

Perspective taking and belief attribution: From Piaget's theory to children's theory of mind^s

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This paper analyzes the origins and specificity of the recent research trend on the development in children of a Theory of mind which has undergone an impressive expansion over past the fifteen years. A comparison with Piaget's approach is proposed regarding the experimental data available on the coordination of perspectives as well

as the epistemological foundations. The issues of the naturalization of the mind and its irreducibility are addressed within the framework of recent reductionist theories advanced by the philosophers of mind. Piaget's contribution is considered as one of the most thorough of this century.

I come from a background in which the object of study of psychology is as much human behavior as conscious phenomena or mental processes (Janet, 1946). The emergence about fifteen years ago of a new research trend concerned with the study of the development of a "Theory of mind" in the young child appeared as quite surprising to me and at the time I confess having been at a loss to find any novelty in the approach. The initial project of this trend was to determine at what age the child acquires an adult-like understanding of human behaviors i.e.: through a naïve or common type of psychology that considers behavior as determined (causally) by the interactions between beliefs, knowledge or desires or in other terms between mental states (intentional states, propositional attitudes, mental representations, etc.).

Until now most of the research carried out under the Theory of mind label has concerned the capacity of the young child to attribute to others beliefs different from his own and to predict or manipulate the behavior of others according to these beliefs. A majority of studies convey the impression of studying a new field of research

with novel problems never addressed before. Yet, the study of children's capacities to predict judgments or behaviors in their peers presents nothing new as such. Therefore the novelty must lie within the *type of approach* to these old problems. The understanding I finally reached is that the novelty of this approach lies within the deliberate choice to study mental states as such, for what they are, since the mental states are what express the intentional nature of behavior. For this reason, it would seem important to investigate the manner in which these mental states become organized to constitute one or several naïve theories considered as a set of functional relationships between mental states. In other words, psychologists need to consider mental states as an *irreducible* level of analysis. Yet, such a position is greatly compromised by epistemological presuppositions (over which there is much controversy among philosophers) and calls for a position to be adopted. I will discuss these considerations in further detail in the conclusion.

This paper will focus on the comparison between the studies carried out in the Theory of mind approach on the child's capacity to attribute beliefs to others and the research carried out by Piaget on the coordination of perspectives which has been interpreted in reference to mental states, not only in terms of operations but also in terms of points of view, egocentrism and decentration. It is common knowledge that these concepts have been widely criticized and subject to controversy. However, it seems interesting to

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compare these two approaches – to which I will hereafter refer to as Piaget's Theory and the Theory of mind – so as to highlight their similarities and differences as well as their significance in the debate on reductionism.

It could be considered that the common issue addressed by both these approaches, treats of the origin of the human capacity to differentiate the point of view of a peer from one's own perspective or to attribute to others a belief or a knowledge different than one's own relative to a given situation and eventually to predict or anticipate peer behavior on the basis of this belief (perspective coordination tasks and "false-belief" attribution tasks). In both approaches, there is a second problem equivalent to the first (calling upon similar competences) which is the capacity for a subject to have several explicit, non-exclusive representations (points of view, perspectives, beliefs) of a same object (perspective construction tasks and tasks on the appearance/reality distinction).

Let us now examine these two approaches. I will first present a brief introduction for each of them before presenting some experimental results and interpretations.

Piaget's theory: coordination of perspectives

The concepts of points of view, egocentrism and decentration are frequently encountered throughout Piaget's work in which they hold an important position. They are also a source of many controversies and misunderstandings. The crucial point, often misunderstood, is that these concepts are not absolutes and that they only qualify the child's position regarding the world in a relative way, relatively to a level of mental organization. Thus, each of the stages defined by Piaget is characterized by the transition from a specific form of egocentrism to a specific form of decentration. Similarly, at each stage the child must rediscover the existence of points of view (this is also true for the rest of life). In this perspective, the child should not be defined as being simply "egocentric" or "decentered" but rather as egocentric or decentered either relative to the mental organization of his sensory-motor activities (0 to 18 months) or relative to the representational organization of his concrete

thought or reasoning (from 1,5 years to 10–11 years), or to the representational organization of his abstract thought or reasoning (10–11 to 16–18 years) (vertical decalages). In particular, the decentration relative to actions and perceptions should be clearly distinguished from that relative to representations. It is also necessary to define the specific content that the decentration and egocentrism refer to (accounting for the horizontal decalages).

