Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception

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'A travelling salesman found himself spending the night at home with his wife when one of his trips was unexpectedly cancelled. The two of them were sound asleep, when in the middle of the night there was a loud knock at the front door. The wife woke up with a start and cried out, 'Oh, my God! It's my husband!' Whereupon the husband leapt out from the bed, ran across the room and jumped out the window.'

Schank and Abelson, 1977, p. 59.

Abstract

Understanding of another person's wrong belief requires explicit representation of the wrongness of this person's belief in relation to one's own knowledge. Three to nine year old children's understanding of two sketches was tested. In each sketch subjects observed how a protagonist put an object into a location x and then witnessed that in the absence of the protagonist the object was transferred from x to location y. Since this transfer came as a surprise they had to assume that the protagonist still believed that the object was in x. Subjects had to indicate where the protagonist will look for the object at his return. None of the 3–4-year old, 57% of 4–6-year old, and 86% of 6–9-year old children pointed correctly to location x in both sketches. Of the many cases where 4–6-year olds made an error they failed

in only about 20% to remember *the initial location correctly. As a test of the stability of children's representation of the protagonist's wrong belief the sketches continued with a statement about the protagonist's intention to either deceive an antagonist or truthfully inform a friend about the object's location. Independent of age, of those children who correctly thought that the protagonist would search in x, 85% of the time they also correctly thought that he would direct his antagonist to location y and his friend to location x. This shows that once children can represent a person's beliefs they can* constrain *their interpretation of this person's stated intentions to the person's beliefs. In a more story-like situation another group of children had to infer a deceptive plan from the depiction of a goal conflict between two story characters and one character's expedient utterance. At the age of 4–5 years children correctly judged this utterance as a lie only 28% of the time while 5–6-year olds did so 94% of the time. These results suggest that around the ages of 4 to 6 years the ability to represent the relationship between two or more person's epistemic states emerges and becomes firmly established.*

Premack and Woodruff (1978) argued that one could demonstrate that chimpanzees have a 'theory of mind', i.e., an ability to impute mental states to themselves and others. In Pylyshyn's (1978) explication this means that somebody who has a theory of mind does not only have a representation about a state of affairs (x) and stands in certain relationships to these representations (e.g., wanting x, believing x, etc.) but also represents these relationships explicitly. Pylyshyn refers to this ability as an ability for 'meta-representation'. This ability looms large in philosophical discussion as a necessary precondition for moral responsibility, self-consciousness, and social interaction (e.g., Dennett, 1978a).

It was thought that the best method of demonstrating an ability for meta-representation in non-linguistic chimpanzees is to teach these animals to deceive a competitor. Deceptive action is a good way of demonstrating the presence of a theory of mind, because on the one hand, flexible application of a deception strategy ought to have high adaptive value, while on the other hand it requires the conceptualization of the deceived person's wrong belief as a subgoal in one's planning strategy. Woodruff and Premack (1979) succeeded in teaching deceptive pointing to 2 out of 4 chimpanzees but only after an extensive training effort of 5 months. This difficulty in teaching chimpanzees to deceive is comparable to the difficulties encountered in teaching them language. Thus it seems that the *natural* acquisition of language and of a 'theory of mind' is a human characteristic.

Although the natural occurrence of deception is a convincing indicator of meta-representational activity it is a very conservative measure because it requires many additional complex planning steps. Since children are capable of language there is alternative access to their meta-representational ability. One obvious indicator of this ability is children's use of meta-representational language, i.e., their reference to people's 'wants', 'beliefs', etc. In an observational study Bretherton and Beeghly (in press) found that at the age of 2 1/2 years the majority of children spontaneously used a substantial vocabulary about perception, volition, major emotions, and knowledge. The most popular of these words were used equally frequently for self and others. Hood and Bloom (1979) reported that at 3 years children referred quite frequently to their own and others' intentions in response to 'why'-questions.

Experimental studies tested the correct use and understanding of these words at an early age. For instance, Shultz *et al.* (1980) demonstrated that 3 to 5-year olds distinguished correctly between intended acts and unintended behaviour, such as mistakes, reflexes, and passive movement. There is also evidence that 4-year olds start to understand correctly some, although not all aspects of 'know' and 'guess' (Johnson and Maratsos, 1977; Miscione *et al.*, 1978), of 'remember' and 'forget' (Johnson and Wellman, 1980) and start to understand the presuppositions of these words (Macnamara *et al.*, 1976).

The studies cited above demonstrate that very young children already explicitly represent and hence are able to verbalize the relation in which they and others stand to their representation of propositional content.

A more complicated meta-representational problem arises when one has to explicitly represent the *difference* between one's own and somebody else's relation to the *same* propositional content. This problem arises when one has to account for the lack of knowledge in another person. In a series of studies on epistemic egocentrism subjects had *information* about some event and also had information about the fact that another person had *no* such information. Chandler and Greenspan (1972) and Flavell *et al.* (1968) generated this difference in knowledge by introducing a late arriving by-stander. Marvin *et al.* (1976) and Mossler *et al.* (1976) used a different technique based on selective presentation of sense specific information. For instance, in one study children were shown a television sketch in which a boy was entering a house and asked his sister for a biscuit. Then they watched the same sketch over again in the presence of their mother but with the sound track turned off, so that it was clear that the mother did not hear the auditorily conveyed information. Sixty percent of 4-year and 85% of 5-year olds answered correctly that the mother knew that the boy entered

the house and that she did not know that he asked his sister for a biscuit. These results show that from 4 years onwards children are able to differentiate between their own knowledge and the *absence* of this knowledge in the other person.

In contrast to these studies which investigated children's ability to represent the absence of knowledge in another person the present series of experiments investigated children's competence in representing another person's *definite* belief which differs from what the subject knows to be true. This problem has not been investigated developmentally. It can, however, be conveniently studied in the following formal paradigm which has been outlined by Bennett (1978), Dennett (1978b) and Harman (1978) independently in their comments on the paper by Premack and Woodruff (1978): The subject is aware that he/she and another person observe a certain state of affairs x. Then, in the absence of the other person the subject witnesses an unexpected change in the state of affairs from x to y. The subject now knows that y is the case and also knows that the other person still believes that x is the case.

