

Primacy of Action in Early Ontogeny

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Much of the recent research on infant cognition is framed around a critique of Piaget's theory regarding *The Origins of Intelligence* (1936/1952) and *The Construction of Reality in the Child* (1937/1954). The article of Müller and Overton provides a humbling reexamination of this critique, bringing back to us how much has been thought and is accounted for in the monumental work Piaget left behind. But who can afford a thorough reading of Piaget in the current 'publish or perish' culture of academia? Müller and Overton seem to have managed, providing an eloquent demonstration that Piaget's action-centered view on cognitive development cannot be easily dismissed when considering it as a whole, not as a collection of discrete claims. More importantly, it challenges the current Zeitgeist that presumes prewiring, modularity, unsuspected cognitive processes and sophistication at the outset of development. Whether or not we agree with the long argument proposed by the authors, their discussion reminds us that developmental questions regarding transitions and the role of action in early ontogeny cannot be ignored.

Many infancy researchers (including ourselves) have based a great deal of their work on disproving Piaget's claims regarding the developmental timing of certain competencies (e.g., the notion of a permanent object) and demonstrations of precocious spatial and physical knowledge that elude the fundamental questions of their developmental origin and the process underlying their rapid growth. In the frenzy of emerging new experimental techniques and paradigms for the study of infants, we have developed a formidable appetite for demonstrations of discrete sophistication in specific domains at the youngest age possible. But what are we left with and what kind of baby are we building in theory? Is it a mere collection of precocious abilities mysteriously accruing in development? We share the concerns of Müller and Overton that the recent neonativist stance inspiring much of the current theories and research in infancy might have thrown out the baby with the bath water. We will briefly suggest here that it is time to reconsider infants as developing actors in a meaningful environment, not as born philosophers contemplating a Cartesian world. If infants eventually develop as little philosophers, this development is grounded in their primary experience as actors in a resourceful environment.

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From birth infants act in relation to functional goals: they root to suck, suck to feed, track to see, and grasp to hold. If there is sophistication at the origin of development, it is primarily in the organization of behavior. From birth, behavior is organized as action systems that are remarkably well adapted to tap into specific environmental resources on which newborns' survival depends: objects that afford food, people that afford care. It is in this basic functional context that infants rapidly learn to anticipate, recognize, perceive, and in general develop cognition about themselves and the environment. The early ontogeny of cognition is grounded in such active contexts and this grounding has important theoretical implications. It highlights the fact that what is developing first is a 'know how', the kind of emerging practical intelligence carefully documented by Piaget with his own infants. The question of course is how infants, in addition to knowing how to do basic functional things, develop an ability to represent, conceptualize, and theorize about past and future outcomes in their environment.

In the practical intelligence that develops from birth, infants not only grow new ways of interacting with objects in the environment, but also learn by being active *observers* of regularities in events occurring independently of their own actions. A major problem in Piaget's account is the centrality of self-produced action as a determinant of cognitive changes. Current infancy research demonstrates that very early on infants are attentive and learn from contemplating things that they perceive as external and independent of themselves (at least by 3–4 months). Thus, Piaget's emphasis on the radical egocentrism and subjectivity of cognition in early ontogeny needs to be revised. However, the precocious ability of infants to contemplate and learn from externalized objects that are substantial, have some permanence, can be recalled, and that behave according to certain core principles [Spelke et al., 1992] does not answer the developmental question of how learning to do things on objects relates to learning how objects behave independently of self-produced action.

Recent infancy research suggests that, contrary to Piaget's view, there might not be an obvious causal link between the development of practical intelligence and the emergence of representational abilities. For example, infants might not yet be able to reach behind a screen for an object, but they already demonstrate some rudiments of object permanence in the way they look longer at the impossible outcome of an object that vanished surreptitiously from behind an occluder [Baillargeon, 1993; Rochat and Hespos, 1996; Spelke et al., 1992]. But does that mean that the functional know-how or practical intelligence developing in the first months is unrelated to the early emergence of representational abilities? It is doubtful to the extent that the *content* of early representations must pertain to action, either self-produced or object-produced action.

What infants represent first are what actions can be done on objects of particular kinds, and what objects of particular kinds can do to one another. What is puzzling and needs further empirical investigation is whether infants perceive and represent what objects afford for one another in the same way that they perceive and represent what objects afford for their own actions. It is conceivable that the same process might underlie perception and representation in both domains: the active domain of self-produced actions and the contemplative domain of active observations. In both domains infants develop core practical knowledge about events in the environment, whether or not they are caused by self-produced actions. Knowledge developing in both domains must relate to each other and certainly must interact at some level in their development. This remains an open empirical question that more research should address.