It should be noted that Piaget did not always use the term of mental states in its present acceptation. Therefore, it is necessary to provide some clarifications. For Piaget, conscious phenomena or conscious states, which correspond to mental states, are already present during the very first weeks of development. These mental states only become intentional states with the means-end coordination around the age of 8 to 10 months. During the sensory-motor stage, the mental states do not correspond to "thoughts" as such. For Piaget it is only at the second stage that thoughts will emerge with mental representations (Piaget, 1947). Each stage is characterized by mental states of a specifically distinct nature: sensory-motor schemes for the first stage, concrete thoughts for the second stage and finally abstract thoughts for the third stage.

During each of these stages Piaget has characterized the child's development through general processes which define the nature of the transformations or modifications in the subject's relations with his environment. These are the process of *differentiation* of the subject's relations with the world, the correlative process of *objectivation* of the world (and of the subject's own specificity), the knowledge *decontextualisation* process and the *decentration* process or the coordination of points of view. The main consequence of these transformations is the reversibility (by reciprocity and/or by inversion) acquired by the child's actions, then later by the child's concrete thought and the abstract reasoning in the adolescent and adult. These transformations are not independent from one another and they all result from cognitive progress made by the child at each stage.

The *differentiation process* allows the subject to progressively dissociate in his interactions with his environment that which results from his actions or his representations from that which

has its origin in the outside world or in another person. Thus, for Piaget at the beginning of each stage, the child is in an undifferentiated state, although again this non-differentiation is only relative (and corresponds to the concept of ego-less egocentrism that I will address further on). The three year old child who has a brother but is unable to acknowledge that his brother also has a brother is, according to Piaget, an adequate illustration of "representative" undifferentiation that is relative to the organization of his concrete reasoning. Yet, the same child may also present behaviors showing a perfect differentiation for instance in his displacements in a familiar environment (home, kindergarten).

The *decentration process* globally characterizes the fundamental transformations of the subject's relations with his environment. It corresponds to the passage from an initial position (at the beginning of each stage) unfortunately termed *egocentric* without an *ego* by Piaget, that is without the existence of a point of view, to a position defined as *subjective* which corresponds to the discovery of shared points of view, common to all, identical for all (as in shared attention behaviors) and then finally to a position defined as *decentered* or *objectivated* which is the result of a true differentiation between points of view (and where points of view may of course diverge). Piaget has also characterized the initial positions of each stage in terms of centration upon some aspects and neglects of others.

Most of the misgivings concerning egocentrism come from the fact that Piaget proposed two distinct and apparently contradictory formulations for the concept, either as an *absence of point of view* or as a *centration on the own point of view* which as such is *ignored by the subject* (without ego), in other words an absence of a point of view!

A modern equivalent of this decentration process can be found in the attentional mechanisms responsible for the activation and inhibition processes and correspond to the subjects capacities to select and activate the appropriate actions and knowledge (mental states, points of view) for a given situation and to inhibit those that are judged irrelevant. Yet, these capacities determine what is defined as the more or less important *flexibility or rigidity* of the subject's behavior (simultaneously taking into account several

aspects or points of view, change in criteria or perspective). The correspondences between rigidity and centration or between flexibility and decentration seem quite obvious.

Let us now examine the experimental approach to the coordination of perspectives problem as it was addressed by Piaget & Inhelder (1948/1956) through the Three Mountains Task.

The Three Mountains Task or the coordination of perspectives

As a preliminary remark, it should be noted that all the experimental situations studied by Piaget concern the coordination of points of view, but more specifically of the subject's own points of view (within subject). Nevertheless, there are several tasks that Piaget and his team have used to study the child's capacity to differentiate between his point of view and that of his peers. The best known is the Three Mountains Task or the coordination of perspectives (Meyer, 1935; Piaget & Inhelder, 1948/1956). This task consists in confronting 4 to 11 year old children to a scale model representing three mountains and to ten pictures of the model corresponding to various points of view. Subjects are asked to reconstruct the various perspectives from which a doll would be able to perceive the scenery.

