Simplifying Second-order Belief Attribution: What Facilitates Children’s Performance on Measures of Conceptual Understanding?

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Abstract

This study investigated how 4- to 7-year-old children's second-order belief attribution might be facilitated by either reducing information processing or varying the sequence of task questions. In Experiment 1, compared with Perner and Wimmer's (1985) original second-order false-belief task, a new task with reduced information-processing demands promoted better second-order reasoning. In Experiment 2, half the stories included a second-order ignorance question before a second-order belief question. The ignorance question promoted second-order belief understanding, superseding the improvement induced by lowered processing demands. Together, the findings suggest that second-order belief performance can be facilitated if children focus on the concept of ignorance during the sequence of questioning.

Keywords: theory of mind; second-order beliefs; second-order ignorance; development.

The development of theory of mind (ToM) is one of the most important skills to develop in early childhood with implications for the development of social interaction, emotion understanding and communication. A wealth of research has shown that some aspects of this ability to reason about others’ mental states can be seen in the first three years of life (Bartsch & Wellman, 1995; Repacholi & Gopnik, 1997; Yuill, 1984). However, other aspects of ToM, such as understanding false beliefs, do not appear until children are older, at around 3 to 5 years of age (see Hughes & Leekam, 2004; Wellman, Cross & Watson, 2001 for reviews).

In contrast to research on understanding first-order mental states (e.g., ‘he thinks that . . .’), far fewer studies have investigated the earliest age at which second-order ToM (e.g., ‘he thinks that she thinks’) emerges. It is widely assumed that this ability develops later than first-order ToM, yet like the understanding of first-order ToM, there are different aspects of second-order understanding that may appear at different points of development. Gaining further insight into the development of these different aspects
may provide not only a fuller picture of children’s social and cognitive abilities, but also the opportunity for greater task specificity in clinical and neurological studies that use second-order mental-state tasks (Corcoron, 2000; Happé, 1995; Langdon, Michie, Ward, McConaghy, Catts & Coltheart, 1997).

The aim of our study was to gain a clearer picture of how the ability to attribute second-order false beliefs may be promoted in 4- to 7-year-olds under certain conditions. Specifically, we aimed to assess the extent to which performance on tests of conceptual understanding can be facilitated by reducing informational demands and varying the sequence of task questions.

Research on first-order ToM provides conclusive evidence that simplifying false-belief tasks leads to enhanced performance by preschool children. A number of studies have improved information-processing demands in false-belief tasks by testing mental-state reasoning in simplified or ecologically valid conditions, showing that this assists children’s performance (e.g., Chandler, Fritz & Hala, 1989; Prior, Dahlstrom & Squires, 1990). A particular focus in this research has been on the way that language may constrain or facilitate the performance on these tasks. Related to this is the way that question forms may enhance conceptual understanding.

Siegal and Varley (2002), for example, report findings from studies with children and adults that implicate language as a supportive system for false-belief reasoning. Their findings indicate that for individuals with brain lesions, ToM reasoning could still occur via support from neural mechanisms associated with the processing of language propositions. They also suggest that false-belief performance can be enhanced if test questions are presented in a manner that explicitly signals the purpose/relevance of tasks, for example, by using a test question that explicitly asks where the protagonist thinks the other person will look first for the object, as this allows the child to avoid inferring that the question refers to the first location to be searched.

Bloom and German (2000) also consider how children’s understanding on false-belief tasks may be influenced by the nature of the test questions that are asked and by children’s language abilities. They argue that children’s understanding of (false) beliefs may be less apparent because of the ‘inherently difficult’ nature of false-belief tasks. Children from an early age learn that beliefs are supposed to be true, and so it may be that the novelty of questions about false belief overloads their processing capacity, masking an underlying fledgling ToM ability. It is important to assess the nature of false-belief tests and the questions involved in order to determine whether children’s responses to these are a fair reflection of their actual ToM reasoning ability or whether this is masked because of inefficient processing capacities.

Whereas Bloom and German (2000) suggest that the inherent difficulty of the false-belief task has an adverse effect on children’s performance, Fabricius and Imbens-Bailey (2000) propose that a feature of the false-belief test may actually undermine the validity of the test. The basis of their argument is that in false-belief tasks, when the child is asked where they think the character (X) will now look for the object, the correct answer can be reached by the child simply realizing that X does not know about the object being in the new location. So, on the basis of attributing ignorance (rather than false belief) the child may choose the old location when asked to choose between the two locations.

Fabricius and Imbens-Bailey’s (2000) research suggests that understanding of ignorance might assist the child in making a correct false-belief judgement; however, this explanation might not apply to all types of false-belief task. Perner and Horn’s (2003) findings show that when the unexpected contents version of this task is given, in which
the child is not asked about imminent action (where will the protagonist look) but what a protagonist thinks, children have more difficulty in attributing false belief.

