Children's Suggestibility in Relation to Their Understanding about Sources of Knowledge.

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Child Development (2003), 74, 48-62.

Abstract

Children chose either to maintain their initial belief about an object's identity or to accept the experimenter's contradicting suggestion. Both 3-4 and 4-5 year olds were good at accepting the suggestion only when the experimenter was better informed than they were themselves (implicit source monitoring). They were less accurate at recalling both their own and the experimenter's information access (explicit recall of experience), though well above chance. Children were least accurate at reporting whether their final belief was based on what they were told or on their own direct experience (explicit source monitoring). Contrasting results emerged when children decided between contradictory suggestions from two differentially informed adults: 3-4 year olds were more accurate at reporting the knowledge source of the adult they believed, than at deciding which suggestion was reliable. Decision-making in this observation task may require reflective understanding akin to that required for explicit source judgements when the child participates in the task.

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An interesting new development in research into children's suggestibility involves examination of the relationship between children's readiness to accept an incorrect suggestion, and their source monitoring skills. In the research presented here we build on this recent work. The general assumption made in the published work is that awareness of the sources of one's knowledge can help one resist false suggestions, and this has been applied both at the level of competence and at the level of performance. At the performance level, failure spontaneously to monitor sources could lead to acceptance of false suggestions (Thierry, Spence and Memon, 2001). A second study which could be construed as looking at performance issues is Ruffman, Rustin, Garnham and Parkin (2001). They tested children aged 6 to 10 years and showed, amongst other findings, relationships between inhibitory control, rejecting false suggestions, and ability to identify whether an event occurred on a video or an audio tape.

At the competence level, Welch-Ross and colleagues have carried out several studies in which children's willingness to accept false suggestions has been related to their understanding about beliefs. Welch-Ross (2000) suggests that on the one hand children with more advanced understanding of the connection between information access and knowledge state should be better able to resist the suggestion of an apparently uninformed other, while on the other hand children who can handle conflicting representations should be better able to avoid updating their original (true) representation on the basis of subsequent misleading input. Empirical support for this account comes from a study by Welch-Ross, Diecidue and Miller (1997). They found that 3- to 5- year olds' performance on a battery of tasks involving false belief, appearance-reality and pretend-real distinctions, predicted their resistance to

misleading suggestions when age and memory were taken into account. Consistent results are reported by Welch-Ross (1999a). In addition, Welch-Ross (1999b) showed that only children who passed false belief tests were less likely to accept misleading suggestions from an interviewer who professed ignorance of the relevant events, than from an interviewer who had shared the same experience as the child and so could be assumed to be equally knowledgeable. A connection between resistance to suggestibility and understanding of experience as a source of knowledge is also reported by Leichtman (1996) (cited by Perner, 2000).

In all the above studies, children's own direct experience was reliable, and the interest is in their ability to resist conflicting false suggestions. Clearly this situation is relevant to eye witness testimony, when what is important is that the witness can give an accurate account of what they themselves experienced directly, and avoid confusing that with input from indirect sources. In other real life circumstances, though, it can be important to believe what one is told even when it contradicts what one currently believes to be true. Although children would not fare well in the real world if they always believed whatever they were told, neither would they fare well if they mistrusted information from another person whenever it conflicted with what they already knew. It is important to make the right decisions: To believe contradicting new input only when it is true.

Real life source monitoring can differ from the experimental studies in another important respect. In most research on children's suggestibility and on their source monitoring skills, they are asked to report explicitly either the source of a particular piece of information, or the information received from a specified source. In real life, in contrast, much source monitoring activity is carried out at a procedural or automatic level: We make decisions about what to believe without necessarily making explicit our underlying reasoning. In the research

reported here, we examined children's readiness to update their own belief in line with a suggestion from an adult who was or was not better informed than they were themselves. We were interested in the accuracy of children's decision making in relation to their ability to reflect on the sources of their beliefs. Children's ability to reflect on how they know something is taken to be a sign of their understanding of the connection between information access and consequent knowledge (e.g. Gopnik & Graf, 1988; O'Neill & Gopnik, 1991; Perner & Ruffman, 1995). On the assumption that such understanding is necessary for correct decisions about whether or not to believe a suggestion from a speaker who is better or less well informed than oneself, we would expect that children who make correct decisions to more likely to report accurately the source of their beliefs.

In contrast to work on suggestibility and on eye witness testimony, we did not expose children to complex sequences of events. Rather, we used procedures more akin to those used in work within the theory of mind tradition on children's understanding about sources of knowledge (e.g. Gopnik & Graf, 1988; O'Neill, Astington & Flavell, 1992; O'Neill & Gopnik, 1991; Pillow, 1993; O'Neill & Chong, 2001). In this kind of procedure children typically experience or expect to experience a single object via a particular sense such as sight, touch or smell, or else are told about the object by the experimenter who has had such an experience. Children report or otherwise indicate how they know the object's identity or property, or predict what property they can expect to identify as a result of that access. We modified this type of procedure, which involves access to a single source, in a way that would allow us to assess children's ability to make correct decisions about which of two conflicting inputs to believe. In our tasks, the child either experienced an object directly and was given a contradicting suggestion by the experimenter (Experiment 1) or chose between the contradicting suggestions of two people who had different kinds of access (Experiment 2).

Children therefore had two sources to keep track of, as in the source monitoring studies in which they experience two distinct events such as real life and video events. Our procedure differed from these, though, in that both sources informed the child about one particular reality (the identity of a particular object) and the child's task was to decide which was true.