Piaget and Inhelder (op. cit.) described the evolution of the subjects behaviors in four stages. In a *first stage* (typical of children 5 to 6 years old) children show a complete lack of discrimination between different positions of the doll in relation to different pictures. All the pictures representing the three mountains are suitable for all points of view. In a *second stage* (around 7 years), subjects anticipate that to each point of view corresponds a position of the observer that can be determined and that one does not perceive the same scenery from all possible observation points. Here, it is not the relations between the three mountains that are modified (according to the observer's point of view), but only the relations between the observer and one of the mountains or the set of mountains considered as a whole, an invariant (false-absolute). In a *third stage* (around 8 years), the child has discovered that the relations between the three mountains change depending on the observer's position, al-

though they are unable to coordinate all of these relations. Finally, in a *fourth stage* (around 9–10 years) the coordination of all the points of view becomes possible.

Interpretation

Let us now examine the explanation proposed by Piaget and Inhelder (1948/1956). First, it should be noted that this development concerns the construction of the *projective space on a representational level* and not on a perceptual level. "The system of perspectives constructed by the child in the course of the four stages we have identified is not perceptual but representational" (1948, p. 289; 1956, p. 245). At the initial starting point (at about 5 years old), the child is described as "linked to his own view in the narrowest and most restrictive sense such that he is unable to imagine any other perspective than his own... A change in the subject observation point induces a similar attitude again from the new position!" (1948, p. 286; 1956, p. 242–243). Moreover, "the child can only represent a group of mountains by constantly referring to his own view point. Actually, the subject *is not aware of possessing a view point* distinct from those of other observers" (1948, p. 287; 1956, p. 243). The "own point of view ignored as such by the subject" corresponds to a representation or several representations (verbal, mental images) constructed by the child as an "interpretation" of the three mountains. One of the particularities of these representations is that they are *realistic* and undifferentiated from their referent, the object and its referent are one, the object is what the subject imagines or represents. When Piaget and Inhelder write "...this point of view has nothing of a perspective representation and is only an illegitimately centered, ego-centered, intuition" (1948, p. 287; 1956, 243), they mean that, for them, it does not yet constitute a true representation and corresponds rather to a pre-concept. Thus, they further write "...the child's own point of view can only give rise to a genuine representation (one that can anticipate, reconstruct and record) in so far as it is distinguished from other viewpoints and this process can only occur within the framework of a global coordination" (1948, p. 286-287; 1956, p. 243). Finally, we

must consider how this global coordination arises. "The child can only discover his own point of view when he becomes able to acknowledge other observers' view point" (1948, p. 287; 1956, p. 243).

Starting out with these rigid and realistic mental representations centered on his actual view point, the child progressively constructs other representations involving some relationships and a limited decentration based for instance on relations established between the doll and one of the mountains. The child then becomes able to integrate the relations (left-right, in front of-behind) between the mountains allowing for more complex decentered representations.

Before the representational elaboration of the projective space and the coordination of perspectives, Piaget described a perceptual elaboration which occurs during the sensory-motor period.

Discussion

Piaget and Inhelder's interpretation has been widely criticized and largely misunderstood. The main criticisms, as well as the rejection of their explanation, are essentially based on empirical data evidencing the early existence of representative decentration in pre-school children (mainly in 3–4 year olds) whereas during this period, Piaget and Inhelder describe children as egocentric at the representational level. The data refer mainly to the work conducted by Flavell and his team in which they used simple perspective taking tasks to evidence non egocentric capacities in 3 to 4 year old children and which constitute one of the origins of research on the Theory of mind (Masangkay et al, 1974; Flavell et al., 1981; Flavell, 1992). Such results, among others, have led researchers to reject the Piagetian interpretation of egocentrism. As Carey (1990, p. 161) explains "Piaget's characterization of preschool children as generally egocentric is false". However, Carey considers the problem as more general and more profound and believes that the experimental results are incompatible with the concept of general stages as proposed by Piaget. Her criticism reflects a point of view held by a majority of developmental psychologists in favor of a domain-specific interpretation. Thus, two problems emerge. The first is to know

if systematic transformations occur in the different domains in the children's representations which would allow to maintain the hypothesis of a general decentration process. The second problem concerns the existence of a general change in representational capacities (such as around 4 years of age) that would induce a reappearance of a form of egocentrism and thought rigidity relative to these new representations.

Although I do not deny the importance of domain-specific mechanisms, I remain convinced of the existence of general mechanisms common to the different domains (domain-general). The solution I have been recommending for several years (Mounoud, 1990, 1993, 1994) consists in redefining a first stage spanning from birth up to 3,5-4 years of age instead of 18 months as Piaget proposed and a second stage ranging from 4 to 10 years of age. This new segmentation allows for a much more satisfactory reorganization of the experimental data.