Together, all of the above evidence points to two avenues through which children may be facilitated in their performance on false-belief tasks—either lowering the information-processing demands of false-belief narratives or varying the nature/sequence of false belief test questions. The same arguments about task and question modifications facilitating false-belief performance that apply to first-order ToM should also apply to second-order abilities. Second-order mental state attribution is traditionally tested using Perner and Wimmer’s (1985) paradigm. In this paradigm, two characters—Mary and John—are independently informed of the location of a critical object, X, such that they both have a true first-order belief as to the object location but John has a false second-order belief about Mary’s belief. Children are asked where they think John thinks Mary will look for X. Results suggested that the ability to correctly reason about second-order beliefs is not present until 7 years of age. Hogrefe, Wimmer, and Perner (1986) provided further evidence of emergence of this ability at 7 years of age. Their study also showed that 5-year-olds could attribute second-order ignorance, supporting the evidence from first-order studies that ignorance is a simpler mental state for children to understand.

Subsequent studies have shown that second-order understanding emerges earlier than documented in the studies of Perner and Wimmer (Leekam & Prior, 1994; Perner & Howes, 1992; Winner & Leekam, 1991). However, as for first-order understanding, a distinction needs to be made between second-order representational and nonrepresentational understanding (Leekam, 1990). Thus, it is possible that the ability to understand second-order states such as ‘he doesn’t want her to know’ may appear as early as 4 to 5 years.

Sullivan, Zaitchik, and Tager-Flusberg (1994) proposed that children may understand second-order beliefs, a representational state, as young as 4 to 5 years old. Crucially, Sullivan et al. simplified the information-processing demands of their second-order false-belief stories by shortening story length, providing feedback to four probe questions and involving fewer characters, locations, and episodes. They found that by simplifying the stories created by Perner and Wimmer as well as their own, children as young as 4 years of age were able to exhibit second-order reasoning of false beliefs and 90 per cent of children aged 5.5 years were able to do so. Therefore, they argued that the processing requirements of Perner and Wimmer’s paradigm were sufficiently demanding to underestimate the age at which children are able to engage in second-order reasoning by several years.

While Sullivan et al. found that they could improve upon Perner and Wimmer’s original results, there was a crucial difference between their paradigms. Perner and Wimmer did not incorporate a second-order ignorance question into their task, whereas Sullivan et al. did. As second-order ignorance understanding is known to precede second-order belief understanding by about two years (Hogrefe et al., 1986), combining these two mental states within one task may have influenced the child’s conceptual understanding as Karmiloff-Smith, Klima, Bellugi, Grant, and Baron-Cohen (1995) also note.

Given Fabricius and Imbens-Bailey’s (2000) suggestion that children may answer false belief questions correctly on the basis of their understanding of ignorance rather than belief, it is important to explore how a questioning sequence incorporating ignorance immediately prior to belief may lead to different false-belief performances than if ignorance had not been included. Thus, in the two experiments reported here, we
attempted to distinguish between the more general effects of information-processing factors and conceptual understanding more specifically related to second-order belief attribution.

In Experiment 1, we aimed to simplify the information-processing demands in the story (e.g., memory load and linguistic complexity) that were unrelated to mental-state reasoning itself. In Experiment 2, we attempted to scaffold children’s conceptual understanding as well as reduce information-processing demands by providing a lower-level mental-state question about second-order ignorance as a stepping-stone to assist the child towards more complex representational inferences. Our hypothesis was that simplifying the task complexity in both experiments would facilitate second-order reasoning skills. However, we expect that false-belief performance will be most enhanced by the inclusion of ignorance within the question sequence.

**Experiment 1**

The aim of Experiment 1 was to reduce the information-processing demands of the second-order belief paradigm designed by Perner and Wimmer. Using a simplified task, Sullivan *et al.* (1994) found that children could attribute second-order beliefs up to two years earlier than Perner and Wimmer had claimed. However, it is possible that Sullivan *et al.* did not simplify Perner and Wimmer’s task sufficiently. The second-order belief stories of both Perner and Wimmer, and Sullivan *et al.* necessitated that children pay attention to at least three different dialogues. We argue that these stories are unnecessarily complex, where there is no need to include any dialogue at all. Furthermore, to minimize information-processing demands, the second-order belief story should require only two characters rather than the usual three or more characters featured in the stories of Perner and Wimmer, and Sullivan *et al.* To answer the second-order false-belief question correctly, it is necessary only to have directed attention towards the epistemic states of two characters rather than three. Finally, stories need have only two scenes, rather than the usual three or more scenes; thus requiring the child to concentrate on less narrative detail. Therefore, given that the aim of Sullivan *et al.* was to simplify Perner and Wimmer's task by reducing task complexity, it would seem logical to further reduce the information-processing demands of second-order belief stories. On this premise, we presented a new story format (see Appendix A), in addition to the stories used by Sullivan *et al.* This story format was based on only two characters, contained no spoken dialogues, had fewer scenes, and was shorter. Unlike in Sullivan *et al.*’s task, children were asked directly about second-order beliefs, rather than being asked about second-order ignorance first. Also unlike Sullivan *et al.*, we compared performance on our simplified stories with performance on Perner and Wimmer’s original paradigm.

