

## Young Children's Ability to Identify the Sources of Their Beliefs

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Young children's ability to understand which experiences led to a belief was investigated in 3 studies. Three-, 4-, and 5-year-olds learned about the contents of a toy "tunnel" in three different ways: They saw the contents, were told about them, or felt them. Immediately after each trial, children were asked to state what was in the tunnel and also how they knew about the contents of the tunnel. Three-year-olds had difficulty identifying the sources of their knowledge, while 4- and 5-year-olds did not. Experiment 2 determined that the 3-year-olds' performance was not due to an inability to distinguish between the 3 modes of seeing, telling, and feeling. Experiment 3 compared source questions that did and did not involve inference, and used an even simpler questioning format. Three-year-olds continued to have difficulty identifying all the types of sources, although inference proved to be especially difficult.

As adults, we not only know that we know something, but often we also know how we know something. We know the sources of our beliefs. This knowledge is part of our adult "folk psychology" or "theory of mind"—our commonsense understanding of how our own minds and the minds of others work. Of course, we do not have a complete causal account of how our experiences lead to our current representation of the world. If we did, cognitive psychology would be out of business. However, we do know that a variety of events, including perception, communication, and inference, can lead to beliefs, and much of the time we can identify which particular type of event led to a belief. We recognize, for example, whether we know something through hearsay or through seeing it with our own eyes.

Understanding the origins of our knowledge is an important ability. In particular, knowing which type of event led to a belief plays an important role in evaluating and justifying the belief and in deciding how easily it should be discarded. Social psychological literature (Nisbett & Ross, 1980) suggests that failure to consider the sources of one's knowledge may result in false impressions, interpretations, and beliefs that may have serious consequences.

Recently, a number of studies suggest that children develop important aspects of the causal account of origins of beliefs somewhere between the ages of 3 and 6, and some very simple parts of this account seem to be in place as early as age 3. Given very simple tasks and straightforward questions, 3-year-olds apparently appreciate that there is a relationship between whether or not you look at something and whether or not you know about it. These children seem to know that someone who has not seen an object will not know about that object (Pillow, 1989;

Pratt & Bryant, 1990). They know that visual perception leads to knowledge.

On the other hand, there is evidence showing that an understanding that inference leads to knowledge is much more difficult and may not occur until as late as age 6 (Sodian & Schneider, 1990; Sodian & Wimmer, 1987; Wimmer, Hogrefe, & Sodian, 1988). Sodian and Wimmer (1987) used a task similar to the Pillow (1989) task, but that involved inference. Children had to determine that someone who had been in a position to infer some fact was more likely to know that fact than someone who had not been in such a position. They found that even 4- and 5-year-olds had difficulty with this task—it was not solved until age 6.

Other studies, although not specifically designed to consider inference, show similar results. Chandler and Helm (1984) and Taylor (1988) presented children with a limited view of a picture that did not by itself allow one to infer what the picture was. They then showed them the entire picture and asked children whether someone else who saw only the limited view would be able to identify the picture. Until age 6, children said that the other person would be able to identify it. They failed to appreciate the limits of the other person's inferential capacity.

There is evidence that other tasks involving sources fall between these two extremes. We might differentiate two questions: "Did an experience lead to a belief?" and "Which experience led to the belief?" The Pillow (1989) task asked the first question. It tapped children's understanding of a single type of experience, and asked simply whether that experience led to knowledge. We also might ask whether children can identify which experience led to a particular belief. This question requires that the child differentiate between the possible events that could lead to beliefs, remember which event took place, and relate that event to a particular belief. It is plausible that the second question might be more difficult than the first and that it would be an important part of a full causal account of how experiences and beliefs are related. Certainly, we would need to be able to answer the second question in order to distinguish, for example, between hearsay and eyewitness evidence.

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There is evidence that 3-year-old children do have difficulty identifying which experience led to a belief. In a pilot study, Wimmer, Hogrefe, and Perner (1988) found that 3-year-olds were unable to answer the question, "How do you know that?" Similarly, Pillow (1989) found that, although 3-year-olds could identify which character knew about an object concealed in a box, they were unable to justify their choice by referring to the specific source of the information. Of course, both these findings could simply reflect a general inability to answer open-ended questions like "How do you know?"

