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Is Little Red Riding Hood afraid of her grandmother? Cognitive vs. emotional response to a false belief

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The essentials of a theory of mind are generally considered to be acquired around 4 years of age when the child succeeds in the standard 'Maxi task' (Wimmer Perner, 1983). However, rational thought is not attained before 7-8 years of age in ocher domains of cognitive development. This study demonstrates that the mastery of mental state attribution using logical criteria is not reached before age 7-8 years when several assessments of a belief need to be coordinated. This is revealed by the dissociation between the cognitive and emotional assessments of a false belief which yield contradictory responses in most of the children who succeed on the standard task. The results were replicated in five experiments with a total of 254 children aged 3-8 years. The analysis of this *décalage* focuses on the autonomy of emotional attributions and the semi-mental and semi-behavioural structure of belief understanding implied in the standard task. An increase in processing capacity leads to a rational concept of belief around 7-8 years: this concept is called here 'third-person', in opposition to 'second-person' which involves only an initial differentiation from the first-person point of view. Second-person depends on an opposition between the self and the other in terms of a single, modular evaluation of belief, whereas third-person depends on an integration among various assessments and provides a consistent and isotropic concept of belief.

Ca me fait penser à l'histoire du chien qui perdait toujours au poker parce que chaque lois qu'il avait du jeu, il remuait la queue ... (This reminds me of the story of the dog who played poker and always lost because each time he had a good hand, he wagged his tail ...).

Brigitte Bardot (1996, Initials BB, p. 530)

The topic of this study is the achievement of rationality and consistency of thought in the young child from 4 to 7 years of age. It echoes Piaget's preoccupations and tries to improve the description of cognitive development from the stage of reflection (i.e. awareness of some mental states; secondary intention according to Brentano, 1874) at 4 years of age, to the stage of reason described by Piaget in terms of the concrete operational stage. In order to demonstrate both the generality and the robustness of the child's cognitive inconsistency during this period, a well-studied domain in contemporary child

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psychology was chosen: the acquisition of a theory of mind. The aim was to demonstrate that, despite the so-called conceptual revolution raking place at 4 years of age, a consistently logical appreciation of false belief is not achieved before 7 or 8 years of age, because of its computational complexity and the mental load that it imposes. Success on the standard task (Wimmer & Perner, 1983) does not directly entail that a genuine concept of belief underlies the accurate predictions nor that all the deductive consequences of a given belief can be calculated.

Several findings indicate the gradual acquisition of false belief attribution in young children. Cements & Perner (1994) showed an implicit understanding of false belief earlier than on the standard task (Wimmer & Perner, 1983); Mitchell (1994) argued that, because of the realist bias, various external indices of the mental state (e.g. the posting procedure in the Smarties task) help to reduce the age of success on the task. On the other hand, a task in which the child is asked to predict what a protagonist will say about the contents of a box that has been modified during his or her absence (Hogrefe, Wimmer & Perner, 1986) is more difficult than the standard task of Wimmer & Perner (Bradmetz, 1998).

It is likely that from 4 to 7 years of age, each peripheral module has its own resources for computing a false belief and that these various modules are only partially integrated into a single coherent system by means of operational structures and consciousness. This effect is evident in the examples cited above concerning the constitution of a single belief (the *ontological* aspect): implicit (visual) belief seems easier than embodied belief (posting procedure) which is easier than procedural belief (Where will Maxi look for his chocolate?') which is itself easier than declarative belief (what will a protagonist say about the content of the box modified in his or her absence?). It is argued that developmental difficulties also appear in the *epistemological* aspect, i.e. coordination of various modular assessments of a false belief as long as the explicit coordination structure is not in place.