**Method**

**Subjects.** Sixteen girls and 17 boys from a primary school in Scotland participated in this study. Ages ranged from 5 years and 9 months to 7 years and 2 months. This age range was chosen to encase the main findings of Sullivan *et al.* and Perner and Wimmer which suggested that second-order belief understanding was evident by ages 5 and 7, respectively.

**Design and Procedure.** A within-subjects design was used where all 33 children were tested on both second-order false-belief stories. Within one test session, children
received one standard story and one new story, with order counterbalanced across children. The children were randomly selected from the classroom and tested individually in a quiet environment. Children were asked to listen carefully to the stories and told that they would be asked a few questions throughout each story. Perner and Wimmer’s ‘standard’ story and the new reduced-complexity story were both acted out with Lego models depicting the key locations and dolls to represent the story characters. The main characters and initial locations were introduced to the child before starting each story. Feedback was given to three control questions such that if children gave the wrong answer they were reminded of the story detail and prompted towards the correct answer. Feedback was not given either to test questions or to justification questions.

Coding of Responses. Test question responses were scored as correct or incorrect. Responses to justification questions were scored according to the criteria used by Perner and Wimmer (1985). These are shown in Appendix A.

Results

Children were deemed to be passers of second-order belief attribution if they could provide the correct answer to the second-order belief question while also providing an appropriate justification. There were no order effects between the two stories. There were no significant effects of age or gender and data were therefore combined for subsequent analysis.

Table 1 shows that only two (6 per cent) of the children were able to attribute second-order beliefs when presented with the story created by Perner and Wimmer whereas 14 (42 per cent) were able to attribute second-order beliefs when given the new story introduced here. Furthermore, the two children who could pass Perner and Wimmer’s second-order belief story were two of the 14 children who could pass the new second-order belief story. Fourteen children passed the new story but failed the Perner and Wimmer story compared with none who showed the opposite pattern of passing the Perner and Wimmer story while failing the new story (McNemar’s Test, \( p < .001 \)). Furthermore, of the 5-year-olds tested, 50 per cent (six children) were able to attribute second-order belief in the new story. Therefore, this suggests that the information-processing demands associated with Perner and Wimmer’s second-order belief story may have undermined the second-order reasoning abilities of children, suggesting, like Sullivan et al., that Perner and Wimmer’s stories are unnecessarily complex.

Discussion

Significantly more children were able to attribute second-order belief in the new story than in the Perner and Wimmer story. Moreover, significantly more children passed

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the new stories while failing to attribute second-order belief in Perner and Wimmer’s paradigm than the reverse. These findings indicate that simplifying the task complexity in terms of reduction of the information-processing demands appeared to facilitate children’s second-order reasoning skills. By using a repeated-measures design, this study has shown that the simplified task introduced here was significantly easier for children than the original second-order task designed by Perner and Wimmer (1985).

Given the extensive simplification of the second-order story format in comparison to the format adopted by Sullivan et al. (1994), a surprising finding was that only 42 per cent of 5- and 6-year-olds could pass these simplified second-order stories. In contrast, Sullivan et al. found that 90 per cent of children at this age could attribute second-order beliefs. What could explain this discrepancy?

One possibility is that performance on Sullivan, Zaitchik, and Tager-Flusberg’s (1994) task was due to their inclusion of prompts and memory aids, whereas these were not included in the current study. On a more conceptual level however, it is possible that the findings in Sullivan et al.’s study overestimated children’s ability to attribute second-order beliefs. In their study, modifications are made to the original Perner and Wimmer paradigm, such that their second-order false-belief question is preceded by a second-order ignorance question. It is suggested here that this juxtaposition may lead the child through to answer a question on second-order false-belief understanding simply on the basis of attributing a character’s ignorance of another’s belief. This is illustrated in the story designed by Sullivan et al. Their story is based on a mother’s ignorance of her son’s belief, where he, Peter, wants a puppy for his birthday, is told by his mother that he is receiving a toy, where in fact the mother had bought him a puppy as a surprise. Peter later finds the puppy, unbeknownst to his mother. The crucial stages of second-order ignorance and second-order belief proceed as follows:

(i) Grandma: ‘Does Peter know what you really got him for his birthday?’
(ii) Second-order ignorance question: ‘What does Mum say to Grandma?’
   (Answer: NO)
(iii) Grandma to Mum: ‘What does Peter think you got him for his birthday?’
(iv) Second-order false-belief question: ‘What does Mum say to Grandma?’
   (Answer: TOY)