Let us now turn to the Theory of mind approach which shall bring further data and should induce some decentration !

The theory of mind approach: belief attribution

This new approach first appeared about fifteen years ago and has spread considerably in a few years to become widely represented throughout scientific publications in the field. In fact, it could be considered that this proliferation is the sign of a true epistemological modification, although not really emphasized by the authors in the field. An impressive amount of literature reviewing this research field is already available and I will provide only a few references for those who wish to further their knowledge in the field (Astington, Harris & Olson, 1988; Battistelli, 1995; Frye & Moore, 1991; Lewis & Mitchell, 1994; Perner, 1991; Wellman, 1990; Whiten, 1991).

The origins of this approach are probably quite varied and diffuse. In particular, the emergence of various forms of moderate reductionism acknowledging the irreducibility of the mind – in spite of its naturalization or materialization – constituted an important contribution to this approach. Another factor has been the emergence

in cognitive science as a whole, of a growing interest for the phenomenon of consciousness and intentionality as well as for the study of non-conscious processes such as implicit learning and memory.

Nevertheless, four major influences seem to predominate which are: the philosophy of mind, cognitive ethology, part of the research on language acquisition (terms related to mental states), as well as the work conducted by Flavell and his team on the appearance/reality distinction (Piaget's indirect influence). Let us now briefly consider each of these sources separately.

Contemporary trends in the *philosophy of mind* (refer to Engel, 1994; Pacherie, 1993; Pinkas, 1995; for a review) to which psychologists have made discrete references have nonetheless exerted considerable influence. It was these philosophers who first raised the general problem of the attribution of mental contents within the larger context of the theories of interpretation – in particular Quine's thesis (1960) on the indeterminateness of translation and on the irreducibility of intentionality. Similarly, the debates on the existence of mental states considered for example as physical events by Davidson (1980) or as theoretical entities by Dennett (1987), as well as Fodor's theory (1987) on information semantics or Dretske's naturalist theory of mental contents (1981) have had a definite and complex influence upon the development of the reflection and research on the Theory of mind in psychology. Yet, it is surprising to note the absence of reference to Piaget's contribution among these philosophers. I will return to this remark in the conclusion.

In the field of *cognitive ethology*, research on language and communication abilities in apes has proven a determinant factor. In particular the target paper published by Premack and Woodruff (1978) entitled "Does the chimpanzee have a Theory of mind?" has often been referred to as a founding article for this new research trend. Research on the effects of a belief induced in peers, among gorilla (deception), conducted by Seyfarth and his team (1980), have generated surprising results.

The work on *language acquisition* and more specifically on the acquisition and comprehension of terms related to mental states (Shatz, Wellman & Siber, 1983; Bretherton & Beegly,

1982; Johnson & Maratsos, 1977; Johnson & Wellman, 1980) constitute another source for the emergence of research on children's Theory of mind.

Last but not least, the more direct impact exerted by Flavell and his collaborators' work on the *appearance/reality distinction* as a continuation of the experiments on perspective taking. Considering children's cognitive limitations in common inter-person perspective taking tasks, Flavell chose to study the less familiar within or intra-person perspective taking where the different points of view belong to the same person (Flavell, 1992). Thus, Flavell devised one of the three experimental paradigms at the origin of the research on children's Theory of mind. These researches constitute what I suggest to call "Piaget's indirect influence".

The appearance/reality distinction paradigm (Flavell, Flavell & Green, 1983)

Most of the work conducted on the appearance/reality distinction (over ten publications by Flavell and his group) are variations of the procedure described hereafter. The experimenter familiarizes the child with the meaning of such a distinction by using for example a Charley Brown puppet inside a ghost costume ("Charley Brown looks like a ghost to your eyes right now", but "is really and truly Charley Brown"). The child is then presented with a deceptive object such as a realistic-looking fake rock made of soft sponge-like material. He can manipulate the object to discover its identity after what he is asked two questions relative to its reality ("What is this really and truly? A sponge or a rock?" and "does it look like a rock or does it look like a sponge?"). A 4-year-old will answer correctly to these questions whereas 3 year-olds give the same answer to both questions: "it looks like a rock and is really a rock (phenomenism) or it looks like a sponge and is really a sponge (realism)". This result indicates that under 4 years of age, children are reluctant to apply different representations or meanings to the same object. Yet, at three years old they can grasp the difference between a rock and a pretend rock and are capable of explicitly referring a present mental state to a past one (Shatz et al. 1983). Thus, as Flavell predicted,

within-person perspective taking is contemporary with between-person perspective taking and seems to be based on the same mechanisms.