Following philosophical usage, the structure which eliminates contradiction and implies the logical integration and coordination of the various points of view of the other is called 'third-person', and the intermediate structure which is based only on perspective separation and opposition *via* one modular evaluation is called 'second-person'. During the intermediate period, children understand that their beliefs can differ from those of another person, but it is not yet an amodal or intermodal concept of belief; rather, it is tied to particular modules. Data from the different peripheral systems are not yet easily commensurable with one another and the characteristic of this period is an instability of response and systematic *décalages* between, for example, the cognitive and emotional assessment of a false belief which is the focus of this study. In other words, the child who interacts on the basis of a second-person structure interacts with a partial person and a partial mind. (There is an analogy with the partial and total object of the psychoanalytic theory.)

Piagetian studies have illustrated this type of developmental progression in the preoperational stage. Children understand *pre-concepts* around 4-5 years of age (Bradmetz, 1996), but integrate them into a coherent and closed structure only around 7 or 8 years of age. For example, when asked: 'Which is the longer of these two sticks?' they are able to compare two sticks of different lengths around 4 years of age, revealing an understanding of what is the length of an object, but they will not be able to transform this

pre-concept into a concept (i.e. conservation and invariance of length) until 7 or 8 years of age.

To investigate the dissociation between the assertion of a false belief and the negation of one of its logical consequences, it was decided to contrast two assessments of a situation: a cognitive and an emotional assessment. If the child has developed a mentalistic theory of mind, he or she should understand that emotion is founded on the doxastic attitudes of an agent and not on the actual state of affairs when these conflict. This was demonstrated by Harris, Johnson, Hutton, Andrews & Cooke (1989) in a set of experiments in which children had to assess the emotional state of a protagonist who had been deceived by a joker. The experimental design consisted in questioning the child about the emotions of the protagonist (happiness about a desired food or drink and sadness about a disliked food or drink), first when he falsely believes he knows the contents of a box (that has been modified without his knowledge) and, second, after he has discovered the real contents of the box and the deception. The child is also questioned about the reason for which the protagonist is happy (sad) at first and then sad (happy). The authors demonstrated an increasing age-linked justification of emotion based on the belief of the protagonist and not on the actual state of affairs, but noted difficulties even up to 6 years of age. These results are important and confirm the relevance of the belief – desire psychology framework. Within this framework, however, they are nor counter-intuitive because the authors did not try to contrast various evaluations of a false belief situation: they did not ask the child where the protagonist would look for the desired food or drink before or after questioning him about his emotional state. Ruffman & Keenan (1996) conducted a series of experiments to assess the appearance of a belief–based concept of surprise in the child. They discovered a tag between the understanding of a false belief and the mastery of surprise, because it is not until 7 years of age that children reach the latter. In earlier phases, surprise is understood in terms of desire (3-4 years) and ignorance (5-6 years).

The goal of the present study is different because it does not examine the development of the link between a specific emotion and its cognitive basis, but the extent to which an understanding of false belief permeates the entire conceptual organization and modifies or inhibits basic emotion attributions that are acquired early by children. In other words, in demonstrating the difficulty with which a belief-based rationality (as measured by the success on the Maxi task) is employed to moderate autonomous judgments of emotion, the incompleteness and inconsistencies of the underlying concept of belief are also demonstrated. Although the relevance of mentalistic belief desire emotion psychology is not disputed, its acquisition should be progressive and monitored by parallel and modular processes. This can be demonstrated by revealing contradictions in the child's reasoning during an intermediate period between 4-5 and 7-8 years of age. From this point of view, the crucial fact is not the increasing mastery of emotion attributions with age, but the expected contradictions or fluctuations between various false belief judgments and the inability to overcome them before sufficient computing capacities and conceptual organisation become available.

