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CHILDREN'S UNDERSTANDING THAT UTTERANCES EMANATE FROM MINDS: USING SPEAKER BELIEF TO AID INTERPRETATION

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Abstract

Children interpreted an utterance made by a protagonist with a false belief, such as, "I would like the car in the garage." Calculating the speaker's belief in conjunction with the literal meaning of the utterance would lead to the correct interpretation that the intended referent is the car on the track, given that the car in the garage swapped places with the one on the track. In Experiments 1 and 2, many children aged around 4 and 5 years wrongly indicated the car in the garage. In contrast, many correctly indicated the car on the track when it was unnecessary to consider the speaker's belief because the utterance was, "the car I put in the garage". Six- year-olds found both kinds of utterance equally easy in Experiment 1, while 3-year-olds had equal difficulty with both. In Experiments 2 and 3, the speaker gave an ambiguous utterance and many children aged between 3 and 6 years successfully used information about the speaker's belief to identify which of several candidate referents was intended. We discuss the results in relation to characteristics of utterance comprehension and consider implications for developments in understanding the mind by children beyond 4 years.

Utterances from minds

CHILDREN'S UNDERSTANDING THAT UTTERANCES EMANATE FROM MINDS:
USING SPEAKER BELIEF TO AID INTERPRETATION

Just as speakers need to take into account their listener's perspective and knowledge when they construct an utterance, so listeners may need to interpret the utterance in the light of what they know of the speaker's perspective. This particular requirement of effective listening has been given rather little research attention, though the broader issue of the need to go beyond literal meaning has attracted a great deal of interest (e.g. Olson, 1994). Ironic utterances present one example of this, but it is not yet clear how best to characterize the process of interpreting irony (e.g. Gibbs, 1986; Searle, 1983; Sperber and Wilson, 1986). Another example concerns the interpretation of metaphors and idioms. Considerable development in the ability to distinguish between literal and intended meaning seems to occur around the age of 6-8 years (Ackerman, 1983; Demorest, Meyer, Phelps, Gardner & Winner, 1984; Donaldson, 1978; Mitchell & Russell, 1989; Winner, Rosentiel & Gardner, 1976).

We are concerned here with the circumstance of a speaker intending to make an accurate statement about reality but where the listener knows independently that the speaker has an inaccurate mental representation of the relevant features. For example, the speaker expresses her preference for one of two pictures saying "I like the one above the clock." The listener knows that the two pictures have been moved since the speaker last saw them, and the one which was above the clock is now above the television. The listener must take into account both the words spoken and the speaker's out-of-date representation of reality to make the correct interpretation -- the speaker likes the picture which is above the television. With this kind of utterance we can examine the processes responsible for young children's success or failure in analysing an utterance in relation both to external reality and to the speaker's mental representation -- the tripartite analysis which underpins effective interpretation of utterances.

Utterances similar to the example just given have been used in the message-desire discrepant task (Robinson & Mitchell, 1992, 1994). A speaker requested one of two objects whose location had changed in the speaker's absence, and children were asked to interpret the utterance. Although many aged around 4 and 5 years made the correct interpretation,

performance was below ceiling. Accordingly, it seems success at this task is more gradual (Robinson & Mitchell, 1994) than is applying the same understanding to predict where a person with a false belief will search for a target item (e.g. Perner, Leekam & Wimmer, 1987, Gopnik & Astington, 1988). Why might this be?

An examination of how utterances are comprehended sheds light on children's difficulty utilizing their understanding of the belief of the speaker as an aid to interpreting utterances. We identify four hypothetical levels at which children might perform. First, they might completely fail to comprehend the utterance, and if so presumably they would either not respond when asked which picture the speaker likes, or would make a judgment at random. Second, children might achieve partial comprehension, and base their response only on the phrase "the one above the clock". Third, children might fully process the literal meaning only, and once again would interpret the utterance as referring to the picture above the clock. Finally, children might progress beyond the literal and consider the speaker's belief, in which case they would interpret reference to the picture above the television.

In the message-desire task, satisfaction with literal meaning would lead to a systematic error. A child listener who was satisfied with literal meaning would in effect not be treating reference as primarily to the picture above the clock in the speaker's mind's eye. A failure to progress beyond the literal could obstruct the child in basing an inference of utterance meaning on the speaker's false belief.

It would not be surprising if satisfaction with literal meaning faded during development. Younger children might lack the qualities of processing needed to consider potential alternatives once they have hit upon a possible interpretation. At least, this is how children below the age of about 6 or 7 years are characterized in the literature on children's logical judgments (e.g. Fabricius, Sophian & Wellman, 1987; Mitchell & Robinson, 1990, 1992; Somerville, Hadkinson & Greenberg, 1979; Sophian & Somerville, 1988).

In the above account, we suggested two reasons why children might interpret the utterance as referring to the picture above the clock (the mentioned location): At the second hypothetical level children make this interpretation simply because they only partially

comprehend the utterance, and at the third level they do so because they fully comprehend the literal meaning but fail to go beyond that. We can discriminate between these two possible bases for the same response by changing the utterance to, “I like the picture I put above the clock” . Now, literal comprehension leads to the interpretation that the speaker is referring to the picture that is above the television. I put refers to a past event, and it is literally and truly the case that the picture that the speaker put above the clock is now above the television.

In contrast, if comprehension were partial, then children would still interpret the speaker to be referring to the location mentioned, above the clock, even when the utterance included I put. This follows because the only element in the utterance that in isolation would guide children to one location in preference to the other is “...above the clock.” The elements “...picture...” and “...I put...” would not lead to a particular location because there were two pictures and the speaker had put each of them somewhere. Indeed, since the default of partial comprehension would be to identify the item in the mentioned location, there might even be a sense in which children need to inhibit pointing to that mentioned location.