A recent study by Gopnik and Graf (1988) directly addressed the issue of whether young children can identify and remember which event was the source of a belief. In their study, 3-, 4- and 5-year-old children learned about the contents of a drawer in three different ways: They saw the contents, were told about the contents, or inferred their identity from a clue. The children were then asked how they knew about the contents of the drawer. In order to avoid the problem of an open-ended question, the source question was presented to the children as a forced choice between three different options that explicitly specified the different possible sources of information. Thus, the question asked was "How do you know there's an *x* inside, did you see it, did I tell you about it or did you figure it out from a clue?" Gopnik and Graf found that the 3-year-olds, even those given a training session, had difficulty identifying the sources of their beliefs, but the 5-year-olds did not.

However, two objections might be raised to this study. First, one of Gopnik and Graf's (1988) sources involved inference—children were asked, "Did you figure it out from a clue?" If children fail to understand inference, then questions involving contrasts between inferences and other types of sources of knowledge may be particularly difficult for them. Although the 3-year-olds in the Gopnik and Graf tasks displayed difficulty in identifying sources, their scores when inference was the source of knowledge were actually significantly higher than those scores when seeing or telling were the sources. This might suggest that the children were actually better at identifying inference as a source of knowledge than they were at identifying other sources. However, there may have been other reasons for this high performance.

A second difficulty with this study was that forced-choice options were not counterbalanced, and the inference option was always presented last. Children may have treated the inference alternative as a kind of default—when in doubt, they always answered with what they heard last—and so received artificially high scores in this condition.

If the potentially confusing inference condition was removed, children might prove to be able to identify which source led to a belief. The first of our studies, therefore, sought to investigate young children's ability to identify the sources of their beliefs using a very simple task, without the potentially confusing inference case, and with three source types that young children would be familiar with and would find easily distinguishable. The forced-choice alternatives in the source question were also counterbalanced in order to avoid possible order effects. SEEING, TELLING, and FEELING were chosen as the three types of source. SEEING and TELLING were obvious choices, because these function as important sources of knowledge early in a child's life. FEELING was chosen because

recent evidence suggests it is easy for children as young as age 3 to reflect on tactile experiences and to differentiate them from the objects that give rise to them. Flavell, Green, and Flavell (1989) report that, in two studies, 3-year-olds performed almost without error on appearance-reality and Level 2 perspective-taking tasks involving tactile appearances.

## Experiment 1

### *Method*

#### *Subjects*

Subjects were children attending Toronto day-care centers. Thirty-six children were tested in all, twelve 3-year-olds (ranging in age from 3-0 to 3-10, mean age = 3-6), twelve 4-year-olds (ranging in age from 4-0 to 4-11, mean age = 4-5), and twelve 5-year-olds (ranging in age from 5-0 to 5-12, mean age = 5-6).

#### *Materials*

A red "tunnel," (approximately 30 × 25 × 15 cm) was constructed out of styrofoam. At either end, the openings were covered by felt flaps. The objects used in the training task were a toy helicopter, a toothbrush, and a plastic cup. In the experimental task, a toy horse, a box of crayons, a toy car, a pair of scissors, a ball, and a plastic spoon were used. The objects were kept in a covered box, and when an object was transferred into the tunnel, it was covered by an opaque scarf.

#### *Procedure*

*Introduction.* With the child and the experimenter seated facing each other across a small table, the tunnel was placed in front of the child. The experimenter told the child: "This is my big red tunnel. In this game I'm going to put different objects in the tunnel. Then I'm going to let you look and see what's inside; or I'm not going to let you look inside but I'll tell you what's inside; or I'll let you put your hands inside the tunnel so you can feel what's inside and guess what it is. Then I'll ask you what's inside and how you knew that's what was inside."

*Training task.* All the children received a brief training session consisting of three trials—one for each of the three types of source information (SEE, TELL, FEEL). The procedure following was very similar to that of the ensuing experimental task, except that the three types of sources were explicitly identified, and the children received feedback about their responses. On the SEE trial, the toy helicopter was placed in the tunnel, and the experimenter said "Lift the tunnel up and look inside. Can you see what's inside?" On the TELL trial, the toothbrush was placed inside the tunnel, and the experimenter said, "This time you can't look inside, but I'm going to tell you what's inside. There's a toothbrush inside." On the FEEL trial, the cup was placed inside the tunnel, and the experimenter said, "This time you can't look inside, but you can put your hands inside and feel what's inside." The order of presentation of the three types of trials was counterbalanced.

In each case, after the children had seen the object in the tunnel, or had been told the identity of the object, or had felt the object in the tunnel, they were asked to identify the object inside the tunnel. The identification question explicitly mentioned the source in each case (e.g., "What did you see inside the tunnel?"). When the children had correctly identified the object, as all did, they received the source question.

