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What Children Know About the Source of their Knowledge Without Reporting it *as* the Source.

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Abstract

We argue that, amongst 3- to 5- year-olds, failure to report the source of knowledge recently acquired in answer to "How do you know…?" is due to a specific failure to make a causal inference, in line with source monitoring theory but not fuzzy trace theory. In three Experiments, children (N = 37; 30; 59) identified a hidden toy by seeing, feeling, or by being told, having had two modes of access on each trial, one informative (e.g. seeing a toy identified by colour) and the other uninformative (e.g. being told the toy's colour by the Experimenter who had only felt it). Children who answered the know question wrongly nevertheless reported accurately who saw and who felt the toy, and what the well-informed player had said. They also realised when the Experimenter's uninformative access implied their own knowledge was unreliable, suggesting precocious working understanding of knowledge sources.

What Children Know About the Source of their Knowledge Without Reporting it *as* the Source.

Knowing how we know plays a central role in many aspects of adult decision-making (Johnson, Hashtroudi & Lindsay, 1993), and inaccurate beliefs about the sources of our knowledge can have serious consequences for our assessments of the reliability of our knowledge. For example, a person who believes he has seen for himself something he was only told about, may over-estimate the likely truth of that belief. Adults sometimes make such errors of source attribution, but young children have a much greater problem and make surprising errors under conditions that would be trivially easy for adults. In particular, we have known for twenty years that children aged three to four years are poor at reporting the source of knowledge they have only just acquired (Gopnik & Graf, 1988; Wimmer, Hogrefe & Perner, 1988), and interpretations made on the basis of these early studies remain largely unchallenged. In a typical study children gain knowledge about an object by seeing it, or feeling it, or being told about it. Shortly afterwards they are asked to report back what they know, and how they know it. Children aged 3- to 4- years are usually accurate at reporting the content of their knowledge, but relatively poor at saying how they know, how they found out, or how they learned the item in question (e.g. Drummey & Newcombe, 2002; Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Perner & Ruffman, 1995; Taylor, Esbensen & Bennett, 1994; Wimmer, Hogrefe & Perner, 1988).

Within the literature on children's developing conceptions of the mind, such source reporting errors are treated as an indication of a failure to understand the causal

connection between information access and knowledge state. As such, they are considered to be qualitatively different from adults' source attribution errors. Importantly, errors suggesting a similar failure to understand about the knowing process occur in a number of quite different tasks, suggesting that children do not simply misunderstand the intended meaning of the question "How do you know…?" (e.g. Naito, 2003; O'Neill, Astington & Flavell, 1992; O'Neill & Chong, 2001; Pillow, 1993). For example, 3- to 4- year olds make incorrect decisions about whether to look at or feel an object to find out its colour (O'Neill, Astington & Flavell, 1992; Pillow, 1993), and they are poor at re-enacting what they just did to find out an object's smell or feel (O'Neill & Chong, 2001).

Although there is widespread agreement that young children's errors in reporting how they know arise from failure to understand the causal connection between information access and knowledge state, it remains unclear precisely what their difficulty comprises. We consider two possibilities and relate these to two contrasting theoretical accounts: Source monitoring theory and fuzzy trace theory.

First, children's difficulty answering "How do you know….?" could be *confined* to making the causal inference. O'Neill & Gopnik (1991) seem to take this view: "....Many 3-year-old children had difficulty identifying which experience led to their beliefs. … 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." (p 395). This view could readily be accommodated by source monitoring theory (Johnson, Hashtroudi & Lindsay, 1993) according to which decision processes, whether automatic or deliberate, take place at the time of remembering, resulting in an attribution of source. That is, there is a conceptual separation between the information encoded in memory, and the decision

processes upon that information. This makes it possible for the theory to accommodate the case of recollection of relevant source information (what was experienced) yet failure to make the appropriate source attribution (inferring the experience as causally connected to the knowledge state). Johnson et al.'s account does not take a developmental perspective and so they do not consider the case of an individual who lacks understanding of a causal connection between information access and consequent belief. In fact the account assumes that this underlying understanding is in place. What is important for our purposes is that there is an explicit separation between memory of a knowledge-gaining episode, and the subsequent inference based on that memory of the knowledge source. These authors state, for example: "…..source monitoring depends not only on the quality of the information as encoded but also on the quality of the decision processes when source-monitoring judgments are made…." (Johnson et al., 1993, p.6) In principle it would be possible therefore, within this account, to recollect the source, for example "I saw it," without necessarily treating it *as* the source "I know because I saw it."