In brief, children who only partially comprehend literal meaning will identify the picture above the clock when interpreting an utterance in a message-desire task, whether or not it includes I put. Children who do comprehend literal meaning, but who do not progress beyond that, will point wrongly when I put is excluded from the utterance but point correctly to the picture above the television when I put is included. This was the primary issue of investigation in Experiments 1 and 2.

In Experiments 2 and 3, we concentrated on children’s ability to apply knowledge about the speaker’s belief when it would be unnecessary to inhibit defaulting to the mentioned location. In the new task, instead of items being swapped from one location to another, more items were added in the speaker’s absence. The speaker’s subsequent reference to an item at that location was ambiguous, but could be appropriately disambiguated by taking into account the speaker’s belief that a particular item was there. If children still found it hard to identify the referent, then presumably this would be due primarily to an inability to infer a nonliteral interpretation from what they know of the speaker’s belief.

In the research described below we also aimed to examine reasons for success in the message-desire task. In earlier studies (Mitchell & Robinson, 1994; Robinson & Mitchell, 1992; 1994) we assumed that children who judged correctly that the speaker wanted the item in the nonmentioned location, understood that she was referring to where she believed the item to be, rather than to where it was currently. Leslie (1994) points out, though, that children who interpret by pointing to the nonmentioned location may do so by a non-mentalistic route in which they consider only the exchange of items and not the speaker's ignorance of this. Leslie proposed a control condition in which the speaker sees the items exchanged and so retains an accurate belief about reality. Now it is correct to interpret the utterance by pointing to the mentioned location, despite the swap. Children who simply fixate on the exchange rather than the speaker's knowledge might be tripped up by this procedure and judge that she wants the item in the nonmentioned location. On the other hand, when I put is included, it is irrelevant to the interpretation whether or not the speaker has seen the exchange. Regardless of whether the speaker has seen or not seen the exchange of items, we should interpret her to be referring to the item in the nonmentioned location in that circumstance. Table 1 shows the correct pattern of judging arising from combining the speaker sees versus not sees with I put included in the utterance versus excluded. The design effectively allows us to address two principal questions: 1. Do children discriminate between the speaker seeing and not seeing the exchange of items when appropriate (i.e. when I put is not included)? 2. Does the addition of I put in the speaker's utterance help children to make correct interpretations in no sees conditions?

Table 1 near here

Experiment 1

In this experiment we aimed to identify age-related differences in the pattern of interpretations made of utterances in which the speaker held either a true or a false belief about the aspect of the world to which s/he referred (because s/he had either seen or not seen

the exchange of items). Additionally, comprehension of the literal would either be sufficient (as in “I like the picture I put above the clock”) or it would be necessary for the participant to venture beyond that (as in “I like the picture above the clock”).

Method

Subjects. Eighty-one girls and 79 boys aged between three and seven years were recruited from state-funded schools in north Staffordshire, UK. The catchment area of these was predominantly working class. We split the children into 4 age groups of equal size ($n=40$) according to the school class they belonged to: Nursery children were mostly aged 3 years (mean, 3;10; range, 3;0 to 4;5); Reception children were mostly aged 4 years (mean, 4;10, range, 4;6 to 5;5); Year 1 children were mostly aged 5 years (mean, 6;1, range, 5;6 to 6;4); Year 2 children were mostly aged 6 years (mean, 6;11, range, 6;3 to 7;4).

Design & Procedure. We devised two cartoon stories. One was about Mum hanging pictures in the living room which Dad rearranged when Mum had left the room, as described in the Introduction, and the other was about toy cars. Each was accompanied by four coloured cartoon scenes. We shall illustrate with reference to the cars story, which is shown in Figure 1. David put one car in the garage and another on the race track, then left the room. Sarah then swapped the cars the other way round in David’s absence. Finally, David called from the adjacent room to request one of the cars. He shouts that he would like the one in the garage. The experimenter told the story to the children and then gave a brief recap. Following this, the experimenter asked the child participant, “Now which car does David want... Can you point?”

Figure 1 near here

The stories could vary in two ways: The speaker could either be present (“sees”) or absent (“no sees”) when the items were moved, and the speaker either included or did not include I put in the utterance. David either stated “I would like the one I put in the garage please.” or “I would like the one in the garage please.” We label these wordings “transparent”

and “opaque” respectively.

Each child listened to both the car and the picture stories. In one, the speaker saw the exchange of items and in the other the speaker did not see. The order of story presentation varied between children, and the order of sees versus no sees varied also but independently. Half the children listened to stories in which the speaker made opaque utterances in both stories and the rest heard the transparent utterance in both stories.

Prior to testing, the experimenter spent a short period accompanying children in their routine activities, and once they had become familiar with her they were tested individually in a quiet area separate from the classroom.

Results

This section is sub-divided according to the two main questions we identified at the end of the Introduction. We begin each section by examining general trends and then probe further to investigate whether those trends maintain independently for each age-group. Table 1 shows what would be an ideal pattern of judging in the 4 cells that are created by crossing the wording of the speaker’s utterance with whether the speaker sees or does not see the exchange of items. Table 2 shows the actual pattern of data.

Table 2 near here

Do children discriminate between the speaker seeing versus not seeing the exchange?

The speaker’s seeing or not seeing is only relevant to interpretations of an opaque statement (without I put), and accordingly we began the analysis by focussing on children who heard this wording. Sixty-five children (81%) correctly pointed to the mentioned location when the speaker saw the exchange of items. Forty-one children (51%) wrongly pointed to the mentioned location when the speaker did not see the exchange. In total, 36 children (out of 80) judged differently between stories according to whether the speaker had seen or not seen the exchange. Of these 36, 30 judged that the speaker was referring to the item in the

nonmentioned location when s/he had not seen the exchange, but to be referring to the item in the mentioned location when s/he had seen the exchange. Only 6 children judged in the reverse pattern, while a further 9 (6 in the oldest group) judged the speaker to be referring to the nonmentioned location in both stories. Hence, the group pattern of data suggests many children were attuned to the speaker's belief when interpreting his or her utterance: McNemar χ^2 (corrected, 1, $n=36$) = 14.69, $p < .001$.