It is plausible that the child can answer (iv) by merely following on from answer ‘No’ to (ii) to correctly answer ‘toy’ rather than ‘puppy’. On this basis, the child can correctly answer ‘toy’ by acknowledging that the mother is ignorant of reality, rather than making an inference from the analysis of two conflicting propositions that define both the reality of the situation and the situation as falsely believed by the mother (i.e., holds a false belief of reality). If this is the case, and given that children’s understanding of ignorance precedes belief in second-order reasoning (Hogrefe et al., 1986), it may be argued that the juxtaposition of a second-order ignorance question with a second-order false-belief question serves to facilitate a child’s ability to attribute second-order beliefs.

Further support for the argument outlined above is provided in a study conducted by Karmiloff-Smith, Klima, Bellugi, Grant, and Baron-Cohen (1995). Their study examined ToM, among other variables, in individuals with Williams Syndrome. Children were tested on the original Perner and Wimmer paradigm and on the second-order story designed by Sullivan et al. (1994). It was found that 31 per cent of individuals succeeded on the former story whereas 88 per cent succeeded on the latter.
Karmiloff-Smith et al. explained this inconsistency by suggesting that second-order belief attribution was ‘couched’ in the latter story via the simpler propositional mental state ‘know’ rather than ‘believe’. Experiment 2 investigated this possibility.

**Experiment 2**

The aim of Experiment 2 was to investigate whether conceptual constraints on second-order belief attribution might be eased by asking a question about second-order ignorance immediately before a question about second-order belief. In this study, the question format (ignorance question first vs no ignorance question) was manipulated in a standard task identical to that given by Sullivan et al. (1994). The same manipulation was also made in a new story version based on the story used in Experiment 1 which reduced the complexity of Sullivan et al.’s paradigm further. We predicted that the children who received second-order false-belief stories that included a second-order ignorance question would show significantly better second-order belief understanding than children who did not receive an ignorance question within the sequence. We also predicted that the new story format developed for Experiment 1 would produce better performance, especially when a second-order ignorance question was included. To examine the reliability of performance on each story type, we also tested children on two story trials for each version of the second-order belief task instead of one trial, as in Experiment 1. A younger age group of children was also used in this study compared with those in Experiment 1.

**Method**

**Subjects.** Fifty children from two primary schools participated in this experiment. The majority of them were either 4 or 5 years of age ($N = 41$), with several 6-year-olds (9). The mean age of all the children tested was 5 years and 6 months (range = 4 years and 0 months to 6 years and 5 months). There were a roughly equal number of boys (23) and girls (27) who participated. Twenty-five children were given the ‘False belief only’ question-format and 25 were given the ‘Ignorance and false belief’ question-format. The mean age of the children in these groups was 5 years and 5 months, and 5 years and 6 months. None of the participants had taken part in Experiment 1.

**Design and Procedure.** A mixed design was used with question-format (ignorance + false belief (IG + FB), false belief only (FB)) as a between-subjects variable and information load/story type (standard, new) as a within-subjects variable. The dependent variable was the number of correctly justified false-belief responses. The story order was counterbalanced within and across groups.

The 25 children in each question-format group were presented with two ‘standard’ stories taken from Sullivan et al. (1994) and two ‘new’ stories based on Experiment 1. The format of standard and new stories was essentially the same; however, the new stories were shorter in length, omitted any dialogue between characters, and had fewer scenes and characters.

The story themes for the standard story type included Sullivan et al.’s puppy story and their chocolate bar story, which was slightly differently themed (cake story), but importantly, retained the same structure as before. The theme for the new story type included the robot story adapted from Experiment 1 and another story about a child.
who moved a bar of chocolate to stop it melting on the beach and was observed by the second child. An example of each story type is shown in Appendix B.

In order to enable children to visualize the stories, the experimenter used various dolls to act out each story. All of the characters featured in the stories were represented by three-dimensional figures while modelling clay and Lego were used to construct the various locations and furnishings described in the stories.

The experimenter saw all the children individually inside a quiet area of their school. Before beginning each story, the experimenter introduced the child to the various characters, props, and furnishings that were to be used. After explaining the procedure to the child, the experimenter then orally presented the stories to the child verbatim as outlined in Appendix B in parallel with the enactment of each story.

In order to replicate the procedure used by Sullivan et al. (1994), all of the stories contained a series of probe and control questions. Following Sullivan et al., each story contained three probe questions after the first episode to ensure that the children understood the central theme of the story. Furthermore, both standard and new stories included a nonlinguistic control question that assessed the children’s understanding of first-order knowledge. For all probe and control questions, feedback was provided and corrections were done if necessary. In a similar way to Sullivan et al., all ‘yes’ and ‘no’ responses to these questions were balanced in order to avoid creating a bias for responses.