A second possibility is that children's difficulty answering "how do you know…?" arises from a broader failure to encode or remember the events that surrounded the acquisition of knowledge. Perner and Ruffman (1995) make an argument along these lines: Because children do not understand the causal connection between information access and knowledge state, they fail to lay down episodic memories of the relevant experiences. Similarly, the characterisation of children as suffering from source amnesia (O'Neill & Chong, 2001) seems to be consistent with this second possibility. The broader deficit specified in this second possibility could be accommodated by fuzzy trace theory (Brainerd & Reyna, 2004). This treats source not as an inference but as an item in verbatim memory. Knowledge content can be

retained in gist form once verbatim memory has decayed, leading to loss of source information. The important point for our purposes is that fuzzy trace theory leaves no room for a distinction between recall of what happened (e.g. "I saw it") and interpreting this *as* the source of one's knowledge.

To summarize: The possibility of children remembering accurately what happened during a knowledge-gaining episode, while failing to realise how their knowledge was acquired, follows readily from source monitoring theory, but is hard to accommodate within fuzzy trace theory. Fuzzy trace theory conflates source memory (for example, "I saw it") with treating the source *as* a source ("I know because I saw it"), while source monitoring theory specifies an inferential process distinct from the laying down of memories of what happened. Given these different ways of conceiving of source memory, it is of theoretical interest to find out whether children who fail to report how they know, can indeed, as O'Neill and Gopnik (1991) assumed, recall the relevant events leading to knowledge acquisition. Note that although in the above discussion we have sometimes implied a simple dichotomy between being able to report the source of one's knowledge or not, we do not envisage that children make a sudden leap from complete failure to understand, to adult-like understanding of the causal connection between information access and knowledge state. For experimental purposes it is often convenient to place children into categories even if we assume an underlying continuum in development.

Children and adults clearly do make errors in reporting events which led up to knowledge acquisition under some circumstances. For example, in research on children's suggestibility and eye witness testimony, participants are typically asked to report whether they saw or were told about an event, and of course it is the errors made which are of interest in this research (for example research reported by Roberts

& Blades, 2000). The complexity of events and the timescales involved are much greater than in research on children's developing understanding about the mind, and so the fact that children commonly make errors of source recall in such research tells us little about the likely accuracy of immediate recall in simpler situations. In any case, we do not know whether or not children would make the same errors if asked "How do you know…?" rather than, for example "Did you see it…?" Interestingly, in this literature reporting one's source and reporting it *as* a source are not differentiated. One aim of the research reported here was to examine empirically this distinction: Just what, if anything, can children report about the sources of their knowledge without reporting them *as* sources?

We were particularly interested in children's realisation of when their knowledge was gained from another person's utterances. It can be important to realise when we gained knowledge indirectly via another person, rather than from our own direct experience. For example, a person who wrongly assumed they had direct experience of an event might give too much weight to their knowledge, and hold on to it in the face of subsequent contradicting information. This person might be overly confident in passing on the knowledge to others, perpetuating what might be false rumour. She might provide inaccurate evidence in a legal setting in which she is required to report only direct experience (Principe & Ceci, 2002; Principe & Kanaya, 2003; Principe, Kanaya, Ceci & Singh, 2006).

So far we have considered only verbally explicit reports about sources and the bases of knowledge. However, as Johnson et al. (1993) point out, much of our source monitoring activity is automatic rather than deliberate. Children might reveal *working* understanding of the causal connection between information access and knowledge state, even if they fail to report explicitly how they know something. In the research

reported below, we investigated that possibility in order to characterise more precisely just what children's difficulty was in answering the explicit question "How do you know….?"

In all three experiments reported below the procedures were modifications of one used previously (Whitcombe & Robinson, 2000; Robinson & Whitcombe, 2003). In those studies, on each of a series of trials child and experimenter played a game to identify which one of a pair of toys was hidden inside a tunnel, in an elaboration of O'Neill, Astington and Flavell's (1992) procedure. Toys within the pair either felt the same but looked different, or looked the same but felt different. On each trial one player felt the toy and the other saw it, so one had informative access and the other did not. Both players said which toy they thought it was, the experimenter's suggestion contradicting the child's. Then the child made the final judgment about the toy's identity. When the chid had uninformative access she therefore had the opportunity to revise her judgment based on the well-informed experimenter's suggestion. Children aged 3- and 4- years performed near ceiling at accepting the experimenter's suggestion when she was the better informed, but rejecting it when she was less well informed than the child. Importantly, when both players had uninformative access, children were less likely to accept the experimenter's suggestion than when the experimenter was well-informed and the child was poorly informed: Children did not believe the experimenter simply because they themselves were unsure, but took into account the speaker's information access.