This procedure was developed by Whitcombe and Robinson (2000) from related procedures (Robinson, Champion & Mitchell,1999; Robinson, Mitchell & Nye, 1995) but their results were not in line with the expectation above. This expectation was that children who understand about the connection between information access and consequent knowledge state (assessed by ability to report accurately the source of their knowledge) should show a clearer pattern than those who do not, of accepting a suggestion from a better informed other and rejecting one from a poorly informed other. What Whitcombe and Robinson (2000) found, in contrast, was that children aged 3-4 years generally made very accurate decisions about whether or not to believe an adult's suggestion, whether or not they reported accurately the source of their final belief. For example, some children who correctly believed the adult's suggestion when she was the better informed, nevertheless reported that they knew the object's identity because they had seen or felt it, rather than because they had been told what it was. This result was found using two variations of the procedure outlined above. In one, a pair of pictures portrayed objects of the same colour, e.g. a banana and some cheese. One of the pictures was chosen in secret, and the aim was to find out which one it was. One player (either child or experimenter) saw a small uninformative part and made a guess about its identity, then the other player saw the whole picture and made a conflicting guess. The child was then asked to make a final identity judgement, which should be in line with that of the person who saw the entire picture. In the second procedure, based upon O'Neill, Astington and Flavell's (1992) tunnel game, one of a pair of objects was placed secretly in a tunnel. To identify which

one it was, it was necessary on some trials to see its colour, and on others to feel it. On each trial, one player (child or experimenter) looked in the tunnel and the other felt, and again the experimenter contradicted the child's suggestion. The better informed person, whether child or experimenter, sometimes gave their judgement first, and sometimes second. The child then made a final identity judgement. With both the tunnel and the picture procedures, children's final identity judgements were much more accurate than their reports of the source of their final belief.

Whitcombe and Robinson (2000) interpreted these results as demonstrating that the children who could not reflect accurately on the sources of their knowledge nevertheless demonstrated working understanding of the relationship between information access and consequent knowledge or belief, since they were sensitive to the relative informedness of themselves and the experimenter. If that interpretation is correct, the results might add to the growing literature on children's implicit understanding about the mind in the absence of explicit knowledge (Clements & Perner, 1994; Garnham & Perner, 2001; Dienes & Perner, 1999; Ruffman, 2000). In these studies, children's eye movements, or their impulsive gestures, were towards the location where a protagonist falsely believed his desired object to be, even though children's subsequent verbal judgements referred incorrectly to the current location of the object. Similarly, in Whitcombe and Robinson's (2000) task, children's nonreflective decisions appeared to be sensitive to an understanding about the mind which was absent from their explicit reports.

It may be premature though to develop an argument about implicit versus explicit understanding about sources of knowledge. There is a plausible interpretation of Whitcombe and Robinson's (2000) results which does not assume that correct decisions required understanding about sources of knowledge. The good decision-making of the young children

might not really have been based on a comparison of the reliability of the information access of child and adult. An alternative possibility is that children correctly accepted the suggestion of the better informed adult simply because they were unsure of their own initial belief when that was based on inadequate information access. If this alternative interpretation is correct, then children would be just as inclined to believe the adult's suggestion whether she was as poorly informed as they were themselves, or better informed. We tested this prediction in the first experiment reported below.

One possible result is that only children who can report accurately the source of their final belief, give final identity judgements which discriminate accurately between trials on which both players are guessing, and trials on which only the child is guessing. This result would be in line with the original expectation expressed above, that (explicit) understanding about the connection between information access and consequent knowledge state is related to accurate assessment of the relative reliability of conflicting sources.

We also tested in a different way the possibility that children relied on their own uncertainty when deciding whether or not to accept the adult's suggestion. Instead of gaining direct experience of the object themselves, children observed two adults gaining experience of an object in a game similar to the tunnel game described above. One adult's experience was sufficient for her to identify the object but the other's was not. The adults gave conflicting suggestions about what the object was, and the child decided whom to believe. Children who did not understand about the relative informativeness of the two experiences would have no basis for deciding correctly. If children's good decision making when they were a participant in the game was based only on their own uncertainty when their experience was uninformative, then they would be expected to perform poorly in the observer condition, since they had no feeling of uncertainty on which to draw. This procedure was similar to one used

by Povinelli, Nelson and Boysen (1990) with chimpanzees, and by Povinelli and deBlois (1992) with children.

In summary, the experiments reported below are concerned with relationships between children's suggestibility and their verbally explicit source monitoring skills in contexts in which both kinds of response can reveal understanding of the connection between information access and consequent knowledge state.

Investigation 1

The main aim of this investigation was to check whether children's correct decisions about whether or not to believe the experimenter's suggestion were based simply on uncertainty about their own belief, or whether they were genuinely based on a weighing up of the relative informedness of themselves and the experimenter. If children were merely relying on their own uncertainty then (i) they would be no less likely to accept the experimenter's contradicting suggestion when both she and the child were equally uninformed than when she was the better informed and (ii) they would perform poorly when they had to decide which of two adults, one well informed and one poorly informed, to believe. On the other hand, greater readiness to accept the suggestion of the better-informed than the poorly informed speaker in either task would be in line with genuine weighing up of relative informedness of the two players.

Method

Participants. We tested 54 children (27 boys and 27 girls) from an infants' school in Birmingham, UK. Thirty were from a nursery class (range, 3;7 to 4;6, mean = 4;3), and 24 from a reception class (range, 4;8 to 5; 6, mean = 5;3). Subgroups of 3, 4 and 5 year olds were small, and we had no strong theoretical reasons to compare those age bands in particular, so we grouped children by nursery / reception class.

Materials. For the tunnel game, we used a cardboard tunnel with a window cut in one side for seeing through, and end openings for feeling. Six pairs of toys were used, three matched on every dimension except colour, e.g. red and blue ladybirds, and three matched on every dimension except feel, e.g. two snowmen, one filled with plaster of paris to make it hard and the other soft. A bag was used to hide items while they were secretly moved into the tunnel. A lion puppet, Leo, operated by the experimenter, asked all the questions during the experiment.

For the video game we used a personal video machine with a 4 inch screen. The videos showed a box in which one of a pair of objects was hidden. Two pairs of objects looked the same but felt different, e.g. two identical yellow balls, one squashy and one hard. Two pairs felt the same but looked different, e.g. two toy cars of the same model, one green and one red. Two people, Jack and Anne, appeared on the videos, as did the experimenter (EW).

Design. Each child had ten trials, six as an active participant in the tunnel game, and four as an observer of the video game. In the tunnel game, children were randomly assigned so that they either only saw the content of the tunnel (*window to child)* or only felt it (*window to experimenter*). On two trials the child was the better informed (e.g. in the window to child condition, the child saw an object identifiable by its colour, and the experimenter felt it), on two the experimenter was the better informed (e.g. in the window to child condition, the child saw an object identifiable by its feel, and the experimenter saw it), and on two trials both child and experimenter were equally poorly informed (e.g. both felt an object identifiable by its colour).

