Young Children's Implicit and Explicit Understanding of Speaker Knowledge

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Abstract

Here we present findings about young children's understanding of reliability of speaker knowledge. In order to shed new light on the details of implicit versus explicit understanding of knowledge formation, this study was designed to allow for direct comparison of two binary contrasts: (a) use of linguistic vs. behavioral clues indicating different degrees of others' epistemic states; and (b) on-line, or spontaneous judgment of speaker reliability vs. off-line reflection on sources of speaker knowledge. The results suggest that for young children, behavioral indications of knowledge formation in others are more effective as clues than linguistic equivalents. Moreover, results indicate that development of the ability to make on-line judgment on reliability of speaker knowledge precedes development of the ability to reason reflectively about source of knowledge. We discuss further implications of these findings, in particular, with respect to multi-leveledness of explicit knowledge (Dienes & Perner, 1999; Karmiloff- Smith, 1992).

Introduction

Questioning how and when young children become able to competently assess the reliability of sources of information has motivated much recent theory of mind research. Existing studies suggest that when faced with contradictory information, preschool-age children can judge which is more likely to be true (Whitcombe & Robinson, 2000; Robinson & Whitcombe, 2003). For example, three-year-olds can tell that a person who has seen an object has more reliable information about the object, than a person who was told about the object or who simply inferred what it was: they understand that the act of seeing provides stronger evidence than the act of being told or inferring. On the other hand, it has been shown that three-year-olds have difficulty indicating how they reached a decision about what to believe (Gopnik & Graf, 1988; O'Neill & Chong, 2001). O'Neill and Gopnik (1991), for example, tested whether preschoolers could identify an object that was hidden in a tunnel by touching it, by seeing it, or by being told what the object was. When later asked how they came to know what was inside the tunnel, 3-year-olds generally failed to explain how they knew, despite being able to identify the object itself.

These findings suggest that the ability to make appropriate on-line decisions about what to believe needs to be differentiated from the ability to tell how one comes to believe something. More generally, there seems to be consensus that being able to explicitly represent and monitor sources of belief is prerequisite to having explicit understanding of belief formation and evaluation of belief as end-product (e.g., Gopnik & Graf, 1988). In Dienes & Perner's terms, if one has conscious access to one's own beliefs and can reflect on and verbalize them, those beliefs can be considered as 'explicit knowledge' (Dienes & Perner, 1999). Typically, such explicit knowledge is contrasted with 'implicit knowledge,' which is characterized as being inaccessible to consciousness, or being procedural (Kamiloff-Smith, 1992). As evidenced by wide-spread use of false-belief tests, a central issue in theory of mind research has been to determine when children acquire explicit understanding of beliefs. The questions of how and when implicit understanding of beliefs develops, however, have been neglected until quite recently (see Ruffman, 2000).

Relatively little research has been conducted on how well preschoolers understand linguistically encoded reliability of speaker/information. Two types of epistemic vocabulary are distinguished in existing studies: (1) expressions of speaker (un)certainty, which convey speakers' attitudes or degree of commitment to the truthfulness of the propositions expressed, and (2) expressions of evidentiality, which concern the basis of a speaker's belief for the states of affairs described in the propositions expressed (Chafe & Nichols, 1986). The main findings so far are that while understanding of false belief and understanding of linguistically encoded speaker (un-)certainty appear to have the same watershed age—roughly around one's fourth birthday (Moore et al., 1989)—children's awareness of linguistically encoded evidential strength seems to develop relatively slowly. The latter is suggested, for example, by Aksu-Koc (1988).

These findings, however, need to be interpreted with some caution. One problem with the existing studies on this general topic is that no clear conceptual distinction has been made between spontaneous (implicit) assessment of speaker certainty on the one hand, and more reflective (explicit) understanding of speaker knowledge on the other. Although some tasks employed by researchers require children's reflective and metalinguistic understanding of linguistically encoded speaker reliability (as in Aksu-Koc, 1988), and others require only spontaneous and unconscious assessment (as in Moore et al., 1989), the difference has not been clearly acknowledged by the authors of these studies.