Once the children had been asked the various probe and control questions, they were required to answer the crucial test questions. One group of children were asked a second-order ignorance question followed by a memory aid and a second-order false-belief question whereas the other group of children received the same presentation with the exception of the second-order ignorance question. Both ignorance and false-belief questions were asked as open-ended questions; however, if the children did not provide an answer then a forced-choice format was adopted. For example, ‘Does Sally know that Paul knows where the robot is?’ or ‘Does Sally not know that Paul knows where the robot is?’ In these cases, the forced-choice response was counterbalanced across children. Finally, all the children were asked to justify their response to the second-order false-belief question. No feedback or correction was provided for either of the test questions or the justification responses. Responses to justification questions were coded using Perner and Wimmer’s (1985) criteria in the same way as for Experiment 1.

Results

All results are based on correctly justified false-belief responses. One point was awarded to a child for each story with a correct response and justification to the second-order false-belief question. There were no practice effects for either group. The forced-choice question-format was used a total of five times: one time each for three children from the group who were asked the ignorance question and one time each for two children from the other group. Initial analyses of normality revealed that the dataset was not normally distributed because of a negatively skewed distribution within the group of children who were also asked an ignorance question; therefore, nonparametric statistics were used to analyse the dataset.

First, we examined the effect of question type. As predicted, children who received the second-order ignorance question before the second-order belief question (IG + FB) performed better on the second-order false-belief question than children who received
only the second-order belief question (FB). The mean score for children in the IG + FB group was 2.04 ($SD = 1.27$) whereas the mean score for children in the FB-only group was 1.28 ($SD = 1.17$); Mann-Whitney, $U = 204, z = -2.17, p = .03$. Within each of these groups, no significant differences were found that arose from simplifying the information load (i.e., performance on the new vs original stories). Children in the IG + FB group had similar scores whether they were given either Sullivan et al.’s standard stories or the new stories (mean ‘standard’ = 1.00; $SD = .71$; mean ‘new’ = 1.04; $SD = .79$). The same applied to children in the FB group (mean ‘standard’ = .68; $SD = .69$; mean ‘new’ = .68; $SD = .75$). Therefore, contrary to expectation, the more simplified format in the new stories did not enhance performance.

Given that there was no difference between performance on new and standard stories, we combined responses from both story types in subsequent analyses. Table 2 shows the number of children passing one, two, three, or all four trials of false-belief test questions. Taking a strict criterion of three out of four trials correct, it may be seen that irrespective of story type, 36 per cent (nine children) in the IG + FB group consistently attributed second-order false beliefs, whereas only 12 per cent (three children) in the FB group consistently attributed second-order false beliefs ($\chi^2 = 3.95, p < .05$).

These results show that irrespective of age and story type, children within the group who received a second-order ignorance question in addition to a second-order false-belief question were significantly better in their second-order false-belief performance than children who did not receive a second-order ignorance question. This supports the hypothesis that second-order false-belief tests incorporating a second-order ignorance question have a facilitative effect upon higher mental-state understanding.

**Discussion**

This study has shown that 4- and 5-year-olds are significantly more likely to correctly answer second-order false-belief questions when these are preceded by a second-order ignorance question than when they are not. Additional attempts to lessen the demands of the story did not make any difference beyond the simplification already made by Sullivan et al. (1994). The findings indicate that crucial to facilitating children’s second-order belief understanding was the inclusion of the concept of ignorance. Almost 40 per cent of 4- and 5-year-olds could consistently provide the correct answer to second-order false-belief questions, having been asked about second-order
ignorance immediately beforehand. In contrast, just over 10 per cent of 4- and 5-year-olds could consistently provide the correct answer to second-order false belief in the absence of second-order ignorance. These findings convey the extent to which a child’s grasp of second-order belief understanding can be strengthened by couching it within second-order ignorance understanding.

The proposal raised by these results is that the opportunity to reflect on second-order ignorance might help to scaffold a fragile understanding of second-order false beliefs. What might be the mechanism for this facilitation? It might be argued that the use of complex syntactic structures might help children to answer the belief question. Giving the child a question with a double embedded structure ‘Does Sally know that Paul knows where the robot is?’ may prime the child to answer a subsequent question of a similar structure ‘Where does Sally think that Paul will look?’ This view would be supported by recent linguistic accounts of ToM development, which propose that understanding of syntactic complexity plays a major role (e.g., de Villiers, 2000).

To examine the possible role of syntactic priming, we carried out a post hoc experiment with 15 children (mean age 5 years and 6 months) drawn from the same schools as Experiment 2. All were subjected to the IG + FB condition only. The procedure for Experiment 2 was carried out in exactly the same way with one small change. Prior to the second-order ignorance question, these participants were also asked a linguistic control question ‘Does Sally know that Paul saw her hide the robot in the cupboard?’ This question taps a higher level of linguistic complexity than the original nonlinguistic control question (‘Does Paul know that Sally hid the robot?’), yet it does not refer to higher-order mental states directly.