We proceeded to check whether the effect maintained within each of the 4 age groups independently. The effect fell short of significance in the case of 3-year-olds and 4-year-olds (7:4 and 6:1, respectively), but was significant for 5-year-olds and 6-year-olds: 5-year-olds -- 8:1, McNemar χ^2 (corrected, 1, $n=9$) = 4.0, $p < .05$; 6-year-olds -- 9:0, McNemar χ^2 (corrected, 1, $n=9$) = 7.1, $p < .01$. In all age groups, then, the trend was to interpret the speaker to be referring to the item in the nonmentioned location when s/he had not seen the exchange, but to be referring to the item in the mentioned location when s/he had seen the exchange. The tendency was sufficiently strong in the two older groups for a significant effect to emerge independently for them, but not in the two younger groups.

We conducted analogous analyses on children's interpretations of the speaker's statement when it included I put. In this case, whether the speaker had seen or not seen the exchange is irrelevant, and children should always take the speaker to be referring to the item in the nonmentioned location; it would be wrong for children to discriminate between stories in their interpretations. Initially, we combined data from the 4 age groups. As expected, when children did interpret differently between stories, there was no significant preference to judge in the pattern that the speaker was referring to the item in the mentioned location in "sees" but to the item in the nonmentioned location in "no sees" (10 children) than to judge in the opposite pattern (7 children). Neither did such a preference emerge in any of the age groups independently.

Does the addition of "I put" help children to make correct interpretations in no sees conditions? The next step was to check whether children found it easier to interpret reference to the item in the nonmentioned location when the speaker stated (for example) "I would like

the car I put in the garage” than when he stated “I would like the car in the garage”. With both wordings, it was appropriate for children to interpret the utterance by pointing to the car on the track when the speaker had not seen the exchange. However, considering data combined from the 4 age groups, children were significantly more likely to point to the item in the nonmentioned location when the request included I put: $\chi^2(\text{corrected}, 1, N = 160) = 18.73, p < .001$. The right-hand column in Table 2 shows that while a substantial majority of children (83%) correctly pointed to the nonmentioned location for the transparent I put wording, only approximately half the children (49%) correctly pointed to the nonmentioned location after hearing an utterance containing opaque wording.

We proceeded to check whether the advantage conferred by including I put in the speaker’s utterance maintained for each age group independently, and summary data are shown in Table 3. There was no effect in the youngest group of children [$\chi^2(\text{corrected}, 1, n = 40) = 0.41, \text{N.S.}$] and neither was there any in the oldest group [$\chi^2(\text{corrected}, 1, n = 40) = 1.76, \text{N.S.}$]. Only about half the children in the youngest group correctly interpreted either kind of statement by pointing to the nonmentioned location. In contrast, most of the children in the oldest group correctly pointed to the nonmentioned location following both kinds of statement. In the two intermediate age groups, only about half the children pointed to the nonmentioned location when the statement was opaque (without I put), while nearly all pointed to the nonmentioned location when that could be achieved from a literal reading (with I put): For children aged 4 years -- $\chi^2(\text{corrected}, 1, n = 40) = 10.67, p < .01$; For children aged 5 years -- $\chi^2(\text{corrected}, 1, n = 40) = 8.03, p < .01$.

 Table 3 near here

Miscellaneous analyses. In further analyses, we confirmed that the incidence of correct interpretations for either kind of statement did not differ according to whether the story in which the speaker did not see the exchange was presented first or second. We went on to confirm that carry-over could not explain the effect associated with the wording of the

statement more directly. We isolated data from children whose first story depicted a speaker who did not see the exchange. Combining data from the two intermediate age groups, we still found that children were more likely to point to the nonmentioned location when I put was included in the statement than when excluded.

Discussion

In the stories we presented, two factors could lead participants to interpret an utterance as referring to the item in the location not mentioned. One was the wording of the utterance. If the speaker stated (for example) that he would like the car he put in the garage, then it was largely only the nursery children who failed to point to the car that was currently on the track. The other factor was whether the speaker had seen or not seen the exchange of items. If the speaker did not see the exchange and stated that he would like the car in the garage, even without saying I put, then we can infer that he is referring to the car on the track. Only in the oldest group did a majority interpret the opaque utterance in the no see condition by pointing to the item in the nonmentioned location. Children in the two intermediate age groups found it easier to point to the nonmentioned location when I put was added than to do the same just on the basis of the speaker not seeing the exchange of items (without I put).

It might have been that the children did not even get as far as comprehending the literal meaning fully, in which case they would probably point to the mentioned location by default. If that was the sole basis of their incorrect interpretations, then they would point to the mentioned location whether or not I put was included in the utterance. Indeed, the youngest children did point to the mentioned location just as much when the statement included I put as when omitted, though we cannot be sure that these children remembered the sequence of events.

The data suggest a developmental trend. Although it seems members of the youngest group might have some difficulty comprehending literal meaning fully, slightly older children were able to do that given their success in pointing to the nonmentioned location when the utterance included I put. Even so, they had difficulty correctly identifying the nonmentioned

location when it depended on venturing beyond literal comprehension. Hence, a limiting factor in children's interpretations was an apparent lack of ability to progress beyond the basic comprehension of the utterance proposition. This was evident in our sample up to the age of about 5 years. Only the children in our oldest group (6 years) found it as easy to point to the nonmentioned location when the message was opaque (I put excluded and the speaker did not witness the exchange) as when transparent (I put included).

Curiously, 6 children in the oldest group wrongly pointed to the nonmentioned location when the speaker had seen the exchange in the opaque stories. Perhaps they felt such an answer would demonstrate that they had noticed the exchange. Since the exchange was probably the main feature of the story, perhaps children felt that their answer should reflect this. In consequence, coupled with the fact that the primary focus was on how children handled the stories in which the speaker was ignorant of the exchange, we dispensed with the sees control in the subsequent studies.

