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a systemic property of this emergent action system. It cannot be reduced to or 'squeezed' out of lower levels. Similarly, further differentiations and coordinations of structured levels of consciousness emerge through the co-action of consciousness and the world it encounters. Thus, at a particular level of structured consciousness, symbolic representation comes to constitute a systemic property of that level of action system.

Understanding cognitive development as arising from co-actions and leading to emergent systems is not totally foreign to recent nativist reworkings of the concept of the 'innate'. Just as Elman *et al.* (1996) suggest that there are 'interactions, all the way down' the many levels of development, I would suggest that there are 'co-actions, all the way up' and these co-actions constitute the fundamental mechanism of transformational development. This position cuts the Gordian knot of nativism versus empiricism in the account of development because development necessarily entails complementary and reciprocally functioning systems.

It should also be mentioned in passing that any complete understanding of cognitive development demands a definition of agent that goes beyond Russell's. For Russell knowledge acquisition involves the pick-up of precoded information by a machine armed with the ability to alter perceptual inputs at will. As a consequence, the symbol-grounding problem does indeed, as he himself suggests, loom large for the theory. This significant issue – as we have shown (Mueller & Overton, 1998a) – is fully resolved, however, in a dynamic action systems approach that stresses the centrality of *embodiment* in the definition of agency (Overton, 1997). For neither mere movement nor even directed (intentional) movement can account for human meaning. It is acts that arise from a particular kind of

action system – an embodied system – that produce the kinds of human meanings that constitute human knowledge.

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What is homeopathic when you overdose?

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Provocative, slightly rash with a pleasant sense of humour, Russell's target article raises fundamental questions, such as the self–world dualism, the origin and roles of symbols and propositional systems,

suggesting an original reformulation of Piaget's ideas in terms of executive functioning, working memory and theory of mind. Indeed, he is strongly critical of Piaget's theory as well as of other conceptual frameworks. I

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especially appreciate his reformulation relating to the decentration process and to self-consciousness, as well as the notion of 'structured expectations' which corresponds to one aspect of the Piagetian concept of 'schemes' as do other related expressions such as 'potential action' (Arbib, 1980), 'intention to act' (Jackendoff, 1992) or 'coordinative structures' (Bernstein, 1967) (cf. Mounoud, 1995).

Yet, despite his wish to keep Piaget at arm's length, Russell stays deeply entangled in his model, of which he has incorporated the essence. His *plaidoyer* to demonstrate the executive character of the theory and to save it from various perils denotes Russell's underlying strong attraction for Piaget's theory. His attempt is particularly courageous in the land of empiricists who are in the process of rediscovering the mind encapsulated in modules, something that is clearly not to Russell's taste.

Thus, Russell adopts the distinction made by Piaget between developmental levels with 'progressively more sophisticated forms of mental action' (p. 248) or 'forms of thinking' (p. 254). He distinguishes two levels of executive monitoring, one of physical actions and the other of mental actions (or intentions or judgements) (the monitoring system *seems* to be the same for both levels); the transition from one level to the next stems from the maturation of the symbolic function (between the ages of 12 and 18 months).

Briefly, let us examine how these two levels are defined since they are difficult to tease out from Russell's article.

The *executive monitoring of physical actions* (or basic actions) is called 'low level'. Basic actions are deprived of explicit intentionality (the actions are not experienced by the child as his/her responsibility). Knowledge is only related to the physical world (by opposition to the mental world). The reversibility-as-negation (R-negation), qualified at this level as a 'non-cognitive' version, consists of 'casting the attention back' in order to 'engender the experience of a datum as being predictably available for re-perceiving' (p. 250) or in other words to predict 'what the world will look like or feel like or sound like when the action is taken' (p. 254) ('outcome predictions', 'structured expectations'). Consequently, for Russell, these physical actions now seem minimally intentional. Finally, the child's working memory maintains accessible the non-explicit intentions while actions are executed.

The *executive monitoring of mental activities* (intentions) or monitoring of explicit judgements is referred to as 'high level'. The cognitive version of the R-negation consists of 'casting the mind back in memory' (p. 250) in order to cancel out the centration of thought ('cognitive' attention) (p. 257). For Russell, R-negation

explains the child's capacity to change mental fixation (centration) (p. 250), whereas for Piaget reversibility expresses the capacity to coordinate various centrations (points of view). Finally, for Russell, the child's working memory maintains accessible the explicit intentions during mental activity. Framing explicit judgements (as mental actions) on reality is considered by Russell as a form of self-regulation (p. 248). This is rather similar to the adaptive function (regulation) attributed by Piaget to children's judgements during conservation tasks for example. The shift from preoperational to operational judgements was interpreted by Piaget as change from partial compensations ('it is longer, higher...') to complete compensations ('it is longer but thinner' or 'it is longer but there is more space between...') relative to the transformations' effects. We are at the heart of Piaget's theory which postulates that operational judgements result from interiorized actions coordinated in systems and reversible. At this point it is difficult to comprehend what disagreements Russell has with Piaget!