The results showed no further facilitative effect of the linguistic control question on second-order belief attribution when compared with the children who were given the second-order ignorance question but not the linguistic control question. Given the earlier findings, this implies that there is something special about reflecting on second-order ignorance that may allow it to facilitate second-order belief. The wording of the linguistic control questions focuses on knowledge of action, whereas the wording of the ignorance questions (despite varying between standard and new stories) focuses on knowledge of knowledge. Thus, it would appear that it is the conceptual understanding of ignorance that is fundamental to providing a short cut to second-order belief understanding.

**General Discussion**

The aim of these studies was to clarify the age at which second-order belief attribution develops and the way it might be facilitated by reducing the information processing and varying the question sequence within the task. The outcome of Experiment 1 indicated that reduction of information-processing demands would appear to be a sufficient factor to facilitate second-order belief understanding in children who are 6 and 7 years of age. However, in Experiment 2, it was found that further reducing the information-processing load of the narrative (i.e., from the already simplified standard stories of Sullivan et al. (1994)) did not have a further facilitative effect upon second-order belief understanding in younger children at 4 and 5 years of age. The provision of questions that focus on children’s knowledge of a simpler second-order mental state on the other hand, did enhance performance, suggesting that lower level conceptual understanding of the mental state of ignorance may scaffold the complex conceptual understanding of belief. It may be that directing a child’s
attention to someone’s knowledge immediately prior to their belief is a sufficient and necessary factor in simplifying second-order belief understanding. Knowledge is inherently more concrete and less open to interpretation than belief, so by presenting such a sequence of questions in false-belief tasks, focus on knowledge may be enough to prime children’s fragile understanding of false beliefs. It is possible then that conceptual understanding is more crucial in earlier ToM development at the ages of 4 to 5—the age of children in Experiment 2—whereas information-processing resources come into play later in development as the 6-year-olds in Experiment 1 may demonstrate.

Our findings, in comparison with Sullivan et al. (1994), underline the importance in making a distinction between different mental states when combining these within measures of ToM. We have also shown how children’s performance on false-belief tasks can be significantly improved, not only by making the task easier but also by focusing children’s attention on key issues. That is to say that children’s understanding of mind can be masked due to inefficient processing capacities, and can be encouraged by using simple concepts such as ignorance, which provide a stepping-stone to more complex concepts such as belief. Perhaps familiarity with the language which encapsulates the conceptual understanding of ignorance is sufficient to prime children’s response to questions that deal with the unfamiliar territory of false beliefs.

A modular account of ToM might argue that there are encapsulated areas of the brain function that are specialized for ToM processing. However, it seems apparent that there is a linguistic framework underpinning the way in which children respond to false-belief questions (de Villiers & de Villiers, 2000). For example, Siegal and Varley (2002) argue that there may be a designated region of the brain that processes ToM concepts, but which is heavily supported by language. Our study has shown that ToM ability can be demonstrated under different conditions with different language and information-processing requirements. However, as the meta-analysis of Wellman et al. (2001) showed, while ToM ability can be facilitated under certain conditions, it is still the case that there is a conceptual change in children of around 4 years of age. Hence, although there is likely to be a core mechanism to ToM ability, this is likely to be subversed by many co-opted systems, such that 3-year-olds will have a fledgling ToM ability and may not be able to reason competently about belief but can be facilitated in their performance by co-opted systems.

In order to examine these issues more fully, future second-order belief studies should adopt the methodologies outlined here and examine the roles of conceptual understanding and information-processing loads in 4- to 7-year-olds. Such studies would provide a comprehensive profile of the age at which children can consistently reason about second-order beliefs and how conceptual understanding and information-processing demands can encourage such understanding over development. As Sullivan et al. say: ‘Given the central role of second-order attributions in our social reasoning, it is crucial to get the descriptive story right’ (p. 400).

It may be important to understand what is facilitated in simplified second-order ToM tasks in order to provide clearer research findings and supportive interventions for atypical groups. First, the findings have relevance to our understanding of ToM in deaf and language-impaired children. The basis of these simplified stories could be adopted in a future study where the narrative is presented in the form of thought pictures and bubbles (see Custer, 1996; Woolfe, Want & Siegal, 2002). Combining the simplified story with pictorial representations should provide an ideal basis with which to assess second-order reasoning skills of language-impaired populations (e.g., deaf children). Understanding the difficulty which schizophrenic individuals experience with the
metarepresentational aspect of second-order ToM tasks (Frith & Corcoron, 1996; Pickup & Frith, 2001) could also be investigated using second-order tasks that incorporate the less complex concept of ignorance.