Another problem arises when one attempts to directly compare existing findings about young children's ability to understand linguistic indication of knowledge state (e.g. *-dl* to indicate directly witnessed event, and *–mls* to indicate inferred event in Turkish) with findings about their ability to understand behavioral equivalents (e.g. having direct evidence by seeing, or only indirect evidence by hearing from someone). Such direct comparison seems virtually impossible. In the previous investigations of children's understanding of knowledge formation, child participants played two quite different roles depending on the exact ability examined. In a typical experiment to investigate young children's understanding of linguistically-encoded knowledge states, child participants played a role of an outside observer (as in Aksu-Koc, 1988 and Moore et al., 1989). In a typical source-monitoring task (as in O'Neill & Gopnik, 1991 and Whitcombe & Robinson, 2000), however, child participants play the role of a direct witness to the events in question. We believe that to understand the knowledge state of another witness of an event that you also witness yourself is quite different from grasping others' knowledge states about an event that you lack first-hand experience of. To directly compare these two kinds of epistemic capabilities, a new experimental design is required.

The current study is designed to address this need by allowing for direct comparison of two binary contrasts: (a) effectiveness of clues (linguistic vs. behavioral) and (b) sophisticatedness of understanding (on-line vs. off-line). Child participants played a single role, that of observer, throughout all phases of the experiment.

Children's understanding of linguistically encoded speaker certainty and evidential strength has recently been investigated by Matsui et al. (2006). They showed that children first understand linguistic indication of degree of certainty sometime between three and five, and that they later come to discriminate various evidential strength, sometime between four and six. These onsets seem relatively late, compared to the typical age (around three) when children start showing their understanding of behavioral clues to indicate reliability of knowledge (e.g. Pillow, 1989). This finding, however, is based solely on the result of an on-line assessment task, and therefore, the question of when children acquire more reflective understanding of the same concepts remains to be examined.

A comparison between on-line vs. off-line understanding of knowledge formation has been recently carried out by Robinson and her colleagues (Robinson & Whitcombe, 2003). They found that when young four-year-olds (*M*=4,3) witnessed an event themselves, their on-line assessment of the knowledge state of another witness relative to their own turned out to be more accurate than their off-line equivalent. In addition, they found that when the same children had to judge the reliability of others' knowledge as an observer, their on-line assessment turned out to be surprisingly poor (at chance), and was worse than their off-line source judgments (which were above chance). They suggest that assessing reliability of other's knowledge by observation alone may require more abstract or reflective reasoning than grasping the knowledge state of other witnesses of the event which a child himself has a direct experience of. If this suggestion is essentially correct, the performance of our children should follow the same pattern: namely, while on-line knowledge assessment may be difficult for them, off-line monitoring should be relatively easy.

Young children's observer-based understanding of behavioral clues which indicate other's knowledge state, when they are observers, has also been examined by Povinelli & de Bois (1992). They found that their young 4-year-olds (*M*=3,11) scored significantly better than their young 3-year-olds (*M*=3,1) in the on-line assessment of others' knowledge state (knowledgeable vs. ignorant). They also found children who were successful in the on-line judgment (all 4-year-olds) were also successful in providing appropriate (off-line) justification for their judgment. The results seem to suggest that accurate on-line discrimination between knowledgeable and ignorant persons is based on abstract reasoning about their knowledge states. If this assumption is correct, it follows that children's off-line reasoning about knowledge formation is prerequisite for their on-line assessment of relative reliability of others' knowledge.

On the basis of the existing findings on young children's observation-based understanding of other's knowledge states, we formulate our hypotheses about performance of children over 4-years of age as follows:

(1) Understanding of behavioral clues indicating other's knowledge states develops earlier than understanding of equivalent linguistic clues;
(2) On-line judgment of reliability of other's knowledge co-develops with off-line assessment of source of the knowledge.

Experiment

In our study, adopting the methodology developed by Moore et al. (1989), we presented preschoolers with hidden object tasks that prompted them to make decisions based on pairs of conflicting utterances. We selected two contrasting pairs of Japanese linguistic forms to test sensitivity to degrees of speaker certainty/evidentiality: the verbs of certainty *know* (*shitteru*) and uncertainty *think (omou*); and the verbs of direct knowledge *see* (*miru*) and of hearsay *hear that (kiku*). As with the linguistic pairs, we produced two types of non-linguistic pairs of stimuli, to test children's sensitivity to behavioral clues that yield different degree of certainty/evidentiality. Here we were interested in learning about whether differences in the ability to use linguistic clues to identify a more reliable speaker and the ability to assess others' states of minds based on other types of behavioral clues would emerge.