According to Russell, the shift from physical to mental activities seems to take place between the ages of 12 and 18 months (p. 265) owing to the symbolic function which allows mental growth (Piaget would have used the expression 'development of thinking' since he has already used the term 'mental' to qualify sensorimotor schemes).

Finally, according to Russell, in order to conceptualize a mental content in a propositional form 'we also need to posit the development of a propositional system' (p. 266), but he adds 'a theory-like grasp of the representing relation which could plausibly be linked to the developing language capacity' (p. 266), thus adhering (at least partially) to the position adopted by various 'theory of mind' psychologists. Consequently, he situates this 'theory-like grasp' at around age 4. Even after reading Russell's paper carefully, I must confess my difficulty to understand why the development of a propositional system needs a theory-like grasp (Mounoud, 1996b). Does age 4 represent the full achievement of Russell's second level (the mental and cognitive one), or possibly the emergence of a third 'metacognitive' level? Russell's text is not explicit on this topic.

This large conformity with Piaget raises numerous issues. One crucial point for Piaget was to demonstrate the existence of a kind of intelligence without language, indeed *before* language, without symbolic function (or at a subsymbolic level). For Piaget, it was crucial to demonstrate the existence of a (kind of) sensorimotor form of intelligence before the emergence of language. But why does Russell, who postulates the innateness of a

symbolic function, consider its emergence between 12 and 18 months of age, driving him to reproduce the opposition developed by Piaget between physical and mental actions (in order) *to characterize two developmental levels*? In my opinion this position is unsustainable, although it took me many years to reject it and numerous pages to justify this rejection (Mounoud, 1986, 1988, 1996b)!

Now I would like to formulate some questions raised by the position that Russell adopts.

- Is there no evidence of any judgement during the child's first year of life? Or does Russell call judgement only what is verbally expressed in a propositional form?
- Can there be no 'mental world' during the first year of the baby's existence? What about the precursors for the attribution of mental states to others (Whiten, 1994), e.g. protocommunicative or protodeclarative behaviours (Bates, Benigni, Bretherton, Camaioni & Volterra, 1979; Camaioni, 1993)?
- Is it really possible to make the distinction between 'casting the attention back' and 'casting the mind back in memory' without relying on the absence or the presence of language? And, consequently, how is one to define the presence or absence of language since, for me, there is already language during the first year of life as discussed below?
- Is the symbolic function not a necessary condition during the first year of life to explain the progressive acquisition of the first words or of the first signs (in the case of deaf children for example)? Or should we consider that symbols are elaborated before the initiation of the symbolic function? But how then do we understand an organism creating symbols without symbolic functioning? In truth, the first symbols expressed or understood by infants probably do not immediately hold symbolic status for them. One must also wonder what role prelanguage may play in executive functioning. In addition to the baby 'naming' and 'notifying', labelling by adults influences the infant's categorization early on.
- Does the 1-year-old baby possess explicit intention? Must one wait for the propositional system at around 4 years of age for intention to be explained? The *means-ends* coordination emerging at the end of the first year of life would seem to make possible some explicit intentions. For Tomasello (1995, p. 455) this constitutes the first experience of the baby with a 'mental entity' (i.e. the goal). For him, this milestone points to the emergence of a differentiated self-concept, dissociated from the direct sensorimotor action and from direct perception.

I am not convinced of the usefulness of pursuing this redundant enumeration of dead-ends. As my questions pointedly suggest, I have real trouble understanding how Russell, in Piaget's wake, can justify the opposition between physical and mental actions in order to characterize *levels of development* located before and after 12–18 months of age. I have suggested (Mounoud, 1993, 1996a) that in all developmental process the actions (physical or mental) can be described as initially determined and controlled by two different knowledge systems: either by a *first* complex and fully formed system, processing a large amount of information and generating automatized actions (physical or mental), or by a *second* system in elaboration which selects and consciously reinterprets subsamples of information that are relevant regarding the goals consciously pursued, in order to generate and control intentionally performed actions (physical or mental). These two systems maintain dialectic and fairly complex relations, the latter superseding the first over time. These transformations of central cognitive mechanisms are recursive. This conception bears some similarity with Norman and Shallice's non-developmental model (1986).

To conclude, I will comment on some misinterpretations that Russell makes relating to Piaget's ideas on the symbolic function and its acquisition.

Russell asserts in opposition to Piaget's interpretation that 'actions are not arbitrary.... Pretend play would appear to be an exception, but there is nothing arbitrary about play actions either' (p. 262). But in pretend play, the action is not at all arbitrary for Piaget; only the link between the substituted object (the stand-in object or the symbolizing object) and the one it refers to or designates can be more or less arbitrary. In the famous 'banana as a receiver' example, there is still some relationship of similarity between the banana and the receiver, whereas if the child takes a stone or uses his/her hand on its own, the relationship becomes even more arbitrary than between the word 'phone' and the object it refers to. The action itself of bringing the hand to the ear is by no means arbitrary; it is only reproduced, represented outside its usual context, thus defining the meaning attributed to the object. And furthermore, for the 2-year-old child the referenced object may not only be the object itself but include its functional properties. This is what the child discovers when she is confronted with language. She must comprehend that words can be substituted for objects and evoke their meaning in spite of their arbitrariness. By the way, the adult's activity of naming or labelling becomes an index for the child to orient his attention on objects selectively, what has been called the 'taxonomic bias' by Markman (1989).

