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5 Ego function of early imitation

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Early imitation is typically associated with cognitive and social-communicative functions (Uzgiris 1981, 1999; see also Nadel & Butterworth, 1999). The cognitive function of infant imitation is put forth in theories such as Piaget's (1962) who considers imitation as a central process by which infants develop an ability to function symbolically, performing actions (signifier) as standing for the action of someone else (signified). The cognitive aspect of early imitation is also emphasized in current research and theories suggesting that via imitation, infants pick up information about the identity of others and might express a sense of others as equivalent to themselves. Accordingly, from an early age infants take a "like-me stance" (Meltzoff & Moore, 1994, 1999; Gopnick & Meltzoff, 1997).

Early imitation is also discussed in relation to its potential social-communicative function, a way by which infants maintain contact and social-proximity with others (Uzgiris, 1981, 1999). The early propensity to imitate would not only be the expression of cognitive capacities, but also a mean for infants to create interpersonal contacts and establish grounds for shared experiences, hence to develop intersubjectivity. In support of this contention, infants are shown for example to repeat an imitative act in the presence of the experimenter who modeled the action, for no other apparent reason than the maintenance of dialogic interaction (Killen & Uzgiris, 1981).

In this chapter, I argue that aside from a cognitive and social-communicative function, early imitation serves an *ego function*. Aside from the willful (i.e., nonautomatic) attempt to reproduce more or less accurately the behavior of others, imitation is viewed here as part of the general propensity of young organisms to *repeat* their own actions and engage in what has been described for a long time by pioneer infancy students as "circular reactions" (Baldwin, 1925; Piaget, 1952). In general, early imitation is considered here as a basic mechanism contributing to the emergence of self-objectification in early ontogeny.

At the crux of my argument is the idea that self-reflection or contemplation of the self as object (self-objectification) is a process emerging from young infants' propensity to reproduce their own actions and engage in *self-imitation*. From the repetition of own actions, the self becomes objectified, becoming both an embodied experience and a potential object of thoughts (i.e., self-reflection).

The chapter is organized as follows. First, I use the example of mirrors as perfect imitators of the self to introduce the idea that self-objectification emerges from the process of self-imitation. I show that the process underlying mirror self-recognition is self-imitation or the reproduction of own action. Then, I link own action reproduction by young infants to self-exploration and the intermodal calibration of the own body. The body is considered here as a primary object of exploration in infancy. Next, I try to articulate the process of self-objectification putatively attached to action reproduction in early infancy. For that purpose, four determinants of self-objectification in early development are proposed. Together, these determinants would account for the emergence of a *contemplative stance* taken by infants at around two months of age. This stance is viewed as the first developmental sign of a self-reflective process.

In general, what is proposed here is that the systematic repetition of self-produced action (i.e., self-imitation) is a mechanism contributing to the emergence of a contemplative stance in infant psychological development. Again, aside from a cognitive and social-communicative function, there is a primary *ego* function attached to early imitation when considering young infants' playful and gratuitous propensity to reproduce their own action.

Imitation is a primary source of knowledge about the self and a basic process by which infants gain self-reflective abilities. Such abilities are arguably a trademark of human cognition and the question of their origins is among the most challenging empirical issues in both the perspective of primate evolution and child development.

Mirrors as perfect imitators

In its simplest acceptation, imitation is the process by which one behavior is mapped onto another. In relation to this definition, the specular images or image of the self reflected by mirrors provide a perfect, absolute version of this process. What a mirror projects back to actors, assuming that their surface is well polished and flat, is a perfect visual reproduction of self-produced action, an absolute visual analog of what is felt proprioceptively by the actor behaving in front of the mirror. The visual analog of the specular image is absolute both in terms of its perfect temporal

contingency and relative spatial congruence. Spatially, although the specular image is inverted along its vertical axis in relation to the actor standing in front of the mirror, it provides absolute spatial congruence in terms of the form and amount of self-generated movements.

Fundamental to the issue of imitation is the issue of the differentiation between imitator and imitated. When standing in front of a mirror, one might ask who is imitating whom. Is it me or my reflection? Of course, this question is absurd if we take for granted that what is seen in the mirror is the specular image of the embodied self. There is no imitator nor any imitated, but one self. This realization can occur only when the inclination to dissociate the embodied self from its specular image is overcome. This realization is not a simple feat. This is particularly evident in the temporary puzzlement adults typically experience while trying to make sense of the left-right reversal of mirrors: that when lifting my left arm the specular image of myself is actually lifting its right arm. The rationality of light bouncing from the self onto the flat surface of the mirror alleviates such apparent dissociation.