The two "false belief" experimental paradigms

Paternity of the two main paradigms called "false-belief paradigms" may be attributed to Wimmer & Perner (1983). These paradigms were specifically designed to reveal the presence of a theory of mind in children.

The action prediction tasks or the unexpected transfer (Wimmer & Perner, 1983). In this type of tasks the child attends a puppet-show involving two puppets and three containers. In the task presented here the protagonist ("Maxi") observes his mother while she puts a piece of chocolate in one of the containers, he then leaves the room to go and play. In his absence his mother changes the chocolate from container A to container B. When returning from the playground, Maxi asks for the chocolate. At this point, the child is asked to predict where he thinks Maxi will look for the chocolate. If the answer is correct the child is further asked to guess what Maxi will say about the chocolate's location to his grandfather (to whom he tells the truth) or to his brother (whom he wishes to deceive). If the child takes into consideration what Maxi knows about the location of the chocolate, his prediction will be that Maxi will look for the chocolate in container A (belief-based prediction). If he neglects Maxi's belief and only considers the actual situation then he should predict that Maxi will look in container B (reality-based prediction). The results show that, although they have no difficulty in remembering the critical facts of the story, 3 year-olds typically provide reality-based predictions, while 4 year-olds give belief-based predictions and are capable of reasoning further on Maxi's false belief by inferring for example that he will tell his brother where the chocolate actually is when wanting to misinform him (!).

The belief prediction tasks or the deceptive box (Hogrefe, Wimmer & Perner, 1986; Perner, Leckam & Wimmer, 1987). In these tasks the puppet scenario is not used so as to control its possible influence on children's judgments. The ex-

perimeter presents the child with a closed box whose exterior proclaims its contents – for instance a box of "Smarties" or a matchbox – and asks the child what he thinks it contains. Once the child has answered "Smarties", the experimenter opens the box and shows that it surprisingly contains pencils. He then closes the box again and asks what another child would think is in the box. As is the case for the action prediction tasks, 3 year-old children often give the wrong answer "pencils" (reality-based prediction). This task can be completed with an additional question concerning the subjects' initial belief about the deceptive box's content (Gopnik & Astington, 1988). Again, 3 year-olds give an erroneous answer. This finding suggests that – at this age – children are unaware of the representational nature of their own mental states (as are the older children in the three mountains task). Their representations are not dissociated from reality. It is a symptom of egocentrism defined as the absence of points of view. Consequently, as already demonstrated by the appearance/reality tasks, the development of a theory of mind in children also refers to knowledge of their own beliefs.

Interpretation

For a majority of authors, an important change occurs between the age of three and four in children's conceptual capacities. This change concerns the ability to simultaneously take into consideration two conflicting representations of a given situation, or the ability to establish relationships between various points of view pertaining to a given situation. These representations can be true or false, antagonistic or complementary.

Moreover, children understand slightly earlier false-belief situations (inter-subject) than they do situations involving representational changes (within subject) such as appearance/reality tasks (Gopnik & Astington, 1988). Consequently, it is probable that children discover their own representations by confronting them with those expressed by their partners. The research conducted by Bennelli & Carelli (1995) and Perner, Ruffman & Leekam (1994) comparing the consequences produced by different types of social

experiences in various family contexts, has confirmed the facilitating effect of inter-individual confrontations.

To simultaneously take into consideration two representations of the same object or two successive states of a given situation, these representations have to be dissociated from their referents (from the situation or the object they represent), in other words they have to be riden of their realistic nature. For many authors, (such as for instance Wimmer & Perner, 1983) and in reference to Pylyshyn (1978), the child must have an explicit representation of the relationship between his representations and their referents ("the state of affairs"), i.e. he must possess *meta-representations*. On the contrary, I consider sufficient to say that children's mental representations – initially undifferentiated from their referents – have to acquire the status of true representation. From this point of view, 4 year-olds competences characterize the achievement of a construction realized during the first four years of life instead of the emergence of meta-representations. (In my opinion these representations could only be called meta-representations with regard to the representational system of the newborn. Similarly, the representational system elaborated by children from 5 to 11 years of age could be called "meta-representation" in relation to the previous system).