Further, Russell states: 'But a theory which grounds symbolizing in action is doomed to fail for the simple reason that *no matter how hard you squeeze an action you will never get a symbol out of it*' (p. 262). Again Russell misunderstands: the imitative actions which constitute symbols or mental images are not the intentional actions which confer meanings to the objects. It is not the make-believe activity of giving a call which is symbolic as such but rather the *act of substituting* a symbolizing object for a referred one, or the act of reproducing an action out of its usual context in order to refer to it.

Russell claims that 'Not only does the historical-Piagetian theory fail to account for this [language acquisition], but it is able to ignore ... that language is an ideal vehicle for representing means and ends...' (p. 262). Rather, for Piaget, it is the symbolic activities which result from the means-ends differentiation. From this point of view, a stand-in object (a gesture or a symbol) can become a means in order to represent something else which constitutes the goal (the object it refers to). As already mentioned, it can be seen as the origin of mental entities which ground the development of language as a propositional system.

Finally, Russell asserts that 'the word, or "sign" for Piaget, was taken to be the perfect amalgam of the pretend gesture...' (p. 262). Once more Russell is wrong. As already mentioned, for Piaget, words and mental images are not produced by or derived from intentional activities ('agency') like the pretend gesture of giving a call or opening a box, but from imitative activities, i.e. from accommodative actions adhering to their models in order to reproduce them. Piaget clearly opposes the intentional activities (agency) constituting the *operative tools* which engender knowledge related to 'transformation' (at the origin of meaning), and the imitative activities constituting the *figurative tools* like words, mental images or configurations of perceptual indexes from which stems the knowledge related to the 'states' of the objects. In fact, for Piaget, these two types of tools are undissociable, although he dissociates them for the purpose of analysis.

Interiorization of imitative actions (activities) constitutes for Piaget an 'extra executive mechanism' (according to Russell's terminology) required for the acquisition of any lexicon. I believe Piaget's major mistake lies in having situated the origin of the symbolic function at the age of 18 months instead of realizing that it is necessary from birth onwards to explain the first steps of the acquisition of any type of symbolic system (conceptual systems). Should it not be Russell's, rather than Piaget's, theory that should be jettisoned because it is insufficiently nativist? In this perspective, the larger problem would seem to lie with the emergence of conscious meanings. How do infants end up attributing conscious

or explicit meanings to objects and how are these meanings maintained without direct contact with the object (outside the action-perception circle)? Piaget's answer could have been by means of the executive functioning. As James Russell said.

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Experience, action and theory of mind

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James Russell assumes that a theory of mind must be grounded 'in the first-order experience of controlling, within limits, one's mental life'. The Piagetian flavour in this claim is that knowledge about the self is gained through the *exercise* of an executive competence. Exercising self-control is the 'soil' on which an explicit theory of mental life will eventually flourish. In contrast with the historical-Piagetian theory, Russell further acknowledges that a child's ability to 'become a second-order representer' cannot emerge from 'simply doing a lot of first-order representation'. Russell supplements the Piagetian theory with a representational theory of agency, according to which the structured expectations about the results of one's actions are what allows an infant to grasp object permanence. James Russell has thus brought two important ideas to bear on the theory of mind domain of research. The first is that mentalizing as a representational capacity relies in part on executive capacities (such as resisting prepotent stimuli, maintaining a representation active in working memory in delayed execution etc.). The second is that language – as an innate capacity for symbolic thought – is a necessary condition for grasping the relation between propositional attitude and mental content, and for developing a second-order thought. This two-tiered theory offers a welcome functional–developmental alternative to the modular view on the acquisition of mental concepts. This line of investigation appears to me inspiring and fruitful. I would like to question only a particular aspect of Russell's argumentative strategy.

A major theoretical issue that Russell raises by insisting that a theory of mind be grounded in 'the first-order experiences of controlling one's mental life' is whether the relevant facts have to be *experienced* in order to play a causal role in theory of mind acquisition. To use the philosophical jargon: does the 'feeling like' associated with R-negation or structured expectations play a causal role in building up a self? Several arguments may lead us to question the causal relevance of what could be called *agency qualia*. Although folk psychology has it that only experienced events and properties can be memorized and recalled, scientific psychology considers that implicit memory may also store regularities and influence behaviour (Kelley & Jacoby, 1993). Furthermore, as shown by Nisbett and Wilson (1977), agents are often wrong about why they acted: the personal level may be more appropriate to the demands of social cohesion than to individual psychological explanations of intentional action. Thus one could suggest that what drives mental states understanding is not so much pre-theoretical *experience* of mentality as a practical, largely implicit, *knowing-how* to achieve mental control.

The question of what the respective roles for consciously accessible states and for informational states and processes (independently from their conscious availability) are leads to the question of subpersonal versus personal explanations of behaviour. In his target paper as well as in his book (1996), Russell accepts the view that agency should be explicated in subpersonal terms, but denies that acting at will can be accounted for

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