For the video condition all children observed two trials in which the protagonist who saw inside the box was better informed, and two trials on which the protagonist who felt inside the box was better informed.

Between children the order of tunnel game and video was counterbalanced, as was order of conditions (child better or less well informed) within the tunnel game. The equal access trials in the tunnel game always came in the middle between the child better and child less well informed trials; since both players were guessing on the equal access trials they seemed an unsatisfactory start or finish to the game. Order of presentation of the forced-choice alternatives in both the identifying question and source question were counterbalanced.

Procedure. Children were tested individually. The *tunnel game* began with a demonstration of looking and feeling inside the tunnel, and children practised both. The puppet Leo was introduced. Each child experienced four trials on which child and experimenter had different access: One saw and the other felt. In the *window to child (colour)* condition, a trial began with the experimenter introducing the materials, for example "First, we're going to play with these two bugs," placing the objects in front of the child. "How do they feel?" (prompted answer as necessary). "That's right, they're both soft." "What colours are they?" "That's right, one is red and one is blue." "Can you pass me the red one…., can you pass me the blue one…Thank you." (To check naming of colours). "Now, Leo is going to hide one of the bugs in the tunnel, but we won't know which one." The puppet placed both bugs inside the bag and then secretly moved one into the tunnel. The child was asked to look into the tunnel through the window, "Have a look through the window and I'll have a feel from my side."

The puppet asked the child the *initial identity question*, "Which bug is in the tunnel, is it the red one or the blue one?" Next, the puppet asked the experimenter, "Which bug is in the tunnel?" The experimenter's response contradicted the child's, whatever reality. As if puzzled by the contradicting responses of child and experimenter, the puppet asked the child the *final identity question* "Which one is it?" Here, the child could either repeat his/her original response (the correct thing to do in this example, as the child was better informed), or update

his/her belief to agree with the experimenter. Finally, the puppet asked the child the *source reporting question*, "How do you know it's the red bug, because you saw / felt it, or because I said so?"

In the *window to experimenter (colour)* condition, the experiences of child and experimenter were swapped, so that the child felt inside the tunnel whilst the experimenter looked inside. On these trials the experimenter checked by looking through the window that the child's hand had explored the object. *Window to child (weight)* and *window to experimenter (weight)* trials ran similarly, with minor alterations so the script would make sense.

Each child also had two trials in which child and experimenter had the same information access and both were poorly informed. For children in the window to child condition, both experimenter and child looked at an object that could only be identified by its feel. For children in the window to experimenter condition, both experimenter and child felt an object that could only be identified by its colour. Apart from the fact that both players either felt or saw, these trials were identical in format to the differential access trials.

For the *video game* children were shown the personal video player and told they were going to watch some people finding out about the content of a box. A trial began with the experimenter seen on the video seated at a table with a box and a pair of items that differed in either colour or rigidity. The experimenter picked up the items, labelled them and demonstrated if one was squashy and the other was not. The experimenter said "I'm going to put one of them into my box (box picked up, opened and replaced on the table), but you won't know which one it is." The camera panned up to see just the experimenter's head and shoulders as she hid one of the items in the box and removed the other from the table. The experimenter then left the table, leaving just the box in view. Next, Jack entered, with the

experimenter's voice explaining "Here comes Jack. He wants to know what's inside my box. But Jack, he only wants to feel inside. What does Jack think is inside?" Jack was seen putting his hand inside the box without looking and was then heard saying "It's the (red car)". Next Anne entered, and with the experimenter's voice over explanation as before, Anne looked inside and announced what she thought the object was, contradicting Jack's suggestion. The experimenter's voice over then asked the *final identity question*: "So which one is it? Is it the (red car) or the (green car) in my box?" The video was paused and experimenter repeated this question in real life. Finally children were asked the *source question* in relation to the person whose identity judgement they had believed, e.g. if Jack, "How did Jack know it was the (red bug), did he see or did he feel inside the box?" Each child had four video trials, two on which *feeling* was informative, and two on which *seeing* was informative. Jack and Anne's experiences of the box content were counterbalanced: On half the trials Jack felt, and on half he saw, on half the trials Anne felt and on half she saw. The order of the options in the identity and source questions were counterbalanced between children.

Results

Tunnel game. First we checked whether the results for the four differential access trials were in line with those reported by Whitcombe and Robinson (2000). In their studies, children performed well in answer to the final identity question (insofar as they tended to accept the experimenter's suggestion only when she was the better informed) but relatively poorly in answer to the source question. We gave each child two scores out of 2 according to the number of correct final identity judgements given on trials when the child was the better informed, and on trials when the child was poorly informed. Mean scores appear in Table 1.

Insert Table 1 near here

In line with the previous findings, performance was well above chance across all trial types in both age groups (chi squared test showed that the observed distribution of scores differed significantly from that expected by chance, with high scores over-represented and low scores under-represented). Children were scored as correct in answer to the source question if they reported the source that they had believed, whether that was right or wrong. For example, if the child believed the experimenter's suggestion (final identity judgement), whether or not that was the correct thing to do, and then reported that s/he knew because s/he had been told, the source judgement was scored as correct. Mean scores appear in Table 1. This time only the reception children performed significantly better than chance (again assessed by chi squared tests). To compare performance on identity and source judgements, an ANOVA was conducted using the within child variables judgement (identity or source report) and informedness (child well or poorly informed), and the between child variables age (nursery or reception), modality (window to child or window to experimenter), order of tunnel trials and order of tunnel and video games. In line with the earlier findings, children were more accurate in their identity judgements than in their source judgements: F (1, 50) = 6.66, p = .01. In addition, reception children performed better than nursery: F (1, 50) = 7.45, p = .009. Children also performed better when they were the better informed: F (1, 50) = 29.86, p < .001. That is, although children generally made correct decisions about whether or not to believe the experimenter's suggestion, when they erred their tendency was to repeat their own identity judgement rather than accept the experimenter's suggestion. They also tended to report that

they knew the item's identity because they had seen or felt it, rather than because they had been told. There were no other significant main effects and no significant interactions.