Second, the research has relevance for studies of patients with brain damage. Happé, Brownell, and Winner (1999) have shown that right-hemisphere (RH) lesioned patients are impaired on ToM relative to left-hemisphere (LH) patients, but were not able to pinpoint the brain areas involved precisely. Happé’s (1994) brain-imaging study of higher-order mental states (e.g., double bluff and white lies) found activation of left-medial frontal cortex during stories that require mental-state reasoning, whereas a functional magnetic resonance imaging (fMRI) study by Gallagher, Happé, Brunswick, Fletcher, Frith, and Frith (2002) found that only the activation of the medial prefrontal region distinguished between the ToM and non-ToM narratives. However, these studies do not specify which aspects of ToM are being examined. Such studies indicate that it is now a matter for systematic research to identify the critical regions involved in different aspects of ToM understanding. As the present study has highlighted there may be something specific about the concepts of ignorance and belief that needs to be singled out in order to identify the brain areas crucial to the conceptual development associated with social cognition.

In conclusion, the present study highlights the need to distinguish between second-order ignorance and second-order belief, suggesting that the former can have a facilitative effect on the latter. It is hoped that future research studies using this type of methodology might have impact in facilitating the development of children who are delayed in ToM and provide more detailed and accurate information on how brain areas underlying second-order reasoning are affected in clinical populations.

References


**Acknowledgments**

Experiment 2 within this study was supported by a grant from the Economic and Social Research Council (PTA-030-2002-00028) to Greig Coull. The authors thank the children from Hayshead Primary School in Arbroath and Durham St. Hild’s Church of England Primary School for their participation in this study. The useful comments of three reviewers are gratefully acknowledged.
Appendix A

Examples of Story Formats used in Experiment 1—New Story Used in Explicit Comparison with Perner and Wimmer (1985) Story, and List of Appropriate and Inappropriate Justifications

New Story

It is Paul’s birthday. Paul and Sally are in his play room. He is showing Sally his favourite new present—a robot. Paul puts the robot back in the box with the lid on and then has to go outside. While Paul is away, Sally decides to play a trick on Paul and move the robot from its box and hide it away in the cupboard. While Sally is hiding the robot in the cupboard, Paul passes by the window and sees Sally hiding the robot in the cupboard. But Sally doesn’t see Paul watching her hide the robot in the cupboard. She doesn’t see him! Paul then returns to the toy room.

Second-order false-belief question: ‘Where does Sally think Paul will look for the robot?’ Box. (Example answer)

Justification question: ‘Why does Sally think Paul will look for the robot in the _____?’ Because she doesn’t know that Paul knows the robot is in the cupboard.

Probe question 1: ‘Does Paul know that the robot is in the cupboard’? Yes.
Probe question 2: ‘Does Sally know that Paul saw her hide the robot’? No.
Probe question 3: ‘Where will Paul look for the robot’? In the cupboard.

Perner and Wimmer Story

Introduction: This is a story about John and Mary who live in this village. This morning John and Mary are together in the park. In the park there is also an ice-cream man in his van.

Episode 1: Mary would like to buy an ice-cream but she has left her money at home. So she is very sad. ‘Don’t be sad,’ says the ice-cream man, ‘you can fetch your money and buy some ice-cream later, I’ll be here in the park all afternoon.’ ‘Oh, good,’ says Mary, ‘I’ll be back in the afternoon to buy some ice-cream. I’ll make sure I won’t forget my money then.’

Episode 2: So Mary goes home. . . . She lives in this house. She goes inside the house. Now John is on his own in the park. To his surprise, he sees the ice-cream man leaving the park in his van. ‘Where are you going?’ asks John. The ice-cream man says, ‘I’m going to drive my van to the church. There is no one in the park to buy ice-cream; so perhaps I can sell some outside the church.’

Episode 3: The ice-cream man drives over to the church. On his way he passes Mary’s house. Mary is looking out of the window and spots the van. ‘Where are you going?’ she asks. ‘I’m going to the church. I’ll be able to sell more ice-cream there’ answers the man. ‘It’s a good thing I saw you,’ says Mary. Now John doesn’t know that Mary talked to the ice-cream man. He doesn’t know that!