In order to test subjects' comprehension of the other person's wrong belief, stories like the following were constructed: A story character, Maxi, puts chocolate into a cupboard x. In his absence his mother displaces the chocolate from x into cupboard y. Subjects have to indicate the box where Maxi will look for the chocolate when he returns. Only when they are able to represent Maxi's wrong belief ('Chocolate is in x') apart from what they themselves know to be the case ('Chocolate is in y') will they be able to point correctly to box x. This procedure tests whether subjects have an explicit and definite representation of the other's wrong belief. Yet, there is neither a problem in framing the test question by using mental verbs (e.g., 'What does Maxi *believe*?') nor are subjects required to verbalize their knowledge about other's beliefs since a mere pointing gesture suffices.

The practical importance of representing another person's wrong beliefs consists in the use of this representation as a frame of reference for interpreting or anticipating the other person's actions. That is, the interpretations and anticipations have to be *constrained* to the realm of the other person's beliefs. In order for such a constraining function to occur, the representation of the other person's beliefs has to be firmly established. As a test of the firmness of children's representation of wrong beliefs, the 'wrong belief' paradigm as outlined above was extended by describing Maxi as wanting to tell something wrong or something true.

In a competitive story version Maxi's brother was introduced who, too, wants the chocolate and asks Maxi where it is. Maxi (who wrongly believes that the chocolate is in x) decides *to tell his brother something wrong.* Sub-

jects are then asked 'Where will Maxi tell his brother the chocolate is?'. A correct answer to this question depends on the correct interpretation of Maxi's intention to tell something wrong. Maxi's message to his brother has to be 'wrong' in relation to 'Maxi's wrong belief'. Ironically, this correct interpretation can lead to the answer that Maxi will try to mislead his brother by telling him: 'The chocolate is in y', where it actually is. Hence there is a temptation for subjects to make the typically 'egocentric', incorrect interpretation. Maxi's message, which he intends to be wrong, could easily be construed as actually wrong, i.e., it is interpreted as being 'wrong' in relation to the subject's own knowledge.

In a cooperative story version Maxi asks his Grandpa for help and has the explicit intention *to tell the truth* about the location of the chocolate. Again, there are two possible interpretations of 'true': the correct interpretation relates the 'true' statement to Maxi's wrong belief, while the incorrect one relates it to the subject's own knowledge of the truth. The correct interpretation leads to the answer that Maxi tells his Grandpa: 'The chocolate is in x', where the subject knows that it is not.

Therefore, the correct interpretation of the instruction to make Maxi say something wrong can lead to a statement that is actually true, while the correct interpretation of the instruction to make him say something true should lead to an utterance that is actually wrong. One can empathise with the subject's temptation to take the wrong interpretation: when asked to make Maxi say something (which he thinks is) wrong or true, it is but natural to make him say something that is *actually* wrong or true. This temptation will meet little opposition if subjects are still uncertain about the distinction between their own knowledge and the protagonist's beliefs. Hence, we can expect that correct interpretations will only occur once this distinction has been firmly established in the child's mind. The representation of Maxi's belief has to be firm enough so that the interpretation of his intention to say something wrong or true can be constrained to the realm of his beliefs.

Experiment 1

Method

Subjects

Thirty-six children from several kindergartens and summer camps in Salzburg, Austria participated in this study. There were twelve subjects in each of the following age groups: 4–5 years (4;0 to 4;7, 5 girls, 7 boys); 6–7 years (6;0 to 6;11, 6 girls, 6 boys), and 8–9 years (8;1 to 9;3, 4 girls, 8 boys).

Materials

Three cassette containers and 3 large match boxes were used for the 3 hiding locations. The three containers were glued equally spaced along the bottom of one side of a 40 cm wide and 30 cm high polyesther wall. The match boxes were glued onto the other side along the upper rim of this wall. The wall was erected on a 80 cm by 40 cm platform. The colours of the containers were blue, green and red and yellow, red and white for the match boxes. Fifteen cm paper cut-outs of a young boy and a young girl were used to represent the absence and presence of the story protagonist.

Procedure and Design

Each child was told two stories. Each story existed in two versions (Table 1). In one version it was made clear that the protagonist wanted to cooperate with another character in obtaining the hidden object; in the other version the protagonist competed with an antagonist.

   Story 1 is fully described in both its versions in Table 1. Story 2 had essentially the same structure. It was set in a kindergarten where a little girl hid her favorite book. When all children were on a walk a caretaker reshelved the book. Upon returning from the walk the second character is introduced. In the cooperative version it is the girl's friend to whom she offers to show her book. And she tells him where to find it. In the other version a child is competing for the book and the little girl tries to mislead him.

   Story 1 was always told before story 2. For half the subjects story 1 was told in its cooperative version and story 2 in its competitive version. The other half was told the complementary versions. The stories were tape recorded and played to the subject while the experimenter carried out the stage instructions. The test questions were asked by the experimenter.

Results

Representing Wrong Beliefs

Table 2 shows the number of children who pointed correctly to location x in response to the 'Belief'-question: e.g., 'Where will Maxi look for the chocolate?'. All incorrect responses consisted of pointing to the actual location of the chocolate (location y); there were no wrong responses of pointing to the third location z. Table 2 reveals a strong age trend. A majority of 4—5-year olds pointed wrongly to the actual location y while almost all 6—9-year olds

Table 1. *Cover story 1 in its cooperative and competitive version including [stage instructions]*

Version	
Cooperative	Competitive
[Scene with match boxes fixed high on the wall]	[Scene with cassette containers low on the wall]

[Boy-doll present; representing Maxi waiting for his mother.]

"Mother returns from her shopping trip. She bought chocolate for a cake. Maxi may help her put away the things. He asks her: 'Where should I put the chocolate?' 'In the blue cupboard', says the mother.

'Wait I'll lift you up there, because you are too small.'