Except for the inclusion of explicit feedback regarding their responses, the source question was identical in the training and experimental situations. Following the identification of the object under the tunnel on each trial, the source question was first posed to the child in

the form of an open-ended question: "How do you know that's what's inside the tunnel?" If the children responded immediately, they were scored as either correct or incorrect. In the training session, this was followed by explicit feedback (e.g., "That's right, you *saw* the helicopter" or "No, you *saw* the helicopter"). If the children did not respond immediately, or replied with a general response such as "because," the source question was repeated and the children were then presented with three forced-choice alternatives that specified the different possible sources of information (e.g., "Did you see it, did I tell you or did you feel it?"). The three alternatives were presented separately to the children and they were allowed to respond "yes" or "no." The correct pattern of "yes" and "no" answers was counted as a correct response to the source question. Once again, feedback followed the children's answers to the alternatives in the training task. The order of presentation of the forced-choice alternatives was counterbalanced in the training and experimental task.

*Experimental task.* Following the training task, all the children received six experimental trials. In two SEE trials, the experimenter told the children, "There's something inside the tunnel. Lift the tunnel up." The children saw the object (a toy horse or box of crayons) inside the tunnel, and the tunnel was once again lowered over the object. In the two TELL trials, the experimenter told the children, "There's something inside the tunnel. There's an *x* (a toy car or a pair of scissors) inside." In two FEEL trials, the experimenter told the children, "There's something inside the tunnel. Put your hands inside." The children were then allowed to feel the object (a spoon or a ball) until they had identified it either by naming it aloud automatically, or in response to a prompt of "What's inside?" The children were then asked to remove their hands from the tunnel and to leave the object inside. The order of the six experimental trials was counterbalanced, and no two successive trials were of the same source type. In each trial, after the children had received the information about the object in the tunnel, the children were asked, "What's inside?" Unlike in the training task, this question no longer made mention of the source. When the children had correctly identified the object, as all did in every condition, they then received the source question as described for the training task above, except that no feedback was now given. For example, once they had identified the object, they were asked, "How do you know that's what's inside?" If they did not respond immediately, or responded with a stereotyped response, the question was repeated and followed by the three forced-choice alternatives.

### Results

Children received a score of 0–6 depending on how often they answered the source question (in either open-ended or forced-choice form) correctly in the experimental task. The mean scores are shown in Table 1. A two-way repeated-measures analysis of variance (ANOVA) was performed with the children's score on the source question as the dependent mea-

sure, age as the between-subjects variable, and type of source (SEEING, TELLING, or FEELING) as the within-subjects variable. There was a significant effect of age,  $F(2, 33) = 21.34$ ,  $p < .001$ , with performance increasing across the three age groups. There was no source effect and no Source  $\times$  Age interaction.

Overall, the 3-year-olds answered 41.7% of the experimental questions correctly, and the 4- and 5-year-olds were almost perfect. In this task, the 3-year-olds had a 1/3 chance of answering the open-ended source question correctly, and a 1/8 chance when presented with the forced-choice alternatives. The 3-year-olds almost always (97 of the 108 experimental trials) were unable to answer the open-ended question and so were presented with the forced-choice alternatives. As in Gopnik and Graf (1988), the 3-year-olds' performance was at better than chance level,  $t(11) = 2.87$ ,  $p < .05$ . However, the 3-year-olds' performance was still substantially worse than that of the 4- and 5-year-olds. Post hoc Newman-Keuls tests confirmed a nonlinear effect of age. The difference between the scores of the 4- and 5-year-olds was not significant, but the difference between the scores of the 3- and 4-year-olds was highly significant ( $p < .01$ ).

The children's performance on the source question can also be analyzed by dividing children into those who did and did not make errors in each age group. This analysis also suggests that some 3-year-olds are able to solve these tasks correctly, but that this ability develops between the ages of 3 and 5. The percentage of children who made no errors in each of the age groups was 17%, 75%, and 83% for the 3-, 4-, and 5-year-olds respectively,  $\chi^2(2, N = 36) = 13.03$ ,  $p < .005$ .

The absolute scores of the 3-year-old children in this experiment were slightly, but not significantly, worse than those in the Gopnik and Graf (1988) study, where 60.5% of the "see" and "tell" questions were scored correct (66% overall). However, the probability of scoring correct by chance was also lower in this study, because almost all of the 3-year-olds responded to the three forced-choice alternatives separately. The difference between chance performance and actual performance was almost the same in the two studies: 29.2% in this study and 27.2% in Gopnik and Graf. The number of 3-year-olds who did not make errors (17% in the present study, 42% in the see and tell conditions of Gopnik and Graf) also did not differ significantly between the two studies.