This hypothesis of a systematic *décalage* between cognitive and emotional evaluation is explained by the absence of a third-person structure that overcomes contradiction. It is also based on the fact that, despite its cognitive basis, an emotional response has a vividness which renders it less penetrable and modifiable than a cognitive response. If it is first supported by the actual state of affairs it is assumed that it will be more difficult

to modify or inhibit than a more neutral response. In each of the following experiments a protagonist has a false belief, as in the classical tasks. The real state of affairs should lead the child to attribute to the protagonist a belief (B) and an emotion (E) whereas the state of affairs believed by the protagonist implies attributing to him a belief (B^t) and an emotion (E^t). The youngest children were expected to give B and E responses and the oldest were expected to give B^t and E^t responses. The hypothesis tested here is that the pattern B^t E will be observed during a long developmental period whereas the pattern B E^t will never be observed. From a functional point of view, this assumption is founded on a modular-like conception of the mind which supposes that the child is able to act before understanding and that implicit knowledge comes before explicit knowledge, i.e. that each system which computes a particular type of response is not, at first, linked to the other systems.

EXPERIMENT I

Method

Participants

A total of 53 participan$_t$s, 27 girls and 26 boys, took part in the experiment (mean age = 59.8 months, SD = 11 months). All the children came from a French kindergarten.

Procedure

During the week preceding the experiment, the teachers told children the story of Little Red Riding Hood several times, until they all knew its main episodes. The following week, the experimenter interviewed each child individually. He told the child the story again up to the moment when Little Red Riding Hood enters the grandmother's house. Then the experimenter asked the child Three questions: (1) 'When Little Red Riding Hood goes into grandmother's house, does she think the wolf is in the bed or does she think the grandmother is in the bed?' (order counterbalanced across the sample); (2) When Little Red Riding Hood goes into grandmother's house does she feel afraid?' and (3) 'Why?'.

Results

Table 1 shows the number of children in each age group giving three different response patterns. All the children who answered both questions correctly (i.e. that Little Red Riding Hood believed the grandmother was in the bed, and was not afraid—final row of Table 1) also provided good justifications: 'Because she believed the grandmother was in

Table 1. Number of children in each age group giving three different response patterns

Belief	Emotion	3 years	4 years	5 years	6 years	Total
Wolf	Afraid	5	6	4	0	15
Grandmother	Afraid	3	9	9	3	24
Grandmother	Not afraid	0	1	9	4	14

the bed, she was not afraid of her grandmother!' 'Because she believed there was nobody else in the house!', 'Because she didn't know the wolf was in the bed?', etc. Children who said that Little Red Riding Hood believed the grandmother was in the bed, and was afraid, mostly justified their answers by invoking the wolf: 'Because it is a wolf!' 'Because the wolf wants to eat her!', 'Because the wolf is dressed like the grandmother'; sometimes they mentioned a likely outcome: 'Because, afterwards, the wolf will eat her!' or 'Because the wolf had eaten her! (3;4)'. Four 3-year-olds did not justify Little Red Riding Flood's fear. There were also three children intrigued by the situation and the disguise of the wolf: She feels a little frightened because she can see the ears and the teeth (5;11)', 'Because she can hear strange breathing (4;10)', 'Because his skin is not pink enough (5;10)'. In fact, on the pictures which the teachers presented to the children, it could be seen that the character in the bed was the wolf, so that for the child the situation was ambiguous. This shortcoming was remedied in the two following experiments.

Of the 38 children who correctly said that Little Red Riding Hood believed the grandmother was in bed, 24 simultaneously thought that she was afraid of the wolf. From a logical point of view, this answer is surprising and this 64% raises an important theoretical problem. This response pattern varied with age in that only one child below 5 years of age provided the correct response with an appropriate justification.

A second experiment was conducted to eliminate the effect of the wolf's ambiguous disguise.

EXPERIMENT 2

Participants

A total of 40 participants, 22 girls and 18 boys (mean age = 59.7 months, SD = 10.7 months) took part in this experiment. All the children came from a French kindergarten,

Materials

A small house (40 X 40cm), two toy animals (a little goat and its mother, a nanny-goat) and a wolf puppet were used for the second story.