Participants

Fifty-two Japanese preschool children participated in the experiment. They were divided into two groups: the four-year-old group (*M*=4,0; range=3,5-4,5; *N*=26) and the six-year-old group (*M*=6,1; range=5,6-6,5; *N*=26).

Materials

Participants were presented with computer animations that were created using Macromedia Flash software. Sound files of recorded voices were imported as characters' utterances and were played to coincide with the cartoon motion of the character's speech.

The animation depicted ten instances of trials. The first two trials were given as practice procedure. Two test trials per each contrastive pair (two behavioral-clue conditions and two linguistic-clue conditions) were administered. The order of the two conditions and the order of the contrastive pairs within each condition were counterbalanced across children.

In the linguistic-clue condition, two characters simultaneously appeared on opposite sides of a container and, in turn, provided contradictory identity statements about the object hidden inside. Each pair of statements was marked linguistically—either with an indication of speaker certainty (*know* vs. *think*), or with an indication of evidential strength (*see* vs. *hear that)*. Examples of stimuli sentences used in the linguistic-clue conditions are shown in Table 1.

Table 1: Example utterances in the linguistic-clue conditions.

Contrasts	Contrastive pairs of utterances with linguistic clues in italic
Certainty	"*I know* what's inside is an apple."
	"*I think* what's inside is a strawberry."
Evidentiality	"*I saw it.* What's inside is a grape."
	"*I heard it.* What's inside is a banana."

In the behavioral-clue condition, each character approached the container separately, exhibited a relevant behavioral clue, and then made a statement about the identity of the object. In the behavioral-certainty condition, the behavior of the characters differed in that one character brought his/her own belonging and put it into the container, and hence was certain about the identity of the object, while the other simply looked at the object for the first time, and hence was less certain about it. The logic here is that the owner of an item is more knowledgeable about it than someone who only sees it for the first time. In the behavioral-evidentiality condition, the contrast was demonstrated by having one character look at an object in the container (strong evidence about the identity), and having the other merely be told about the identity of the object in the container (weaker evidence).

Procedure

Children were engaged in the tasks individually in a playroom of their kindergartens or nursery schools. The experimenter and child sat in front of a computer and the session was videotaped with a camera. An accomplice kept a log but did not otherwise participate in the tasks. Before the tasks began, the experimenter explained that she and the child would play a game together, and the child has to guess what is hidden in the container. The child was told (a) that two characters would appear on the computer screen, and that each would tell him/her something different about the contents; and (b) that the child has to listen to what they say or watch what they do very carefully as one of the two characters knows better than the other.

Once having heard the two conflicting statements, the child was asked two target questions: (a) an identity question: "Which (one) is hidden in this container?" and (b) a source question: "How did you come to know that's what's inside?" The child's response to each question was written down by an accomplice and was double-checked by another experimenter using the video-taped recording.

Coding

Answers to the identity questions were scored as correct when the child chose the object identified by the more reliable speaker. Children's verbal responses to the questions together with pointing were considered as answers. When an answer to an identity question was incorrect, the answer to the subsequent source question was automatically counted as incorrect. Answers to the source questions were coded according to whether a relevant source (i.e. the utterance or the action of the more reliable speaker) was identified. The child's response was coded as correct only if the child referred to the key action or to the relevant linguistic clue in each stimulus. In the behavioral-clue conditions, reference to the character's key behavior (e.g. "The girl looked inside the box." or "The boy brought the rope.") and/or the behavior's effect on their cognitive states (e.g. "The girl is sure because she saw it.") were regarded as correct answers. In the linguistic-clue conditions, reference to the exact linguistic item(s) (e.g. "The boy said *know.*") and the relevant mental state of the character (e.g. "The boy knows better." or "The girl is not sure.") were regarded as appropriate answers. Answers referring only to the character's having said something (e.g. "The boy said so." or "The girl told me.") were not counted as correct. Answers that referred to the order of presentation or the color of the containers, or that attributed judgment to something the child himself did were judged as inappropriate. Coding was conducted independently by two coders. Disagreement about how to categorize answers were later discussed until agreement was reached.