Experiment 2

We could characterize the results of Experiment 1 as suggesting that children were defaulting to the mentioned location, and were able to overcome this more easily with the I put cue than without it. Full comprehension would help divert children from the mentioned location in the case of a transparent utterance (I put included) but might actually hamper them in the case of an opaque utterance (I put excluded). In Experiment 2 we presented a modified version of the message-desire utterance (the "superficially ambiguous task") in which the correct response was to point to an item in the mentioned location. In this, the speaker saw an item in Location X, then left the scene. More items were added to that location, and the speaker subsequently asked for the item in Location X. The child's task would thus be to use what they knew of the speaker's belief to disambiguate the utterance. Since children would not need to inhibit pointing to the mentioned location, it might be especially easy for them to demonstrate that they are taking account of the speaker's belief. As before, we included a version in which the utterance included I put to make the problem of reference soluble without recourse to the speaker's belief.

In the control for the superficially ambiguous task, recruiting knowledge about the speaker's belief would not help to single out one of the items in the mentioned location. Since the speaker saw that there were 4 items in the mentioned location, presumably, any of these would satisfy him/her.

Method

Subjects. The participants were 70 girls and 58 boys aged between 4 and 6 years from two state-funded schools in north Staffordshire, UK. The catchment area of the schools had a wide socio-economic range, but was predominantly working class. We split the children into 2 groups of equal size ($n=64$) according to the school class they belonged to: Reception children were mostly aged 5 years (mean, 5;4, range, 4;10 to 5;9); Year 1 children were mostly aged 6 years (mean, 6;4, range, 5;8 to 6;8).

Design & Procedure. Each child listened to two stories, one about cars that was adapted from Experiment 1 and another about teddy bears. One of them was presented in a modified message desire discrepant version. In this, for example, the speaker put one car in the garage and another on the track. Later, in the speaker's absence, the listener protagonist swapped the cars the other way round and then added a further three cars to the one in the garage. Subsequently, the speaker announced from the adjacent room, still without knowing about the movement of cars, "I'd like the one (I put) in the garage please." The experimenter then asked the test question:

"Which car does (speaker) want -- can you point?"

A correct response was to point to the car on the track.

The other story varied according to which group the child belonged to. For half the children, it was in a superficially ambiguous version. The story was similar to the adapted discrepant version, except that the listener protagonist did not swap the cars the other way round, but just added a further three cars to the one in the garage. Apart from that, the utterance and test question were identical, and it was correct to point to the particular car in the garage that the speaker had put there earlier.

The rest of the children heard a similar version, except the speaker remained when the

listener added a further three cars to the one the speaker had already put in the garage. Also, the speaker said, “I’d like one of the cars in the garage please.” and the test question was modified to “Look at all the cars in the garage. Now can you choose one for (speaker)?” This was a control to serve as a point of comparison for children’s judgments in the superficially ambiguous task: Would children single out the item the speaker had put in Location X more frequently in the superficially ambiguous story than in the control?

In this study, we also presented a memory question in the discrepant and superficially ambiguous conditions, such as, “Which car was in the garage first of all?” It was presented either immediately before or after the test question. This would enable us to check whether children interpreted the I put utterances wrongly simply because they had forgotten what happened.

Half the children heard the speaker make requests with I put included in the discrepant and superficially ambiguous stories and half heard the speaker make the request with that phrase omitted. Note that the control story always had the standard worded utterance shown above. The order of stories (discrepant first or second), the order of the test/memory question, the wording of the utterance (I put present or absent) and whether one of the stories was superficially ambiguous or control, formed four factors which were completely crossed with each other. Children were assigned to conditions on a rotating basis. The main features of the design are schematized in Table 4.

Table 4 near here

As in Experiment 1, the experimenter spent time initially with the children in their regular school activities. Testing took place in a quiet room separate from the classroom.

Results

Preliminary analysis. In the discrepant story, the vast majority of children answered the memory question correctly by identifying, for example, which car was in the garage first of all. Only 10 out of 128 answered incorrectly. Children were similarly accurate in the

superficially ambiguous story, with only 3 out of 64 answering wrongly. One of the children who erred on the memory question in the superficially ambiguous story also made a memory error in the discrepant task. Whether children who made memory errors were included or excluded makes no difference to the pattern of data concerning children's interpretation of the utterance. In the following analyses, the children who made a memory error were excluded unless stated otherwise. In a preliminary analysis, we established that there were no effects associated with the presentation order of conditions or questions, and did not consider these factors further. It might have been that answering the memory question provided a hint to take into account the exchange when answering the interpretation question. However, there was no sign of any difference in children's answers whether they had the memory question before or after the interpretation question.

Does the addition of "I put" help children make correct interpretations? We compared responses in the discrepant task with and without the inclusion of I put. Combining both age groups, 37 out of 60 children (62%) pointed correctly to the item in the nonmentioned location when I put was absent. When it was included, 55 out of 58 (95%) pointed correctly to the nonmentioned location. This replicates the finding reported in Experiment 1 that inclusion of I put yielded an increase in successful interpretations: $\chi^2(\text{corrected}, 1, N=118) = 17.07, p < .001$. The effect maintained for each age- group independently (5-year-olds -- $\chi^2(\text{corrected}, 1, n = 56) = 8.06, p < .01$; 6-year-olds -- $\chi^2(\text{corrected}, 1, n = 62) = 7.07, p < .01$), and collapsing over utterance-wording, there was no general age difference in children's correct interpretations: $\chi^2(\text{corrected}, 1, N=118) = 0.96, \underline{N.S.}$

In the superficially ambiguous story, a substantial majority of children correctly identified the item that the speaker put in Location X as the one that s/he was referring to, whether the speaker included or excluded I put in the utterance. Fifty-seven out of the total sample of 61 (93%) pointed to the correct item. This ceiling performance meant that there was no scope in the data for inclusion of I put to help children any further. Still, it is notable that all 4 children who pointed to the wrong item were interpreting an utterance that did not include I put.