Procedure

The experimenter individually interviewed each child in a separate room. He told the child the following story. This is a little goat and this is his mother. They live here, in this house. The mother has to go out and leave the little goat alone in the house. She explains to him that there is a bad wolf living in the neighbourhood and that he likes to eat little goats. When his mother went out, the goat was told not to open the door unless his mother showed him her white *leg* through the hole in the door.' (The experimenter showed the child how the mother put her leg through the hole.) When the child had understood this first part of the story, the experimenter went on. When the goat was alone, since his mother had gone out, the bad wolf came [the wolf puppet is on the experiment hand] and said to him in a tiny voice: 'Open the door for me, I am your mother and I want to come inside. The goat answered: 'I won't open unless I can see your white *leg'.* Then the wolf put white flour on his *leg,* showed i$_t$ through the hole and said: 'See, I am your mother, open the door'. Then the goat opened the door, the wolf went in and are the goat up.'

After this first story the experimenter told the child that he would tell the story to him or her again co be sure the child knew it properly. The second time the experimenter told the story, he stopped at the point where the wolf has put its leg through the hole, and asked the child three questions: (1)'Now, does the goat

think his mother will come in or does lie think the wolf will come in?' (order counterbalanced across the sample); (2) 'Now, before opening the door, is the goat afraid?' and (3) 'Why?'

Result

Table 2 shows the number of children in each age group giving the different response patterns. Ten of the 28 children who correctly said that the goat believed his mother wanted to come in simultaneously thought that he was afraid of the wolf. This percentage (37%) is lower than that in the Little Red Riding Hood story, perhaps because the ambiguity about the appearance of the wolf had been removed and the fact that the hero was acting (the goat opened the door) instead of being simply present as in the previous story. In addition, as in the Little Red Riding Hood story, the children knew the end of the story and this could have retroactively interfered with their assessment of the current situation.

To use a weaker emotion than fear, to eliminate the stereotypes attached to the character of the wolf and to avoid using a typical deception scenario and its associated interference, a third experiment was conducted. This was a modification of the classical 'Maxi' task (Wimmer & Perner, 1983).

Table 2. Number of children in each age group giving three different response patterns

Belief	Emotion	3 years	4 years	5 years	6 years	Total
Wolf	Afraid	6	4	1	1	12
Grandmother	Afraid	2	3	3	2	10
Grandmother	Not afraid	1	4	6	7	18

EXPERIMENT 3

Method

Participants

A total of 55 participants, 26 girls and 29 boys (mean age = 67.8 months, SD 6.3 months) took part in the experiment. All the children came from two French kindergartens. A sample with a higher mean age was selected because the previous experiments had shown that erroneous responses were found even after the age of 6 years.

Materials

The materials for this third story were: a toy house (40 X 40cm); two little toy figures, one yellow and one red (Maxi and his brother); two boxes (one blue and the other white); and two pieces of chocolate (plastic).

Procedure

The experimenter individually interviewed each child. He told them the following story. 'See. This is the story of a little boy called Maxi. This is Maxi [the experimenter pointed to the yellow figure]. Maxi is at

home with his brother [the experimenter showed the house and the brother). He has a piece of chocolate and he puts it in this blue box [the experimenter put the big piece of chocolate in the blue box). Then Maxi goes outside to play [the experimenter showed Maxi walking away from the house]. While Maxi is playing outside, his brother opens the blue box, takes the piece of chocolate and begins to eat it. He eats almost all the chocolate and there is only a small piece left [the experimenter took the big piece and replaced it by the small piece). Then, the brother puts the small piece in the white box.' At this point, the experimenter told the child he would tell the story a second time. After telling it a second time, the experimenter continued. 'Now Maxi wants to come home to eat his chocolate. He is hungry'. The experimenter showed Maxi walking into the house. Maxi stops in front of the door and the experimenter asked the child three questions: (1) 'Maxi is in front of the door, where will he look for his chocolate?' (2) 'When Maxi is in front of the door, is he happy?'; and (3) 'Why?'. In contrast to the two previous experiments, the order of questions 1 and 2-3 were counterbalanced across the sample.