In the experiments reported below we assumed that children would show this correct pattern of gaining knowledge from their own direct experience when that was informative, and gaining knowledge from the experimenter when he was well-informed. We used these knowledge-gaining circumstances to examine what children

understood, or could report, about their process of gaining knowledge. In all three experiments children were asked the standard question used in theory of mind research to assess children's understanding of the source of their knowledge: "How do you know it's (the hard one)?" This assessed their verbally explicit understanding of the causal connection between information access and knowledge state.

Importantly, unlike the classic research cited above (e.g. Wimmer, Hogrefe & Perner, 1988; Gopnik & Graf, 1988) on each trial children experienced *two* potential knowledge sources. For example, they both saw the toy and were told which one the Experimenter, who had felt it, thought it was. Hence to answer the "How do you know…?" question correctly, children had to realise which of those two potential sources they in fact relied on. In the procedure typically used, children experience only a single source on each trial and so in principle could report correctly, for example, "I saw it" without necessarily understanding "I know because I saw it."

In Experiments 1 and 2 we examined the relation between (i) the accuracy of children's reporting of how they got to know which toy was in the tunnel, and (ii) the accuracy of their reports of the relevant surrounding events: Who looked and who felt in Experiment 1, and who had said the right thing and what the well-informed player had said in Experiment 2.

One possibility was that performance on (i) and (ii) would be associated in that children who could not report how they knew which toy was in the tunnel also failed to report these events relevant to the knowing process. If so this would suggest a problem of attention to sources either at input or at recall, associated with or as part of identification of sources *as* sources. Another possibility was that children might fail at (i) but succeed at (ii). If so, this would pin-point children's errors in answer to "How do you know…?" specifically to the causal inference.

In the final experiment, Experiment 3, in addition to asking children to report how they knew the hidden toy's identity, we examined their working understanding of the source of their knowledge. We gave children the opportunity to express uncertainty about their knowledge after the Experimenter doubted that he had seen or felt the toy adequately. The Experimenter's expression of doubt about his access had implications for the accuracy of the child's belief about the toy's identity when the child had relied on the Experimenter's suggestion. In contrast it was irrelevant when the child herself had had informative access (Robinson, Haigh & Nurmsoo, 2006). Children who correctly realised when the Experimenter's doubt about his access had implications for their own belief, revealed working understanding of the source of their knowledge. We were interested in the relationship between children's explicit reports of how they knew which toy was in the tunnel, and their working understanding.

Taken together, the results of the three experiments would help us to characterise more precisely what children's difficulty is when they fail to report how they know.

Experiment 1

We began by comparing children's ability to report the source of their knowledge in answer to "Who saw, who felt….", and their ability to report it *as* a source in answer to "How do you know…?" As mentioned above, logically a child might realise how she had experienced an object without inferring that that experience is causally related to her knowledge state. Such a distinction is readily accommodated by source monitoring theory, but not by fuzzy trace theory.

Method

Materials. We used a tunnel (150mm x 150mm x 350mm), open at both ends with a viewing window (120mm x 120mm) cut into one side. The viewing window was covered by transparent Perspex to prevent inquisitive fingers feeling inside and had a curtain that could be drawn to obscure the view inside when necessary. Each end of the tunnel also had a curtain through which an arm could be placed to feel inside, but which prevented children from seeing inside. Eight pairs of toys were used, one pair for each of the 2 warm-up and 6 experimental trials. The toys within a pair differed either in how they felt or in colour: Four pairs (stylised cats, lions, teddy bears and frogs) looked the same but one felt hard and the other soft; the other 4 pairs (bears, ducks, cats and rabbits) felt the same but differed in colour. A mole glove puppet, called 'Mole', operated by the experimenter, was used to place the pairs of toys in a bag and then secretly place one of the pair into the tunnel. Mole also asked the identity questions.

Participants. We tested 37 children (15 boys and 22 girls; age range, 3;6 to 5;5 mean = 4;7). Eighteen were from a nursery class: age range, 3;6 to 4;4 mean = 4;1. Nineteen were from a reception class: age range, 4;4 to 5;5 mean = 4;11. All children attended schools serving mixed white and Asian, working and middle class catchment areas of Staffordshire, U.K, and had adequate command of English.