Moreover, like Gopnik and Graf (1988), we found that the training task, which had been designed to make the demands of the experimental task very obvious to the children, did not appear to help the 3-year-olds. Eight of the 4-year-olds answered the first training question correctly, but all 12 answered the last training question correctly, suggesting that the training may have had some benefit for them. However, although four 3-year-olds responded correctly to the source question on the first trial, only three did so on the last trial. The performance of the 3-year-olds did not improve over the three training trials. It is also interesting to note that, on the first training trial, several of the 4- and 5-year-olds contributed more information than was necessary to answer the source question. For example, after seeing the helicopter and having been asked the source question "How do you know that's what's inside?", they responded by describing the features of a helicopter (e.g., "it has twirly things

Table 1  
Mean Score (Maximum = 2) of Subjects in Three Age Groups on Three Source Questions in Experiment 1

Age	Source type			Total
	See	Tell	Feel	
3	0.83	1.00	0.67	2.50
4	1.67	2.00	1.92	5.59
5	1.92	1.83	2.00	5.75

on top"). For these children, to answer "because I saw it" seems too simple and obvious a reply.

No order effects for trials were found for any age groups. Errors were not made more frequently on any one trial than another,  $\chi^2(5, N = 72) = 1.56, p > .1$ . Furthermore, there were no effects of source type. The 3-year-olds did equally poorly regardless of whether the trial involved seeing, hearing about, or feeling the object.

When the incorrect responses of the 3-year-olds who failed all or some of the six experimental trials were examined, several interesting patterns emerged. After the initial "How do you know that's what's inside?" source question, 10 of the 12 children responded on each of the six trials with a stereotyped response such as "I don't know" or "cause," silence, or irrelevant information about the object. When given the three forced-choice alternatives separately, the most common error was to say "yes" to more than one alternative. However, it should be noted that, by and large, the children did not simply answer yes to everything; they did not display a general yes bias. Only 1 of the 3-year-old children answered yes to all three forced-choice alternatives on each of the six experimental trials. The other children answered with yes to all three alternatives on only 8 of 41 incorrect trials. In fact, although most children produced more than one error pattern in responding, the most common error was to say yes to two alternatives of the three (22 errors). Most (90%) of the errors made by the 4-year-olds also involved saying yes to more than one alternative.

## Experiment 2

Experiment 1, then, supported the original Gopnik and Graf (1988) finding. Even without the inference source, 3-year-old children continued to have difficulty in identifying which source led to their belief, but 4-year-olds did not. There are a number of possible explanations for this finding: Identifying sources involves identifying an event in the world (such as an act of seeing), remembering that event, and relating it to a later belief (in this case, the belief that a particular object was in the tunnel). If children were unable to perform any of these subportions of the task, they would have had difficulty identifying the sources of their beliefs. It seemed that identifying and differentiating the various component activities of seeing, feeling, and telling should be possible for children of this age, but we wanted to test this experimentally.

### Method

The subjects were an additional twelve 3-year-olds (ranging in age from 3-1 to 3-10, mean age = 3-6) attending Toronto day-care centers. The materials and procedure for the training and experimental tasks were identical to those described earlier. However, after completing the six experimental trials, the children were introduced to Katie, the experimenter's doll, and were asked if they would help Katie play the same guessing game by helping her find out what was underneath the tunnel. All the children agreed. Then, while Katie was not looking, the children were asked to place one of the toys used previously in the tunnel. Once this was done, the experimenter told the children, "Katie wants to know what's in the tunnel." This statement was followed by one of three questions: "Can you help her SEE?", "Can you TELL her?", or "Can you help her FEEL?" This procedure was repeated an-

other two times so that all three questions were asked with each child. The order of the questions was counterbalanced. The children received a correct score if (a) in the see case they lifted up the tunnel or let Katie look under the end flaps, (b) in the tell case they told Katie the identity of the object in the tunnel, and (c) in the feel case they put Katie's hand inside the tunnel.