Results

Table 3 shows the number of children in each age group giving the different response patterns. Remember that for half the children, the order of the questions was varied and the experimenter asked if Maxi was happy before asking where he would go to get his chocolate). All the children who gave the correct pattern justified their response by explaining that Maxi was happy because he did not know that his brother had eaten his chocolate. Children who said that Maxi was unhappy, even though he would look for his chocolate in the blue box, justified their response by explaining that the brother had eaten the chocolate.

Of the 48 children who correctly predicted that Maxi would go to the blue box, 38 also said that Maxi was unhappy because his brother had eaten the chocolate. Four of them added that Maxi was unhappy because there was nothing in the blue box (final outcome).

In order to examine the reactions of older children in Expt 3, another investigation with the same procedure, but using the Piagetian method of counter-argument, was conducted.

Table 3. Number of children in each age group giving three different response patterns

Belief	Emotion	4 years	5 years	6 years	Total
White box	Not happy	4 (2+2)	3 (2+ I)		7
Blue box	Not happy	3 (2+1)	21 (10+11)	14 (6+8)	38
Blue box	Happy	1 (0+1)	4 (2+2)	5 (3+2)	10

Between parentheses are the number of children who answered condition 1 (action question followed by the emotion question) and 2 (emotion question followed by action question).

EXPERIMENT 4

Method

Participants

A total of 60 participants, 30 girls and 30 boys, aged from 6;4 co 8;7 (mean age = 85.65 months; SD =. 5.48 months) took part in the experiment. All the children came from two French primary schools.

Procedure

The procedure was exactly the same as that in Expt 3, except for further questioning after the children's initial replies to the two test questions. When children succeeded on question 1, For both types of response to questions 2 and 3 (i.e. happy or unhappy) the experimenter gave a counter-argument in order to assess the robustness of the child's response. If the child said that Maxi was unhappy when he was in front of the door of the house because his brother had eaten the chocolate, he or she was asked if Maxi knew that his brother had eaten the chocolate and then he or she was asked again if Maxi was happy or unhappy when lie was in front of die door. If ,he child answered that Maxi was happy, possibly saying that he did no, know that his brother had eaten the chocolate, he or she was questioned again: 'His brother has eaten the chocolate, do you really think that Maxi is happy about that?' Several counter-arguments occurred if the child changed his or her point of view during the questioning.

Results

Table 4 shows the number of children in each age group giving the different response patterns. It can be seen that 30 children did not answer both questions coherently. Moreover, they did not change their opinion about Maxi's emotion after having said that he did not know that his brother had eaten the chocolate. These results reveal a strong dissociation between a cognitive and emotional assessment of the situation and the difficulty of explicitly coordinating them. All these children succeeded, however, in correctly answering that Maxi did not know that his brother had eaten the chocolate. They showed, in their emotion attribution, the same pattern as that reported by Hogrefe, Wimmer & Perner (1986) concerning the action question in the classical task, i.e. they understood that Maxi did not know the actual state of affairs but, even so, they thought that he would react in accordance with that state of affairs. When this question led children to change their mind, a further counter-argument always provoked the reappearance of the erroneous emotion response. Thus, a spontaneous incorrect emotion response is a robust sign of the lack of logical mastery of the situation. By contrast, nine children who had initially given a correct answer to the emotion question were sensitive to the counter-argument and regressed in their reasoning.

Table 4. Number of children giving five different response patterns

Belief		Order of questioning		Total
	Emotion	Action-emotion	Emotion-action	
White box	Not happy	5	5	10
Blue box	Not happy // Not happy	13	17	30
Blue box	Not happy // Happy	0	0	0
Blue box	Happy // Not happy	4	5	9
Blue box	Happy // Happy	8	3	11.

