in order to pretend, recognize pretence in other people, or possess the concept 'pretend'. Indeed, if they did need to know all this, then they would also need to possess the concepts 'mentalistic', 'subjective' and 'representational'. And how would they acquire those concepts?

Of course, we agree that pretence is, as a matter of fact, a mentalistic, subjective, representational state. However, one doesn't need to know this to have the concept 'pretend'.[3] It is likewise perfectly true that water is H_2O, but one doesn't need to know that to have the concept 'water'. Recognizing that very young children would not plausibly know much or anything about pretence, Leslie (1987) made a more modest proposal in which a specialized mechanism underlies young children's ability to pretend and to recognize pretence in other people. The mechanism allows the child to attend to

[2] Some commentators have faulted the ToMM model for ignoring development. For example, Riggs and Mitchell (2000) write, '... a problem with [the ToMM] account is that it says nothing about *developmental* mechanisms (beyond maturation of modules)' (p. 5). However, as far as we know, there are only two known 'developmental mechanisms', namely, maturation and learning, both of which are assigned roles in the ToMM model.

[3] It certainly would not help to 'know' that pretence is aimed at 'fictional depiction', even if the child had the concept 'fictional depiction,' because often pretence involves a 'faithful depiction' (Leslie, 1987, 1994a).

and represent those states and thus to begin to learn things about those states; perhaps even, eventually, to learn esoteric things, like the 'representational theory of mind'.

The second point we want to highlight is that determining the child's representational power (competence) requires us to carefully study the child's processing power (performance). Learning is always the result of the interaction between competence, performance and, of course, environmental exposure. We have been investigating this interplay in regard to solving false belief problems through studying an executive function we call 'selection processing' (SP) (German & Leslie, 2000; Leslie, 1992, 1994b; Leslie & Roth, 1993; Leslie & Polizzi, 1998; Leslie & Thaiss, 1992; Roth & Leslie, 1998). According to the ToMM-SP model, children require more than simply the concept 'believe' in order to pass false belief tasks. For one thing, they must also reach certain levels of ability in necessary performance factors. Together with others (e.g. Carlson, Moses, & Hix, 1998; Cassidy, 1998; Mitchell, 1994; Russell, Mauthner, Sharpe, & Tidswell, 1991), we have suggested that the salience of the actual state of affairs taxes children in false belief tasks. In particular, the SP model says that success in false belief situations requires an ability to inhibit making the default attribution of a true belief. But such an ability emerges only gradually through the pre-school period. Before this inhibitory ability has developed sufficiently, it is difficult for the child to attend successfully to false belief situations for the simple reason that they will appear to the child to be true belief situations. This, in turn, diminishes the child's ability to learn about false beliefs and the circumstances in which they occur.

However, in the ToMM-SP model, the door is left open to learning about false beliefs because, unlike Wellman's (1990) proposed 'copy theory' concept, the concept 'believe' does not actually rule out the possibility that beliefs can be false. Furthermore, there will be occasional naturally occurring situations (akin to simplified false belief tasks) in which inhibitory demands are reduced and in which the child will succeed in attributing a false belief. As the child's powers for successful 'selection processing' increase, so will the number of situations in which the child successfully attends to the false belief. Eventually, the child can be vigilant for the occurrence of false beliefs and project hypotheses about their causes and consequences. As Roth and Leslie (1998) put it, the false beliefs in situations will begin to 'pop out'. No prior 'representational theory of mind' is required.

'Theory of mind' and the study of concepts

The child's 'theory of mind' provides an intriguing opportunity to study the larger issues concerning the nature of abstract concepts. A central tenet of current theory-theory approaches to mental state concepts is that the mature representational theory is not acquired until around 4 years of age when the child first reliably passes standard false belief tasks. As we saw, this means that, despite appearances, the younger child cannot possess the concept 'pretend' because, like 'believe', 'pretend' can only be possessed by grasping the representational theory of mental states. Whatever concept of pretence the younger child does hold, it must be a different concept from the adult concept because, according to this view, the adult concept is crucially based on the representational theory of mind. Lillard reasoned that this implication of representational theory-theory could be tested in a new way. She examined whether children, old

enough to understand 'knowing' and 'not knowing', appreciated the implications of ignorance for attributions of pretence. For example, if someone has a complete lack of knowledge about, say, rabbits, including the knowledge even that there are such things as rabbits, then how could that person represent 'rabbits' in the content of a pretend? Because they could not, such a person could never pretend to be a rabbit. If a child appreciates the fact that ignorance constrains pretend contents, it would, according to Lillard's analysis, show that the child employs a representational theory of pretence. Alternatively, if a child does not understand this, then it would mean that the child lacks a representational theory of pretence. Thus, Lillard extended the theory-theory approach in an interesting way by pointing out that it entails that the child be able to make certain inferences from one mental state to another, namely, from knowing to pretending.

Lillard further hypothesized that if children did not have a representational understanding of pretence, then they would have to understand pretence merely as action. To test the action hypothesis, Lillard (1993) presented 4- and 5-year-olds with a story in which a character (from another planet) did not know anything about rabbits but was nevertheless jumping up and down 'like a rabbit'. Children were asked whether the character was pretending to be a rabbit. Most children responded that the character was indeed pretending to be a rabbit, ignoring his lack of knowledge (Lillard, 1993). Furthermore, their performance was worse on this task than on a standard false belief task (Perner, Leekam, & Wimmer, 1987), prompting Lillard (1993, p.375) to suggest that understanding 'pretence' as mental representation lags behind understanding 'belief' as mental representation.

Other tasks have also cast doubt on whether the child understands that pretence is a representational mental state. Perner *et al.* (1994) required participants to decide whether a character, acting as if a rabbit was in a hutch when there was no rabbit there, was pretending that the rabbit was there or really believed that the rabbit was there. When the character knew the rabbit was absent, the children were required to attribute pretence; when the character did not know the rabbit was absent, the children were required to attribute (false) belief. Three-year-old children were typically unable to draw the required distinctions.

Ignorance and theory-theory: does 'pretence' lag 'belief'?

The findings above suggest that it is important to distinguish the processes required for children to engage in and to recognize pretend play which emerge around 24 months (Harris & Kavanaugh, 1993; Leslie, 1987, 1988, 1994a) from later developing knowledge about pretence. Specifically, the ability to recognize pretence in other people and to infer the content of their pretence may not require an understanding of the relationship between ignorance and pretence. This is compatible with the ToMM view of pretence in which the relationship between ignorance and pretence may be one of the many things about pretence the child has to learn.

Within the framework of the representational theory-theory, however, an appreciation of the role of ignorance has a fundamental role. What a person can or will mentally represent is constrained by what they know. In the standard false belief task, Sally represents the marble as being in the basket because she does not know it is in the box.