### Results

The results of the control task suggest that the 3-year-olds had little trouble identifying the sources themselves or differentiating between the three source types. The mean score of these children on the source question (3.42, 57% correct) did not differ significantly from that of the previous 3-year-olds tested,  $t(22) = 1.03, p > .05$ . Nine of the twelve 3-year-olds (75%) made mistakes on the source question. However, when tested on the control task with Katie, 8 of these 9 children answered all three questions correctly, and 1 child answered two out of the three questions correctly. Overall, 98% of the control questions were answered correctly. Clearly, these children were able to discriminate between the three source types and to identify them linguistically, without difficulty. Nevertheless, they had great difficulty identifying which of the three was the source of their own belief. The problem seemed to stem from an inability to relate the activities the children had engaged in—seeing, telling, and feeling—to their later belief.

### Discussion

The results of Experiments 1 and 2 suggest that many 3-year-olds have difficulty identifying which source led to their belief, regardless of source type. Even though the children were presented with easily discriminable source types, a training task, and a forced-choice source question, the majority of the 3-year-olds could not state how they knew the object was inside the tunnel. The 3-year-olds' performance was in marked contrast to the performance of the 4- and 5-year-olds, who had little trouble with the task. However, the 3-year-olds were not completely unable to identify the sources of their beliefs. As in Gopnik and Graf (1988), their performance was considerably better than chance.

Interestingly, the 3-year-olds in Experiments 1 and 2 did not have less difficulty in the feel condition than in the see or tell condition. This result contrasts with those reported by Flavell, Green, and Flavell (1989), who found 3-year-olds to be very competent at tasks of a similar nature involving tactile appearances. The reason for this discrepancy is not clear.

## Experiment 3

Experiments 1 and 2 demonstrate that children's inability to identify which experience led to their beliefs is not simply a function of their inability to understand inference. Even when inference questions are not asked, many 3-year-old children still have difficulty. The results of these two experiments also suggest that the better performance of the 3-year-olds in the inference condition of the Gopnik and Graf (1988) study may have been an artifact. However, the question remains of whether identifying inference as a source of knowledge is, in fact, more difficult for young children than identifying other

sources of information. Experiment 3 was designed to test this question directly, by comparing source questions that did and did not involve inference. This experiment was also designed to provide another test to see if children were able to better understand feeling than the other types of sources. Finally, it was possible that the three-option forced-choice question presented difficulties for the youngest children. Therefore, in Experiment 3, we presented each child with only two options. Five groups of children were asked questions contrasting see and feel, see and tell, feel and tell, see and infer, and feel and infer. (Because of the possible confusion between *tell* and *infer* we did not include this option.)

### Method

#### Subjects

One hundred twenty children attending Toronto day-care centers participated—twelve 3-year-olds and twelve 4-year-olds in each of the five conditions. The age ranges were 3-0 to 3-11 and 4-0 to 4-11, and per age group the means per condition were 3-6 and 4-5 years old.

#### Materials

The same red tunnel was used as in Experiments 1 and 2. The objects used in the training task were a toy helicopter, a plastic cup, a small children's book, and a toy crib that contained a toy baby. In the experimental task, a pair of scissors, a toy horse, a plastic spoon, a ball, a toothbrush, a toy car, a box of crayons with crayons inside, and an egg carton with an egg inside were used. The objects were kept in a covered box. When an object was transferred into the tunnel it was covered by an opaque scarf.

#### Procedure

The procedure was identical to that of the two previous experiments, except that each child was exposed to only two of the three source types, and an additional INFER condition similar to the infer condition of Gopnik and Graf (1988) was included. In this condition, children were shown a container for an object and were asked to figure out what the object was that belonged inside. In the introduction to Experiment 3, children in this condition were told, "I'm going to give you a chance to find out what's inside by showing you/letting you feel or by letting you figure it out from a clue." In the training trial, children were shown a toy crib and were told, "This time I'm going to give you a clue so you can figure out what's inside the tunnel. What's inside belongs in here" (and the experimenter pointed to the inside of the crib). As in the previous training trials, children received feedback on their responses.

In the experimental trials, the children were shown either an egg carton or a crayon box and were told, "What's inside belongs in here." Each child received two trials with one source type and two trials with the other source type in counterbalanced orders such that no two successive trials were of the same source type. In each condition, the order of the presentation of the two forced-choice options was also counterbalanced across children. Unlike in Experiments 1 and 2, the initial form of the source question was no longer the open-ended question, "How do you know that's what's inside?" Instead, the two relevant forced-choice alternatives were presented immediately. If children did not answer this question, the two alternatives were presented separately. Depending on which alternative the children responded with, the children were scored as correct or incorrect. In the training session, this was followed by explicit feedback as in the previous two experiments.