It is counterintuitive to think that representations or image schemas arising from a contemplative mode via perceptual analysis as proposed by Mandler [1992] are somehow unrelated to representations arising from self-produced actions. How can someone build a baby that would develop in independence an ability to do practical things and an ability to conceive things? We think that many current infancy researchers adopting a nativist stance are doing just that. The infants they build are little Descartes endowed with innate, 'conscious' abilities to conceive and theorize above and beyond their protracted, 'unconscious' sensorimotor clumsiness. To take on Müller and Overton's argument, why remove cognitive (conscious) status to the practical (functional) intelligence expressed in early sensorimotor (action) development? By actively adapting to their environment, young infants develop strategies that are somehow represented, not unlike the representations they develop by experiencing things as spectators of their environment. Fundamental to Piaget's approach, much cognition is expressed in the way infants perform practical actions. What infants do tells us about the way they think, as much as habituation or preferential looking paradigms inform us about what babies know in an observational context. In recent years, it seems that this view has been dismissed. It is necessary to consider that cognition develops in relation to both active and observational contexts. We need to understand how these contexts coexist and relate to one another, not how one exists in independence of the other.

The propensity of researchers to unveil 'innate' sophistication in babies has fostered the consideration of early cognition in independence of action. In recent years, young infants have emerged as competent thinkers despite their great clumsiness as actors. This view is to a large extent nondevelopmental, deflating any potential links between action development and infant cognition. It removes much of the interest to consider key transitions in early ontogeny, these transitions being particularly marked at the level of action development (e.g., emergence of reaching, sitting, self-locomoting). The focus on developmental transitions in infancy often provides clear evidence that cognition and action develop jointly, hence should not be considered separately. As we will suggest next, such joint development is particularly evident when considering, for example, the important transition occurring by the second month of postnatal age.

Claims regarding innate cognitive abilities are typically based on phenomena discovered with infants aged between 2 and 8 months. The abundance of findings within this age range, and not prior, reflects in part the fact that experimental paradigms such as the 'violation of expectation' used extensively by Spelke, Baillargeon, and many others, work best with infants around this age. But it reflects also a difficulty in finding much evidence of core physical knowledge with younger infants. In fact, an important transition occurs by the 2nd month, marked by the emergence of new actions and a corresponding new level of cognitive engagement.

Healthy infants between birth to approximately 6 weeks move, act, and fluctuate in their behavioral states essentially in the same way that they did as fetuses in the last month of pregnancy [Prechtl, 1984]. A dramatic shift in action and cognition occurs by the 6th week of postnatal age that coincides with the emergence of socially elicited smiling. Note that this is the behavior from which most parents report discovering a person in their baby. At this point in developmental time, infants appear to attend to the physical and social world in a radically different way. At the level of action, they sleep less, spend significantly more time in a calm active state, cry differently, and develop actions oriented towards objects around them, in addition to actions oriented towards their own body. Compared to newborns, they also demonstrate a striking awareness in

the consequences of their own actions. They start to express negative emotions when their own arm pulling on a string is not followed by an expected outcome [Sullivan and Lewis, 1989]. Two-month-olds demonstrate an active/exploratory modulation of their sucking activity in relation to particular contingent auditory outcomes that are their commensurate (analog) or non-commensurate (nonanalog) to the pressures they apply on the pacifier introduced in their mouth. In contrast, newborns do not express any signs of such active/exploratory sucking modulation in relation to particular auditory outcomes [Rochat and Striano, in press]. By 2 months, infants start to explore the consequences of their own actions and demonstrate an emerging awareness of their own agency in the world.

There is much converging evidence that an important transition occurs by the 2nd month, a transition we like to call the '2-month revolution'. This transition entails radical changes in both action and cognition. Other major key developmental shifts seem to occur in later infancy, in particular by 9 months with the emergence of new social cognitive competencies expressed in joint attention, social referencing, and communicative gestures [Tomasello, 1995]. This later transition is also linked to important changes in action development, in particular the development of locomotion that opens up new ways of exploring the environment and that brings the interaction between the infant, objects, and people around them to radically new levels.

The processes underlying such key transitions as well as the relation between action and cognition in early ontogeny need to be further explored, not dismissed. It is in the quest for such a developmental account that we will move beyond the static, modular account of early cognition. What characterizes infancy, more than any other period of development, is changes, and in particular active changes as suggested by Piaget. This is fortunately the focus of emerging developmental approaches that force us to rethink innateness and reconsider infant behavior in its remarkable *active* plasticity [Elman et al., 1996; Thelen and Smith, 1994].

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