Lillard's task pushes this 'logic' one step further by introducing a character who has never encountered or heard of a particular kind of thing (e.g. rabbits) and therefore has no knowledge whatsoever regarding such things, including no knowledge even that such things exist.[4] The character's ignorance precludes him from representing rabbits and thus from pretending about rabbits. Failure to appreciate this relationship between ignorance and pretence is thus evidence that the child does not assimilate pretence within a representational theory.

This line of reasoning raises the puzzle of why a representational understanding of pretence should lag that of belief. If the representational theory is induced by general learning mechanisms, as is generally assumed (Gopnik & Meltzoff, 1997; Perner, 1991), then why should the theory be induced only from belief states and not from pretence? The much greater salience of pretend play over belief states makes this all the more puzzling.

One possibility is simply that Lillard's conclusions are wrong. Recently, there have been reports that young children do interpret pretence as a mental state (as opposed to merely action). Custer (1996) presented 3- and 4-year-old children with a task in which they were required to choose which of two 'thought bubbles' depicted the content of various mental states (pretending, believing and memory). One picture showed the real state of affairs and the other depicted an appropriate mental state content. Four-year-olds performed well for all the story types, while the 3-year-olds performed well only for the pretend and memory tasks. In a similar vein, Bruell and Woolley (1998), report several experiments suggesting that 4-year-olds understand that the contents of two individuals' pretends can be different, despite their performing the same action. In addition, when children were provided with the additional support of thought bubbles; a procedure first used by Wellman, Hollander, and Schult (1996), similar results were obtained from 3-year-old children (see also Joseph, 1998). Hickling *et al.* (1997) and Cassidy (1998) have shown that 3-year-olds can successfully attribute a false belief to another person when the content of the false belief concerns another person's pretence.

However, all of the above studies show only that children appreciate that pretence behaviour has mental content (and therefore counts as mental state rather than mere behaviour). The data are not sufficient to show that children understand pretence as mental representation. Important additional features are required for understanding 'mental representation' as opposed to understanding 'mental state with content'. For example, mental representations are distinguished by their form as well as by their content; two people could have a mental representation of the same cat sitting on the same mat, but this content might be represented by a mental image in one case and by a sentence in the other. Although they would have the same belief by content, these two people would have different mental representations. See Leslie and Thaiss (1992) and Perner (1991) for discussions of this distinction in the context of 'theory of mind' research.

Lillard's pretend task differs from these other studies in that it requires children to draw an inference from one mental state to another. Specifically, children are required to

[4] This is not a trivial demand to place on children, who have been shown to find it difficult to quarantine their real world knowledge for certain kinds of reasoning (e.g. Dias & Harris, 1990; Scott, Baron-Cohen, & Leslie, 1999). We are grateful to Michael Siegal for drawing this to our attention.

infer from what a character does not know to what that character cannot pretend. Her findings suggest that children may begin relatively late, at 6 years old or more, to understand that ignorance constrains pretence by limiting the mental representations a person may form. From the point of view of theory-theory, such a finding is important because it indicates that the representational theory of pretence, and possibly the entire representational theory of mind, is not grasped until much later than is generally believed.

Lillard's studies have been restricted to know–pretend inferences. Her conclusion that the concept 'PRETEND' lags the concept 'BELIEVE' is based on comparing two very different sets of tasks: know–pretend inferences vs. standard false belief. Before accepting this conclusion, it is important to compare the two concepts within identical task structures. We therefore began (Experiment 1) by directly comparing know–pretend inferences with know–believe inferences using tasks with the same inference structure, based on Lillard (1993). In two further experiments, we examined possible performance and pragmatic demands inherent in these cross-state inference tasks.

EXPERIMENT 1

Children were given tasks requiring an inference between two mental states. One group was asked to solve know–pretend inference tasks modelled on Lillard (1993, Expt 1). A second group was asked to solve closely matched know–think inference tasks, involving an inference from what a character knows to what a character might believe. Performance on both inference tasks was compared with performance on a standard test of false belief (Perner *et al.*, 1987). We expected performance on the know–pretend inference task to replicate the findings of Lillard (1993, Expt 1), with children failing to infer from what a character does not know to what they cannot pretend. Because the know–think inference was tested with the same task structure, we also expected children to have difficulty with know–think.

Method

Participants

The participants in this experiment were 64 children, recruited from schools serving a range of socio-economic backgrounds in Colchester, Essex, UK. A further four children were excluded for failing control questions twice. There were 32 older 4-year-olds randomly assigned to a Pretend condition (eight boys and eight girls, mean age 4:10, range 4:6–5:1) and to a Think condition (seven boys and nine girls, mean age 4:9, range 4:1–5:1). There were also 32 6-year-olds, randomly assigned to the Pretend condition (ten boys and six girls, mean age 6:3, range 5:11–6:8) and to the Think condition (nine boys and seven girls, mean age 6:3, range 5:11–6:9).

Tasks and design

Children in both mental state conditions were each given four inference tasks followed by a 'standard' false belief task (Perner *et al.*, 1987). Children in the Pretend condition received tasks identical to the tasks presented in Lillard (1993, Expt 1). Children were shown a small human doll and were told: 'This is Sally. Sally knows what a rabbit is. Look, she's pretending to be a rabbit.' Sally was made to hop up and down across the table in front of the children. Sally was put away and the children were introduced to a small troll doll and told: 'This is Luna. Luna comes from a far-off land. Luna's never seen a rabbit and she's never heard of one either. Luna doesn't know what a rabbit is. Look Luna's hopping up and down

like this.' The troll doll was made to hop up and down exactly as the human doll had. Children were then asked a control question: 'Does Luna know what a rabbit is?' They were then asked the test question: 'Is Luna pretending to be a rabbit?' Finally, children were asked to justify their response: 'Why do you think that?'

Two of the pretend tasks involved 'self-pretend', where a character pretends to be something (hopping/rabbit and swooping/bird), while the other two involved the character pretending that some object was another object (pretending a pen was a train and pretending a box was a castle). The tasks were presented in one of two orders. Half the children received one Self-pretend task, followed by two Object-pretend tasks and then the final Self-pretend task (SOOS). The remaining children received the tasks in the opposite order (OSSO). There were also two possible contents for the pretend. For example, half the children received stories where the character hopped and were asked whether she was a rabbit, while for the other half of children the character hopped and the children were asked whether she was a kangaroo. For the swooping/bird, pen/train and box/castle tasks the other contents were plane, truck and den respectively.[5]

Children in the Think condition received Think tasks modelled on the Pretend inference tasks. Children were shown an opaque container (e.g. a bag) and told: 'Look, there's a rabbit in this bag. It's hopping up and down.' The bag was made to hop up and down across the table in front of the children. The children were then introduced to a small troll doll and told: 'This is Luna. Luna comes from a far-off land. Luna's never seen a rabbit and she's never heard of one either. Luna doesn't know what a rabbit is. Luna sees the bag hopping up and down, like this.' The bag was once again made to hop up and down. Children were then asked a control question: 'Does Luna know what a rabbit is?' They were then asked the test question: 'Does Luna think that there's a rabbit in this bag?' Finally, children were asked to justify their response: 'Why do you think that?'