Design and procedure. On two warm-up trials, children were introduced to Mole, the pairs of toys and their properties, and the tunnel, and practised looking at and feeling a toy placed inside the tunnel. The Experimenter told children that sometimes they would know which toy was inside the tunnel because they had seen or felt it and sometimes they would know because he had told them.

Four experimental trials followed. On two of these (*direct trials*) the child could identity the hidden toy accurately from her own direct access, seeing on one

trial and feeling on the other, while the Experimenter had uninformative access. On the other two experimental trials (*tell trials*) the child had uninformative access and the Experimenter had informative access, again once through feeling and once through seeing. All possible orders of trial types were cycled across children. In addition, half the children received the "How do you know…?" question before the being asked to report each player's experience, and half received the other order.

What follows is the procedure for a *tell trial* on which the Experimenter was well informed by feeling inside the tunnel and the child was poorly informed by looking.

1. The child saw and felt both toys in a pair and agreed that they looked the same but one was hard and one was soft. Both toys were placed in a bag, shaken up, and Mole, operated by the experimenter, slipped one of them in secret into the tunnel.
2. The Experimenter invited the child to look inside and said "Tell me which [frog] you think it is". The child replied.
3. The curtain was lowered over the viewing window and the experimenter felt inside saying "I'll feel and tell you which [frog] I think it is." The Experimenter gave a suggestion that contradicted the child's, even if the child happened to guess correctly. Since children made no direct check at the end of the trial, any deception was undetected. At this point we relied on the previous findings mentioned above, that children usually believe what they are told by a well-informed Experimenter, and rely on their own experience when they are well-informed.
4. The Experimenter asked the *know question:* "Now you know which toy is inside. How do you know which one it is?" with counterbalanced prompts if necessary such as "Do you know because you saw it, or because I told you about it?"

5. For half the children the know question was followed by the *experience questions*, and the remaining children had the reverse order. The *experience questions* asked them to report each player's direct experience: "Who looked inside that time?" and "Who felt inside that time?" (counterbalanced).

The procedure was similar with appropriate modifications on tell trials when the Experimenter was well informed by seeing, and on *direct knowledge* trials, when the child was well informed by seeing or by feeling. When the Experimenter was poorly informed he always gave the incorrect identity (by unobtrusively checking which toy was placed inside the tunnel) so that the child would always contradict him on the basis of her informative access. On all experimental trials the player with uninformative access went first. This was to avoid the circumstance of the Experimenter hearing a well-informed child's suggestion but then contradicting it on the basis of uninformative access. Such irrational behaviour on the part of the Experimenter could call his trustworthiness into question or confuse the child as to the purpose of the game.

Results and Discussion

Preliminary analyses of order effects revealed no systematic differences or interactions between order of questions and age, trial or question, so order was not considered further. We used a strict criterion for success at reporting experience: Children had to report accurately both their own and the Experimenter's experience on a particular trial to gain a score of 1. Children were given a score of 1 for each correct answer to the know question. Each child gained a score of 0, 1 or 2 for: (i) experience reports on direct trials; (ii) experience reports on tell trials, (iii) know reports on direct; and (iv) know reports on tell trials. Mean scores appear in Table 1.

A 2 x 2 x 2 ANOVA was carried out on the within-child variables of question (experience *vs*. know question) and trial type (direct *vs*. tell) and the between-child variable of age (older *vs*. younger). The use of a more stringent rejection region of 0.025 due to heterogeneity of variance did not affect any significant results. Significant main effects of age, question and trial type were found: F (1, 35) = 22.42, MS_e = 0.88, $p < .001$, F (1, 35) = 11.14, MS_e = 0.55, $p = .002$ and F (1, 35) = 18.27, MS_e = .49, $p < .001$ respectively. No other significant effects were found.

The main effect of age arose because older children performed better than younger children. The main effect of question type arose because children were better at recalling who had looked and who had felt than they were at answering how they knew. The main effect of trial type arose because children were better on the direct knowledge trials than on the tell trials.

It is clear from these results that children performed better at reporting their own and the Experimenter's sources of knowledge than they did at reporting their source *as* a source of knowledge. One possibility is that children simply failed to understand the know question, despite really understanding how they knew the toy's identity. We can argue against this. Children's answers to the know question were more accurate when the correct answer was "I know because I saw it" or "I know because I felt it", than when the correct answer was "I know because you told me." This suggests that some children understood the know question, and also understood when their knowledge arose from seeing or feeling the hidden toy, without yet understanding when their knowledge came from the Experimenter. Hence the difference between accuracy of answers to the know and experience questions on tell trials at least cannot be explained in terms of failure to understand what the know question meant.