Table 2  
Mean Score (Maximum = 4) of Subjects in Each Condition per Age Group in Experiment 3

Condition	Age		<i>M</i>
	3	4	
See/feel	3.5	3.58	3.54
See/tell	3.08	4.0	3.54
Tell/feel	3.0	3.82	3.41
Feel/infer	2.58	3.5	3.04
See/infer	1.92	2.92	2.42
<i>M</i>	2.82	3.56	—

### Results

Children received a score of 0-4 depending on how often they answered the source question correctly in the experimental task. The mean scores are shown in Table 2.

A two-way ANOVA was performed with the children's score on the source question as the dependent measure and age and experimental condition as the between-subjects variables. There was a significant effect of age,  $F(1, 119) = 19.286$ ,  $p < .0001$ . Overall, the percentage of correct answers to the source question per age group was 70.4 for the 3-year-olds and 89.2 for the 4-year-olds. There was also a significant effect of experimental condition,  $F(4, 119) = 6.300$ ,  $p < .0001$ . There was no significant Age  $\times$  Condition interaction. Overall, the children (including both 3- and 4-year-olds) were correct on 60.4%, 76.0%, 85.2%, 88.5%, and 88.5% of the see/infer, feel/infer, tell/feel, see/tell, and see/feel questions, respectively. Post hoc Newman-Keuls comparisons revealed that the children's performance was significantly ( $p < .05$ ) worse on the see/infer condition than on all other conditions. The feel/infer condition was significantly more difficult than the three noninference conditions, though significantly easier than see/infer ( $p < .05$ ). Performance did not differ significantly among the three noninference conditions (tell/feel, see/tell, and see/feel).

We can also consider the absolute levels of performance. In doing so, however, it is important to realize that children were much more likely to be scored correct if they responded randomly in this study than in the previous studies. In the three-choice questions in Gopnik and Graf (1988), and Experiments 1 and 2, there was only a 33.3% chance of being scored correct even if the children responded immediately. There was a 12.5% chance of being scored correct if children responded to the three separate yes-no alternatives, as most of the children did. In this experiment, the majority of children in each age group answered the source question in its initial form. Only 6 out of sixty 3-year-olds and 2 out of sixty 4-year-olds needed to be presented with the forced-choice alternatives separately. Thus, children who responded at random had a 50% chance of being correct. Moreover, in this experiment, there was no reason for children to produce the same wrong answer consistently. Although the absolute scores in this task may appear high, with 70% or 80% of the trials scored correct, the children who had no understanding of the task at all, who responded randomly, or

who always gave the same answer to each question, would still be likely to get half the trials right by chance alone.

The 3-year-olds' performance in the see/infer condition did not differ significantly from chance,  $t(11) = 2.01, p > .05$ . Moreover, only one of the children answered all four questions correctly. Although the 4-year-olds' performance differed significantly on this condition from that of the 3-year-olds,  $t(22) = 3.704, p < .05$ , they also had substantial difficulty as 5 of the 12 children made errors. A similar, although somewhat less dramatic pattern held for the feel/infer condition. Again, the performance of the 3-year-olds did not differ significantly from chance,  $t(11) = 2.20, p > .05$ , but did differ significantly from that of the 4-year-olds,  $t(22) = 3.407, p < .05$ . Nine of the twelve 3-year-olds and 4 of the twelve 4-year-olds made errors.

The 3-year-olds did not identify one source type significantly better than another, nor did they show a strong preference for using one source type in their answers. For example, on 15 trials the 3-year-old children said that they had seen the object, when they had actually inferred it. On 10 trials they said they had inferred the object, when they had actually seen it. Similarly, on 10 trials they said they had felt an object, when they had actually inferred it. On 4 trials they said that they had inferred an object, when they had actually felt it. These children did not appear to be consistently interpreting "infer" to mean "see," or using infer as a default option.

The 3-year-olds in the other conditions did show some competence at the task. As in the previous task and the Gopnik and Graf (1988) experiment, these children performed at significantly better than chance levels,  $t(11) = 6.52, 3.76, \text{ and } 3.32$ , respectively, for the see/feel, see/tell, and tell/feel conditions,  $p < .05$  in all cases. However, their performance also differed significantly from that of the 4-year-olds in both tell conditions,  $t(22) = 3.407, 3.307$ , for see/tell and tell/feel conditions, respectively,  $p < .05$  in both cases. In these two conditions, the children did not identify one source type better than another, nor did they show a preference for using one source type in their answers. Rather, they responded with each incorrect alternative equally often. In the see/feel condition, 3-year-olds did show a tendency to respond more often with the incorrect alternative when they had felt the object than when they had seen it. In all three noninference conditions, the most common error pattern (11 of the thirty-six 3-year-olds) was to answer each of the four questions with the same source type (note that these children would be scored correct for 2 questions). Again, no one type of source was preferred.