Since data of the kind we have in this experiment are not ideally suited to ANOVA, we checked the most important result using a nonparametric test. In line with the results of the ANOVA, 32 children gained higher scores in answer to the identity question than in answer to the source question, compared with 3 who showed the opposite pattern of responding: Wilcoxon signed ranks test, $z = -4.53$, $p < .001$.

The important finding from the previous study was therefore replicated: Children who made accurate decisions about whether or not to believe the experimenter's contradicting suggestion did not necessarily report accurately which source they had decided to believe. Source errors tended to consist of over-reporting of children's own direct source of information, a result also reported by Whitcombe and Robinson (2000). In addition, children's identity judgements were more accurate when they were the better informed, implying a tendency to repeat their own initial belief rather than accept the experimenter's contradicting suggestion. This result alone argues against the possibility that children's decisions to believe the experimenter's suggestion were simply based on their own uncertainty; if anything it seems children had to overcome a preference for their own poorly informed belief when they correctly accepted the experimenter's suggestion.

Next we checked on the possibility that children's own uncertainty was guiding their decisions about who to believe, rather than a comparison of their own and the experimenter's informedness. We compared children's readiness to believe the experimenter (as revealed by their final identity judgements) in the equal access condition, in which both child and experimenter were poorly informed, with their readiness to do so on the trials in which the child was poorly informed and the experimenter was well informed. If children were simply

accepting the experimenter's suggestion because they were unsure of their own belief, we would expect no difference between the two trial types in the extent to which the experimenter's suggestion was accepted. If, on the other hand, children were sensitive to the experimenter's level of informedness, they should be more inclined to believe her when she was well informed than when she, like them, was guessing.

Each child was given two scores out of 2 according to the number of times their final identity judgement was in accordance with the experimenter's suggestion. We conducted an ANOVA with the repeated measure informedness (both players guessing or experimenter informed) and between child variables age (nursery or reception), modality (window to child - child sees, or to window to experimenter- child feels), order of trials within the tunnel game, and order of tunnel and video games. None of the between child variables showed any significant effects or interactions, and the only significant effect was for trial type: Children of both ages were much more likely to believe the experimenter's suggestion when she was well informed (mean score 1.65, sd .59) than when she, like them, was guessing (mean score .91, sd .92): F (1,50) = 34.54, $p < .001$. Nonparametric analysis confirmed the main result: 30 children were more likely to accept the experimenter's suggestion when she was better informed than when both were guessing, compared with 4 who showed the opposite pattern: Wilcoxon signed ranks test, $z = -4.52$, $p < .001$. Children did not just accept the experimenter's suggestion whenever they themselves were guessing. It appears that children were genuinely making a comparison of their own and the experimenter's informedness.

Video game. Children gained two identity scores out of 2 according to the number of times they correctly believed the suggestion from the person who was well informed when seeing was informative, and when feeling was informative. They also gained two source scores according to the number of times they correctly reported the source (seeing or feeling)

of the person whose suggestion they had believed, whether or not they believed the better-informed person. For example, a child whose final identity judgement was based on Jack's statement, and who correctly reported feeling as Jack's source, gained a score for a correct source judgement whether or not Jack was in fact the better informed. The mean identity and source judgements appear in Table 2. Since the source question referred to the person believed, absolute numbers of questions referring to seeing and to feeling differed between children, so only percentage scores appear in Table 2.

Insert Table 2 near here

The pattern of results in the video game looks very different from that in the tunnel game; this time nursery children's source judgements were above chance, but their identity judgements were not. We conducted an ANOVA with judgement type (total identity or total source score) as a repeated measure, and age and order of video and tunnel tasks as between group variables. This confirmed that children found it more difficult to answer the identity than the source reporting question, F (1, 50) = 18.06, $p < .001$; mean identity score = 2.50 (1.21), mean source score = 3.32 (0.89). There was also a significant interaction between judgement type and order of video and tunnel tasks, F (1,50) = 5.79, $p = .02$. This was accounted for by higher identity scores in the video game when children had played the tunnel game first (mean 2.8, sd 1.33), rather than the video game first (mean 2.2, sd 1.00). Note though that even the better identity scores were substantially lower than those in the tunnel game itself (mean 3.5, sd .69). Order had no effect on source scores. We come back to this interaction in the discussion. In line with the results of the ANOVA, 7 of the 54 children

scored higher on the identity questions than on the source reporting question, compared with 33 who showed the opposite pattern (Wilcoxon signed ranks test, $z = -3.52$, $p < .001$).

Comparison between tunnel and video games. Each child had 4 scores out of 4: For the tunnel task, total identity and source scores for the 4 differential access trials (combining across the see and feel trials), and for the video task, total identity and source scores for the 4 trials (again, combining across the see and feel trials). For the tunnel game, the mean scores for the younger children were: Identity 3.33 (.75); source 2.33 (1.24). For the older children: Identity: 3.83 (.48); source 3.00 (1.18). For the video game, the mean scores for the younger children were: Identity 2.23 (1.13); source 3.26 (.83). For the older children: Identity 2.83 (1.24); source 3.37 (.97). We conducted an ANOVA with judgement (identity or source score) and task (tunnel or video) as repeated measures, and age and order of video and tunnel tasks as between subject variables. There was a significant main effect for age: $F(1,50) = 10.23$, $p = .002$. There was an interaction between task (video or tunnel) and judgement (identity or source): $F(1,50) = 60.64$, $p < .001$. Related t tests showed that this interaction was due to a crossover in scores, with identity significantly higher than source scores for the tunnel task, but source significantly higher than identity scores for the video task. Identity scores were significantly higher in the tunnel task than in the video task, while source scores were significantly higher in the video task than in the tunnel task (all unadjusted p values < .001). Wilcoxon signed ranks tests showed the same significant differences, again with all unadjusted p values < .001. There was also a marginally significant 3-way interaction between task, judgement and video order $F(1,50) = 4.00$, $p = .051$. This was accounted for by higher identity judgements in the video task when it followed the tunnel task, as already identified in the analysis of the video performance alone.