The answer after // is the one which was given after the counter-argument.

If the false belief concept had been acquired around 4-5 years of age, 60 correct response patterns would have been expected in the present sample, but only 11 were actually observed. Seventy-eight per cent (39/50) of the children aged between 6;4 and

8;7 correctly answered the action question but incorrectly answered the emotion question.

Obviously, 11/60 is different from 60/60 and 78% is different from 0%.

The order of questioning had no observable effect on the responses, indicating the robustness of the results. In the pattern with correct action and emotion responses, the 13/17 distribution is not different from chance (i.e. 15/15) and in the pattern with a correct action response and an incorrect emotion response, the 8/3 distribution is not different from chance (i.e. 5.5/5.5) (Sign test).

Three major conclusions can be drawn from both this experiment and the preceding one: (i) the combination of an incorrect action response and a correct emotion response was never observed, with the strong implication that success on the emotion question predicts success on the action question; (ii) the order of questioning had no effect on the response; and (iii) an initially incorrect emotion response revealed the inconsistency of the false belief concept, whereas an initially correct emotion response was robust only 50% of the time.

A final experiment was conducted to replicate and extend the findings.

EXPERIMENT 5

Method

Participants

Forty-six children aged from 4;0 to 6;1 (25 boys and 21 girls) took part in the experiment. Al) the children came from two French kindergartens.

Procedure

This fifth control experiment was conducted in the same way as the third, but without varying the order of the questions, because this had had no observable effect on the responses (thus, the children were always asked the action question before the emotion question). Except for this modification, the procedure was exactly the same as that used in Expt 3, i.e. without the counter-argument introduced in Expt 4. In this control experiment, the experimenter was not the same as in the previous ones. He knew the standard false belief task and its administration, but he was not informed of the present paradigm and the expected results.

Results

Table 5 shows the number of children in each age group giving the different response patterns. The same general trend can be seen: 20 of the 26 children who correctly predicted Maxi's action failed to predict his emotion.

Given the absence of an order effect and for comparison purposes, the results of Expts 3, 4 and 5 can be combined, but only taking into account the spontaneous responses in Expt 4 and not those given after a counter-argument. Table 6 gives the results for the three experiments conducted on a total sample of 161 children aged from 4;0 to 8;7. There was a strong effect of age (Jonckheere's test gives an S value equal to 4.67 sigmas, $p < .0001$) on the level of response, but note that beyond even 6 years of age more than 50% of the children still did not successfully answer the two questions. It should also be remembered that the successful emotion responses in Table 6 were spontaneous and that Expt 4 showed that about half of these responses were not robust.

Table 5. Number of children in each age group giving three different response patterns

Belief	Emotion	4 years	5 years	6 years	Total
White Box	Not happy	13	6	1	20
Blue Box	Not happy	7	8	5	20
Blue Box	Happy	0	4	2	

GENERAL DISCUSSION

The intermediate and contradictory patterns of responses observed in all the experiments confirm the general conception presented in the introductory test to this study. There is a gradual development that reflects improved communication among different assessments (e.g. implicit, procedural, declarative, emotional) of a false belief situation and the progressive mastery of contradiction. In the introductory test, this was called the epistemological aspect of belief. Two separable, but related, issues need to be assessed: (i) the fact that the belief question is answered earlier than the emotion question, and (ii) the fact that children are inconsistent in their responses to logically related questions. The first issue is mainly related to the psychology of emotion, the second is more general and epistemological because it concerns the foundation of rationality, namely consistency.