We can also look at the numbers of 3- and 4-year-olds who made no errors in the noninference conditions of this experiment. The two age groups differed significantly on this measure, as 56% of the 3-year-olds made no errors as compared to 89% of the 4-year-olds,  $\chi^2(1, N = 72) = 7.686, p < .05$ .

We can also compare performance in the non-inference conditions of this task to performance in Experiment 1 and 2 and in the noninference conditions of Gopnik and Graf (1988). Again, although the absolute level of performance in this condition, 79.8%, may seem high in comparison to performance in the previous experiments, this reflects the difference in the number of forced-choice options and in the chance of being correct by random guessing. When we consider the difference between chance level and the absolute level of performance in this exper-

iment, the result, 29.8%, is similar to the 29.2% in Experiment 1, the 44.5% in Experiment 2, and the 32.7% in Gopnik and Graf (1988).

We can also look at the numbers of children who made no errors. Of the children in the noninference conditions of this experiment, 56% made no errors. This was significantly better than the performance of the children in Experiment 1,  $\chi^2(1, N = 58) = 7.74, p < .05$ , but was not significantly different from the performance in Experiment 2, or the noninference conditions in Gopnik and Graf (1988), where 42% of the children made no errors.

### Discussion

The results of Experiment 3 support the hypothesis that understanding inference is more difficult than understanding other types of sources. The performance of all three age groups was poorest in the inference conditions of Experiment 3. Moreover, the absolute performance of these children was strikingly poor. Even 4-year-olds had difficulty with this task.

However, as Experiment 1 had suggested, children's difficulties were not limited to tasks involving inference. Even with only two choices, neither involving inference, many 3-year-olds still had difficulty identifying which event led to their beliefs.

### General Discussion

The results of our three studies are consistent with the results of Wimmer, Hogrefe, and Perner (1988) and Gopnik and Graf (1988), which suggest that many 3-year-old children have difficulty identifying which experience led to their beliefs. These children could identify and differentiate the activities appropriate to the different types of sources, as evidenced in Experiment 2, at least with respect to telling, feeling, and seeing. Presumably, they could remember them as events, since they had taken place only moments before. However, many of the 3-year-olds failed to relate these activities to the beliefs that they led to. Although they could identify them as events, they did not identify them as the sources of particular beliefs.

Moreover, our results elaborate on the nature of this difficulty. First, the results of all our studies suggest that 3-year-olds are not completely unable to answer the source question. However, even when given a question involving only two very simple alternatives, their overall performance is substantially poorer than that of the 4-year-olds—nearly half the children make errors. Second, these difficulties persist despite explicit training in identifying sources in all three experiments.

In fact, given the training, given their ability to differentiate the events, and given the simple two-choice alternatives in Experiment 3, it would have been possible for children to be correct by using a simple strategy of answering the "How do you know?" question by referring back to the event that had just taken place, even without understanding the significance of that event or its relation to the belief. The use of this strategy may have caused us to overestimate children's performance. It is striking to us that many children did not use this strategy and so made errors. These children seemed to treat the question as a genuine question, to which they did not know the answer.

Third, the results of our third experiment lead us to suggest

that certain types of sources are more difficult for young children to identify than others. In particular, like the results of Chandler and Helm (1984), Sodian and Schneider (1990), Sodian and Wimmer (1987), and Taylor (1988), our results suggest that children have difficulty identifying inference as a source of knowledge before at least 5 years of age. In contrast to the other source types, 3-year-olds are at chance on these tasks, and even 4-year-olds have substantial difficulty.