Two of the Think tasks involved evidence of the content in the form of movement/action on the part of the container; the rabbit story described above and a task involving a cage covered with a cloth which shook back and forth and was described as containing a bird. Another task involved evidence in the form of sound. An opaque box was described as containing a motorbike and was made to make 'engine' noises. The final Think task involved no evidence; a different opaque box was simply described as containing an apple.

As for the Pretend tasks, the order of presentation and specific contents of the mental state were counterbalanced across children. There were two presentation orders: half the children received the first action story, followed by the sound story and the no evidence story and finished with the other action story (ASNA), while the other half received a different order (SAAN). The alternative mental state contents, received by half the children, were a kangaroo (for the hopping bag), a hamster (for the moving cage), a car (for the 'engine noise' box) and an orange (for the silent box).

Children in either condition who failed the control question were corrected; the experimenter told them again that Luna hadn't seen or heard of a rabbit and didn't know what a rabbit was. The control question was then repeated. Repetition was required for nine children who then passed. A further four children failed a second time and were excluded and replaced.

The false belief task was a standard deceptive box task (Perner *et al.*, 1987), where the participants were introduced to a familiar box of sweets (Smarties) and asked to say what was inside. After their response, they were shown the true content (a pencil) and then, with the box closed again, were asked the test question: 'When you first saw this box, before we opened it, what did you think was inside?', followed by a control question: 'What's inside here really?'

Materials

The materials for the pretend tasks were two small dolls, one boy and one girl, and two small troll dolls, one with blue hair and one with yellow hair. Children heard all stories about dolls introduced as the same sex as they were. A small box (10× 8× 6 cm), and a yellow highlighter pen served as the objects in the Object-pretend tasks. The same trolls were used for the think tasks, along with two different small boxes (approx. 10 × 8 × 6 cm; 14 × 10 × 8 cm), a wire cage (13 × 12 × 7 cm), a piece of cloth, and a

[5] Two possible pretend contents were included here to allow comparison with Expt 2.

cloth bag, fastened with a rubber band. For the false belief task, a 'Smarties' tube containing a pencil was used.

Procedure

Participants were tested individually in a quiet corner of their classroom. They were told that they would hear some stories about people who might be pretending (or thinking) certain things, and would be asked some easy questions about the stories. They were then introduced to the first doll and the first task commenced. The children heard the four inference tasks in one of the two orders, and under the counterbalancing measures described above. After the inference tasks the participants were presented with the false belief task. They were then thanked for their participation.

Results

Preliminary analyses

Children were scored correct on a given story if they predicted the content of the character's mental state in line with that character's knowledge state. Children were required to deny that the character was pretending to be a rabbit (Pretend condition) or that the character thought there was a rabbit in the bag (Think condition). Preliminary analysis revealed that there was no difference between scores obtained on the Self-pretend stories and on the Object-pretend stories or on the various versions of the think inference task. These were therefore combined for all further analyses to yield a score between 0 and 4 for the four inference tasks. Submitting these data to an ANOVA showed no effects either of order of presentation or the specific pretend contents used (e.g. rabbit version vs. kangaroo version), and no interaction (all Fs < 1).

Main analyses

Table 1 shows mean scores by Condition and Age. Children's scores were analysed in a Condition (Pretend vs. Think) × Age (4-year-olds vs. 6-year-olds) ANOVA. Age was significant as a main effect ($F_{(1,63)} = 5.11$, $p < .05$). There was no effect of Condition ($F_{(1,63)} = 1.92$, $p > .5$) and no interaction ($F < 1$).

Table 1. Expt 1: Mean scores out of 4 (SDs in parentheses) and percentage of children passing (scoring 3 or 4 out of 4) according to age on know–pretend and know–think inference tasks

	Condition	
Age	Know–Pretend	Know–Think
4-year-olds	0.69 (1.25) 13%	1.13 (1.78) 25%
6-year-olds	1.50 (1.78) 31%	2.25 (1.95) 56%

The results were also analysed non-parametrically to assess performance against that expected by chance. The numbers of children scoring 0, 1, 2, 3 and 4 out of 4 were

tallied for children in each condition, at each age. On the Pretend tasks, 11 4-year-olds scored 0 out of 4, two scored 1 out of 4 and one each scored 2, 3 and 4 out of 4. This pattern is significantly worse than that expected by chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .625$, $p < .01$). Among 6-year-olds, seven children scored 0 from 4, four scored 1 from 4 and the remaining five scored 4 from 4. This pattern of responding is also significantly different from chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .432$, $p < .01$) although here there are significantly more children scoring both 0 and 4 from 4 than expected by chance. In the Think condition, 11 4-year-olds scored 0 from 4, one scored 2 from 4 and the remaining four scored 4 from 4, a pattern again that is significantly worse than that expected by chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .625$, $p < .01$). In the 6-year-old group there were six children who scored 0 from 4, one each scoring 1 and 3 from 4 and the remaining eight scored 4 out of 4. As with the analysis of the older children on the Pretend task, this pattern is significantly different from chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .438$, $p < .01$), with more children scoring both 0 and 4 from 4 than would be expected.

Adopting Lillard's (1993) criterion of 3 out of 4 tasks correct as a 'pass', Table 1 also shows the percentage of children passing the inference tasks by condition and age. Collapsing across conditions, performance improved with age (Upton's $\chi^2 = 4.58$, $p < .05$, two-tailed), although neither condition separately reached significance (Fisher's exact, $p > .05$). Collapsing across ages, performance did not differ significantly by condition (Upton's $\chi^2 = 2.58$, $p = .11$, two-tailed).