The capacities of the four year olds may also be defined in another manner. These children are able to activate or to inhibit their representations at will, which implies the important role of attentional mechanisms in the development of such competencies as shown in particular by Houdé (1995).

Some interpretations may lead to the impression that before the age of 4 children do not have any capacity to attribute mental states to others. Nevertheless, a majority of researchers consider rather that the child is able quite early to attribute mental states to peers. Some have even proposed that in man and in apes there could exist a genetically programmed initial disposition for attributing mental states to other members of their species (implicit, non intentional attributions) (Whiten & Byrne, 1988; Trevarthen, 1987; Humphrey, 1986). Moreover, it is possible to identify during the first three years of life various behaviors that clearly evidence different lev-

els or different "grades" in the capacity to attribute mental states (Whiten, 1994). These behaviors have been called the *precursors* of a Theory of mind. They concern in particular shared visual attention described at 6 months (Scaife & Bruner, 1975; Butterworth & Castillo, 1976), means-end differentiation (8 months) (Piaget, 1936; Harris, 1994; Tomasello, 1995), manual pointing (12 months), protodeclarative behaviors (9-13 months) (Bates et al., 1979; Camaioni, 1993), social referencing (during the second year) (Campos & Stenberg, 1981), pretend play or make-belief behaviors (1,5–3 years) (Piaget, 1945; Harris, 1994) and deceptive behaviors (or induction of false belief) for which the age of acquisition has generated much controversy (Chandler, Fritz & Hala, 1989; Peskin, 1992; Sodian, 1994).

From the experimental results it may be considered that, during the first four years of life, children become progressively able to situate themselves relatively to their partners, to attribute mental states to them, to manipulate their beliefs and to predict their behavior. Hence, the necessity to reconsider the stages as defined by Piaget is confirmed. Nevertheless, the concept of stage, so strongly rejected by many developmental psychologists, has resurfaced and the processes of decentration, differentiation and decontextualisation still seem adequate to characterize the general transformations of relationships between children and their environment.

Conclusion

Understanding the fascination exerted by the Theory of mind on my colleagues as well as the scientific challenge hidden beneath the surface reactions has proven quite time consuming. I remain convinced that there are strong epistemological reasons which explain the emergence of this new approach. These reasons are mainly related to the emergence of new and more moderate forms of reductionism. The actual problem is no longer to "materialize the mind" or "to naturalize the intentionality" to borrow the evocative titles of two recent publications on the philosophy of mind (Pacherie, 1993; Pinkas, 1995) but rather to understand that mental entities, even

entirely naturalized, constitute a unique level of functioning and that each level of description is irreducible to other levels. Another crucial issue is to decide if animal behavior can be satisfactorily described without having recourse to mental states.

In the course of my necessarily limited readings on the Theory of mind I did not encounter any explanation concerning the novelty of the approach. It is as if such research was justified in itself, by its presumed novelty. Furthermore, the theory or concepts evidenced in 4 year-old children are far from vague or imprecise as a naïve theory would be supposed to be. On the contrary, the 4 year-olds theory seems to be quite rational and similar in nature to that attributed by Piaget to the 6-7 year-olds for instance. The aim of the approach could not be solely limited to the evidencing of a theory of mind which would only be naïve before its emergence (in the ways a non conservation judgment could be considered as naïve). The objective remains to understand the origin of the rational norms or of the laws of the mind. To quote Engel (1994, p. 77) "the aim of a developed science of mind is to establish the cognitive mechanisms that underlie the laws of the mind". Which mechanisms – which may include rational principles – generate intentional states. In my opinion this is precisely what Piaget endeavored to realize. To call upon a "Theory of mind" (TOM) module to account for a metarepresentative function which should appear at around the age of 2 years or 3–4 years as Leslie (1987) and Baron-Cohen & Ring (1994) have done in order to explain the emergence of a theory of mind, resembles surprisingly to the hypothesis proposed by Piaget concerning the symbolic or semiotic function and leads to the same problems and dead-ends. In my opinion such a solution could be called "magical".

To conclude more positively, I consider that the major contribution of this approach has been to bring together various fields of research ranging from perception to psycho-pathology including psycholinguistic, social psychology, psychology of emotion, to mention only a few. This reuniting function shows to what extent the Theory of mind approach has constituted a strong attractor which is not a meagre achievement.