Children's ability to disambiguate the utterance. In the following, we did not exclude any who made memory errors, given that such exclusions could not be made from children who judged about the control story, which did not have a memory question. In the superficially ambiguous story, combining the two utterance wording conditions, there was a highly significant preference for the item that the speaker had put in the mentioned location, as shown in 57 out of 64 children (89%): $\chi^2(3, n=64) = 140.38, p < .001$. The effect was apparent for the opaque utterance independently, where 26 out of 32 children (81%) correctly chose the item that the speaker knew was in the mentioned location: $\chi^2(3, n=32) = 54.25, p < .001$. In contrast, in the control story only 9 out of 64 (14%) selected the item that the speaker had put in the mentioned location, and generally there was a lack of preference for any specific item: $\chi^2(3, n=64) = 5.63, N.S.$

Evidently, there was a substantial contrast between the superficially ambiguous and control conditions: $\chi^2(\text{corrected}, 1, N=128) = 69.10, p < .001$. The effect was apparent independently with an opaque utterance [$\chi^2(\text{corrected}, 1, n=64) = 27.67, p < .001$] and with a transparent utterance [$\chi^2(\text{corrected}, 1, n=64) = 39.68, p < .001$]. The results show that children did not have a general preference for the item the speaker put in Location X, but only when that item could be singled out from a literal reading of the utterance (with inclusion of I put) or by taking account of the speaker's informational history.

On the face of things, it appears children found the superficially ambiguous utterance easier to interpret in relation to the speaker's belief than the discrepant one. However, it is difficult to be certain about this given that the two tasks have different baselines. In the discrepant task, failure to take into account the speakers' representation results in pointing to the incorrect item (in the mentioned location). In the superficially ambiguous task, in contrast, failure to take into account the speakers' representation results in pointing at any one of the items in the mentioned location, including the correct one. If all items were equally appealing and salient, then the probability of choosing the correct item by chance alone is .25.

After removing 2 children who made memory errors, 4 pointed to one of the 3 incorrect items in the superficially ambiguous story when I put was excluded. If we assume

that these errors are distributed over the 3 incorrect items without bias, then we can take it that on average, each of the 4 items was singled out on 1.3 occasions purely by chance. Hence, while 26 children in the superficially ambiguous story pointed to the correct item, it is possible that one or perhaps two of these just made a lucky guess, and that at least 24 out of 30 (80%) made a correct interpretation for the correct reason. In the discrepant story, the number correct was 37 out of 60 (62%).

Thirty-two children were presented with both a discrepant and superficially ambiguous story that contained utterances without I put. Five were excluded for making one or more memory errors. Of the remaining 27, 5 made a correct interpretation in the superficially ambiguous story only, while 2 made a correct interpretation in the discrepant story only. As already suggested, we cannot be sure whether there were any false positives among those 5 who were correct exclusively in the superficially ambiguous story.

Discussion

As in the first experiment, inclusion of the phrase I put in the utterance led to more correct interpretations in the discrepant story: This shows that children did not point to the mentioned location when interpreting an utterance in the discrepant story simply because they failed to process literal meaning adequately. If they had not even processed the literal meaning, it might have led them to the mentioned location by default even when I put was included. The advantage conferred by the addition of I put was not apparent in the superficially ambiguous story owing to correct interpretations being at ceiling in that. We have no firm evidence that the superficially ambiguous story resulted in a higher frequency of genuinely correct interpretations compared with the discrepant story. On the other hand, interpreting the superficially ambiguous story posed very little problem for any of the children, even when that depended on recruiting knowledge about the speaker's belief. This at least is consistent with the suggestion that when the possibility of defaulting to the mentioned location is eliminated, little further stands in the way of utilizing knowledge of the speaker's belief as an adjunct to interpretation.

Performance was so good in the superficially ambiguous procedure that it raises the

possibility that even younger children might be able to interpret correctly. In our third experiment, therefore, we included nursery children and compared interpretations of the superficially ambiguous utterance with performance in the control condition in which the speaker was present when more items were added to the array. If substantially more children singled out the correct item in the superficially ambiguous story than chose the item that the speaker had previously handled in the control story, this would demonstrate that as a group children were disambiguating the utterance by recruiting knowledge of the speaker's representation.

Children's performance in the discrepant task generally resembled that reported in Experiment 1, which was that members of Reception and Year 1 classes were very similar. Although most Year 1 children were 6 years old at the time of testing, they seemed to have more in common with the Year 1 Children in Experiment 1 who were mainly aged 5, than the Year 2 children in Experiment 1 who were mostly aged 6.

Experiment 3

As mentioned above we were interested in how nursery children would perform with the superficially ambiguous utterances. We modified the procedure used in Experiment 2 in one respect: It is possible that the presence of the definite article in the utterance in the superficially ambiguous condition provided children with a hint that they should point to the only item that had been in that location originally. For example, the utterance "I'd like the one in the garage please" implies that the speaker is referring to a particular car, but actually there are several cars in the garage. A simple way of deciding which one the speaker wants is to think back to the earlier time when there was only one car in the garage. A child might do this without having any understanding that the speaker's internal representation models the earlier time. If this suggestion is correct, then we might have gained some false positives in the superficially ambiguous condition in Experiment 2. In this experiment the utterance contained no determiner at all, so there were no explicit clues of this kind.

Method

Subjects. The participants were 43 girls and 52 boys, forming two distinct age-groups

from a state-funded school in north Staffordshire, UK. The catchment area of the school had a wide socio-economic range, but was predominantly working class. The 52 children in the nursery class were aged between 3;4 to 4;6 (mean, 4;0). The 43 children in Year 1 were aged between 5;1 and 6;0 (mean, 5;6).