Mother lifts him up.
Maxi puts the chocolate into the blue cupboard. [A toy chocolate is put into the blue match box.] Maxi remembers exactly where he put the chocolate so that he could come back and get some later. He loves chocolate. Then he leaves for the playground. [The boy doll is removed.] Mother starts to prepare the cake and takes the chocolate out of the blue cupboard. She grates a bit into the dough and then she does *not* put it back into the *blue but* into the *green* cupboard. [Toy chocolate is thereby transferred from the blue to the green match box.] Now she realizes that she forgot to buy eggs. So she goes to her neighbour for some eggs. There comes Maxi back from the playground, hungry, and he wants to get some chocolate. [Boy doll reappears.] He still remembers where he had put the chocolate."

['BELIEF'-question] 'Where will Maxi look for the chocolate?'

[Subject has to indicate one of the 3 boxes.]

"OK, there he'll look, but he is too small to reach up there. There comes Grandpa and Maxi says: 'Dear Grandpa, please help me get the chocolate from the cupboard.' Grandpa asks: 'Which cupboard?' "	However, before Maxi gets a chance to get at the chocolate his big brother comes into the kitchen. He, too, is looking for the chocolate. He asks Maxi where the chocolate is. 'Good grief', thinks Maxi, 'now big brother wants to eat up all the chocolate. I will tell him something completely wrong so that he won't find it, for sure'."

['UTTERANCE'-question] 'Where will Maxi say the chocolate is?'

[The box indicated is opened.]

['REALITY'-question (asked only if the box opened is found empty)] 'Where is the chocolate really?'

['MEMORY'-question] 'Do you remember where Maxi put the chocolate in the beginning?'

Table 2.   *Number of subjects giving correct answers to 'Belief'-question in Experiment 1*

	Number of correct answers		
Age (years)	2	1	0
4–5	4	2	6
6–7	11	0	1
8–9	11	1	0

pointed to the correct location x. For a test of statistical reliability the data of Table 2 were collapsed into a 2 X 2 contingency table (4–5-year olds *versus* older children, and children who responded correctly on both occasions *versus* children who gave wrong responses on at least one occasion): *Chi Square* = 10.82, *d.f.* = 1, $p < 0.01$.

Wrong responses could not be due to a failure of remembering the actual sequence of events because in 80% of the cases where children pointed to location y in response to the 'Belief'-question they gave a correct answer to the 'Memory'-question: e.g., 'Do you remember where Maxi put the chocolate in the beginning?'). Conversely, correct answers to the 'Belief'-question were not due to a failure to remember the actual location of the object, because *all* children who answered the 'Belief'-question correctly, also gave correct answers to the 'Reality'-question.

Construction of Utterances

Inspection of the data showed that there was no discernible effect caused by the two stories. Thus, the data were collapsed. Table 3 separates the data for those children who responded correctly to the 'Belief'-question from those who responded incorrectly. For deceitful utterances called for by the competitive version the relevant data are in the first two rows of Table 3. The last column shows that for children of all ages who answered the 'Belief'-question correctly with location x, 23 were also able to construct an appropriately deceitful utterance by letting the protagonist direct their competitor to either location y (20 of them) or z (3 of them). Only 5 gave incorrect answers: *Chi Square* = 11.57, *d.f.* = 1, $p < 0.001$.

For truthful utterances in the cooperative version the analogous data are in the third and fourth row of Table 3. The proportion of responses is quite opposite to the one in the competitive version: Twenty-three subjects let the protagonists direct their cooperating friends to location x, while only 4 let them point to location y: *Chi Square* = 13.37, *d.f.* = 1, $p < 0.001$.

Table 3. *Number of subjects who answered the 'Belief'-question with locations x (correct) or y (incorrect) and gave the same or a different answer to the 'Utterance'-question in Experiment 1*

Answer to 'Belief'-question	Story Version	Answer to 'Utterance'-question	Age (years)			
			4–5	6–7	8–9	Total
Correct (x)	Competitive	Same: x	1	3	1	5
		Different: y or z	4	8	11	23
	Cooperative	Same: x	4	10	9	23
		Different: y or z	1	1	2	4
Incorrect (y)	Competitive	Same: y	7	1	0	8
		Different: x or z	0	0	0	0
	Cooperative	Same: y	5	1	0	6
		Different: x or z	2	0	1	3

Note. In the competitive version the correct response to the 'Utterance'-question consists in giving a *different* answer than to the belief-question, while in the cooperative version the *same* answer should be given. Since each child was told two stories, one in its competitive the other in its cooperative version, the numbers in the table add up to twice the number of subjects in the experiment.

For the cooperative as well as the competitive story version Table 3 shows that the proportion of correct answers to the 'Utterance'-question remained roughly constant across ages for those children who responded correctly to the 'Belief'-question.

These results show that children at all ages who correctly ascribed to the protagonist a wrong belief were also able to construct for the protagonist an utterance which is *deceitful* or *truthful in relation* to the protagonist's *belief.* Such a belief-dependent construction of utterances is a quite intricate cognitive achievement in the present experimental situation. If the protagonist intended to point to the *true* location, then the subject had to point for the protagonist to a location which is known to the subject as the actually *false* location. Conversely, if the protagonist intended to cheat and point to a *false* location, then nearly all subjects pointed for the protagonist to the actually *true* location. Many children were observed to react with an ironical smile to the protagonist's counterproductive deceptive effort.

The lower half of Table 3 presents the data for those subjects who responded incorrectly with the actual location y to the 'Belief'-question. Most of these subjects responded with location y also to the 'Utterance'-question regardless of the truthful or deceitful intentions of the protagonists.

Experiment 2

In this experiment two explanations are explored of why a high proportion of the youngest subjects in Experiment 1 failed to correctly ascribe a wrong belief to the protagonist.