Interestingly, the question of who is imitating whom in front of mirrors, hence specular dissociation, becomes eventually obsolete only after some major evolutionary and developmental changes. For example, regardless of age, a dog facing its specular image will smell it, growl, or engage in playful engagement while maintaining eye contacts, as if encountering another dog (Zazzo, 1979). Aggressive responses are found in fish (Tinbergen, 1951) and birds (Smythe, 1962) encountering their own reflection on a polished surface. Children up to about three years will sometime search behind the mirror to find the other child they confound with the specular image of themselves (Zazzo, 1981).

It might be argued that these kinds of behavior are unusual and due essentially to the peculiar optical affordances of mirrors which make them unique among other objects in the environment (Loveland, 1986). However, beyond the perceptual learning attached to mirrors and their unique properties, behavioral changes in front of them index unmistakable, interesting, and reliable cognitive changes in the perspective of both phylogeny and ontogeny (Gallup, 1970; Lewis & Brooks-Gunn, 1979; Zazzo, 1981).

From a comparative perspective, only few of our close primate relatives demonstrate clear evidence of mirror self-recognition in the context of the "rouge task" (i.e., orangutans and chimpanzees, see the thorough review by Tomasello & Call, 1997). On the other hand, from a developmental perspective, it is only by the middle of the second year that children pass the rouge task, touching with embarrassment the rouge spot put surreptitiously on their face and that they detect in the specular image (Amsterdam, 1972; Lewis, Sullwan, Stanger, & Weiss, 1989). This novel

reaction to mirrors indexes unambiguously a concept of self as “me and only me” in the mirror, not another individual facing and imitating me. From then on, the question of “who is imitating whom?” does indeed become absurd.

So how do children develop an ability to recognize that it is themselves in mirrors, not someone else reproducing their acts perfectly? I will submit that it is by developing a sense of self-agency via repetition of self-produced action, namely *self-imitation* construed as the systematic attempt to *reproduce* and *match* previous patterns of self-generated action. To illustrate this process, I will use a simple example that I suppose we all can relate to. Suppose that you enter a video store full of TV monitors all projecting an online “security” view, from different angles, of the crowd in the store. Suppose now that you wonder whether it is actually an online view of the store. The way you will untangle this question is by trying to recognize yourself on the TV monitors. You would scan the screens until you recognize yourself. But that would not give you any certitude as to whether the image of the store is actually online. The faster and more accurate way to address this question would be to move in an identifiable fashion and explore the perfect temporal contingency and spatial form between felt and seen movements on the screens. This is what you would do also if different cameras were filming you simultaneously, providing different views of yourself and you wanted to figure where the cameras are actually located in the store. You would move around and compare the proprioceptive sense of your own body in space and its various visual projection on the screens.

In these examples, the untangling of the question of what view is projected on the screens, and whether it includes oneself, entail the systematic comparison between self-produced action and its online visual consequences. From this intermodal comparison, one can overcome the dissociation between the embodied self and its specular image (or TV’s images in the above examples). What is important here is the systematicity aspect of this comparison which makes it deliberate and intentional, in the sense that it is based on repeated actions as part of a plan (e.g., figuring the cameras’ locations in the store). Such comparison express a sense of *self-agency* on the part of the perceiver/actor.

I propose here that such process of intentional comparison and, in general, the sense of self-agency originates in early development from the propensity of young infants to repeat actions that are self-produced. Self-imitation is presented as a primary mechanism for the calibration of the self as both embodied and reflected back by objects such as mirrors, shadows, videos, calm liquid surfaces, acoustical echoes, as well as the social mirroring provided by others.