Results

Certainty Contrasts: Linguistic vs. Behavioral Clues Two 2 (age) × 2 (clue) mixed design ANOVAs, one for the identity questions and one for the source questions, were conducted with the post hoc Bonferroni test for multiple comparisons. For the identity questions, there was a main effect of behavioral/linguistic clue difference ($F(1, 50) = 12.63$, $p < .01$) and age group ($F(1, 50) = 14.88$, $p < .001$), but no interaction was found. A post-hoc pair-wise comparison revealed a significant age difference in the linguistic-clue condition ($p < .01$), but not in the behavioral-clue condition. Within each age group, 4-year-olds scored significantly better when the clues to the character's epistemic states were given behaviorally than linguistically ($p < .01$), while no significant difference between the two conditions were found in the performance of the 6-year-olds.

For the source questions, there was again a main effect of behavioral/linguistic clue differences ($F(1, 50) = 14.04$, $p < .001$), and age group ($F(1, 50) = 31.01$, $p < .001$) with no interaction. Post hoc analyses revealed significant differences for age in both behavioral-clue and linguistic-clue conditions ($p < .001$). Within each age group, children scored better in the behavioral-clue condition than in the linguistic-clue condition ($p < .05$ for 6-year-olds, and $p < .01$ for the 4-year-olds)(see Figure 1).

Certainty Contrasts: Identity vs. Source Questions Table 2 shows the numbers of children sorted according to their scores for each question. As explained in the coding section, answers to the source questions get a point only if they score in the identity question, too. If responding to the two questions is equally difficult, there would be no significant decline in the performance across the questions. Wilcoxon's signed rank test revealed, however, a significant effect of questions both in the linguistic ($Z = 4.40$, $p < .001$) and in the behavioral condition ($Z = 3.84$, $p < .001$) for 4-year-olds. Moreover, for the 6-year-olds, a significant decline was found in performance on the second questions for the linguistic ($Z = 3.56$, $p < .001$) and the behavioral condition ($Z = 2.60$, $p < .01$), indicating that children who correctly identify the content do not necessarily perform equally well in the source questions.

Evidentiality Contrasts: Linguistic vs. Behavioral Clues For the identity questions, two-way ANOVAs revealed a main effect of behavioral/linguistic clue difference ($F(1, 50) = 33.00$, $p < .001$) with no other main effect or interaction. Children in each age group performed better in the behavioral-clue condition than in the linguistic-clue condition ($p < .001$, for both groups). No significant age difference was found either in the behavioral- or the linguistic-clue condition.

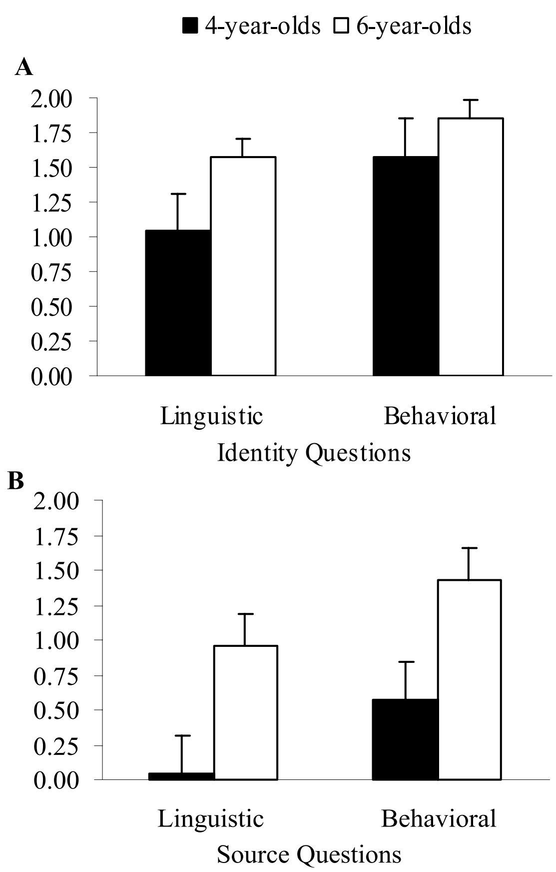

Figure 1: Mean scores in the Identity Questions (A) and the Source Questions (B) for the Certainty Contrasts (maximum score = 2).