A series of studies on impulsivity *versus* reflectivity in children (see review by Kagan and Kogan, 1970) consistently showed for various task domains that young children react much faster but, therefore, less accurately than older children. Indeed, many of the 4–5-year old children in Experiment 1 gave the impression that they pointed automatically without much reflection to the actual location y in response to the 'Belief'- and the 'Utterance'-questions. To control such impulsive behaviour a 'Stop and Think' request was introduced before the 'Belief'-question.

Another explanation attributes the youngest subjects' difficulty with the 'Belief'-question to a possible interference between mental representations. Since the target object is merely displaced from a box of one colour to a box of another colour, the description of the protagonist's wrong belief, e.g., 'The chocolate is in the blue cupboard', is fairly similar to the description of the subject's own knowledge that 'The chocolate is in the green cupboard'. Due to this similarity the representation of the protagonist's belief may be easily overwritten by the dominating description of the true state of affairs. In order to reduce the similarity of descriptions a new condition was introduced in which the target object was taken from the first cupboard (location x) and then disappeared altogether from the scenes, i.e., the chocolate in one story was used up, the picture book in the other story was taken home by a caretaker.

Method

Subjects

Ninety-two children from several kindergartens in Salzburg participated in this study. There were 20 3–4-year old (3;1 to 3;9, equal number of boys and girls), 42 4–5-year old (4;1 to 4;9, 20 girls and 22 boys) and 30 5–6-year old children (5;1 to 5;9, 14 girls and 16 boys).

Material and Procedure

The same two stories were used as in Experiment 1 with the following modifications: for instance the story described in Table 1 was told up to the sen-

tence: 'There comes Maxi back from the playground, hungry'. In the *Standard Displacement* condition the 'Belief'-question followed: 'Where will Maxi look for the chocolate?'. In the case of a correct response by the subject this question was followed by the 'Reality'-question: 'Where is the chocolate really?', otherwise the 'Memory'-question was asked: 'Do you remember where Maxi put the chocolate in the beginning?'.

In the *Stop-and-Think Displacement* condition subjects were given a reminder before the 'Belief'-question: 'Think carefully! What did Maxi do before he went off to the playground? Now he wants to eat the chocolate. Where will he look for the chocolate?'.

In the *Disappear* condition the stories were altered at an earlier point. Instead of using only part of the chocolate children were told: 'The mother grates all of it into the dough. Now there is no chocolate left. The chocolate cake is for the grandmother who has her birthday today. When the cake is ready the mother takes it and brings it over to Granny's. [The chocolate is removed from the scene and placed behind the wall.] Now Maxi returns from the playground'. The 'Belief'-question followed: 'What will Maxi do?'. If no answer or an unclear answer was forthcoming, a prompting question was asked: 'Now look, Maxi returns hungrily from the playground and wants to eat the chocolate. Where will he look for the chocolate?' Subsequently the 'Reality'- or the 'Memory'-question was asked depending on subject's response.

The second story was modified accordingly. The caretaker did not reshelve the picture book but took it home for repair. Each child heard both stories from a tape recorder. Their sequence was counterbalanced across age groups and experimental conditions.

Results

Belief Questions

Table 4 shows the number of subjects who correctly attributed the wrong belief to the story protagonist in both, only one, or in neither of the two stories.

As in Experiment 1 subjects are bimodally distributed over these 3 categories (last row of Table 4). Under the assumption of a single peaked distribution the frequency in the middle should not be less than the smaller frequency of the two end categories, which can be reliably rejected: *Chi Square* = 25.13, *d.f.* = 1, $p < 0.001$.

Table 4. *Number of subjects who answered correctly with location x to 'Belief'-question (e.g., 'Where will Maxi look for the chocolate?') in Experiment 2*

			Number correct		
Age (years)	Condition	n	2	1	0
3–4	Stop-and-Think Displacement	10	0	0	10
	Disappear	10	0	3	7
4–5	Standard Displacement	14	6	1	7
	Stop-and-Think Displacement	14	4	2	8
	Disappear	14	11	0	3
5–6	Standard Displacement	10	5	0	5
	Stop-and-Think Displacement	10	10	0	0
	Disappear	10	10	0	0
Total		92	46	6	40

Five to six year olds found both of the new conditions helpful and scored perfectly on the 'Belief'-question in both conditions. In the Standard Displacement condition, however, only half of them responded correctly. The frequency distribution in the Standard Displacement condition was reliably different from the distributions in either one of the other two conditions (Fisher's Test: $p < 0.025$). This and all subsequent tests of statistical reliability were carried out as in Experiment 1 by collapsing the number of subjects who responded correctly only once with those who did not respond correctly in either story.

The frequency distributions of the 4–5-year olds show a reliable difference across the 3 conditions: *Chi Square* = 7.43, *d.f.* = 2, $p < 0.05$. From Table 4 it is clear that this difference is due to better performance in the Disappear condition only. There is no evidence that the Stop-and-Think condition helped the 4–5-year olds subjects at all.

For the 3–4-year olds there is no reliable evidence that they can correctly ascribe a wrong belief in any of the two experimental conditions.

At all ages children's responses to the modified 'Belief'-question in the Disappear condition merit closer inspection. In 50% of all cases 5–6-year olds gave complete answers to the modified 'Belief'-question ('What will Maxi do?') by responding with location x. In the other 50% of cases they initially gave non-specific answers, e.g., 'He will look for the chocolate' but responded specifically with location x to the subsequent prompting question 'Where will Maxi look for it?'

Four to five year olds gave correct and specific answers to the 'Belief'-question in 39.3% of all cases. In 50.0% of the times they responded non-specifically at the beginning but correctly with location x to the prompting question. In the remaining 10.7% they responded incorrectly to the prompting question by claiming that the protagonist would search for the object behind the scenes.

None of the 3–4-year olds gave any answers to the first 'Belief'-question. In response to the prompting question they responded correctly with location x in only 15% of cases, whereas in all the remaining 85% of cases they claimed that the protagonist would search behind the scenes.

Memory Controls

The 'Memory'-question, e.g., 'Do you remember where Maxi put the chocolate in the beginning?' was asked when subjects gave a *wrong* response to the 'Belief'-question. Table 5 shows the percentage of incorrect answers to the 'Belief'-question out of *all* trials and the percentage of correct answers to the memory question out of all those cases where it was asked following a wrong response to the 'Belief'-question.