The inference tasks, in general, proved harder than standard false belief. In the 4-year-old group, one child passed both Pretend and false belief and four children failed both tasks. However, more passed standard false belief but failed Pretend than showed the opposite pattern (McNemar binomial, $N = 11$, $x = 1$, $p = .003$). For the Think task, this pattern was less clear, largely it appears because in this group, very few children passed false belief (only six from 16). Three children passed both tasks and nine children failed both. Again, among those who passed just one Think task, more 4-year-olds passed standard false belief and failed Think, although not significantly more (McNemar binomial, $N = 4$, $x = 1$, n.s.). In the 6-year-old group, five children passed both the Pretend task and false belief and four failed both. More children passed standard false belief while failing Pretend than showed the reverse pattern (McNemar binomial, $N = 7$, $x = 0$, $p = .008$). For the 6-year-olds in the Think condition, nine children passed both the Think inference task and false belief and none showed the reverse pattern. Again, more passed standard false belief while failing the Think inference (McNemar binomial, $N = 7$, $x = 0$, $p = .008$).[6]

Children's justifications were examined for references to the protagonist's knowledge state (i.e. a judgment of not pretending or not thinking justified with 'because he doesn't know what a rabbit is . . .'). For the Pretend inference, one of the two 4-year-old passers (50%) and all five 6-year-old passers (100%) offered at least one such justification. For the Think inference group, two from four passers at age 4 (50%) and seven from nine passers at age 6 (77%) did so.

[6] The chance of children passing the false belief task by unbiased guessing is 50%, while the chance of reaching the criterion of 3 or more correct tasks from 4 in the inference task is only 32% (binomial theorem). However, standard false belief was still easier on an analysis using the more lax criterion of 2 or more from 4 (chance passing = 68%, binomial theorem).

Discussion

We replicated Lillard's (1993) finding that, even at 6 years old children perform poorly on a know–pretend inference task. We extended these findings to a know–believe inference and found that, in this case too, children who pass standard tests of false belief typically failed the know–believe task. When assessed by these inference tasks, 6-year-olds' understanding of both pretence and belief is marginal.

These findings suggest, somewhat surprisingly, that passing standard false belief tasks may not mean that a child has understood either 'pretending' or 'believing' as a representational mental state. A number of theorists have argued that the representational nature of mental states must be understood in order to pass standard false belief tasks (Gopnik, 1996; Gopnik & Wellman, 1992, 1994; Perner, 1995). However, Lillard has argued that the results of knowledge inference tasks show that pretending is understood by 4- and even by 6-year-olds merely as 'acting-as-if' rather than as a mental state. Extending that argument to our know–think results, we would have to conclude that, even in middle childhood, children understand 'belief' simply as 'acting-as-if' and not as a mental state. If a child does not understand that belief is necessarily constrained by knowledge, then the child cannot understand belief as mental representation. If the possibilities are exhausted by the alternatives 'belief as representation' and 'belief as acting-as-if', then we will have to choose the latter. On the other hand, if we believe there is a 'middle way' for 'pretence', namely, 'mental state with content', then perhaps there is a middle way for belief too in which the child understands belief as an attitude to a content (Leslie & Thaiss, 1992). But before we consider these arguments further, we should examine the performance demands of the knowledge inference task.

An alternative task structure for knowledge inference tasks

Knowledge inference tasks require children to conclude that an agent who is observed doing something, is not doing something (e.g. Moe by hopping up and down like a rabbit is not pretending to be a rabbit, nor pretending anything). Children may be indisposed to deny the only premise offered by the questioner. This makes the task, as it stands, pragmatically awkward. It would be more natural to offer the child a choice between two equally plausible contents for the character's pretending. Given equal background readiness for either possible answer, children might show that they can take the knowledge state of the agent into account.

In the case of the story character, who knows nothing of rabbits, but is jumping up and down like a rabbit, we can ask whether he is pretending to be a rabbit or pretending to be a kangaroo. Children know that rabbits hop and they also know that kangaroos hop, so the character's hopping does not lead exclusively to a wrong answer. Moreover, children can answer the question in a way consistent with the character's action, rather than being required to answer in a way that leaves the behaviour unexplained. Likewise, if there might equally be a kangaroo or a rabbit in the bag, then we can ask whether the character thinks there is a kangaroo or thinks there is a rabbit in the bag. Children can answer this question without being required to say the character is not thinking anything at all. In the next experiment, we tested whether providing an alternative response facilitated correct inferences between mental states. We modified the previous

tasks so that they contained plausible response alternatives. We predicted that children under these circumstances would constrain their attributions of belief and pretence contents to be consistent with the character's knowledge.

EXPERIMENT 2

Method

Participants

Sixty-four children recruited from schools serving a range of socio-economic backgrounds participated. A further six children were excluded for failure to answer control questions on the second attempt. There were 32 older 4-year-olds assigned randomly to the Pretend condition (eight boys and eight girls, mean age 4:9, range 4:6–5:0) and to the Think condition (nine boys and seven girls, mean age 4:10, range 4:3–5:1). There were also 32 6-year-olds, randomly assigned to the Pretend condition (nine boys and seven girls, mean age 6:4, range 5:11–6:10) and the Think condition (nine boys and seven girls, mean age 6:3, range 5:11–6:9).

Tasks and design

Children in both mental state conditions were presented with four inference tasks followed by a standard false belief task (Perner *et al.*, 1987). The new tasks were identical to those in Expt 1 up until the point of the test question. The test question included two possible contents for the protagonist's mental state. For example, in the Pretend tasks children were asked: 'Is Luna pretending to be a rabbit or is she pretending to be a kangaroo?' In the Think tasks, the test question included two possible contents for the protagonist's belief about the bag's content: 'Does Luna think there's a rabbit in the bag or does she think there's a kangaroo?'

The same counterbalancing precautions were used as in Expt 1. In addition, the order of the alternatives provided in the test question was counterbalanced, so that half the children heard the alternatives in one order (e.g. 'Is Luna pretending to be a rabbit or pretending to be a kangaroo?') and the other half were asked the question in the reverse order of disjunction.

The false belief task was the standard deceptive box task described for Expt 1.

Materials and procedure

The materials and procedure were the same as described for Expt 1.

Results

Preliminary analyses

Children were scored correct on a given story if they predicted the character's mental state in line with that character's knowledge state. For example, if presented with a character who knew nothing about rabbits, children were required to choose the alternative content for that character, i.e. to choose 'pretending to be a kangaroo' (Pretend condition) or 'thinks there is a kangaroo in the bag' (Think condition). Preliminary analysis showed no difference between scores obtained on the Self-pretend stories and on the Object-pretend stories or for the varieties of the think inference task. Children's scores across stories were collapsed for further analysis, yielding a score between 0 and 4 for the four tasks. There were no effects of order, the specific contents of

the mental states, or the order in which the alternatives were offered in the test question, as well as no interactions between these factors (highest $F_{(1,63)} = 2.70$, $p > .1$).