Action repetition and self-exploration

First signs that infants contemplate their own body as an object to be explored arise by the second month when they start to bring, for example, their own hands in the field of view and move their own limbs for long bouts of visual exploration (Piaget, 1952). There is a mutual, synchronous feedback from vision and proprioception, infants experiencing with apparent pleasure this intermodal correspondence. But what makes it so compelling for the infant? From a cognitive and epistemological standpoint, Piaget (1952, 1954) proposed that infants when first engaging in repeated visual tracking of their own hand, do so because they visually perceive a dynamic, nonself object. This object is not yet perceived as part of their own body or moving as a function of their own agency. For Piaget, it is compelling to the young infant as any other dynamic objects in the environment would be, whether their movements are self-produced or not. Accordingly, early on infants would not perceive the intermodal correspondence between what they feel proprioceptively and what they see. We know now that this interpretation is probably wrong. Since Piaget, multiple pieces of evidence have been reported demonstrating that from a very early age, and even from birth, infants are capable of matching visual, haptic, proprioceptive, and auditory percepts (Clifton, Morrongiello, Kulig, & Dowd, 1981; Gibson & Walker, 1984; Jouen, 1984; Meltzoff & Borton, 1979). It is thus probable that when young infants start moving their hand systematically in their field of view, they perform this action repeatedly as part of self-exploration, and not as random visual tracking. Such repeated multimodal activity enables them to discover their own body configuration and its degrees of behavioral freedom.

Via self-exploration, young infants develop an intermodal sense of their own body which is a primary object of exploration. Systematic reproduction of self-produced actions allow them to calibrate synchronous information from various perceptual systems. It is probably based on this intermodal calibration that infants develop the perception of their own body as a differentiated entity among other entities in the environment (Rochat, 1995, 1997, 1998). In this calibration process, self-imitation or the propensity to reproduce own actions is a central mechanism.

From birth, infants kick their legs repeatedly (Thelen & Fisher, 1983) or wave their arms (Van der Meer & Van der Weel, 1995), and tend to bring their hands to the mouth (Rochat, Blass, & Hoffmeyer, 1988; Rochat, 1993). Self-imitation as the process by which actions are systematically reproduced is arguably the most pervasive behavioral propensity expressed from birth, even prior to birth (Hopkins & Prechtel, 1984). It is

certainly the most readily observable behavioral trait of young infants and I propose that it is also an important mechanism by which infants come to *objectify* themselves and eventually become self-reflective. But how might such mechanism of self-objectification via repeated self-produced actions work?

Putative determinants of early self-objectification

There might be only a few basic determinants accounting for the mechanism by which infants may start to show first signs of self-reflection, beginning to contemplate themselves as agent and differentiated entity among other entities in the environment. I identify four putative determinants of early self-objectification: (1) the functional pleasure attached to the production of bodily movements expressed by infants from birth; (2) the unique perceptual experience of the self attached to bodily movements; (3) the canalization towards repeated actions due to the prolonged postural immaturity of early infancy; and (4) the contemplative stance arising from patterns of action that are repeated in a process of self-imitation. I describe each of these determinants next.

Functional pleasure of self-produced action

From birth, infants are compelled to move for the apparent sake of moving. They express functional pleasure in setting their own body in motion (Baldwin, 1925; Piaget, 1952; Wallon, 1942/1970). Infant behavior from birth is in great proportion gratuitous, namely without any apparent functional reason attached to it, except for putative "pleasure." Aside from sucking, crying, or breathing, which have clear adaptive and survival functions, young infants' wakeful behavior is characterized by many bodily movements that appear to be performed for the sake of exhausting possibilities for action and exploring behavioral degrees of freedom. This apparent functional pleasure goes beyond the expression of fixed-action patterns or automatic reflexes triggered by nonspecific external stimulation. It is the sensorimotor expression of an early propensity to play. It is worth noting that the propensity to play is not unique to human infancy, it being observed in other young animals. However, the tendency to play is a particular trademark of human infancy, inseparable from its prolonged immaturity in comparison to other primate species (Bruner, 1972; Rochat, in press).

For example, it is now well established that infants from birth demonstrate hand-mouth coordination, compelled to repeatedly transporting their hand(s) to the perioral region. This action is systematically reproduced, under the control of mechanisms that are not rigidly tight,

to afferent-efferent loops or reflex arcs. It entails some form of sensori-motor anticipation, the mouth typically opening in anticipation of manual contact (Blass *et al.*, 1989; Butterworth & Hopkins, 1988; Rochat, Blass, & Hoffmeyer, 1988; Rochat, 1993).