The memory data for 4–6-year olds show that wrong answers to the 'Belief'-question were followed in 83.7% by correct memory responses, which replicates the finding of Experiment 1 where the respective percentage was 80%. For the 3–4-year olds this percentage was substantially lower (37.8%) which suggests that for the majority in this age group the task was too complex. However, all their wrong responses consisted of the same mistakes as the ones made by the older children: in the Stop-and-Think condition they pointed to location y and in the Disappear condition they answered with the location behind the scenes.

For all age groups all correct answers to the 'Belief'-question were followed by correct answers to the 'Reality'-question, with the exception of one 3–4-year old.

If one compares subjects' performance on the 'Memory'-question in the Disappear condition with their performance in the Displacement conditions a counterintuitive trend becomes apparent. The Disappear condition was designed to test the interference hypothesis which gained some support from the data on the 'Belief'-question. The description of the true state of affairs was more similar to the description of the protagonist's wrong belief in the Displacement condition than in the Disappear condition, hence children found it more difficult to keep the two descriptions separate in the former than in the latter condition. The same should hold true for memory of event sequences. When the description of a previous position of an object is very

Table 5.   *Percentage of incorrect answers to the 'Belief'-question (−Belief) and correct answers to 'Memory'-question (+Memory) as a percentage of those cases in which wrong answers were given to the 'Belief'-question in Experiment 2*

	Age and Question					
	3−4 years		4−5 years		5−6 years	
Condition	−Belief	+Memory /−Belief	−Belief	+Memory /−Belief	−Belief	+Memory /−Belief
Standard Displacement	−	−	53.6	100.0	50.0	100.0
Stop-and-Think Displacement	100.0	50.0	64.3	66.7	0.0	−
Disappear	85.0	23.5	21.4	66.7	0.0	−

similar to the description of the present position of this object (as in the Displacement conditions) then it should be more difficult to keep the two descriptions apart then when they are dissimilar (as in the Disappear condition). However, the data in Table 5 show no such trend. In fact, if there were any difference at all, it would be in the opposite direction: The 4−5-year olds who answered the 'Belief'-question incorrectly in the Disappear condition gave only 66.7% correct answers to the 'Memory'-question as compared to 81.8% for the same age group in the two Displacement conditions put together. Also, for the 3−4-year olds the results point into the same direction.

Experiment 3

Experiment 1 showed that almost all of those children who correctly ascribed a wrong belief to the story protagonist were able to construct truthful or deceitful utterances in relation to this wrong belief. Those children, however, who were unable to ascribe wrong beliefs and wrongly thought that the protagonist would search in the actual location y also pointed to location y in response to the 'Utterance'-question. Thus, from among all 4−5-year olds only 1/3 were able to construct a deceitful utterance correctly. This low performance, however, might lead to an underestimation of this age group's true competence, because the complexity involved in attempting to cope with the protagonist's wrong belief may have prevented them from following the rest of the story with full capacity. Experiment 3 attempts to test young children's ability to construct deceitful utterances without the complexities that arise from the representation of wrong beliefs. This can be achieved by

a minor modification of the stories used in Experiment 1. For instance in Story 1, the mother takes the chocolate *from location x* and after having used some of it, puts it *back into location x* (x—x Replacement condition), while in the original version the chocolate was taken from location x and then put into location y (x—y Displacement condition). If the low proportion of successfully constructed deceitful utterances in Experiment 1 was due to belief difficulties, then a higher proportion can be expected in the x—x than in the x—y condition.

Method

Subjects

A group of 29 4—5-year old (4;1—4;9) and a group of 24 5—6-year old children (5;1—5;9) served as subjects in this study. From the younger group there were 5 girls and 7 boys in the x—x condition and 5 girls and 12 boys in the x—y condition. That there was an unequal number of subjects in the two conditions was caused by an error in allocating boys and girls to the two conditions at the beginning of the experiment. In the older group there was an equal number of girls and boys in each condition. All subjects attended kindergartens in Salzburg, Austria.

Design

Each subject was told two stories, one in its cooperative the other in its competitive version. The assignment of story to version and sequence of presentation were counterbalanced. Both stories were appropriately adjusted to the x—x condition. In all other respects the method of Experiment 1 was followed.

Results

Inspection of the data revealed no perceptible difference in responses to the two stories, hence the data were collapsed for stories. Responses to the 'Belief'-question in the x—y condition replicated the results of Experiment 1 and of the Standard Displacement condition in Experiment 2. Table 6 shows the number of subjects in each age group who answered correctly with location x in both, only one or neither of the two stories.

Table 6.   *Number of subjects giving correct answers to 'Belief'-question in x—y Displacement condition of Experiment 3*

	Number of Correct Answers		
Age (years)	2	1	0
4—5	6	2	9
5—6	8	1	3

The number of subjects who responded correctly in both stories was contrasted with the number of subjects who responded incorrectly in at least one story. This contrast showed no reliable difference between age groups: *Chi Square* = 1.66, *d.f.* = 1, $p > 0.10$. Of those cases in which wrong responses were given to the 'Belief'-question 73.1% were followed by correct answers to the 'Memory'-question. All correct answers to the 'Belief'-question were followed by correct answers to the 'Reality'-question.

Inspection of responses to the 'Utterance'-question showed no difference for the two age groups. For competitive story versions in the standard x—y Displacement condition 18 out of 29 subjects (62.1%) were able to construct a deceitful utterance. In the new x—x Replacement condition, not surprisingly, *all* subjects answered correctly with location x to the 'Belief'-question, but only 11 out of 24 (45.8%) gave correct answers (location y or z) to the 'Utterance'-question. Counter to expectations, this percentage was perceptibly not better than the percentage of children responding correctly in the x—y Displacement condition (62.1%). A 5% confidence interval showed that in the most extreme case, allowed for by the interval, at least more than one third of all subjects in the x—x condition would have given a wrong answer (6 out of 24). This result suggests that the construction of a deceitful utterance remains difficult for 4—6-year old children even when no complicated assumptions about the wrongness of the deceiver's beliefs are involved. This result supports findings by Shultz and Cloghesy (1981) who found that not before the age of 5 1/2 years did children show signs of deceptive behaviour in a variant of the 'Hide and Seek' game.