Episode 4: Now John has to go home. After lunch he is doing his homework. He can’t do one of the tasks. So he goes over to Mary’s house to ask for help. Mary’s mother answers the door. ‘Is Mary in?’ asks John. ‘Oh,’ says Mary’s mother, ‘She just left. She said she was going to get an ice-cream.’
Second-order false-belief question: So John runs to look for Mary. ‘Where does he think she has gone’? *Park.*

Justification question: ‘Why does he think she has gone to the _______’? *He doesn’t know that Mary knows the ice-cream man has moved to the church.*

Probe question 1: ‘Does Mary know that the ice-cream van is at the church’? *Yes.*
Probe question 2: ‘Does John know that the ice-cream man has talked to Mary’? *No.*
Probe question 3: ‘Where did Mary go for her ice-cream’? *Church.*

**Justifications**

Appropriate justifications conveyed that the child was able to recognise the relevant information and reason that character A will wrongly predict where/what character B thinks because A is unaware of what B knows and therefore A has a mistaken belief about B’s belief.

i. **Embedding of mental state:** Explicit embedding of one character’s mental state within another character’s mental state, e.g., ‘Sally doesn’t know that Paul knows where the robot is.’

ii. **Nesting of crucial information within another character’s belief:** Important information regarding what character B has found out unbeknown to character A is contained in A’s mental state, e.g., ‘Sally doesn’t know that Paul saw her hide the robot.’

iii. **Location:** Original location of critical object is mentioned, e.g., ‘Paul had left the robot in the box.’

iv. **Note:** Due to the slightly different format of the standard stories in Experiment 2, rather than a justification category regarding location, justifications were categorized in terms of an explicit reference to surprise or deception, e.g., ‘Because Mum wanted to surprise Peter with the puppy.’

Inappropriate justifications conveyed that the child could not grasp the significance of the relevant information.

i. **First-order reasoning:** Irrelevant knowledge of one of the characters is mentioned, e.g., ‘Sally/Paul knows that the robot is in the cupboard.’

ii. **Zero-order reasoning:** Unnecessary focus on actual location of object, e.g., ‘That’s where the robot is.’

iii. **Irrelevant information:** e.g., ‘Paul got the robot for his birthday.’

iv. **Nonsensical response:** e.g., ‘The cupboard is over there.’

**Appendix B**

Examples of Story Formats Used in Experiment 2—New Story Used in Explicit Comparison with the Sullivan, Zaitchik, and Tager-Flusberg (1994) Story

**New Story**

It is Paul’s birthday. Paul and Sally are in his play room. He is showing Sally his favourite new present—a robot. Paul puts the robot back in the box with the lid on and then has to go outside. While Paul is away, Sally decides to play a trick on Paul and move the robot from its box and hide it away in the cupboard.
Probe question 1: ‘Did Paul leave the room’? Yes.
Probe question 2: ‘Did Sally leave the robot in the box’? No.
Probe question 3: ‘Why did Sally move the robot to the cupboard’? To play a trick.

While Sally is hiding the robot in the cupboard, Paul passes by the window and sees Sally hiding the robot in the cupboard. But Sally doesn’t see Paul watching her hide the robot in the cupboard. She doesn’t see him! Paul then returns to the play room.

Nonlinguistic control question: ‘Does Paul know that Sally hid the robot in the cupboard’? Yes.
Second-order ignorance question: ‘Does Sally know that Paul knows where the robot is’? No.
Memory aid: Now remember, Sally doesn’t know that Paul saw her hide the robot.
Second-order false-belief question: ‘Where does Sally think Paul will look for the robot’? Box.
Justification question: ‘Why does Sally think Paul will look for the robot in the ________’? Because she doesn’t know that Paul knows the robot is in the cupboard.

Sullivan, Zaitchik, and Tager-Flusberg Story

Tonight it is Peter’s birthday and Mum is surprising him with a puppy. She has hidden the puppy in the basement. Peter says, ‘Mum, I really hope you get me a puppy for my birthday.’ Remember, Mum wants to surprise Peter with a puppy. So, instead of telling Peter she got him a puppy, Mum says, ‘Sorry Peter, I did not get you a puppy for your birthday. I got you a really great toy instead.’

Probe question 1: ‘Did Mum really get Peter a toy for his birthday’? No.
Probe question 2: ‘Did Mum tell Peter she got him a toy for his birthday’? Yes.
Probe question 3: ‘Why did Mum tell Peter that she got him a toy for his birthday’? To surprise Peter.

Now, Peter says to Mum, ‘I’m going outside to play.’ On his way outside, Peter goes down to the basement to fetch his football. In the basement, Peter finds the birthday puppy! Peter says to himself, ‘Wow, Mum didn’t get me a toy, she really got me a puppy for my birthday.’ Mum does not see Peter go down to the basement and find the birthday puppy.

Nonlinguistic control question. ‘Does Peter know that his Mum got him a puppy for his birthday’? Yes.

Now, the telephone rings, ding-a-ling! Peter’s grandmother calls to find out what time the birthday party is. Grandma asks Mum on the phone, ‘Does Peter know what you really got him for his birthday’?
Second-order ignorance question: ‘What does Mum say to Grandma’? No.
Memory aid: Now remember, Mum does not know that Peter saw what she got him for his birthday.

Then, Grandma says to Mum, ‘What does Peter think you got him for his birthday’?
Second-order false-belief question: ‘What does Mum say to Grandma’? Toy. Justification question: ‘Why does Mum say that’? Because she doesn’t know that Peter saw the puppy.