Discussion

Can we conclude that children who failed to report the source of their final belief, had genuinely compared the reliability of their own information access with that of the experimenter and thereby made a correct decision about whether or not to believe the experimenter's suggestion? Results from the tunnel and video games appear to lead to conflicting conclusions. The accurate identity judgements in the tunnel game, and in particular the strong discrimination between trials on which both players were guessing and trials on which only the child was guessing, strongly suggest that children were making a genuine comparison of their own and the experimenter's informedness, and were not just relying on their own uncertainty when deciding whether or not to believe the experimenter's contradicting suggestion. But had children been reliant on their own uncertainty to make their final identity judgements in the tunnel game, we would have expected them to perform poorly at identity judgements in the video game. And indeed they did. Yet the final identity questions in the tunnel and video tasks were exactly the same: In both the child was asked to deal with contradictory suggestions by deciding "Which one is it?" Despite this superficial similarity, perhaps there is another factor responsible for the relatively poor performance in the video game.

The significant order effect in the video game may provide a clue as to why final identity judgements in the video task were relatively inaccurate. Children's identity judgements in the video game were more accurate when they had played the tunnel game first (though they were still markedly poorer than in the tunnel game itself). These children may have been able to draw on their direct experience of seeing or feeling inside the tunnel to help them infer which of the two adults in the video was the better informed. Indeed, although their decisions were not based solely on uncertainty, uncertainty may well have played some part.

In contrast, children who had the video game first may have had difficulty imagining what experience the adults in the video were gaining when they saw or felt, and so may have had to rely on more abstract knowledge about aspectuality. There is ample evidence to suggest that such knowledge is acquired relatively late (O'Neill & Chong, 2001; O'Neill, Astington & Flavell, 1992; Pillow, 1993; Robinson, Thomas, Parton & Nye, 1997). In O'Neill, Astington and Flavell's (1992) tasks children made knowledge judgements on behalf of characters who either felt or saw a wet sponge while they themselves were sharing that same experience (e.g. "Can Bert tell just by feeling that the sponge is wet?") Three-year-olds performed poorly, and O'Neill et al. (1992) argue that these young children did not understand how they had acquired the modality specific information, and so could not correctly infer the knowledge of another character who shared the same experience. O'Neill and Chong (2001) also report that their participants had difficulty with modality specific knowledge, even though they elicited nonverbal responses from their participants. The nonverbal responses still demanded reflection on how the child had just found out about a particular property, however, rather than on-line decision making as in our version of O'Neill et al's (1992) tunnel task. We suggest, then, that although at first sight the final identity judgements in both the tunnel and video games demand only implicit rather than verbally explicit understanding of the connection between information access and knowledge, the video game demanded a more abstract or reflective understanding than did the tunnel game. We come back to this in the final discussion.

Next we consider the relatively accurate source judgements in the video game. In this case the questions in the tunnel and video games were not exactly matched: In the tunnel game children were asked to report how they knew that the object was such and such, with prompts referring to their direct access (seeing or feeling) and being told. A matching question

in the video game would have elicited the answers "I know because Anne told me" or "I know because Jack told me". This would have been a test of the accuracy of children's external source monitoring (e.g. Foley, Johnson & Raye, 1983). Instead, we wanted to be able to check that wrong decisions about who to believe were not due simply to attention failure or incorrect memory of that person's source. We therefore asked children how the character whose suggestion they accepted, knew that the object was such and such, with prompts referring to the two direct source of access (seeing and feeling).

It is possible, though, that children could answer the source question correctly in the video game without explicit understanding about sources of knowledge. We can perhaps draw on a suggestion made by Gopnik and Graf (1988) in relation to the standard single source procedure for assessing understanding of sources, in which the child either sees or is told about an object on each trial, and is then asked how s/he knows what it is. The suggestion was that when prompts are offered ("How do you know it's a such and such, is it because you saw it or because I told you?"), children can answer the source question correctly simply by reporting what happened (that they saw or were told something on that trial), without necessarily understanding that that was the source of their knowledge. Gopnik and Graf (1988) dismissed this as unlikely, but Whitcombe and Robinson (2000) argued that this could account for their own finding of more accurate source reporting on single than dual source trials. Something similar could happen in the video game. Prompts were offered (did s/he see or did s/he feel in the box?), so children could merely recall, for example, that Jack felt in the box or that Anne saw, and thereby give what appeared to be a correct source report. This suggestion implies that children can recall what experience each player had without necessarily being able to interpret that experience as the source of the player's knowledge. In the next experiment we check on that possibility directly, and then consider the implications.

Investigation 2

The aim of this study was to find out whether we can separate out children's ability to recall experiences, from their ability to report those experiences as source of a belief. To an adult who understands the connection between information access and consequent belief state it almost seems odd to make such a distinction; recalling accurately that one saw inside a box is virtually equivalent to knowing how one knows the colour of the object within it. In the adult source monitoring literature it is assumed that sources are inferred from recall of the details of the experience surrounding the acquiring of the belief (e.g. Johnson, Hashtroudi & Lindsay, 1993). Yet in principle someone who has no reflective understanding of the connection between experience and consequent knowledge or belief might be able to recall accurately the experience without going on to infer that that was the source of their belief. Instead of using the tunnel procedure from Experiment 1, we used a procedure from Whitcombe and Robinson (2000) in which one player saw the whole of a picture and the other person saw a small uninformative part. With this procedure, the mere recall of the experience "I saw all the picture" implies that the resulting belief of the pictured object's identity was reliable, and so "I know because I saw". Similarly, the mere recall of "I saw a little bit of the picture" implies unreliability in this context. "I know because I saw" does not follow. In contrast, with the tunnel procedure, merely recalling "I saw" or "I felt" has no such implications; it depends on what the identifying feature of the object was. The picture procedure therefore gives children the best chance of noticing a relationship between their experience and the source of their belief.

Method

Participants. We tested 68 children (33 boys and 35 girls) from an infants' school in Birmingham, UK, 44 from a nursery class (range, 3;3 to 4;2, mean = 3;6), and 24 from a reception class (range, 4;4 to 5;3, mean = 4;8).

Materials. We used the picture card task devised by Whitcombe and Robinson (2000). Six pairs of picture cards were used, each card depicting a single item. Items within a pair were the same colour, for example strawberry and tomato. Two frames were also used, one with a large window which allowed the entire item to be seen, and one with a small window which allowed only a small patch of colour to be seen. Two dolls, Jack and Anne, took part: Jack had supposedly drawn the pictures, and Anne supposedly wanted to know what they were.