For those subjects who responded correctly to the 'Belief'-question in the x—y Replacement condition answers to the 'Utterance'-question replicated the results of Experiment 1. In the competitive story version 11 of 15 gave correct answers to the 'Utterance'-question. In the cooperative version all 16 subjects who responded correctly to the 'Belief'-question gave correct answers to the 'Utterance'-question. The response pattern to the

'Utterance'-question was reliably dependent on story version: *Chi Square* = 13.7, *d.f.* = 1, *p* < 0.001.

The high proportion of correct utterance constructions by those 4–5-year olds who gave a correct answer to the 'Belief'-question, suggests that there is no age difference in the usage of the correctly constructed belief representation. In order to give an indication of this age independence the relevant data from Experiments 1 and 3 were put together for 4–6 *versus* 6–9-year old subjects. Yet the resulting contingency table shows *no* reliable age difference either for the competitive story version (*Chi Square* = 0.06, *d.f.* = 1, *p* > 0.90.) or for the cooperative version (*Chi Square* = 0.22, *p* > 0.70).

Experiment 4

Children's answers to the 'Utterance'-question in the x–x condition of Experiment 3 showed that half of them had substantial problems constructing a deceitful utterance even though the deceiver's beliefs could have posed no problems (i.e., x–x condition) and even though the protagonist's deceitful intention was stated in such an obvious way that it almost entailed the appropriate utterance (e.g., Maxi thinks: I will tell him something completely wrong so that he won't find it.) Studies on children's conception of lying (Piaget, 1932; Stern, 1914; Wimmer *et al.*, Reference note 1) showed that children at this age have no difficulty whatsoever in judging an utterance as false if it did not correspond to the real state of affairs. Thus, it seems that the difficulty with the Replacement condition must be due to children's failure to understand deceptive plans, in this case, the protagonist's plan to induce a false belief in his opponent.

A difficulty in understanding deceptive plans, however, contrasts with this age group's preference for fairy tales, many of which are based on intricate deceptive ploys, e.g., 'Hansel and Gretel' (Bruce and Newman, 1978). Bühler (1977) characterized the period of 4 to 8 years as the 'fairy-tale age'. It could be the case that the younger children appreciate fairy tales not for their deceptive ploy but for their archetypal figures and archetypal conflict situations as emphasised by psycho-dynamic theorists (Bettelheim, 1976).

It has to be noticed that deceptive acts are quite differently described in fairy tales than in Experiments 1 and 3, and therefore, quite different inferential processes might be required. In the competitive story versions of Experiments 1 and 3 subjects were explicitly told the *goal* of the protagonist (e.g., Maxi wants to eat the chocolate), the protagonist's anticipation of his antagonist's conflicting goal (e.g., Maxi thinks that his big brother wants to eat the chocolate), and the protagonist's explicit intention to deceive his

antagonist (e.g., Maxi wants to tell him something completely wrong). From these three bits of information subjects have to infer an appropriate utterance which satisfies the protagonist's intentions. In contrast, in deceptive fairy tales children are usually told the protagonist's goal, the antagonist's goal, and the protagonist's utterance. From this the listener has to infer the protagonist's deceitful plan.

In Experiment 4 an attempt was made to assess 4–6-year old subjects' ability to make such inferences. Two stories were constructed in which the protagonist made a critical utterance whose truth was to be judged by the subjects. This utterance was preceded by one of three contexts.

The *deceptive context* depicted the conflict between the protagonist's and antagonist's goal. This conflict together with the critical utterance strongly suggested a deceptive plan on the protagonist's part. The inference of such a plan is required in order to correctly judge the critical utterance as false. In the deceptive context there was no additional information on which such a judgement could be based.

Pilot work indicated that 4-year old children tended to judge the critical utterance in the deceptive context as true. Thus an attempt was made to facilitate their task by giving them an *extremely deceptive context*. Factual information was added to the deceptive context which contradicted the protagonist's critical utterance.

In order to control for the possibility that children might stereotypically judge the critical utterance as false, an *informative context* preceded the utterance in a control condition. Here, the critical utterance was made true by the factual information given in the context.

If the younger children's bad performance on the 'Utterance'-question in Experiments 1 and 3 was due to a general inability to understand deceptive plans then children can be expected to misjudge the truth of the critical utterance in the deceptive context.

Method

Subjects

There were 24 4 1/2-year old (4;3–4;8, nine boys and 15 girls) and 16 5 1/2-year old children (5;4–5;8, eight boys and eight girls) from several kindergartens in Salzburg, Austria.

Material

Table 7 shows the 2 stories that were used with their context variations and test questions. All stories were presented by tape recorder. The critical utter-

Table 7. *Critical utterances in two stories in a Deceptive, (Extremely Deceptive) and Informative context*

STORY 1

Setting

Nancy lives in a large house. Behind the house is a playground with a sand box, a slide, a climbing frame and a swing.

Deceptive Context	*Informative Context*
(Extremely Deceptive: One day Nancy walks to the playground and meets the mother of Thomas. Thomas' mother says to her: "Nancy, if you meet Thomas, please tell him, that he should stay longer on the playground today. I will come over myself later.") Nancy wants to use the swing today. On the playground she sees that Thomas is using the swing. Thomas never gets off the swing, but Nancy wants to use it immediately, she says to Thomas:	One day Nancy walks to the playground and meets the mother of Thomas. Thomas' mother says to her: "Nancy, if you run into Thomas, please tell him that I need him and that he should come home." On the playground Nancy sees that Thomas is using the swing. She says to Thomas:

Critical Utterance

"Hallo Thomas, you've got to go home, your mom needs you."