Clearly, the noninference tasks of this experiment were easier than the inference tasks, and more difficult than the simpler Pillow (1989) and Pratt and Bryant (1990) tasks, where 3-year-olds made very few errors and there were no significant differences between 3-year-olds and 4-year-olds. In fact, the pattern of development on the noninference tasks appears to be most similar to the development of a set of other "theories of mind" tasks involving misrepresentation, such as appearance-reality, false-belief, and representational change tasks (Flavell, Flavell, & Green, 1987; Gopnik & Astington, 1988; Perner, Leekam, & Wimmer, 1987; Wimmer & Perner, 1983). Given very simple tasks and very clear procedures, some 3-year-olds (typically between  $\frac{1}{3}$  to  $\frac{1}{2}$  of those tested) demonstrate an understanding of these tasks. However, the performance of 4-year-olds, again given simple tasks and procedures, is almost errorless and similar to adult performance. A number of authors have suggested that there may be a conceptual relationship between understanding aspects of sources and understanding misrepresentations and false beliefs (Gopnik, 1990; Gopnik & Graf, 1988; Perner, in press; Wimmer, Hogrefe, & Sodian, 1988). These data may provide some support for this suggestion.

Why did children find our task more difficult than the Pillow (1989) and Pratt and Bryant (1990) tasks? There are a number of differences between their tasks and our task. Their tasks required that the children identify and remember only a single type of event (looking in the box) and say whether or not that event led to a belief. Our task asked the children to differentiate two or three types of events, remember which event had occurred, and relate that event to a particular current belief.

Experiment 2 demonstrated that the children could indeed differentiate between the three types of events. We do not have direct evidence in these experiments that children could in fact remember which one of these two or three different events took place a very short time before, less than a minute in most cases. However, given children's general memory capacity, it seems unlikely that their difficulty in this task is simply a matter of poor memory per se. This is especially true since the children easily distinguished between the three events in Experiment 2, and the introduction and the training task made it clear that the source was salient information that the children would be expected to remember later.

It seems more likely that the difference in performance on these two tasks reflects the difficulty of relating the events and the beliefs to which they give rise. In the Pillow (1989) and Pratt and Bryant (1990) tasks, this relation is a very simple one: The event takes place or not, and the belief is formed or not. Our task involves a more complex relationship between experiences and beliefs. The child must recognize that there are several different paths that might lead from experiences to beliefs, and they must evaluate which path led to the belief in this particular case. A number of investigators have suggested that children

might shift from a simpler causal model of belief formation to a more complex one in this period (Astington & Gopnik, 1990; Flavell, 1988; Gopnik, 1990; Perner, in press; Pillow, 1989; Wellman, 1990; Wimmer, Hogrefe, & Sodian, 1988). Such a development might be responsible for our findings. If this is correct, our findings complement, rather than contradict, the Pillow (1989) and Pratt and Bryant (1990) results.

The inability to identify which source led to a belief did not seem to be due to a simple memory deficit. It is possible, however, that the ability to remember events as sources of beliefs, and to remember past representations and beliefs, in general, may be different from other types of memory, particularly our simple memory for events. Tulving (1985a) has proposed that there is a distinct form of memory called episodic memory that involves personally experienced events and their temporal relations in subjective time (Tulving, 1985b). What Tulving calls "autonoetic consciousness" is a necessary correlate of episodic memory and it allows us to remember an event as a veridical part of our own past experience (Tulving, 1985a). Thus, we not only know an event has taken place, but we also remember its taking place—we know that we were conscious of the event (Tulving, 1985a). Episodic memory, in short, at least on Tulving's view, involves not only knowing about past events, but knowing about past experiences and beliefs.

Certain kinds of brain-damaged patients show a dissociation between source memory and event memory. It has been suggested that these patients have a specific episodic memory deficit (Schacter, Harbluk, & McLachlan, 1984). Several researchers have suggested that young children may also have deficits in episodic memory and autonoetic consciousness (e.g., Neisser, 1978; Nelson & Gruendel, 1981). Our results as well as those of Gopnik and Graf (1988) and Gopnik and Astington (1988) appear to support this suggestion. Young children may, as Gopnik and Astington (1988) suggest, proceed simply by updating their beliefs as they gain more information about the world, without retaining information about the past history of those beliefs.

The relation between the development of episodic memory and psychological knowledge is a complex one. It is possible that the development of such memory capacities allows children to remember past sources and prior beliefs. It is also possible that the development of psychological understanding, such as the understanding of representation and belief, plays a role in the development of episodic memory and autonoetic consciousness.

A final point of interest about these findings is that, like the Gopnik and Astington (1988) results, they concern children's ability to understand and identify their own mental states rather than their ability to infer the mental states of others. As adults, it might seem that we know about our own mental states simply by introspective inspection of our own minds, rather than by relying on the more general psychological knowledge that allows us to infer the mental states of others from their behavior. In fact, these findings suggest that young children may have difficulty understanding certain types of mental states even when they are their own mental states.

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