Design & Procedure. Each child listened to 2 stories, one about cars and the other about teddies, which were very similar to those prepared for Experiment 2. As in the previous experiment, there were three story variants: Discrepant, superficially ambiguous and control. Every child had a superficially ambiguous story and for half the children this was supplemented with a discrepant story and for the other half it was accompanied by a control story. At the end of discrepant and superficially ambiguous stories, children answered a memory question as well as an interpretation question. This time the utterance was for example “Um, car in the garage please”, with no determiner at all. At the end of the control story, children were just asked to choose an item for the speaker that was in the mentioned location (rather than a specific item that matched the speaker’s mental representation). Half the children had the superficially ambiguous story first and the rest had it second. Presentation order, question order and story combination were completely crossed with each other, creating 8 between-groups cells. Children were assigned to conditions on a rotating basis. Generally, the procedure was similar to that in the previous two experiments, except for the absence of a condition in which the speaker included I put in his or her utterance. This design allowed us to investigate 2 issues: (1) would children be better at interpreting the message in a superficially ambiguous story than in a discrepant one? (2) would they single out the correct item from the array of 4 in the mentioned location more often in the superficially ambiguous story than in the control?

Results

Preliminary analysis. Given the inclusion of younger children in Experiment 3, it was no surprise to find an increase in the number of errors in answer to the memory question compared with Experiment 2. In the discrepant story, 9 out of 48 (19%) wrongly identified the item that was currently in the mentioned location when asked which item was in Location

X first of all. These errors were confined to the 26 members of the younger sample. In the superficially ambiguous story, 7 children out of the total sample (7%) identified the wrong item in answer to the memory question. Six of those making errors belonged to the 52 forming the younger group (12%). In the following analyses, the children who made a memory error were excluded unless stated otherwise. In a preliminary analysis, we established that there were no effects associated with the presentation order of conditions, and did not consider this factor further.

Did children use information about the speaker's belief to disambiguate his/her utterance? In the superficially ambiguous story, there was a highly significant preference for the item that the speaker had put in the mentioned location, shown by 69 out of 88 children (78%): $\chi^2(3, n=88) = 108.91, p < .001$. The effect was apparent in the younger group independently, where 32 out of 46 children (70%) correctly chose the item that the speaker knew was in the mentioned location: $\chi^2(3, n=46) = 66.52, p < .001$. In contrast, in the control story (with both ages combined), only 10 out of 47 (21%) selected the item that the speaker put in the mentioned location, and generally there was no preference for any specific item under the control condition: $\chi^2(3, n=47) = 1.09, N.S.$ This lack of preference was apparent in both age-groups.

Among children who had both a superficially ambiguous and control story, with the two age-groups combined, there was much greater preference to single out the item the speaker had put in Location X specifically in the superficially ambiguous story: McNemar $\chi^2(\text{corrected}, 1, n = 28) = 15.75, p < .001$. The effect maintained in the sample of younger [$\chi^2(\text{corrected}, 1, n = 15) = 15.75, p < .001$] and older [$\chi^2(\text{corrected}, 1, n = 13) = 7.69, p < .01$] children independently. Those who made memory errors in the superficially ambiguous story were included in these comparisons, given that there was no memory question in the control story, so there was no basis for a balanced exclusion between stories.

Comparisons between discrepant and superficially ambiguous stories. In the complete sample, 36 children had both a discrepant and a superficially ambiguous story and answered all memory questions correctly. Seven made a correct interpretation in the superficially

ambiguous condition only, while 2 made a correct interpretation in the discrepant condition only. The contrast is not significant as it stands and in any case should be considered with respect to the possibility that false positives were probably confined to the superficially ambiguous condition. There were 15 children in the younger group who had both a discrepant and a superficially ambiguous story, and who answered memory questions correctly in both stories. Ten of these made a correct interpretation in the discrepant story, while 13 did so in the superficially ambiguous story. Three children made a correct interpretation in the superficially ambiguous story only, while one made a correct interpretation in the discrepant story only.

Discussion

In Experiment 3, even very many nursery children disambiguated the utterance in the superficially ambiguous condition by pointing to the particular item in Location X that the speaker believed to be there. Children were more likely to select the item in the superficially ambiguous story than in the control in which the speaker knew that there were now several items in location X. As a group, these nursery children demonstrated that they took into account the speaker's belief when they interpreted his or her utterance.

It might have been that children's performance in the superficially ambiguous story deteriorated once the definite article was removed from the speaker's utterance. There was no sign of this, suggesting that children were not simply using the definite article as a clue to identify the item that was initially placed in the mentioned location. It remains a possibility that children interpreted the missing article as definite, but at least we can be sure that children's good performance does not depend on the explicit presence of a definite article.

As in Experiment 2, there was still no firm evidence that children found it easier to take into account the speaker's representation when they could do this by pointing at the mentioned location (as in the superficially ambiguous story), than when they had to point to the nonmentioned location (as in the message desire discrepant story). In the superficially ambiguous task, an impediment to correct interpretation caused by a tendency towards the mentioned location was eliminated. Any advantage conferred by this was not sufficiently

potent to yield a contrast in difficulty between the superficially ambiguous and discrepant task.

General Discussion and Conclusions

We examined children's interpretation of utterances given by speakers with out-of-date knowledge of the relevant situation. In one kind of task the speaker said, for example "I'd like the car I put in the garage". Comprehension of literal meaning would allow children to take this to be referring to the car currently on the track. In a second kind of task the speaker said, for example "I'd like the car in the garage", presumably referring to the car s/he wrongly believed still to be in the garage. In this case, interpreting by pointing to the nonmentioned location implies that the child has processed beyond the literal and has considered the speaker's belief. In the third kind of task the utterance was superficially ambiguous but could be disambiguated by taking into account the speaker's belief: The speaker again asked for "car in the garage" but by now there were several cars in that location. In this task the listener could point to the mentioned location but had to identify the particular car which the speaker believed to be in the garage. In contrast to the discrepant task, literal comprehension would lead the child to the correct location, but that was not sufficient to single out the particular item that the speaker was referring to. Our children found the first of these three kinds of task especially easy, and this was the one in which comprehension of the literal meaning itself would lead to the specific item.