Test Questions

(a) Is it really true that Thomas has to go home?
(b) Why did Nancy say to Thomas that he has to go home? (In case of answer: "Because mother needs him" an additional question was asked (b'): "Why did Nancy say to Thomas that his mother needs him?")

STORY 2

Deceptive Context	*Informative Context*
(Extremely Deceptive: When Markus plays football Markus hurts his foot quite often. Today he was playing football, but he did take great care, so that he didn't hurt his foot once.) Markus is now playing in his room with LEGO-blocks. He just started to build a tall tower. His mother enters and says: "Markus could you, please, hop over to the store and get me some milk". Markus, however, wants to finish his tower and says to his mother:	Markus hurt his foot playing football. His foot hurts badly. Now he sits in his room and plays with his LEGO-blocks. He just started to build a tall tower. His friend Rudi enters the room. Rudi says: "Markus, come and play football." Markus answers:

Critical Utterance

"I can't go, my foot hurts. I hurt my foot playing football."

Test Questions

(a) Is it really true that Markus hurt his foot?
(b) Why did Markus say that his foot hurts? (In case of answer: "Because he hurt his foot", an additional question followed (b'): Why did Markus say he hurt his foot?

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ance was recorded only once in a neutral voice and spliced into each of the 3 context variations.

Design and Procedure

Each subject was told each story with the same type of context. Eight subjects in each age group received each story with the deceptive context, another eight with the informative context. A third group of only 4 1/2-year olds was given the version with the extremely deceptive context. Each group was subdivided into subjects who were told story 1 first and then story 2 and subjects who were presented with the two stories in the opposite order. Also the order of the two test questions (a) and (b) was counterbalanced within each experimental group.

Results

The best indicator that the critical utterance was interpreted in relation to the deceptive or informative context are the correct answers to test question (a) about the truth of the utterance. Appropriate interpretation should lead to a 'false' judgment in the deceptive context and a 'true' one in the informative context.

Table 8 shows that there was no difference between the two stories. In the informative context subjects in both age groups tended to give appropriate judgments. Children in the younger group tended to treat the critical utterance always as true even in the deceptive and extremely deceptive contexts. However, almost all 5 1/2-year olds gave a context sensitive interpretation: Fisher's Exact Probability Test showed the difference in response patterns between deceptive and informative context as statistically reliable: $p < 0.005$ for both stories. Also, in the deceptive context the response pattern was reliably different for the two age groups: $p < 0.025$.

This result obtained further support from answers to test question (b) or the additional question (b'). Context sensitive answers should include at least one reference to the 'real' goal of the person who made the critical utterance (deceiver) in the deceptive context (e.g., 'Nancy wants to use the swing'), and in the informative context a reference to the source of the information given in the utterance (e.g., 'Thomas has to go home because his mother said so' or '...because his mother needs him'.). Regardless of age, responses to this test question were in 88% of all cases appropriate in the informative context. In the deceptive context 4 1/2-year olds produced only 50% appropriate responses, whereas, 5 1/2-year olds gave 94% appropriate answers. The dif-

Table 8. *Number of subjects judging the critical utterance as true or false*

		Age and Context				
		4–5 years			5–6 years	
Story	Answers	Extreme	Deceptive	Informative	Deceptive	Informative
1 (Nancy)	'True'	6	5	8	0	6
	'False'	2	3	0	8	2
2 (Markus)	'True'	6	6	7	1	8
	'False'	2	2	1	7	0

erence in response pattern between contexts was statistically reliable for 5 1/2-year old children: $p < 0.025$ for both stories.

The results from the 4 1/2-year olds extend the finding of Experiment 1 and 3 that children at this age have a general difficulty in comprehending deceptive ploys. That these children tended to misjudge the truth of the critical utterance even in the extremely deceptive context came as a surprise, since the falsity of the utterance could have been recognized directly by its blatant contradiction with the factual information given in this context condition. However, studies by Markman (1979) and Wimmer (1979) showed that even older children had difficulty detecting the contradiction between story parts even when they were explicitly asked to do so.

The impressive performance by the older, 5 1/2-year old children indicates that children at this age may find it easier to infer a deceptive plan from the story character's conflicting goals and the protagonist's utterance than to construct a deceitful utterance from the conflicting goals and the protagonist's deceptive intentions. Yet, the gap between acquisition ages for these skills cannot be very large since the 6–7-year old subjects in Experiment 1 were quite able to construct deceitful utterances.

General discussion

Representing wrong beliefs requires the construction of two different models of the world (cf., Johnson-Laird, 1980) and the explicit representation of the falseness relation between propositions in one model and the corresponding propositions in the other model. Within the experimental situation that was explored children of 6 years and older were perfectly able to cope with these representational complexities. This finding stands in a potentially

interesting contrast with findings about adults' logical reasoning capacity. Johnson-Laird and Steedman (1978) reported that adults found it difficult to generate valid conclusions for a syllogism if this required two models or more. In the context of false beliefs six-year olds have no difficulty in representing two models and using this representation to construct appropriately deceitful utterances in relation to these models. Hence the problem which adults encounter with syllogisms which require more than a single model may not only be due to the number of models involved. Part of the difficulty could be caused by the factual form in which syllogisms are stated. Factual information usually enables one to specify a *single* model in more detail, whereas the main purpose of referring to people's beliefs is to direct attention to the possibility that people entertain *different* models.

Four to six-year old children also showed signs of being able to represent wrong beliefs but were susceptible to minor modifications in the task. When the description of the correct belief was dissimilar from the wrong belief, as in the *Disappear* condition of Experiment 2, already 78% of the 4—5-year olds constructed the wrong beliefs correctly. The performance of this age group contrasted sharply to the performance by 3—4-year old children. Only 15% of answers by the youngest age group were correct. This abrupt development step at the age of 4 was also documented by Marvin *et al.* (1976), and Mossler *et al.* (1976). Marvin *et al.*, e.g., found that 80% of 4—5-year olds represented correctly another person's absence of knowledge whereas only 5% of 3—4-year olds were able to do so. The close correspondence between their results and the results from the Disappear condition of Experiment 2 is remarkable in two respects. First, the representation of another person's lack of knowledge does not require a definite representation of a particular proposition. Hence, the danger of interference between the two representations is even less than in the Disappear condition. Yet the 3—4-year olds were not able to represent another person's absence of knowledge any better than another person's wrong belief. Second, it could be argued that the real life situations used by Marvin *et al.* (1976) and Mossler *et al.* (1976) allow children to show their full competence better than in the story formats used in the present series of experiments. Thus it is again important that their 3—4-year olds did no better in the real life situation than in the story format situation.