Hand-mouth coordination, leg kicking, head turning, mouth opening and closing, arm waving, grasping movements, all these actions form complex yet clearly differentiated behavioral patterns displayed by healthy newborns. These behavioral patterns are typically repeated by the infant, in protracted bouts while awake and active (Hopkins & Prechtel, 1984; Wolff, 1987). Aside from an outlet of energy expenditure, the repetition of such action patterns is the source of perceptual experiences that uniquely specify the self. As I will suggest next, it is indeed a primary source of self-knowledge at the origin of self-objectification.

Unique perceptual experience gained from self-produced action

When moving their limbs, touching their own body, or hearing their own voice in crying or cooing bouts, infants make the unique experience of themselves as differentiated entities in the environment. This unique perceptual experience is intermodal, involving proprioception plus other modalities (e.g., touch, vision, or audition).

Proprioception is indeed the sensory modality of the self "par excellence." When uttering sounds, they make the unique experience of proprioceptive feedback accompanying sound production and its actual audition. When bringing their hand(s) to the mouth or field of view, they make the unique experience of joint haptic- or visual-proprioceptive feedback. In addition, in the case of hand-to-mouth contacts, infants experience a "double touch" that is uniquely specifying the self (hand touching the mouth and mouth touching the hand, von Glasersfeld, 1988; Rochat, 1995, 1998).

From moving their limbs, vocalizing and touching themselves, infants have the opportunity to specify perceptually (i.e., intermodally) their own body as differentiated from other entities in the environment. This is obviously the most basic requirement of self-objectification. We recently collected data suggesting that from birth infants do pick up the intermodal information accompanying self-produced movements and specifying themselves as differentiated entities. Analyzing neonates' rooting response (head turn and mouth opening) toward a perioral tactile stimulation, we found that this response varies systematically whether the stimulation is caused by the experimenter's finger or the infant's own hand touching the face (Rochat & Hespos, 1997). In particular, we found that healthy newborns aged less than eighteen hours tended to display significantly more rooting responses (i.e., head turn towards the stimulation

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with mouth open and tonguing) following external compared to self-stimulation. In the context of our research, such differential responding is possible only to the extent that newborns pick up on the specificity of double touch and the presence or absence of proprioceptive feedback accompanying the touch stimulation that specifies either self or nonself experience.

Postural immaturity as a constraint toward action repetition

The prolonged postural immaturity characterizing human infancy does not only determine powerlessness and vulnerability due to a lack of mobility, hence lack of self-reliance in escaping from most adverse environmental circumstances. It also canalizes infants' bodily movements toward the repetition of identifiable, hence explorable, action patterns. Aside from reflexes and pre-adapted action systems such as sucking or tracking moving targets with the eyes, infants' propensity to move their body for the apparent sake of moving, is highly constrained by the limitation in degrees of behavioral freedom. So for example, when laying supine in their crib, the possible repertoire of limbs and head movements are greatly limited and relatively sluggish for at least the first eight weeks of life. Head rotation, hand transport to face and mouth, rhythmical flexion and extensions of the limbs are the main features of this early "play" repertoire. This, I propose, has great functional significance and probably contributes to the development of self-objectification as it promotes self-imitation.

Moving for the sake of moving is highly constrained early in development due to postural immaturity that reduces the degrees of movement freedom. In dynamic systems terminology, free play in early development has few stable attractors (Thelen & Smith, 1994). This means that in moving for the sake of moving, young infants are limited to a very small range of possible bodily movements. This state of affairs constrained them toward repetition. This is one way to account for the cardinal rhythmicity of bodily movements early in development. My contention is that the lack of postural control of young infants has for consequence to *scaffold self-imitation*, namely the basic propensity to reproduce systematically the same (possible) self-generated action pattern and to engage in so-called "circular reactions" (Baldwin, 1925; Piaget, 1952).

Contemplative stance arising from repeated actions

The fourth putative determinant of self-objectivation rests on an important developmental transition observable by the second month of life. This transition marks the passage from actions repeated by the infant for the sake of repetition, to actions that are reproduced in order to explore

systematically the range of their perceptual effects or consequences. This transition characterizes the adoption by the infant of a contemplative stance (Rochat & Striano, 1999a; see also Werner & Kaplan, 1963).