Table 2: Numbers and percentages of children sorted according to their response patterns on the Certainty Contrast Questions.

Scores		4-year-olds (*n*=26)		6-year-olds (*n*=26)	
IQ	SQ	Linguistic	Behavioral	Linguistic	Behavioral
0	0	3 (12%)	2 (8%)	1 (4%)	1 (4%)
1	0	18 (69%)	7 (27%)	8 (31%)	0 (0%)
1	1	1 (4%)	0 (0%)	1 (4%)	2 (8%)
2	0	4 (15%)	9 (35%)	2 (8%)	3 (12%)
2	1	0 (0%)	2 (8%)	4 (15%)	5 (19%)
2	2	0 (0%)	6 (23%)	10 (38%)	15 (58%)

Note: IQ=Identity Questions; SQ=Source Questions

For the source questions, a main effect of behavioral/ linguistic contrast ($F(1, 50) = 15.82$, $p < .001$) and the age group ($F(1, 50) = 22.37$, $p < .001$) was found (with no interaction). The older group of children performed significantly better than did the younger group both in the behavioral-clue ($p < .01$) and the linguistic-clue ($p < .001$) conditions. Within each group, 6-year-olds scored higher in the behavioral-clue condition than in the linguistic-clue condition ($p < .001$), while 4-year-olds did not show any significant difference (see Figure 2).

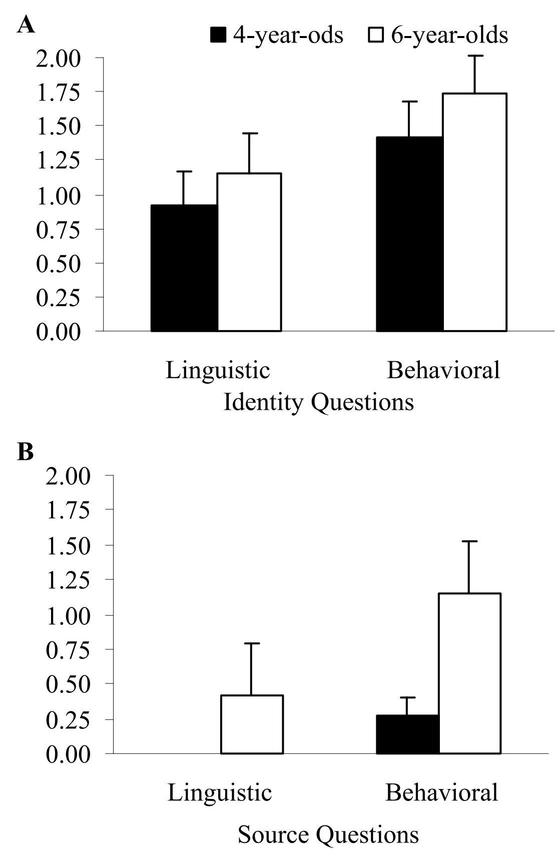

Figure 2. Mean scores in the Identity Questions (A) and the Source Questions (B) for the Evidentiality Contrasts (maximum score = 2).

Evidentiality Contrasts: Identity vs. Source Questions The results again indicate children's difficulty in reporting source of beliefs compared to making on-line decisions (see Table 3). Wilcoxon's signed rank test revealed a significant effect of questions in 4-year-olds ($Z = 4.35$, $p < .001$ for the linguistic condition; $Z = 4.26$, $p < .001$ for the behavioral condition) and 6-year-olds ($Z = 3.69$, $p < .001$ for the linguistic condition; $Z = 2.76$, $p < .01$ for the behavioral condition), indicating a strong difference between the two types of task.

Table 3: Numbers and percentages of children sorted according to their response patterns on the Evidentiality Contrast Questions.