Children's answers to the 'Utterance'-question showed that independently of age nearly all those who were able to construe another person's wrong belief were also able to construct a deceitful as well as a truthful utterance for this person. Correct construction of Maxi's utterance requires a rather complex representation of the contents of his mind. Apart from this additional complexity the boundary around Maxi's mental contents has to be

firmly established so that it *constrains* the interpretation of the ambigous instruction to make *him* say something *true* or *false*. The constraints have to be so strong that subjects' are not susceptible to the obvious temptation to make his utterance just 'true' or 'false', but that they make it 'true' or 'false' *in relation to Maxi's wrong belief.*

In all our experiments children had to infer a protagonist's beliefs from a sequence of events. The results showed that they become able to demonstrate this inferential skill between ages 4 to 6 years. However, from the younger children's failure to show any sign of such a skill one cannot directly conclude that they are incapable of drawing inferences as Bryant and Trabasso (1971) have cautioned us about children's ability to draw transitive inferences. These authors were able to show that if one assures that children remember the facts, then all 4-year olds can draw the correct inferences. In contrast to their finding, in the present series of experiments 80% of 4 to 6-year olds who failed to infer the protagonist's belief correctly remembered the facts. Hence, their failure to infer beliefs cannot be caused by lapses of memory.

Pascual-Leone (1970) and Case (1978) proposed that improved performance on cognitive tasks with age can be explained by a stepwise increase in central processing capacity. One could argue that such an increase is at the heart of the observed development. At the age of 4 and younger the child has at best enough capacity to remember the sequence of actual events, whereas at 6 years the capacity has increased sufficiently so that the protagonist's wrong belief can be represented in addition to the real events. The plausibility of this account is, however, thwarted by our finding that 4 to 6-year olds become able to represent not only a wrong belief but also the protagonist's intentions and actions in relation to this belief. If mental development depended mainly on an increase in processing capacity one would expect that this additional complication in the story should not be understood for at least another two years.

Case (1978) emphasises a particular aspect of Pascual-Leone's original proposal. More complex tasks can be solved without the necessary increase in capacity if experience with the strategy in question leads to automaticity in the basic operations. In the context of belief inferences this would mean that the protagonist's intentions and actions can be represented in addition to his wrong belief if the strategies for inferring his wrong belief had become automatic. Yet, for this automation to occur one would expect that some years of practice were required. However, in the present data there is no indication of such a delay which would be necessary for an increase in mental capacity or an automation of strategies to take place.

In summary it seems, therefore, that the emergence of children's ability to understand another person's beliefs and how this person will react on the basis of these beliefs and their understanding of deception is not a mere side effect of an increase in memory and central processing capacity. Rather, a novel cognitive skill seems to emerge within the period of 4 to 6 years. Children acquire the ability to represent wrong beliefs and to construct a deceitful or truthful utterance relative to a person's wrong beliefs. Within this period several other related abilities also emerge: children start to understand another person's absence of knowledge (Marvin *et al.*, 1976; Mossler *et al.*, 1976). They become able to construct a deceitful utterance (x—x Replacement condition of Experiment 3), and to infer a deceptive plan from a critical utterance in the context of conflicting goals in Experiment 4. Within this age span they also start to understand the competitive nature of the 'Hide and Seek' game (Shultz and Cloghesy, 1981). Correct performance in all these tasks depends on correct representation of two different or even conflicting epistemic states. The convergence of findings from such a variety of different tasks suggests that around the ages of 4 to 6 years the ability to represent the relationship between two or more persons' epistemic states emerges and becomes firmly established within these two years.

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Reference Notes

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Résumé

Comprendre que ce que croit un tiers est erroné requiert une représentation explicitée de cette fausse croyance en relation avec son savoir propre.

On a testé la compréhension de deux sketches par des enfants de 3 à 9 ans. Dans chacun des sketches les sujets observent un protagoniste placer un objet dans un lieu 'x', puis sont témoins du transfert de cet objet de 'x' en 'y' en l'absence du protagoniste. Ce transfert doit causer une surprise chez le protagoniste dont on assume qu'il croit que l'objet se trouve toujours en 'x'. Les sujets doivent dire où le protagoniste va chercher l'objet. Aucun 3–4 ans n'indique correctement le lieu 'x', 57% des 4–6 ans et 86% des 6–9 ans le font. Parmi les nombreuses erreurs des 4–6 ans seules 20% sont attribuables à une incapacité de se souvenir du lieu 'x'. Pour tester la stabilité de la représentation de la croyance erronée, on dit que le protagoniste a l'intention soit de tromper un adversaire soit d'informer un ami sur le lieu où se trouve l'objet. Indépendamment de leur âge, les enfants ayant donné des réponses correctes disent correctement dans 85% des cas que le protagoniste conduirait l'adversaire en 'y' et l'ami en 'x'. Lorsque les enfants se représentent les croyances d'une personne, ils peuvent faire dépendre leurs interprétations des intentions exprimées par celles-ci à partir de ses croyances.

Dans une situation de type histoire, un autre groupe d'enfants doit inférer un essai de tromperie à partir de la représentation d'un but conflictuel entre deux des personnages de l'énoncé tactique d'un des personnages. A 4–5 ans les enfants ne jugent correctement cet énoncé comme mensonger que dans 28% des cas alors qu'à 5–6 on a 94% de réponses correctes. Les résultats indiquent que vers 4–6 ans la capacité de représenter une relation entre les états épistémiques de deux personnes ou plus émerge et se confirme.