The fact that emotion is more difficult to attribute accurately to a character than a more neutral mental state such as belief seems easy to explain: emotional cues are vivid whereas procedural inference are less so. If, for biological and phylogenetic reasons, the vividness of a stimulus renders it less penetrable because of the high priority attached to its message, the asymmetry reported in these experiments can be understood. Previous research (Ruffman & Keenan, 1996) has revealed children's understanding of belief and their understanding of a paradigmatic belief-based emotion, namely surprise, showing that an early conceptual analysis does not immediately trigger an appropriate emotion attribution. Moreover, Harris et *al. (1989)* showed that emotion attributions associated with false belief are difficult for children until the age of 6-7 years, even for simple desire-based emotions like joy or disappointment. The present study revealed that, when an emotion was provoked that did not fit the actual situation, the difficulty was pervasive; children formulated the contradiction without being able to overcome it. These findings reinforce

Table 6. Number of children in each age group giving three different response patterns

Action	Emotion	4 years	5 years	6 years	7 years	8 years	Total
Failure	Failure	17	9	9	2	0	37
Success	Failure	10	29	32	14	3	88
Success	Success	1	8	13	11	3	36
Total		28	46	54	27	6	161

the idea of a strong autonomy and lack of permeability for emotion attributions. A second reason for this *décalage* is linked to the action answer ('Where will Maxi look for his chocolate?'). This type of reply involves a form of realist facilitation (Mitchell, 1994) by incorporating the false belief into a behavioural pattern. By contrast, the emotion attribution does not facilitate this realist incorporation. It is suggested below that, in these circumstances, success on the Maxi task is not based on a completely mentalistic understanding of belief.

The second issue concerns the conditions that make such an inconsistent and counterintuitive analysis of the situation possible for the child. These fluctuations are not to be regarded as merely contingent fluctuations that depend on the format of the question or the context, but rather as genuinely logical failures. The standard Piagetian framework would invoke a lack of coordination between intuitions to account for such failures. Various contemporary accounts are based on a more precise concept of computation and mental load. For example, Frye, Zelazo, Brooks & Samuels (1996) explain interference, inconsistency and lack of inhibition in terms of the absence of meta or higher-order rules that allow a choice among lower-order rules. Zelazo, Carter, Reznick & Frye (1997) provide a more extensive study of the development of executive function. They make an inventory of all the functions implied in a problem-solving task and the specific difficulties associated with each.

The conceptual frame used here distinguished second- and third-person structures acquired respectively around 4-5 and 7-8 years of age. The first step around 4-5 years of age is characterized by the beginning of an explicit awareness of mental states, based on reflection. Reflection is taken to be synonymous with awareness as in the philosophical tradition: By reflection, I mean that notice which the mind takes of its operations and the manner of them; by reason whereof there come to be ideas of these operations in the understanding' (Locke, 1690). In this sense, many developmental facts reveal the beginning of such an awareness at 4 years of age. If there is a stage-like change at this age, it could be called the stage of reflection, after the stage of representation, which begins around 18 months according to Piaget, and before the stage of reason which begins around 7 years of age. With reflection, children become aware of their representational activity *(cf:* the concept of 'primary and secondary intention' of the scholastics (Brentano, 1874; Chisholm, 1986), and the concept of `metarepresentation' (Perner, 1991). They know, for example, that the state of affairs being considered is true or false, and know that they know, but they still cannot coordinate various pieces of explicit knowledge. This period contrasts dramatically with the previous one in which no such awareness is present. One can cite, for example, the notion of 'prelief' (Perner, Baker & Hutton, 1994) or the studies of Harris (1994) and Harris, Kavanaugh & Meredith (1994) who maintained the simulationist thesis, which does not presuppose reflective awareness. They compared the young child who is pretending to the child (or to the adult) who is listening to a story. The child does not need to question the relationship between the truth of the episodes and the author's or narrator's belief in order to follow and enjoy the story and to understand it. Similarly, a person who dreams does not question the relationship between a dream and its reality. The question of whether a dream is fiction does not occur to the person who dreams. From the beginning of reflective knowledge to a first logical closure at around 7-8 years of age, numerous inconsistencies and *décalages* are observed in all domains of cognitive development. According to one's position, these inconsistencies should neither

be taken as residual (equivalent to measurement error) nor as performance variations associated with contextual or linguistic variables. On the contrary, they are a major key to the understanding of the construction of rationality.