Main analyses

Table 2 shows the mean scores obtained by Condition and Age. Scores were analysed in a Condition (Pretend vs. Think) × Age (4-year-olds vs. 6-year-olds) ANOVA. No significant effects were found (largest $F_{(1,63)} = 1.75$, $p > .15$).

Table 2. Expt 2: Mean scores out of 4 (SDs in parentheses) and percentage of children passing (scoring 3 or 4 out of 4) according to age on know–pretend and know–think inference tasks

	Inference task	
Age	Know–Pretend	Know–Think
4-year-olds	2.75 (1.61) 69%	2.56 (1.67) 56%
6-year-olds	3.25 (1.29) 75%	3.06 (1.44) 81%

As in Expt 1, we compared children's performance with the pattern expected by chance. The numbers of children scoring 0, 1, 2, 3 and 4 out of 4 were tallied for children in each mental state condition, at each age. On the Pretend tasks, three 4-year-olds scored 0 out of 4, one each scored 1 and 2 out of 4, three scored 3 out of 4 and the remaining eight scored 4 out of 4. This pattern is significantly better than that expected by chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .438$, $p < .01$). Among 6-year-olds, one child scored 0 from 4, one scored 1 from 4, two scored 2 from 4, one scored 3 from 4 and the remaining 11 scored 4 from 4. This pattern of responding falls only marginally short of being significantly better than chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .313$, critical value for $p \leqslant .05 = .328$). In the Think tasks, three 4-year-olds scored 0 from 4, two each scored 1 and 2 from 4, one scored 3 from 4 and the remaining eight scored 4 from 4, a pattern that is again significantly better than that expected by chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .625$, $p < .01$). In the 6-year-old group there were two children who scored 0 from 4, one scoring 1 from 4, four scoring 3 from 4 and the remaining nine who scored 4 out of 4; again a pattern significantly better than that expected by chance (Kolmogorov–Smirnoff, $N = 16$, $D_{max} = .500$, $p < .01$).

Again, Lillard's (1993) criterion of 3 out of 4 tasks correct was used. Table 2 also shows the percentage of children passing the inference tasks by condition and age using this criterion. Non-parametric analyses confirmed the previous findings. Collapsing across conditions, there was no effect of age (Upton's $\chi^2 = 1.84$, n.s.). Collapsing across ages, there was no difference between conditions (Upton's $\chi^2 = 0.07$, n.s.).

Performance on the modified inference tasks was compared with performance on the

standard false belief task. Unlike Expt 1, children did not find the knowledge inference tasks harder than standard false belief (McNemar binomials, all *ps* > .1).[7]

Finally, passing children's justifications were examined for references to the protagonist's knowledge state, as in Expt 1 (e.g. justifications of judgments of pretending to be a kangaroo in terms of the character not knowing about rabbits). For the Pretend tasks, six from 11 passers (55%) justified at least one of the tasks this way at age 4 years, while 11 from 12 (92%) did so at age 6 years. In the Think task, the frequencies were five from nine (56%) and 10 from 13 (77%) for 4- and 6-year-olds, respectively. The proportions of passers appropriately justifying their answers were similar to those observed in Expt 1 (though the absolute numbers of passers are higher in Expt 2).

Cross-experimental comparisons

Experiments 1 and 2 were designed so that the tasks differed only in whether the test questions did or did not offer alternative contents for the character's pretence and belief. Our expectation was that providing an alternative would lead to better performance on knowledge inference tasks. Because we established an effect of age (6-year-olds > 4-year-olds) but no effect of condition (Pretend inferences = Think inferences) in Expts 1 and 2, a limited ANOVA model was used to test for the effect of Experiment (No alternative contents provided vs. Alternative contents provided) and for the Experiment × Age interaction. The effect of Experiment was highly significant ($F_{(1,127)} = 28.52$, $p < .001$). There was also a significant interaction between Experiment and Age ($F_{(2,127)} = 3.69$, $p < .05$), reflecting more improvement in performance with alternative contents provided in the younger children. Analysis of the simple main effects revealed a significant effect of the experiment at both levels of the age factor ($F_{(1,63)} = 19.74$, $p < .001$ at age 4 years, $F_{(1,63)} = 9.83$, $p < .005$ at age 6 years).

Discussion

So far we have found no evidence that the concepts, 'pretend' and 'believe,' differ with respect to knowledge inference. Whether or not an alternative content is offered, 4- and 6-year-old children perform the same way on knowledge inference tasks involving pretence and those involving belief. Children show markedly improved performance on knowledge inference for both pretence and belief when the experiment provides a plausible alternative content for the character's mental state. Neither experiment gave evidence that understanding of pretence lags understanding of belief.

The improved performance produced by offering an alternative content suggests that children's failure to draw a know–pretend inference in Lillard's (1993) task, and in Expt 1 for both know–pretend and know–think inferences, may be due to pragmatic factors. By not mentioning an alternative, the experimenter may unwittingly lock the child into a 'yes' answer. Children may be unwilling to deny the only content offered them by the experimenter or may be unwilling to leave unresolved precisely what the protagonist

[7] Again, the results are not changed by using a criterion of 2 from 4 (see footnote 3). In Expt 3 the mismatch between probabilities of passing false belief and the inference tasks by guessing is addressed by presenting children with the same number of trials in each task.

was supposed to be doing and why. Perhaps children simply chose the only interpretation on offer. When an alternative was offered, children of both ages preferred the alternative, bringing their performance into line with their performance on standard false belief tests. Finally, most of the children who succeeded were able to justify their response with reference to the character's knowledge state.

In the task protocols we have used so far, children were told, for example, that Luna has 'never seen a rabbit, has never heard of a rabbit, and does not know what a rabbit is'. The character's ignorance is repeatedly mentioned, making it a highly salient feature of the story. A number of writers have attributed a role to salience in children's processing of theory of mind tasks (e.g. Carlson *et al.*, 1998; Cassidy, 1998; Leslie & Thaiss, 1992; Mitchell, 1994; Roth & Leslie, 1998; Russell *et al.*, 1991). We therefore wished to examine the role of salience in knowledge inference tasks. We did this in the next experiment by making the character's ignorance less salient: asking, 'Can children still succeed with reduced salience?'

Another potential effect of repeatedly stressing the ignorance is that it may encourage the children to adopt an 'association strategy'. Children in Expt 2 were given no information to establish a positive association with the right answer, but were given information that might result in the formation of a negative association between the protagonist and the wrong answer. When children arrive at the test question offering a choice between Luna pretending to be a rabbit or pretending to be a kangaroo, the negative association, rather than an understanding of the know–pretend relationship, may bias children toward the correct responses.