There was no firm evidence of any difference in difficulty between the discrepant and superficially ambiguous tasks with opaque utterances, though in an absolute sense children did perform very well when interpreting a superficially ambiguous utterance. In this task, any tendency to point to the mentioned location by default, which might result from partial comprehension, would not hamper children given that the target item was actually in that location. Hence, children would interpret correctly so long as they considered the speaker's belief, which is something many 3- and 4- year olds did in Experiment 3.

Despite this success amongst the youngest children, not all older ones found opaque utterances trivially simple. In Experiment 1 it was not until about age 6 that children

performed at ceiling in the discrepant task. Slightly younger children in Experiments 1 and 2 made more errors with the opaque utterance “I’d like the car in the garage please” than with the transparent “I’d like the car I put in the garage please”. Children would be hampered by the opaque utterance if they were inclined to be satisfied with literal meaning. Putting it another way, in the opaque task, a correct interpretation depends on children having to discount the item that can be singled out by a literal interpretation, while no such problem arises in the transparent utterance with I put.

As mentioned in the Introduction, it seems from the literature on children’s logical judgments that below about 6 or 7 years they tend to be overly satisfied with the first possible response or interpretation that presents itself to them (e.g., Fabricius, Sophian & Wellman, 1987; Mitchell & Robinson, 1990, 1992; Somerville, Hadkinson & Greenberg, 1979; Sophian & Somerville, 1988). This age trend is strikingly consistent with the one we report in the present article. On this account, children who are aged about 7 and above would not necessarily be captured by their initial literal reading because they are effective in considering a range of possible options, and selecting from them the one that seems most appropriate after considering additional factors (e.g., the state of the speaker’s belief).

Gilbert (1991) argues from a Spinozan perspective that we tend to be conservative and perhaps even somewhat resistant to discounting propositions we have accepted during the process of comprehension. The broader literature on sentence comprehension offers support in suggesting that unacceptance is harder than acceptance. For example, people seem curiously gullible in accepting that contentious utterances reflect the extreme attitudes of a speaker whose articulation is made under the coercion of a figure of authority (Zuckerman, Depaulo & Rosenthal, 1981, for a review). Even when told explicitly that information they comprehended was false, the content of this information seems to adhere to the participant as if they find it hard to ignore or reject what they have comprehended (e.g. Bjork, 1972; Wyer & Budesheim, 1987). Indeed, participants sometimes fail to reject information despite being told a priori that it is false. Gilbert, Tatarodi and Malone (1993) told participants that they were going to receive false information about the character and integrity of a target person

and participants were then asked to pass judgment on that person. When judgments were made under conditions of cognitive load or time pressure, participants tended to behave as if they had been influenced by the false information. Gilbert et al interpreted this as suggesting that participants' literal comprehension of the false information committed them to accepting it as true in the first instance, and that the contrived demands placed upon them in the testing situation denied participants the opportunity to complete a further stage of processing in which they would, presumably, discount the false information.

It seems, then, that participants might be overly committed to the literal meaning of utterances, and only overcome this default position in a subsequent stage of processing. In effect, it seems the default setting might be to treat utterances not as things that arise from a speaker's mental representation of reality, but as a direct reflection of reality. This is understandable to an extent, since referential speech appears to be about reality, but is actually about the speaker's mental model of reality. Utterances relate to a mental model which in turn relates to reality. It seems that people might only apprehend the mediating role of the mind with additional effort that can be applied once the initial stage of literal comprehension is completed.

Although our data are consistent with the account stated above (Gilbert, 1991), it is possible to view them in a different light. When presented with a transparent utterance, children were able to make a correct interpretation with a literal reading and without having to make an inference. When presented with an opaque utterance, a literal reading was not sufficient for a correct interpretation, and children needed to make an inference based on what they knew of the speaker's belief. It might be the additional burden of having to make an inference that accounted for the difference in difficulty between opaque and transparent utterances. We cannot be certain whether it was the process (the inference) or the content (that it involved handling belief) that posed the obstacle. Although this issue is worthy of further consideration, it does beg the question of why children might be able to make a belief based inference developmentally earlier in the domain of predicting a protagonist's search (e.g. Perner et al, 1987), than in the domain of interpreting utterances. Perhaps the

interpretation of utterances should be viewed as a special kind of inferential problem.

However abundant an individual's processing resources, this alone would not be sufficient for children to discount the truth of the proposition encapsulated within an opaque discrepant utterance. It would also be necessary to apprehend the relevance of speaker belief, and to apply knowledge about that to the task of utterance interpretation. Successful interpretation depends on being sensitive to the speaker's perspective. Such sensitivity has obvious functional value, and might even be traced to the early acquisition of vocabulary. As Baldwin and colleagues (e.g. Baldwin, 1993; Baldwin & Moses, 1994; Baldwin, Markman, Bill, Desjardins, Irwin & Tidball, 1996) point out, children would get into difficulties if they construed uttered words only in relation to their own perspective: They would risk mapping new words onto whatever occupied their attention at the time they heard them, rather than mapping them on to the item intended by the speaker. Baldwin et al have shown that from about 18 months, infants can recognize that it is the speaker's attentional focus which is relevant for determining the reference of a new word. From the earliest venture into language, then, children may operate on the basis that it is speakers who decide what their utterances refer to.