In the present case, two complementary explanations can be provided for the observed logical *décalage*. First, it is proposed that separate concepts of belief based on various peripheral system and on a specific format of encapsuled information appear in the mind of the child *at* different periods. The development of rationality would then consist in the central communication among the outputs of these modules. A good analogy can be found in the mutual, shared and distributed knowledge theory (see e.g. Fagin, Halpern, Moses &Vardi, 1995; Sandu, 1997) which formalises the different degrees of knowledge in a community of agents. Since Selfridge (1949) and Minsky (1986), the idea of distributed cornpetences has progressed in psychology, but less than in computer sciences. The focus of this conception, which calls into question the Cartesian theory of mind and consciousness (see e.g. Dennett, 1991), concerns the elimination of a central locus of awareness and decision. Competence is not centralised or unified by a single agent, but is distributed among different agents (an agent could be defined as a module which comprises mental states, such as propositional attitudes, production rules or specific knowledge). The key to increasing competence in such a system is the development of communication among the different agents, insofar as this communication is linked to awareness and conceptualisation.

The pre-belief state in the intermediate period—false belief attribution by a single mental agent (e.g. the action agent in the standard task)—can be explained by the absence of mutual knowledge among all the agents and, consequently, the attribution of the emotional agent is not informed and transformed by the procedural agent. In this case, the logical structure which allows a third-person point of view is, in fact, much more complex than accurate performance on the standard task in a second-person form. The latter only requires separating pre-beliefs, but not coordinating them (this is an analogy with the separation and coordination of perspectives as shown on Piaget's three mountains task; Piaget & InheIder, 1947). When the child reaches third-person psychology, at this final level, false belief is an invariant, or the fixed-point of the iteration of the operator *to know* among the mental agents who have moved from *distributed* to *mutual* knowledge (the procedural agent knows that the emotional agent knows the situation, and it knows that the latter knows that it knows, etc.). The products of this mutual knowledge are isotropic in Fodor's sense (Fodor, 1983) in that from any perspective, the point of view is the same; the inference cannot be modified by the way the problem is formulated or the belief embodied. Cognitive progress from distributed to mutual knowledge implies that the various responses of the agents must be encoded in a common language, and consequently in an amodal format. This raises the question for future research of how reason can speak to emotion and vice versa.

A second complementary explanation is to propose that, before reaching third-person psychology, the child has a only partial concept of belief, even if he or she succeeds on the standard task. This view leads logically to the conclusion that false beliefs attributed to the second-person standard are only partial mentalistic false beliefs; they are better described as pre-beliefs based mainly on behavioural cues. A very frequent justification given by the children who succeed on this task is nor 'Because Maxi believes the chocolate is in this cupboard', but 'Because Maxi had put his chocolate in this cupboard'. In the

latter case, Maxi's behaviour is not linked to his mental state, but to his past action. When the behavioural embodiment disappears, in the case of the comparison between action and emotion questions, the correct inference that it supported also disappears in the inconsistent children. Support for this interpretation could be provided by an analysis of the justifications given by the children: those evoking the past action failing the emotion question and those evoking the mental state *(via* `he believes' or 'he thinks') succeeding, If this hypothesis were confirmed, the capacity to predict Maxi's behaviour would not be related to an understanding of belief, but more fundamentally roan understanding of the link between an action and its agent (the subject-verb Zink in language). The young child knows that the chocolate has changed places, but does not associate this fact with the action and the agent that brought it about. It is only when the first location of the chocolate is unambiguously attributed to Maxi and the second to the mother that a correct search prediction can be formulated.

This hypothesis needs further and careful verification. Of course, it does not contradict the first one because the coordination between different modular outputs necessarily produces, at the mutual knowledge level, a more complete and more powerful structure.

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