We tested a possible role for salience by limiting information about the character's ignorance to a single statement. This should also have the effect of balancing any negative association by a single positive statement describing the character's action. We further examined the possible use of an association strategy in an additional condition that offered children an alternative response instead of an alternative content. Offering children an explicit negative response should facilitate an 'association strategy' if they are tempted to use one. Finally, we compared performance on know–pretend vs. know–think further by using a within-participants design.

EXPERIMENT 3

Method

Participants

The participants were 64 children recruited from two schools serving a range of socio-economic backgrounds. Eight children required a control question to be repeated, but none failed a second time. Thirty-two 4-year-olds were assigned to either an Alternative Response condition (eight boys, eight girls; mean age 4:7, range 4:0–4:11) or an Alternative Content condition (eight boys, eight girls; mean age 4:7, range 4:1–4:11). A further 32 6-year-old children were assigned either to the Alternative Response condition (eight boys, eight girls; mean age 6:6, range 6:0–6:11) or to the Alternative Content condition (eight boys, eight girls; mean age 6:7, range 6:0–6:11).

Tasks and design

Each child was presented with six tasks. There were two know–pretend inference tasks, two know–think inference tasks and two standard false belief tasks ('Sally and Anne' after Baron-Cohen, Leslie, & Frith

(1985) and 'Smarties' after Perner *et al.* (1987)). The inference tasks were based closely on the tasks used in Expts 1 and 2, but were modified to balance potential 'associations.'

First, Expt 1 stories were changed so that children were offered an alternative response but not an alternative mental state content (Alternative Response condition). We did this by asking: 'Is Luna pretending to be a bird or is she not pretending to be a bird?', explicitly mentioning the possibility that the protagonist might not be pretending anything. The reason for this was to allow for the possibility that any alternative in the test question might provoke children into adopting an association strategy. They then might be better able to associate 'not knowing' with the response 'not pretending' than with explicitly denying that any pretending is going on. The alternative response versions of the task thus control for the possibility that any alternative in the question will lead children to follow associations between the story elements and the various answers. Note that offering alternative responses alone will not remove the awkward pragmatics of the task; children might still find it difficult to resist the option of attributing pretence. Why, after all, would there be questions about pretending if pretending were not going on? If so, children will attempt to calculate the content of the agent's pretend and, since there is still only one (wrong) content on offer, they will fail.

Second, in the Alternative Content condition, we offered an alternative content as in Expt 2 but balanced the opportunity for the child to form 'negative' and 'positive' associations between the protagonist and the wrong answer. The know–pretend tasks were modified as follows. Rather than being told that 'Luna hasn't seen a bird, hasn't heard of birds and doesn't know what a bird is', children were now told only, 'Luna does not know about birds'. This single, 'negative' association was then matched by also telling the child explicitly that Luna was swooping 'like a bird', so that as in Lillard (1993, Expt 3), there was a positive as well as a negative association between Luna and the wrong answer. Children were then shown the swooping action again and asked a control question about Luna's knowledge before being asked the test question. In the Alternative Content condition, the test question was: 'Is Luna pretending to be a bird or is she pretending to be a plane?'

The know–think inference tasks were modified in the same way. In the Alternative Response condition, children were asked, 'Does Luna think there's a rabbit in the bag or does she not think there's a rabbit in the bag?' In the Alternative Content condition, children were told only that Luna did not know what a rabbit was, rather than the multiple description 'has never seen a rabbit, never heard of a rabbit and doesn't know what a rabbit is'. They were also shown the bag and told that it contained a rabbit, and were shown Luna watching the bag hop up and down. Thus, there were equally good reasons to associate the protagonist with either answer. Children were then shown the hopping bag again and asked a control question about Luna's knowledge about rabbits. Then children were asked the test question, 'Does Luna think there's a rabbit in this bag or does she think there's a kangaroo?'

The possible mental state contents in the pretend tasks were (1) Self-pretend: Luna 'swooping' and pretending to be a bird/plane and (2) Object-pretend: Luna 'driving' a pen up and down and pretending the pen was a car/truck. The know–think tasks involved (1) visual evidence: Luna saw a bag hopping and could believe it contained a rabbit or a kangaroo and (2) audible evidence: Luna heard engine noises from a box and has the option of thinking it contains a car or a motorbike.

The same counterbalancing measures as before were applied; the specific content of the pretend/belief, as well as the order of the alternatives in the test question were counterbalanced across children.

In the 'Smarties' deceptive box false belief task, children were asked first what was really in the box, before the belief question was asked. The Sally–Anne action-prediction false belief task followed the form described by Baron-Cohen *et al.* (1985). Children were introduced to Sally and told that she was going to go off for an outing with her mother and that she wanted to hide her ball until she got back. She leaves it in the cupboard and exits the scene. While she is away, Anne comes along and moves the ball from the cupboard to the basket. Children were asked where Sally hid her ball in the beginning and where it was now, before being asked the test question: 'When Sally comes back from her outing, where will she look for the ball?'

Children received their six tasks in one of two possible orders. All children received the two false belief tasks last (half in the order Sally–Anne then Smarties, half in the reverse order). Half the children received the Pretend inference tasks as a block (bird/plane then train/truck) followed by the Think inference tasks as a block (rabbit/kangaroo then car/motorbike). The other half received the reverse order.

Materials and procedure

A small troll doll was used, with all children hearing stories about dolls introduced as the same sex they were. The same bag and smaller box (10 × 8 × 6 cm) from Expt 2 were used for the Think inference tasks, while the Pretend tasks required the pen and the troll dolls. For the Sally–Anne false belief task two small dolls ('Sally' and 'Anne') were the protagonists, a small ball served as the bait, and a small wicker basket with a cloth 'lid' and a small wooden cupboard were the two locations. The Smarties task used the same materials as before.

With the exception of the details of task ordering discussed above, the procedure was the same as for Expts 1 and 2.

Results

Preliminary analyses

Each child was scored correct if they attributed a mental state content consistent with the protagonist's knowledge state. In the Alternative Response condition, a correct response was stating that the protagonist was not entertaining the particular mental state content on offer, while in the Alternative Content condition the correct response was to choose the alternative mental state content. The Sally–Anne task was scored correct if the child predicted search in the original location. The Smarties task was scored correct if the child correctly identified the previous incorrect belief. Each child thus received a score out of 2 for each of the know–pretend, know–think, and standard false belief blocks.

Performance on the false belief block was at or near ceiling for all children in both conditions, so we included only the results of the pretend and think inference tasks in the initial analysis. This revealed no order effects, either of the tasks (pretend first vs. think first) or alternatives in the test question, and no interaction (all $Fs_{(1,60)} < 1$).