As an illustration, we captured such transition in a recent study in which we compared newborns and two-month-old infants' sucking behavior on a dummy pacifier, of experimental situations where each suck was accompanied by a contingent sound (Rochat & Striano, 1999b). The sound consisted of a sequence of discrete tones that varied in pitch. Infants were tested in two experimental conditions. In one condition, each time they sucked on the pacifier above a minimum pressure threshold, they heard a contingent sound with a pitch variation that was commensurate to the pressure variation they applied on the pacifier. In other words, in this condition, infants were presented with a continuous auditory *analog* of the pressure they exerted on the pacifier: the more they pressed on it, the higher the pitch, and inversely. In another experimental condition, each time they sucked above the minimum threshold, they heard a two-second series of discrete tones that varied randomly in pitch. The tone series were repeated in succession when the oral pressure on the pacifier was above threshold. In this situation, the infant heard a contingent but *nonanalog* auditory feedback. We found that two-month-olds sucked differentially (i.e., frequency of pressure just at threshold, average pressure amplitude on the pacifier, standard deviation of pressure amplitude) in the analog compared with the nonanalog condition, evidently attentive to the form of the auditory feedback that reflects or does not reflect what they do on the pacifier. They appeared to modulate their oral activity on the pacifier as a function of the relative audio-proprioceptive congruence. In contrast, newborns do not demonstrate any evidence of such discrimination, sucking in similar ways in both experimental situations (Rochat & Striano, 1999b).

Such findings indicate that by the second month infants appear to develop a sense of their own agency, controlling their own actions to contemplate their perceptual consequences. This indexes the emergence of a contemplative stance, itself the first manifestation of a self-reflection process. But how to account for such emergence in early development?

I propose that the emergence of the contemplative stance is tied to self-imitation. By virtue of their systematic reproduction, self-generated action patterns become objects of exploration. From the functional pleasure of being executed (e.g., sucking for sucking, kicking for kicking), actions and their intermodal consequences emerge as objects of contemplation for the infant. This cognitive breakthrough finds its roots in the propensity of infants to repeat highly constrained and uniquely self-specifying motor patterns. It is best described as a new cognitive form emerging from systematic self-imitation.

The actual mechanism of such emergence is speculative but it is easy to consider that being repeated, action patterns can be remembered and compared as they leave memory traces. By being reproduced these patterns become also highly automatized leaving much room for novel attentional focus by the infant: from a focus on the here and now of the action execution, to an anticipation and control of the perceptual consequences of such action (e.g., Rochat & Striano, 1999b). Once again, this contention is highly speculative and more research is needed to unveil the exact mechanism of this key developmental transition. Interestingly, Meltzoff & Moore (1997) recently proposed a theoretical model of facial imitation by young infants that also capitalizes, among other, on what they coin "body babbling" or movement practice gained through self-generated action. If body babbling is potentially an important mechanism for the early understanding of others, it is also potentially a primary mechanism for the understanding of the self, as proposed in this chapter.

Summary and conclusion

The argument proposed here is that first signs of self-reflection and in particular the emergence of a contemplative stance by which the self is perceived as agent in the environment are co-determined in part by (1) the functional pleasure attached to the repetition of action from birth and possibly prior to birth; (2) the unique perceptual experience of the self attached to bodily movements; and (3) the constraining effect of prolonged postural immaturity in early human infancy. Together, these three factors would co-determine the early manifestation of self-imitation from which the contemplative stance probably emerges as a new cognitive form by the second month of life.

By imitating their own action in patterns described by pioneer infancy researchers as "circular reactions," young infants gain a sense of themselves as differentiated agents in the environment. Self-imitation, or the propensity of infants from birth to repeat systematically highly constrained movement patterns, serves primarily an *ego* function: the function of giving infants an opportunity to specify themselves as differentiated and agent entities among other entities in the environment.

In conclusion, an important aspect of early imitation is self-imitation, the process by which infants develop knowledge about themselves and an ability to contemplate the perceptual consequences of their own actions. It serves primarily an *ego function*. The *ego function* of early imitation is too often overlooked by researchers and theorists (but see Meltzoff & Moore, 1995). It is of great interest, particularly when considering that self-imitation is probably at the origin of what is arguably one of the

trademarks of human cognition: the capacity for self-reflection and the ability to generate thoughts that fold back upon themselves.

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