Design. Each child had 6 trials. First all children received two single source warm-up trials, one see and one tell. The purpose of these was to familiarise children with the two kinds of information access and the source question, and to provide informative feedback on their answers to the source question. Next, all children received four dual source trials, on two of which seeing was the informative source and on two of which being told was informative. For all children the information from the two sources was contradictory. The child was the better informed on some trials, and the more ignorant on others, and the well-informed person (whether child or experimenter) always gave his/her identity judgement second. This sequence of events makes better sense with this picture procedure, as argued in Whitcome and Robinson (2000). Results reported by Robinson, Champion and Mitchell (1998), Whitcombe and Robinson (2000), as well as the results of the equal access condition of Investigation 1, all provide good evidence that children do not just repeat the second suggestion. We therefore assumed that the risk of false positives due to such repetition was low.

Procedure. For the two *single source warm-up* trials, the child saw one picture through the large window (and so could identify it easily), and was told about the identity of a second picture by the experimenter who looked through the large window. On each trial the child was asked to identify the object in the picture, and then to say how he or she knew that's what it was, with prompts (did you see it or did I tell you about it?) if necessary. Any child who answered the source question wrongly on these warm-up trials was given the correct answer. There followed four *dual source experimental trials*. The child was introduced to the dolls Jack and Anne, and was shown one of the pairs of pictures and identified what each picture portrayed. The experimenter then turned them face down, shuffled them and selected one in a way which made it clear that neither child nor experimenter knew which one it was. The child or the experimenter then saw the chosen picture through the small window, and said which one he or she thought it was (e.g. tomato). On the experimenter's turns at looking through the small window she deliberately gave the wrong answer. The other player then looked through the large window and gave the contradicting suggestion (e.g. strawberry). The experimenter gave the wrong answer when she looked through the large window, if by chance the child had chosen correctly on seeing through the small window. Hence children always experienced a contradiction between their suggestion and the experimenter's. The child was then asked a final identity question, "Anne wants to know which one it is, can you tell her?" This was followed by the source question “How did you know it was a (strawberry/tomato), was it because you saw it or I told you?” and the experience question, “Did you see all of the (strawberry/tomato)? Or a bit of the (strawberry/tomato)?” and “Did I see all of the (strawberry/tomato)? Or a bit of the (strawberry/tomato)?” were asked. The order of source and experience questions was counterbalanced between trials. The order of the two types of trial (seeing informative and being told informative) was counterbalanced between children.

Results

Each child was given 3 scores out of 4, for final identity, source and experience judgements. As before, scores for source judgements took into account children's answers to the identity question; consistency between identity response and source report gained credit. For example, a point was awarded for source if the child reported seeing as his/her source, and his/her final identity judgement was consistent with what s/he had said on seeing, even if the final identity judgement was incorrect. In contrast, scoring for the experience judgements was independent of answers to identity and source questions. What was important here was whether children could report correctly the experiences (seeing all or part of the picture) of themselves and the experimenter. Children gained a score on the experience question only if they answered correctly *both* about themselves and the experimenter's experience of the picture on that trial. Table 3 shows the mean scores for answers to the final identity, source and experience questions.

Insert Table 3 near here

From Table 3 it is apparent that children performed well at identity judgements, and found reporting the source of their knowledge relatively difficult, in line with the results of the tunnel task in Experiment 1. In contrast with their source reporting, children appeared to perform relatively well in answer to the experience questions. An ANOVA was performed with within child variable judgement (final identity/source/experience), and between child variables age (nursery/reception) and question order (source question before or after experience question). There were main effects of judgement: $F\ (1, 64) = 54.19$, $p < .001$, and age: $F\ (1, 64) = 9.12$, $p < .001$. There were no other significant effects. In particular, the order

of source and experience questions had no effect on children's performance (p = .20). To interpret the significant main effect of judgement we conducted related t tests, which revealed significantly higher scores for identity than source judgements: t (67) = 13.31); higher experience than source judgements: t (67) = 5.39; and also higher identity than experience judgements: t (67) = 7.92 (all unadjusted p values < .001; adjusting for multiple post hoc comparisons all remain significant at <.01). Nonparametric analyses confirmed the parametric ones: 58 children scored higher on identity than on source, while none showed the reverse pattern; 42 scored higher on experience than on source compared with 7 who showed the reverse pattern, and 43 scored higher on identity than on experience, while none showed the reverse pattern (Wilcoxon signed ranks tests, all p < .001).

To check whether children's source reporting was more accurate on trials when seeing was informative than when being told was informative, we conducted an ANOVA on the source scores for the two trial types, with age as a between subjects factor. In this experiment, unlike Experiment 1 and Whitcombe & Robinson (2000), there was no significant tendency to over-report seeing rather than being told in answer to the source question (p = .48). In line with the main ANOVA reported above there was a main effect of age: F (1,66) = 10.16, p = .002.

Discussion

In line with Whitcombe and Robinson's (2000) previous findings with the picture task, and the results of Experiment 1 with the tunnel task, children were relatively good at deciding when to believe the experimenter's suggestion but significantly worse at reporting the source of their final belief. The new finding from this experiment is the better performance on the experience question than on the source question: Some children could remember both their own and the experimenter's experience without apparently drawing on this memory to

answer the source question. Being prompted to recall both players' experience did not help children do better on the source question. Even when children had just reported, "You saw all the strawberry, I saw just a bit of the strawberry", they sometimes still answered "I know it was a strawberry because I saw it" in preference to "I know it was a strawberry because you told me". Children's poor performance at reporting the source of their belief in the dual source tunnel and picture tasks is apparently not just due to their having forgotten what happened, and absence of explicit understanding about sources seems not to have been associated with failure to encode the experiences of themselves and the experimenter.

Perhaps children's source errors were due to confusion of their own experience of seeing with that of the experimenter. This could happen at the level of reporting: The child perhaps actually meant "You saw it" and not "I saw it", or it could happen at a deeper level if the child genuinely confused

his or her own experience with that of the experimenter. The possibility that source errors were based on such confusions was considered and dismissed by Whitcombe and Robinson (2000, p342): When the experimenter had felt an object and the child had seen it (or vice versa), children hardly ever selected the experimenter's source when answering the source question. We have no grounds therefore for supposing that such confusions explain source errors in this experiment.