How can Piaget be situated in such a context and how can the absence of any reference to his work – in particular among the philosophers of mind – be accounted for? I believe that Piaget's epistemological position has been perceived as ambiguous for two major reasons. On the one hand he claimed the irreducibility of mind, considering it as being of a different nature from the biological or physical realities and not bound to the causality principle. On the other hand he has simultaneously sought to uncover the biological foundations of the mental processes which he considered as extensions of the biological or organic regulations and as mere improvements of the regulatory mechanisms functioning at the lower level. Regarding cognitive development Piaget sought for the origin of mental processes in the general coordinations of actions (in the coordinative structures of actions). His work is impregnated by this tension between "irreducibility" and "continuity". As I have analyzed elsewhere (Mounoud, 1992), Piaget comes to write almost simultaneously two opposite theses (Piaget, 1941, 1942) that I have called the "continuity thesis" and the "discontinuity thesis" (which could also have been called "irreducibility thesis"). It is noteworthy that in order to defend the continuity thesis, Piaget has been "forced" to rule out all references to the notion of mental representation and only to speak in terms of "techniques of the action" (quite an unusual expression for Piaget). As can be noticed very directly, keeping or rejecting mental phenomena from the field of psychology has very radical and important consequences on the interpretation of the developmental process as continuous or discontinuous.

In my opinion, the only solution to such a dilemma between naturalization and irreducibility of mind would be to introduce differences only *in function and not in nature* between mental, biological and physicochemical processes. Accordingly, to acknowledge the idea of a "mental causality" I would prefer to qualify it as "indirect" in the sense of being only implemented by intermediate levels instead of denying to the mental processes a causal role as Piaget did. Regarding the period of development considered by the Theory of mind, Piaget's main mistake was to have quite arbitrarily introduced the emergence of the symbolic function and the appear-

ance of language at the age of 18 months. In so doing he has created an artificial opposition between the practical and representative forms of knowledge (Mounoud, 1970, 1988, 1993, 1994). It is as if Piaget wished to postpone the emergence of the "mental", creating a sort of protected zone (the first year of life) during which a maximal "continuity-reducibility" with the biological aspect in the absence of "thought-representation" could coexist with a beginning of "discontinuity-irreducibility" due to the presence of conscious or mental phenomena. Thus, Piaget's "mental thought without language" is possibly not so different from Fodor's "language of thought" ! If the symbolic function is the function of our brain that produces mental representations, it is necessary to postulate its existence from birth. Otherwise language development during the first eighteen months of life can not be understood. In spite of these criticisms, Piaget's theory still constitutes in my opinion one of the most subtle and complete attempts at naturalizing the mind (continuity) while recognizing its specific properties or particular qualities (irreducibility-discontinuity).

From my own point of view, so to speak, cognitive development has to be considered as a shift from thought to action more than the reverse as Piaget claimed (Mounoud, 1993, 1994, 1995). Cognitive development is first of all the transformation of the determinants of our actions through the construction of new representations, new conceptions, theories or thoughts (new knowledge systems). The capacity to generate new mental representations should be acknowledged in children as soon as birth if we are to understand the role that mental representations play in the transformation of the child's actions and to follow the development of these new elementary representations until they become – around the age of 3,5-4 years – a new system of representations with its characteristics of arbitrariness and conventionality that enable the child to escape from the realism of his initial representations. To avoid any misunderstanding it is necessary to specify that in such a perspective the newborn comes to the world with a first representational system already constructed (resulting from phylogeny and embryogeny). This first system (similar in nature to those to come) accounts for the exceptional capacities of the new-

born in whom we can admit an initial and implicit theory of mind that is expressed through the direct access to the mind of his partners ("Mindreading" as postulated by various researchers). The access is direct only in the sense that it is based upon a knowledge system constituted of encapsulated or sedimented representations.

To conclude, the new approach introduced by the study of children's theory of mind has been mainly spurred by the reflections of the philosophers of mind and in a less direct way by Piaget's theory. This approach will not develop adequately without intensive interdisciplinary collaborations which have already been initiated as I have mentioned. These collaborations should develop as much with philosophers as with researchers in cognitive neurosciences. Drawn by neurobiology towards the naturalization of mind, psychology has paradoxically recovered its identity through philosophy which has rehabilitated the mind by considering its irreducibility. This is the story of a century to which Piaget has brought a large, yet often much disregarded, contribution.

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