Scores		4-year-olds (*n*=26)		6-year-olds (*n*=26)	
IQ	SQ	Linguistic	Behavioral	Linguistic	Behavioral
0	0	5 (19%)	0(%)	4 (15%)	2 (8%)
1	0	18 (69%)	13 (50%)	11 (42%)	1 (4%)
1	1	0 (0%)	2 (8%)	3 (12%)	2 (8%)
2	0	3 (12%)	8 (31%)	2 (8%)	5 (18%)
2	1	0 (0%)	1 (4%)	2 (8%)	2 (8%)
2	2	0 (0%)	2 (8%)	4 (15%)	14 (54%)

Note: IQ=Identity Questions; SQ=Source Questions

Discussion

Our first prediction is supported by the results, which indicate that there is an overall tendency for behavioral clues to be more effective than linguistic clues in both age groups. Two exceptions to this tendency must be noted. First, 6-year-olds' understanding of linguistic clues indicating the speaker's certainty about the information did not differ significantly from their understanding of the behavioral equivalents. This suggests that by the age of six, understanding of linguistic clues has caught up with understanding of behavioral indication of certainty. Second, in stark contrast, 4-year-olds demonstrated virtually no ability to use either type of clue in responding to the source questions about evidentiality. This suggests that children of this age have no way of explicitly grasping knowledge formation in others in terms of informational access.

The results do not confirm our second prediction. We found that in the identity question tasks, performance of 4 year-olds and 6-year-olds did not differ significantly, except for the certainty contrast/linguistic-clue condition. On the other hand, the age difference was significant in all 4 conditions of the source question tasks. Off-line, reflective understanding of source of knowledge appears to develop much more slowly than on-line understanding of reliability of other's knowledge states. In addition, it was revealed that in both age groups, children who correctly identified the more reliable speaker found it more difficult to verbally justify their choice.

It is important to note here that the poor performance of children of both age groups in our source question tasks may be due to the type of question used. In most existing source-monitoring tasks, forced-choice questions with prompts ("How did you know it was X, because you saw it, or because I told you so?") were used, while in the current experiment, we used an open-ended questions ("How did you come to know that's what's inside?"). Also, in an observer-based source-monitoring task in Robinson & Whitcombe (2003), where 4-year-olds performed better in the source question task than identity question task, the subject of the source questions were not the child participant, but the protagonist chosen by the child as being more reliable than the other ("How did Jack know it was the X? Did he see or did he feel inside the box?"). The performance of our participants suggest that even at age six, answering an open-ended source question is not an easy task for children, and for 4-year-olds, it is virtually impossible.

General Discussion

Typically, fully explicit understanding of other's mental states has been associated with the ability to verbally explain the process of knowledge formation. A child who lacks this ability, but who can spontaneously assess the reliability of another's knowledge state, may be characterized as having implicit understanding. The most important implication of the work presented here, however, is that young children's understanding of other's epistemic states cannot be accounted for by a simple dichotomy between explicit vs. implicit knowledge systems. Our study revealed that, depending on how an epistemic state is indicated (e.g. behaviorally or linguistically), young children's ability to encode the source of knowledge explicitly at the time of input varies. Thus, our results support the claim that explicitness is multifaceted and multi-leveled (Dienes & Perner, 1999; Karmiloff- Smith, 1992).

Developmental characteristics manifested in our experiments may partly be explained by Kamiloff- Smith's RR model. Arguing against the view that explicit understanding can be reduced to an ability to offer verbal reports, she claims that information can be encoded and represented in many non-linguistic ways, and such non-linguistic representations are also available to consciousness. Thus, her model allows for linguistic knowledge both as an implicit procedure and as an explicit representation, together with non-linguistic knowledge as an explicit representation. In addition, between the initial implicit level and final fully-explicit metalinguistic awareness, further levels of explicitness are postulated.

Our results suggest that in order for young children to answer open-ended questions about sources of knowledge, full metalinguistic awareness, which begins to function around the age of six, is required. In the present study, 6-year-olds, but not 4-year-olds, were found capable of answering the source questions. On the other hand, the 4-year-olds were capable of using both linguistic and behavioral clues effectively to select the more reliable source of information when they were outside observers. We speculate that an ability to infer reliability of other's knowledge as a third party on the basis of only limited clues may require something more than implicit or procedural knowledge: namely, explicit representation which is not yet available to conscious access. This may be akin to Level E1 representation in Karmiloff-Smith's model.

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