Main analyses

Table 3 shows means for each group by Mental State (Pretend vs. Think) by Condition (Alternative Response vs. Alternative Content) and by Age (4 vs. 6 years). Children's scores were analysed by a Mental State (2) × Condition (2) × Age (2) ANOVA, with repeated measures on the first factor. This analysis revealed only a main effect of Condition ($F(1,60) = 9.83$, $p < .005$). Children performed better when an alternative mental state content was offered than when an alternative response was offered. No further F ratios reached significance though there was a trend for a Mental State × Condition interaction ($F_{(1,60)} = 3.13$, $p = .08$) reflecting better performance on Pretend than on Think in the Alternative Content condition.

Non-parametric analysis

In the Pretend tasks, children in the Alternative Content condition at both age 4 and 6 performed better than expected by chance ($p = .027$, binomial theorem, probability of eight or more children scoring 2 out of 2, where $N = 16$ and $p = .25$). Performance on the Think tasks was not as good. Only seven of 16 6-year-old children reached criterion in the Alternative Content condition ($p = .08$). In the tasks with alternative responses, the best performance was exhibited by the 6-year-olds on the Pretend inference

Table 3. Expt 3: Mean scores out of 2 (SDs in parentheses) and percentage passing (scoring 2 out of 2) by age and condition on know–pretend and know–think inference tasks

Age	Condition			
	Alternative Content		Alternative Response	
	Pretend	Think	Pretend	Think
4-year-olds	1.44 (0.73) 56%	1.19 (0.54) 25%	0.69 (0.60) 06%	0.94 (0.68) 19%
6-year-olds	1.63 (0.62) 69%	1.25 (0.77) 44%	1.13 (0.89) 44%	0.94 (0.77) 25%

(p = .08). Collapsing across age groups in the Alternative Content condition, more children scored higher on Pretend than on Think (McNemar binomial, N = 17, x = 3, p = .012, two-tailed). There were no differences between Pretend and Think in the Alternative Response condition.

Comparison with standard false belief

In both age groups, the Alternative Response versions of the inference tasks proved to be more difficult than the standard false belief tasks. Fifteen 4-year-olds and nine 6-year-olds scored higher on false belief than on know–pretend with no children at either age showing the opposite pattern (sign tests, $p < .002$ and $p = .004$ respectively, two-tailed). Similarly, 13 4-year-old children scored higher on false belief than on know–think with one child showing the reverse pattern (sign test, $p = .002$, two-tailed); 11 6-year-old children scored higher on false belief than on know–think with none showing the reverse pattern (McNemar binomial, $p < .002$, two-tailed).

Likewise, the Alternative Content inference tasks, though easier than Alternative Response tasks, were still harder than standard false belief. Seven 4-year-old children scored higher on false belief than on know–pretend while none showed the reverse pattern (sign test, $p = .016$, two-tailed) and 11 children scored higher on false belief than on know–think, with one child showing the reverse pattern (sign test, $p = .006$, two-tailed). In the 6-year-old group, five children scored higher on false belief than know–pretend while none showed the opposite pattern (McNemar binomial, $p = .064$, two-tailed); nine scored higher on false belief than on know–think while none showed the opposite pattern (sign test, $p = .004$, two-tailed). Unlike Expt 2, where performance on the Alternative Content versions of the knowledge inference tasks were in line with false belief, results here suggest that the modified inference tasks make stringent performance demands, and remain difficult even for school-aged children.

Discussion

When an alternative response but no alternative content was offered, most children failed knowledge inference tasks, even at 6 years of age. When an alternative mental state content was offered, performance generally improved. Although analysis of

variance found only a marginal interaction between condition and mental state, McNemar analysis of changes found that the 'pretend' tasks were easier than the 'belief' tasks. This departs from the previous two experiments which showed no difference between 'pretend' and 'think' on either analysis.

Taken together, these findings show that a series of performance factors continue to influence children's behaviour in 'theory of mind' tasks up to 6 years of age. If grasp of the representational theory of mind is what bestows conceptual competence, then children should have answered robustly across all conditions. Therefore, conceptual competence must have a quite different basis.

The scenarios in Expt 3 balanced negative and positive associations between the protagonist and alternative mental state contents. In addition, an explicit response alternative was offered in order to encourage and thus reveal any association strategy. However, with an alternative response option, most children failed the knowledge inference task and performance was similar to Expt 1 where no alternative was offered. Children did not appear to rely upon an association strategy. These results (for know–pretend inferences) are in line with recent work by Aronson and Golumb (1999), who also showed improved performance where alternative pretend contents were offered, and no specific effect of the balance between negative and positive associations between the story character and the alternative responses.

There are a number of other reasons for discounting the possibility that children adopt a strategy of answering test questions on the basis of 'associations' drawn between elements of the story task. In the standard false belief task, the character is 'positively associated' with the empty location and 'negatively associated' with (does not know about) the full location. Thus, if children's responses rely upon forming 'associations' rather than upon mental state concepts, then they should never fail this task. Second, in knowledge inference tasks, it is hard to see why an 'association strategy' would only lead children to prefer an offered alternative content but not to deny that the protagonist is pretending. Third, an association strategy seems unlikely in the know–think inference task because children are actually told that the bag contains a rabbit. This should lead the child to positively associate 'rabbit' with the character and counterbalance the 'negative association' provided by his lack of knowledge. Finally, in Expts 1 and 2, we found similar proportions of children who justified correct answers appropriately by reference to the character's ignorance, directly contradicting the use of an 'association strategy.'

While the evidence does not support an association strategy, the reduced emphasis we gave to the character's ignorance seems to have had an effect. With reduced salience, performance suffered, impacting 'think' more than 'pretend'. In standard false belief tasks, 3-year-olds often fail to note that the protagonist is ignorant of the new location of the target object. Roth and Leslie (1998) found that even in a task where over 90% of 3-year-olds did take note of ignorance, only 25% of these children correctly inferred the effect of that ignorance on behaviour. In the standard false belief task, ignorance of a particular fact is what constrains the protagonist to a false belief. In the present know–think tasks, ignorance of a generalization (the existence of a kind of animal) constrains the possible beliefs a protagonist might have. Our results show that even by 6 years of age, children have still not really grasped the know–believe constraint, at least in a way that would satisfy the theory-theorist.