A more likely possibility is that children could recollect how each person had accessed the hidden toy without yet being able to infer how they got to know the toy's identity. This is in line with source monitoring theory, which treats source judgments as inferences. The finding cannot, however, be accommodated by fuzzy trace theory, which treats source information as directly encoded.

Finally, we consider why children found it more difficult to report accurately "I know because you told me" than "I know because I saw it" or "I know because I felt it." Additional reasoning may be involved in attributing an utterance as a source, compared with direct experience: The child may have to recollect what the speaker said as well as the speaker's information access and any other information relevant to the speaker's reliability (Bright-Paul, personal communication, 2005). Another possibility is that some pre-school children consider only direct experiences to be potential sources. We already know that children who understand about seeing as a source of knowledge may not understand about logical inference as a source. Children who themselves make a correct inference about the content of a bag tend to deny that another person who is in a position to make that same inference, will know what is in the bag (Keenan, Ruffman & Olson, 1994; Sodian & Wimmer, 1987). Just as children apparently make inferences without understanding that they or others do so, children may gain knowledge about the world from utterances without understanding that they are doing so.

Direct sources may be relatively easy to understand because of the straightforward relationship between mode of access and type of knowledge gained: Seeing almost always provides knowledge about colour whereas feeling never does; feeling almost always provides knowledge about hardness whereas seeing often does not. In contrast, no general rule can be learned about what kind of knowledge is to be

gained from utterances, since utterances can provide knowledge about absolutely anything, but they can also be unreliable sources of knowledge about anything. It may be the very power of utterances as sources of knowledge about the world, the range of knowledge that can be gained, that makes it difficult for children to come to understand that they are sources.

Experiment 2

Having shown that children who failed to report their source *as* a source could nevertheless recall each player's experience, next we asked children to recall verbatim what was said by the well informed person and which player had said the right thing. Would we again find that children can report accurately the relevant events surrounding their knowledge acquisition without making a causal inference about how they knew?

Participants. Thirty children (13 girls) took part. Their age range was 3;6 to 4;10, mean = 4;3). All children attended schools serving mixed white and Asian, working and middle class catchment areas of Staffordshire, UK, and had adequate command of English.

Procedure. The procedure was the same as in Experiment 1, except that the experience questions were replaced by *tell questions*: "Who said the right thing that time?" with a counterbalanced prompt of "You" or "Me" when needed. Children were then asked what was said by the player who had been well informed, for example "What did I say was inside that time?" The tell questions were always asked in this order, which made the better sense in practice.

Results and Discussion

To gain credit for correct answers to the tell questions on a particular trial the child had to answer both questions correctly (Who said the right thing? What did the

well informed person say?). Mean scores out of 4 for the know and tell questions were 1.63 (1.40) and 3.07 (1.11) respectively: t (29) = 6.74, $p < .001$. That is, children found it easier to answer the tell questions than the know question. As in Experiment 1, order of test questions had no effect. Some children who correctly recalled that the experimenter had said the right thing, and reported what he had said, then apparently failed to infer "I know which one it is because you told me."

Results of the first two experiments suggest that children may have available all the information that would be sufficient for an adult to infer correctly that their source of knowledge was an utterance, and yet still fail to answer the know question correctly.

Experiment 3

Given children's ability to access the information necessary for inferring how they knew which toy was in the tunnel, in Experiment 3 we investigated whether children revealed *working* understanding of the causal connection between information access and knowledge state, even if they could not make a verbally explicit report. We again asked children to report explicitly how they knew the hidden toy's identity in a version of the tunnel game used in Experiments 1 and 2, but this time we compared accuracy of children's answers with their working understanding of the source of their knowledge. We assessed this with a procedure devised by Robinson, Haigh and Nurmsoo (2006), to find out whether or not children reasoned along the lines of: "I believed what you told me because I thought you were well-informed. If after all you were not well-informed then my belief could be false." Children found out whether the hard or soft toy was in the tunnel, either by feeling it themselves, or by accepting the suggestion from the Experimenter who had felt it. After children had announced which toy was in the tunnel, the Experimenter

expressed doubt that he had felt the toy properly. The child was then asked whether it could be the other toy of the pair. Children who understood how they got to know the toy's identity, should accept that it could be the other toy when they had relied on the Experimenter's suggestion, but deny that it could be when they had themselves felt the toy.