The results of Experiment 2 are consistent with (though not a direct test of) our suggestion above, that children's relatively good source scores in the video task in Experiment 1 could be due to their merely reporting what Jack or Anne's experience was in answer to the source question, without necessarily understanding that experience as the source of Jack or Anne's belief. Children cannot achieve good source performance in the tunnel or picture tasks using this strategy, since on each trial the child has both seen or felt *and* been told; unless the

child understands which of those experiences is the source of his or her final belief, s/he has no basis for choosing between them in answer to the source question. In traditional single source procedures, in contrast, as in our video game in Experiment 1, children could give a correct source report merely by recalling their experience on a particular trial. In the final discussion we consider the broader implications of these results.

Final Discussion and Conclusions

The main results from the two experiments are: (i) In line with previously reported findings, 3-4 year olds made accurate decisions about whether or not to update their own belief in line with the experimenter's contradicting suggestion, based on whether she was better or less well informed than they themselves, without necessarily being able to report accurately the source of their final belief. The tendency in Experiment 1 was to over-report their own direct access and under-report being told; (ii) Results of Experiment 2 show that children who misreported the source of their final belief, often recalled accurately both their own information access and that of the experimenter who made the contradicting suggestion; (iii) In Experiment 1, children were more likely to believe the experimenter's suggestion when she was better informed than the child, than when both players were guessing, suggesting that children's decisions were based on a genuine comparison of their own and the experimenter's information access even if uncertainty also played a role; (iv) When 3-4 year olds were observers of rather than participants in the game, their decisions about which of two contradicting suggestions to believe were not accurately based on the informedness of the speakers; (v) As observers, 3-4 year olds were well above chance at reporting the source of knowledge of the speaker they believed, though they might have answered correctly by recalling the speaker's experience without necessarily understanding this as a source of knowledge.

Our expectation at the outset was that the results of the tunnel and the video game would be consistent with each other: Either both would suggest children were reliant on their own uncertainty, so they would fail to discriminate between equal and differential access conditions in the tunnel game, and they would fail to discriminate between well and poorly informed speakers in the video game, or else both would suggest children were making genuine comparisons based on information access, so they would make correct identity judgements in both the tunnel and the video games. As it turned out, the results of the tunnel game indicate that 3-4 year olds were sensitive to the informedness of the speaker who contradicted their own belief, and did not just believe the contradicting suggestion whenever they themselves were poorly informed. In the video game though, when children were observers rather than participants, they seemed not to be able to make the required comparisons between speakers. Our interpretation is that when children participated in the game they could make accurate decisions about which player was the better informed, drawing on automatic or implicit processes. In contrast, we suggest post hoc that answering the very same identity test question when they were observers required more reflective or abstract understanding of the knowledge to be gained by seeing and feeling. Further research could test the accuracy of our post hoc suggestion.

At this stage we leave it vague as to what the labels ‘automatic’, ‘implicit’, ‘abstract’ and ‘reflective’ might mean in terms what knowledge is represented. Dienes and Perner’s (1999) theoretical account of implicit and explicit knowledge is potentially relevant. Their broad approach is to make distinctions between representations in which only the content of the knowledge is explicit, in which the content and propositional attitude are explicit, and in which both of these are explicit and also that it is the self who holds that attitude. Their application of this approach within the realm of cognitive development draws on empirical

studies of acknowledgement of false belief (Clements and Perner, 1994; Garnham & Perner, 2001): Implicit understanding is based on abstraction of situational regularities, whereas verbally explicit understanding is more theory-like and is based on causal understanding of the underlying processes. One difficulty with applying this account of implicit knowledge to our tasks is in specifying what regularities children learned which enabled them to perform well when they were participants in the game but poorly when they were observers. Concerning the more reflective knowledge, within the observer (video) condition we cannot tell whether children who made correct decisions about who to believe also had verbally explicit understanding of sources of knowledge. We suspect that what appeared to be correct source judgements could simply have been correct recollections of experience (for example that Jack felt the object in the box). Further empirical work is needed to clarify how best to describe the understanding revealed when children give correct final identity judgements in participant and observer conditions. Importantly, though, the results presented here allow us to reject the possibility that correct final identity judgements in the participant conditions were simply based on children's own uncertainty about their initial belief. Children's successful decision making in the participant conditions cannot be achieved without some kind of understanding of the connection between information access and knowledge state. We have yet to specify just what form that understanding takes, and what its limitations are.

Grounds for expecting that correct decisions in the observer (video) condition might be associated with explicit understanding come from results reported by Povinelli and de Blois (1992), though they elicited explicit knowledge judgements rather than source reports. In their task, children watched as an adult hid an object in one of a set of locations, though children could not see which particular location was used. A second adult was absent when the hiding took place. The adults then pointed at different locations and the interest was in

whether or not the child searched at the location indicated by the well informed adult. Note that in this procedure the ignorant adult had no relevant information access, and the knowledgeable one not only saw but also hid the toy, so the contrast between the two could have been greater than in our video task. Nevertheless, performance was poor amongst 3 year olds and relatively good amongst 4 year olds, so our results are not out of line with theirs. Furthermore, successful searching was associated with correct explicit judgements of the ignorance of the uninformed adult.

We began the introduction by highlighting recent work examining the relationship between suggestibility and source monitoring skills. Within the context of eye witness testimony, it is important to know whether children are able to keep separate their own direct experience from subsequent indirect inputs (which could be misleading suggestions). Within a broader context, though, it is important that children make correct decisions about the truth of the matter even if that involves accepting a suggestion from another person. Here the literature on suggestibility may be less helpful. The study by Welch-Ross (1999b) is unusual in the suggestibility literature in letting children know the level of informedness of the person who offers the misleading suggestion. In most studies, children have no information about this, so have no cognitive basis for deciding whom to believe. This was also true in the condition in Welch-Ross's (1999b) study in which children received misleading suggestions from an adult who had shared their experience. With procedures of this kind, it is not obvious how accurate source monitoring could help children decide whether or not to believe a misleading suggestion. Understanding about the deficiencies of minds might help children accept the possibility that two people could have different recollections of the same event, but will not necessarily help them decide which person's recollection is the more accurate. Presumably suggestibility will be heavily determined by non-cognitive factors when the information

necessary for making a rational assessment of the reliability of the suggestion is unavailable. Our results presented here suggest that in very simple situations, when it is possible to assess the relative reliability of one's own belief and that of the person making a contradicting suggestion, young children can make accurate decisions and to that extent are not suggestible.