Standard false belief tasks admit of variations in task structure which influence how well 3- and 4-year-olds perform (e.g. Freeman & Lacohée, 1995; German, 1995; German & Leslie, 2000; Leslie & Polizzi, 1998; Mitchell & Lacohée, 1991; Roth & Leslie, 1991, 1998; Siegal & Beattie, 1991; Surian & Leslie, 1999; Wellman & Bartsch, 1988; Zaitchik, 1991). Apparently, knowledge inference tasks too can be modified, making them harder or easier. In Expt 2, we showed that performance could be improved by providing the child with a plausible alternative content for the mental state in question. In Expt 3, offering an alternative content still improved performance on 'pretend' even though the wording of the task reduced the salience of the character's ignorance. In the case of 'belief', however, reducing the salience of the character's ignorance diminished children's performance. These findings may reflect different processing demands that 'pretend' and 'belief' problems make upon the child. Default reasoning in 'belief' problems produces a bias to attribute beliefs with true contents (Leslie, 1994a, 2000; Leslie & Polizzi, 1998; Leslie & Thaiss, 1992; Mitchell, 1994; Roth & Leslie, 1998). The know–think inference task is a type of false belief problem and considerable salience for the character's ignorance appears to be required to overcome the true belief bias, even at 6 years of age.

GENERAL DISCUSSION

There are many things that the child comes to learn about believing that go beyond the requirements of the standard false belief task, and many things about pretending that go beyond the ability to recognize and to infer the content of pretence. Our experiments looked at one particular skill that children develop, namely, the ability to infer how one mental state constrains the contents of another.

We found no support across three experiments for the idea that understanding pretence lags understanding belief, as Lillard (1993) suggested. Lillard did not base her claim upon direct comparisons of 'pretend' and 'believe' within the same task structure, but upon a comparison of know–pretend inference tasks with standard false belief tasks. When we compared like with like, 'pretend' and 'believe' produced highly similar results, with the exception of one condition in the final experiment where it appeared that 'pretend' was slightly ahead.

Our results relate to two main issues: the psychological basis of concepts in 'theory of mind', and the role of performance demands in 'theory of mind' tasks. We discuss each of these questions in turn.

The question of what knowledge is necessary for concept acquisition/possession marks a major divide between theories of cognitive development. On one side of the divide sits 'theory-theory'. Theory-theory claims that in order for a child to have a given concept, say, 'believe', the child must grasp a theory of what beliefs really are. If the child grasps the wrong theory, then the child will have the 'wrong' concept, that is, will not have the (adult) concept, 'believe', but some different concept. For example, if the child holds a 'copy theory' of belief (Wellman, 1990), then the child will have a concept similar to the adult concept 'know' rather than 'believe'. This is because, according to theory-theory, the character of a concept—which concept it is—emerges from the character of a theory. Likewise, the acquisition of a particular concept is achieved by acquiring knowledge of the relevant theory. Again, the character of the acquired theory is critical: which concept

has been acquired is determined by which theory has been acquired. Similarly, for theory-theory, a concept can be innate only if knowledge of its associated theory is innate. Hence, for theory-theorists there is intense interest in the details of the child's knowledge and inferences at any stage because this is held to determine which concepts are innate or have been acquired by that stage. For more extensive discussion of these points, see Leslie (in press).

On the other side of the theoretical divide sits a view like Leslie's ToMM model. This takes a diametrically opposite stance on the relation between knowledge and concept possession. In this opposing view, early developing abstract concepts are much more likely to depend upon mechanism rather than upon knowledge. A cognitive mechanism may play the role of enabling, and even directing, attention to a particular property or set of properties which then become a topic for knowledge acquisition. On this view, concept possession is prior to knowledge. Consequently, a concept may be innate without innate knowledge.

According to the ToMM model, a specialized theory of mind mechanism introduces the concept 'pretend', allowing the child to decide to pretend and to infer from another person's behaviour that that person is pretending. ToMM thereby empowers the child to attend to the mental state property, pretending-that. However, this does not mean that the child is endowed with knowledge of a theory about what pretending really is. More specifically, the ToMM view does not suppose that the very young child knows, or needs to know, that pretending is an internal, subjective, representational mental state.

Current theory-theories argue that knowledge of the representational theory of mind is required in order for someone to possess the concept 'believe' (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1994; Perner, 1995). Three-year-old children are said to lack the concept 'believe' precisely because they are said to lack knowledge of the representational theory of belief. The representational theory tells the child that a person's beliefs are mental representations, that mental representations of situations arise in certain ways, e.g., through perception, and that a person's mental representations will fail to be modified when the situation changes if that person has no knowledge of the changes. Standard false belief tasks are supposed by the theory-theorist to test for knowledge of this theory and thereby test for the presence of the concept 'believe'. By the same token, someone who has never seen or heard of or otherwise encountered a kangaroo will have no knowledge of kangaroos and therefore will have no mental representations of kangaroos. Specifically, the representational theory will tell the child that such a person could have neither beliefs nor pretends about kangaroos. Anyone who grasps the representational theory should understand this. However, our results show that only 25% of 4-year-old children seem to firmly grasp this idea. Even by 6 years of age, only 44–56% of children have grasped the representational theory firmly enough to make this prediction. Therefore, despite passing standard false belief tasks, children may not really understand the representational theory of belief. The conclusion, according to theory-theory, should be that children do not really have the concept 'believe' until several years later than was previously thought.

From the point of view of the ToMM model, however, the failure of 4- to 6-year-old children to make knowledge–belief inferences does not bear upon the question of which concepts the child possesses. It bears only upon questions of what knowledge and skill the child possesses. The ability to make inferences from 'knowing' and 'not knowing'

appears to be unnecessary for the acquisition and possession of the concepts 'pretend' and 'believe'. As subscribers to the ToMM view, we continue to hold that the standard false belief task provides a robust test of 'believe' concept possession. What the knowledge inference task failure does show is that, following an early emergence of mental state concepts, and thus the ability to attend to cognitive properties of agents, the child still has a lot to learn about different mental states and that such learning can proceed relatively slowly. Among the things the child has to learn about are the relations between mental states.

Finally, we expect that the rate at which the child will learn about the cognitive properties of agents will be sensitive to the performance demands that real world situations place upon the child. Our results suggested a role for salience in the knowledge inference task. If a character's ignorance is made more or less salient to the child, it appears that the child will be more or less likely to inhibit a true belief attribution. This finding is consistent with the ToMM-SP model and suggests that the same performance factors continue to influence the child's behaviour long after the standard false belief task is solved, extending the findings of Leslie and Polizzi (1998). One avenue for future research is to try to tease apart the cyclical interactions at different points in development between the performance factors that influence attention to different properties of a situation and the kinds of knowledge the child is able to acquire from these situations.

In summary, we have discussed three kinds of elements that the ToMM-SP model of development highlights. First is representational competence—having to do with what concepts the child has available and consequently what properties the child can in principle attend to. Second are the performance factors that influence and constrain how representational competence can be deployed in actual situations. And finally, there is the knowledge derived from experiences yielded by the competence-performance system.

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