Robinson et al. (2006) found that children aged 3- to 4- years showed that pattern of responses. For example in Robinson et al. (2006) Experiment 4, 81 % said "No" it could not be the other toy on both of two trials following the speaker's doubt about his access when they had themselves had informative access, whereas only 40% said "No" on both of two trials when they had relied on the speaker's suggestion, and the remainder accepted at least once that it could be the other toy. Children responded no differently whether it was a puppet, rather than the Experimenter, who felt the toy in the tunnel and expressed doubt about his access: Children attended to the speaker role rather than to the Experimenter as an individual. Importantly, on trials when children had relied on the Experimenter's suggestion, they were less likely to accept that it could be the other toy in the tunnel when a puppet observer expressed doubt about the hidden toy's identity without giving any reason, than when the Experimenter expressed doubts about his access. Even though the puppet observer said explicitly, for example "I'm not sure it's the [hard cat]," children were *less* likely to accept that it could be the soft cat than when the Experimenter said "I'm not sure I felt properly."

Importantly, this was the case only when children had in fact relied on the Experimenter as their knowledge source. When children had found out the toy's identity by their own direct access, they were no more likely to accept that it could be the other toy when the Experimenter doubted his access than when the puppet

doubted the toy's identity. This pattern of data cannot be explained simply in terms of a greater inclination to answer "Yes" to "Could it be the other toy?" when the Experimenter rather than a puppet asked the question (even though it was the puppet rather than the Experimenter who said "I'm not sure it's [the hard cat]" and the Experimenter made no direct comment on the toys identity). Rather, children's responses took into account the source of their knowledge. In any case, the fact that nearly all children responded "No" rather than "Yes" to the Experimenter's question "Could it be the [other toy]?" when they had informative direct access themselves, suggests that any authority they saw in the Experimenter did not lead to them unthinkingly to say "Yes."

In Experiment 3, we were interested in the relationship between children's explicit judgments of how they knew which toy was in the tunnel, and their responses to the Experimenter's doubt about his access when they had relied on his suggestion about the toy's identity. One possibility was that only children who could report that the Experimenter had told them which toy was in the tunnel, would realise the specific implications of having believed a speaker who was not as well-informed as he had originally seemed. On the other hand, the correct reporting in Experiments 1 and 2 of the Experimenter's experience and of what he said raise the possibility that children would be able to make use of that information to work out the implications of the Experimenter's doubt about his access.

Method

Participants. The sample comprised 59 children, (35 girls) 33 from nursery classes (age range 3y; 7m to 4y; 7m, mean = 4y; 1m) and 26 from reception classes in their first year of formal schooling (age range 4y; 7m to 5y; 6m, mean = 5y; 0m). All

children attended schools serving mixed white and Asian, working and middle class catchment areas of northern UK and had adequate command of English.

Materials. Toys, tunnel and puppet Mole were used as in Experiments 1 and 2. Four pairs of toys were either soft or hard but looked the same and 4 pairs were different colours but felt the same.

Procedure. Children began with two warm-up trials on which they practised seeing and feeling toys inside the tunnel, and being told about the hidden toy by the Experimenter. They received explicit feedback about how they knew the toy's identity. Six subsequent experimental trials were cycled in counterbalanced order so that each trial type appeared in each position in the sequence. Children received 4 trials on which they were asked the *know question* as in Experiments 1 and 2 (e.g. "How did you know it was the hard frog?" with prompts if necessary). On two of these trials they could identify the toy from their own direct experience, seeing on one and feeling on the other (*direct trials*). On the other two trials they had uninformative access and could rely on the well-informed Experimenter's suggestion, once when he had seen and once when he had felt the hidden toy (*tell trials*). The trials on which children had informative access to the toy served to give children turns at being well-informed, to demonstrate that the Experimenter was wrong when poorly informed, and to ensure that the correct answer to the know question was not always "Because you told me."

Two further trials followed a slightly modified procedure. Half the children entered the *Experimenter doubt* condition. The procedure on these trials is detailed below. Stages 1 to 4 served only to lead children to gain knowledge either directly or from the Experimenter. The novel part of the procedure is at stage (v):

1. The child was introduced to a pair of toys and agreed on their properties. Both toys were placed in the bag, shaken, and one toy was slipped from the bag into the tunnel.

2. The Experimenter either looked or felt the toy in the tunnel, saying "Now I'm going to look / feel inside and tell you which toy I think is inside." He then identified the toy correctly, for example "The soft cat."

3. The child was then invited to look at (when the Experimenter had felt) or feel (when the Experimenter had looked at) the toy inside the tunnel.