The rule that meaning is a prerogative that belongs to the speaker seems to be so ingrained that 6-year-olds tended to apply it inappropriately to circumstances in which no meaning was being conveyed (Robinson & Whittaker, 1986). In this study children played a game in which picture cards were used to indicate which of a set of beads the players were to pick up. When one player deliberately selected a particular card to inform the other which bead to choose, children correctly judged that the one who had chosen the card knew which was the correct bead. However, many children continued to judge in that way when the first player picked a card from a set that was face-down, and had no intention to inform the other about a particular card. Children who made this error indicated in other ways that they had a weak grasp of the distinction between the words spoken and the speaker's mental representation. Hence the explicit judgments of the 6-year-olds revealed that they all followed the convention that it is the sender of a message who has the authority to accept or

reject the receiver's interpretation. They seemed to grasp that it is the sender's perspective which defines correct interpretation, even though some apparently did not yet understand why the sender normally has that authority.

Sensitivity to the speaker's perspective can be treated as one aspect of source monitoring, the process whereby sources of knowledge are encoded and subsequently recalled in order to check the reliability of ones' knowledge (Johnson, Hashtroudi & Lindsay, 1993). At around the age of 4 years, children can report the source of knowledge recently acquired (Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Perner & Ruffman, 1995; Wimmer, Hogrefe & Perner, 1988) and tend to treat information gained by seeing as more reliable than information gained by being told when the two are in conflict (Robinson, 1994; Robinson, Mitchell & Nye, 1995). They also give more weight to information conveyed by a well-informed than an ignorant speaker (Robinson, Champion & Mitchell, 1998). Indeed, they even judge that another person would give priority to information gained from seeing than from an utterance when the two are in conflict, other things being equal (Mitchell, Robinson, Nye & Isaacs, 1997). In these respects, then, listeners aged around 4 years demonstrated sensitivity to the speaker's perspective, though in these tasks they did not need to calculate the speaker's belief in order to interpret the utterance, unlike the tasks reported in this article.

As we pointed out in the Introduction, researchers have given scant attention to the way in which child listeners come to handle the fact that when utterances refer to objects or events in the outside world, they do so via the mind of the speaker. In this article we have begun to trace age-related differences. Our suggestion is that we can increase understanding about development by noting accounts of adult cognitive processes, but the reverse may also be true. Parallels are drawn in previous work between childhood errors and adults' errors under difficult conditions in connection with inferences of beliefs: The realist errors routinely made by preschool children when they infer beliefs have recently been found amongst adults who have limited information (Mitchell, Robinson, Isaacs & Nye 1996) or are carrying out a timed sentence verification task (Barquero & Schnotz, 1997). These results raise the

possibility that the issue of continuity between children and adults in this domain of mentalistic functioning is worthy of further attention (Mitchell, 1996; Mitchell & Taylor, 1999).

One matter raised by our findings and interpretations concerns the possibility that children stand to gain very much more insight into the content of other minds if they are able to use the information in utterances as a source to that effect. From an early age, children might hold the appropriate attitude that meaning lies with the speaker, but it would only be when they applied their understanding of representation to the task of interpretation that they were equipped to make even greater strides in their insights into what others think. In this way, we see that an improving skill in applying an understanding of representation unlocks the door to a valuable source of information about the mind through the medium of verbal communication. Precisely how children's understanding of others' minds is enriched by this emerging skill poses an important question for future research.

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Utterances from minds

Table 1. The ideal pattern of judgments that would be made by a competent participant in Experiment 1. The locations identified in the 4 cells are the places that such a participant would point to. See and not see indicate the state of the speaker's visual access to the exchange of items. Opaque and transparent refer to characteristics of the utterance.

	SEE	NOT SEE
OPAQUE (without "I put")	Location mentioned in utterance	Location NOT mentioned in utterance
TRANSPARENT (with "I put")	Location NOT mentioned in utterance	Location NOT mentioned in utterance

Utterances from minds

Table 2. Number and percentage of children (out of 80 in each cell) who interpreted the speaker's utterance by pointing to the nonmentioned location in Experiment 1. This is deemed a correct judgment in all cells except for opaque/see. The data are combined from the 4 different age-groups.

	SEE	NOT SEE
OPAQUE	15 (19%)	39 (49%)
TRANSPARENT	63 (79%)	66 (83%)

Utterances from minds

Table 3. Number and percentage of children (out of 20 in each cell) who correctly interpreted the speaker's utterance by pointing to the nonmentioned location in Experiment 1. The data are exclusively from the condition in which the speaker did not see the exchange of items.

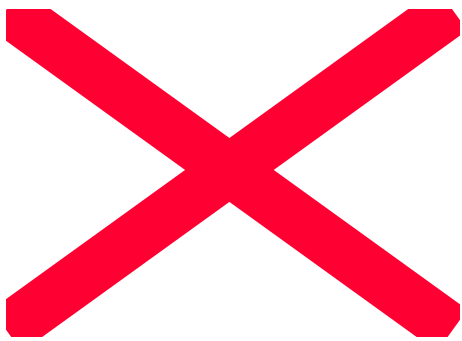
	3 years	4 years	5 years	6 years
Opaque	7 (35%)	7 (35%)	10 (50%)	15 (75%)
Transparent	10 (50%)	18 (90%)	19 (95%)	19 (95%)

Table 4. The ideal pattern of judgments that would be made by a competent participant in Experiment 2. The locations or items identified in the cells show where such a participant would point. Note that opaque and transparent refer to the wording of the utterance in the discrepant and superficially ambiguous stories but not to the control stories.

	DISCREPANT (story 1)	SUPERFICIALLY AMBIGUOUS/ CONTROL (story 2)
OPAQUE (without “I put”)	Location NOT mentioned in utterance	Superficially ambiguous: Item speaker saw in mentioned location
		Control: Any item in mentioned location
TRANSPARENT (with “I put”)	Location NOT mentioned in utterance	Superficially ambiguous: Item speaker saw in mentioned location
		Control: Any item in mentioned location

Figure 1. Line-drawings of the 4 pictures used in the cars story for Experiment 1. These pictures served in the not see condition. In the see condition, David remained in all 4 pictures and was oriented towards Sarah in pictures 3 and 4.

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