In contrast to their accurate decision making when they were participants in the game, children's source monitoring was relatively weak. Their tendency in Experiment 1 was to over-report their own direct access, whether this was seeing or feeling, when asked for the source of their final belief. Children could just have had a superficial response bias towards *saying* "I saw" or "I felt" rather than "You told me". It seems more likely, though, that their bias was to attribute knowledge to direct access rather than to indirect access. Over-reporting of direct access is similar to findings by Ratner, Foley and Gimpert (2002) who found over-attributing of actions to the self amongst 5 year olds. These authors argue that such source monitoring errors can have benefits. They interpret their results within a Vygotskian framework, suggesting that recoding of another's actions as one's own is related to comprehension of the social acts of the other, and may contribute to internalization of knowledge. We might speculate along similar lines that a bias towards interpreting one's knowledge as being based in one's own direct experience, despite in fact being sensitive to the reliability of what one is told, could have the benefit of contributing to feelings of self-efficacy.

Finally, we consider the implications of the result from Experiment 2, that children were more accurate at recalling the experiences of themselves and the experimenter, than at reporting the source of their final identity judgement. This suggests that children could have available the information necessary to infer the source of their belief without being able to make that inference. This result is in line with the view that young children's poor source

reporting is not just due to memory failure (O'Neill & Gopnik, 1991). An associated view is that young children suffer from something equivalent to extreme source amnesia (O'Neill & Chong, 2001). These authors suggest that children are unable "to become explicitly or declaratively aware of the source of perceptual experiences, perhaps as a result of an inability to process the source at the time of learning the perceptual information" (p814). In O'Neill and Chong's study, 3 year olds were very poor at repeating an action which had been used to identify a particular property of an object, such as leaning over to smell some bubble bath, in response to "How did you find out?" We do not know whether the children would have been able to repeat the action had they been asked "What did you just do?", which might have been more equivalent to our experience questions "Did you/I see all of the strawberry or just a bit of the strawberry?" That is, it is possible that children in O'Neill and Chong's study failed to encode their source *as* a source, but nevertheless did encode the relevant experience. If so, it would be inappropriate to draw a parallel with adult amnesic patients who presumably do not lack the relevant abstract understanding of the connection between experience and knowledge. Another difference between elicitation of recalled experience, and O'Neill and Chong's (2001) procedure, is that we offered prompts whereas theirs was an open question. We suggest below that this difference in procedures might be important, and in this case might account for the apparent relative ease of our task.

Our assumption so far is that for children who passed the experience questions but failed the source questions, all that was missing was explicit understanding about the connection between experience and knowledge. Another possibility, though, is that the nature of the memory was different in a child who interpreted the experience as the source of their belief and a child who failed to do that. Perhaps the latter child failed to recollect his or her experience as *having been* experienced, that is as an episodic memory in the strongest sense

(Dienes & Perner, 1999; Tulving, 1985). Perner and Ruffman (1995) argue on the basis of indirect evidence for a developmental relationship between ability explicitly to report sources, and holding of episodic memories. According to their account, children would be unable to recall their experience as an experience without also being able to treat the experience as the source of their knowledge. Episodic memory is normally assessed by free recall. In contrast, we offered children prompts (did you see all or part?). It remains a possibility that had we asked open questions, we would have found no difference in difficulty between experience and source judgements. This possibility is worth pursuing, but it is nevertheless important to know that when given prompts, children clearly can access both their and the experimenter's experiences without seeing any implications for the source of their final belief.

In summary, the results presented here put young children's well documented source monitoring errors in a broader context of sensitivity to source reliability, and accurate memory for their own and their partner's experience, at least under some conditions.

Acknowledgments. The experiments reported here were carried out in partial fulfillment of the degree of PhD for the second author, who was supported by a studentship from the Biotechnology and Biological Sciences Research Council, U.K.

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Table 1. Mean scores (sd) gained in response to the final identity and source questions in the tunnel game in Experiment 1. Max. score = 2; Chance score = 1.

Age	Judgement	Window to child Child sees		Window to experimenter Child feels	
		Child well informed	Child poorly informed	Child well informed	Child poorly informed
Nursery	Identity	1.80	1.53	1.87	1.47
3-4 years	judgement	(.41)**	(.64)**	(.35)**	(.64)*
	Source	1.13	1.13	1.27	1.13
	judgement	(.74)	(.83)	(.70)	(.83)
Reception	Identity	2.00	1.75	2.00	1.92
4-5 years	judgement	(.00)	(.62)**	(.00)	(.29)**
	Source	1.58	1.42	1.58	1.42
	judgement	(.67)**	(.67)*	(.67)**	(.79)*

* sig above chance at .05 level

** sig above chance at .01 level

Table 2. Mean (sd) identity and percentage source scores gained in the video game in Experiment 1. Max. score = 2; Chance score = 1.

Age	Identity judgements		Source judgements	
	Seeing informative	Feeling Informative	Seeing informative	Feeling informative
Nursery 3-4 years	1.10 (.69)	1.17 (.75)	86.5% (22.5)**	76.5% (34)**
Reception 4-5 years	1.46 (.83)*	1.38 (.71)*	81.5% (32.5)**	87.5 % (22)**

* sig above chance at .05 level

** sig above chance at .01 level

Table 3. Mean scores (sd) gained in response to final identity, source and experience questions in Experiment 2. Max score = 4.

Age group	Identity	Source	Experience
Nursery, 3-4 years	3.75 (.49)**	1.41 (1.13)	2.61 (1.20)**
Reception, 4-5 years	4.00 (00)**	2.42 (1.44)	2.95 (1.16)**

** sig above chance at .01 level