4. The puppet Mole then asked the child an *identity question,* "Which one is inside please?" Since the child had uninformative access, she could answer the identity question correctly by relying on the well-informed Experimenter's suggestion. If the child's identity judgment on a tell trial was not in line with the Experimenter's suggestion but instead referred to the other toy, the trial was terminated. When the child repeated the Experimenter's suggestion the trial continued:

5. The Experimenter doubted the reliability of his access, saying, "I'm not sure I looked / felt inside properly" followed by the *doubt question*: "Could it be the [other toy]?"

6. After the child's response, the Child and Experimenter removed the toy from the tunnel to check its identity.

The other half of the children, allocated alternatively, entered the *Mole doubt* condition. The procedure was the same as for those in the Experimenter doubt condition, except at stage (v) of the procedure. Instead of the Experimenter doubting his access, the puppet Mole said "I'm not sure it's the [soft cat]", followed by the *doubt question*.

Results and Discussion

Since we were interested only in children who had acquired knowledge from an apparently well-informed speaker, all children who entered the analyses had answered the identity question at stage 4 in line with the Experimenters' suggestion. Children received a score of 0, 1 or 2 for the number of correct responses to the know question on tell trials, and similarly on direct trials. As in Experiment 1, the mean score (sd) was lower on tell trials, when the correct answer was "I know because you told me" than on direct trials, when the correct answer was "I know because I saw it" or "… because I felt it": 1.19 (.900) and 1.61 (.743) respectively, t (df = 58) = 3.64, $p < .001$. Again, this suggests that children who failed the know question did not just fail to understand what the question meant.

Children also received a score out of 2 for the number of "No" responses to the doubt question. We were primarily interested in the relationship between children's responses to the know question on tell trials (whether they reported that they knew because the Experimenter had told them), and their responses to the doubt questions in the Experimenter and Mole doubt conditions (whether they more frequently accepted that it could be the other toy when the speaker doubted his access than when an observer doubted the toy's identity without giving a reason). These results appear in Table 2. We subjected children's responses to the doubt question to a 3 x 2 x 2 between-group ANOVA, with the variables source scores on tell trials (0,1,2), age group (nursery, 3 - 4 years *vs*. reception, 4 - 5 years) and condition (Mole *vs* Experimenter's doubt). There was a between-child main effect for condition only: F (1, N = 59) = 8.88, $p = .005$. Children responded with "No" (it couldn't be the other toy) significantly more often in the Mole doubt condition (mean 1.27) than in than the Experimenter doubt condition (mean .45). Importantly, there was no sign of

an interaction between condition and scores on the source question. Children who failed the source question showed no less discrimination between Mole and the Experimenter's expression of doubt than did children who explicitly understood that the Experimenter was their source of knowledge.

Our interpretation of these results relies on the previous finding (Robinson, Haigh & Nurmsoo, 2006), explained above, that children treated the Experimenter and a puppet no differently when either was the speaker who expressed doubt about his access. Given this finding, we can argue that children's differential responses in the Experimenter and Mole doubt conditions in Experiment 3 reflect their sensitivity to the specific implications of the speaker's doubt about his access, for example "I'm not sure I felt properly." Children were *more* inclined to accept that it could be the other toy in the Experimenter doubt condition despite the fact that the Experimenter expressed no doubt about the toy's identity, whereas Mole did express such doubt in the Mole doubt condition, saying for example "I'm not sure it's the [soft cat]." Children who did not report explicitly "I know because you told me" nevertheless behaved as if they reasoned along the lines of : "I believed what you told me because I thought you were well-informed. If after all you were not well-informed then my belief could be false." That is, they exhibited working understanding of the source of their knowledge.

General Discussion and Conclusions

In the research presented here we aimed to clarify what underlies children's errors in answer to the classic question "How do you know….?" Errors cannot be dismissed as simply due to failure to understand the question. As mentioned in the introduction, children find it difficult not only to report how they got to know something. They also fail completely different questions such as what access they

need in order to find out something. In addition, in Experiments 1 and 3 children who answered correctly when seeing or feeling was their source, found the question more difficult when they knew because the Experimenter had told them. In the discussion of Experiment 1 we speculated on reasons for this difference in difficulty, but the important point here is that children could understand the know question, without knowing the answer when it was "I know because you told me."

Yet children did not appear to suffer from a deep-seated source amnesia or failure to encode source information: In Experiment 1, children who performed poorly in answering "How do you know…?" reported more accurately which player felt and which saw the hidden toy. In Experiment 2, they reported more accurately which player said the right thing and what the well-informed player had said. Children could, therefore, report the source of their knowledge, yet fail to report it *as* the source. The conceptual distinction between reporting (what to an adult is) the source of knowledge, and reporting it *as* the source, has been largely ignored, yet the empirical finding of a difference in difficulty has potentially important implications for our understanding of children's developing conceptions of the process of knowledge acquisition. We consider two such implications:

First, the difference in difficulty between reporting accurately, for example "You felt the toy" and "You said it was the soft cat" on the one hand, and reporting accurately "I know it's the soft cat because you told me," is easier to accommodate within source monitoring theory (Johnson, Hashtroudi & Lindsay, 1993), than within fuzzy trace theory (e.g. Brainerd & Reyna, 2004). Source monitoring theory treats source judgments as inferences on the basis of recollected experiences. Hence the correct reports of who saw, who felt, what the well-informed person said, could for an older child or adult, form the basis of an inference about the source of knowledge, but

such an inference might not be made for various reasons. In particular, it might not be made by a child who simply did not understand the causal connection between the experiences and the knowledge state. Fuzzy trace theory, in contrast, treats source information as encoded directly and makes no distinction between recollecting "I saw it" and reporting "I know because I saw it". For young children the two clearly are not equivalent.

Second, the difference in difficulty between reporting experiences and answering the know question also has implications for research on eye witness testimony and suggestibility. As mentioned in the introduction, researchers in those areas often conflate recollection of source with understanding it *as* a source: They treat answers to questions such as "Did you see it?" as equivalent to "How do you know…?" It has been argued that children gain some protection against misleading or suggestive questioning such as "He was wearing a red cap wasn't he?" once they understand more about the knowing process and come to treat beliefs as representations which can be in mismatch with reality (Welch-Ross, 2000). To test for such effects it is important to measure children's causal understanding of the knowing process, as Welch-Ross (2000) did, rather than just recall of experiences. One interesting further question to arise from this line of research is whether any such protective effect is afforded by working understanding about sources, rather than or in addition to verbally explicit understanding. On the other hand, in much of the research on suggestibility children are unaware of the experience history of the person who offers the misleading suggestion, and so knowledge of the knowing process, whether implicit or explicit, might not be particularly helpful.

In Experiment 3, we found that children who failed to report explicitly "I know because you told me" performed no differently from those who answered

correctly, at seeing the implications of the speaker's doubt about the adequacy of his information access. Whether or not they could say how they got to know which toy was in the tunnel, children realised that if the speaker had not felt the toy properly, and they had relied on his suggestion, then their belief could be false. These children behaved as if they understood the causal connection between their own knowledge and the Experimenter's suggestion about the toy's identity.

Children spontaneously drew implications from the speaker's doubt about his access without being explicitly prompted to reflect on how they knew the hidden toy's identity, as they were with the question "How do you know…?" We know little about how often pre-school children spontaneously engage in reflection on how they know, or how often they are prompted to engage in such reflection when challenged by peers' or adults' questions. Bartsch, Horvath and Estes (2003) examined the CHILDES data-base for examples of talk about learning or teaching in the everyday speech of 5 children. They found that comments on the source of factual knowledge were rare both in the children's talk and in adults' talk to the children. If explicit reflection on sources of knowledge occurs rather rarely in these early years, children's working understanding about the knowing process may be more important than their relative weakness at reflecting on how they know. Future research may tell us. From the present research we know that for recently acquired knowledge, children's inaccurate explicit reports of how they know do not necessarily indicate deep-seated source amnesia, failure to encode or recall the events surrounding knowledge acquisition, or even failure to understand the causal connection between such events and their resulting knowledge state.

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Table1. *Experiment 1: Mean (sd) number of correct responses to experience and know questions (Max. = 2).*

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	Question					
Age	Know (direct)	Know (tell)	Combined	Experience (direct)	Experience (tell)	Combined
Younger	0.61 (.85)	0.17 (.51)	0.83 (1.04)	1.11 (.83)	0.61 (.70)	1.72 (1.23)
Older	1.53 (.70)	0.84 (.96)	2.37 (1.34)	1.68 (.48)	1.37 (.76)	3.05 (1.18)
Combined	1.08 (.89)	0.51 (.84)	1.62 (1.42)	1.41 (.72)	1.00 (.82)	2.41 (1.36)

Table 2. Experiment 3: *mean number of times (maximum score = 2) that children responded "No" to either protagonist's doubt, denying that it could be the other toy, in relation to scores for know question*.

Doubt	Know score		
Condition	0	1	2
Experimenter	.64	.67	.48
Mole	1.25	1.50	1.27
combined	.89	1.00	.83