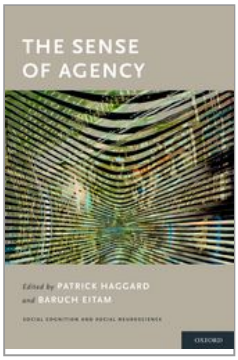

The Sense of Agency
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The Innate Experience of Self-Agency

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Abstract and Keywords

Research is presented showing that an implicit sense of self-agency is probably developing from birth, and possibly even before that. These time points are months before the child begins to manifest explicit (conceptual) self-knowledge, an event that is reported to occur typically in the second year. Implicit self-knowledge in infancy, including the sense of self-agency, is rooted in intermodal perception and action. This chapter proposes a particular role for embodied synesthesia involving proprioception—the modality of self-perception par excellence. From around 6 weeks postpartum, infants show signs of increasingly systematic and deliberate exploration of their own body, and in particular the perceptual consequences of self-produced actions. Infants have expectations regarding such consequences, getting much pleasure when they are met, experiencing displeasure and frustration when they are not. The pleasures of control associated with self-agency would form the affective core and driving motivational force behind mental development from the outset.

Keywords: self-agency, self-knowledge, embodied synesthesia, proprioception, motivation, mental development

Introduction

There is deep, primordial pleasure in controlling and sensing the impact that one has on people and things. The perception of self-agency and the sense of one’s own body in relation to the environment is what psychology is all about, what the life of the mind rests upon. In this chapter I will propose that the experience of having control and associated pleasures are at the core of psychic life from birth (and probably also in the womb during the last trimester of

gestation). *Argumentum a contrario*, I also want to insist that from the outset, a lack of perceived self-agency and control can be the source of deep mental confusion, a hindering force of optimum (healthy) development. In general, I want to promote the idea, like many others long before me, that the experience of having control is arguably what drives psychological development (Watson, 1995) and that the lack of such control can deeply disrupt development and can be the source of devastating helplessness (Seligman, 1975).

The general argument is that the experience of self-agency, a perceptual experience that evolved to become associated with an innate "mood-boosting" and reinforcing affectivity (i.e., the pleasures of control), is the necessary prerequisite for the blossoming of consciousness in child development. This innate affectivity is encapsulated in the reinforcing effects of connecting actions **(p.252)** of the body and their effects on the environment, both social and physical. Accordingly, the basic idea is that consciousness, in the broad sense of having knowledge and being aware of such knowledge (i.e., not being asleep or comatose) is inseparable from the capacity to perceive and predict consequences of one's own actions, and includes being irresistibly drawn toward the highly reinforcing pleasures of enacting such capacity.

There are necessary pre-requisites for perceived self-agency, all expressed in early infancy. They correspond to what can be seen as five developmental pillars of self-awareness and consciousness in general. These pre-requisites are the following:

1. The capacity to have emotions and experience feelings, unlike robots, machines, or other zombie-like entities. This is what defines a sentient creature in contrast to thermostat-like machines, for example. Indeed, to perceive self-agency, one must be endowed with the capacity to experience reinforcing pleasures by getting feedback regarding the impact of one's own actions on things and people.
2. The ability to perceive one's own body as an active entity differentiated from other entities in the world, not in confusion with them. This is the basic capacity for a distinction between self and world, unlike some sort of inherent "blooming, buzzing, confusion" (James, 1890).
3. The capacity to perceive one's own body as organized and coordinated, with parts that are not experienced as moving independently but rather always *in unison*. That would also include some sort of unified processing of simultaneous input from the various perceptual systems.
4. The capacity to perceive the situation of one's own body in relation to other entities in the world and toward which actions can be oriented.
5. The capacity to perceive one's body as substantial and occupying space, hence as being potentially an obstacle and offering physical resistance to other entities in the world, a source of force and physical impact.

Here I want to suggest that these necessary pre-requisites of self-agency exist from the outset of child development, with manifestations even in utero. Perceived self-agency would be part of our innate mental architecture and the necessary foundation of consciousness in development.

First Experiences of Feelings

Experiencing self-agency entails minimal phenomenal awareness, the necessary experience of *what it is like* to have embodied effect and control over things. But when does it all begin? When can we safely ascribe affective mental **(p.253)** states (i.e., experiencing the feelings of pain and pleasure) to the developing child, the newborn, and possibly even the fetus?

For a long time, infants were seen essentially as sensing but not feeling pain (Rochat, 2011; Rochat, 2014). As a case in point, until fairly recently (the 1940s and 1950s), infants and young children were routinely operated on without any anesthesia. Medical teams would paralyze squirming infants by the injection of Curare or similar paralytic agents. Even today, local anesthetics are not routine in painful procedures on newborns (heel prick and circumcision), even in ultramodern, state-of-the-art maternity hospitals. There is a continuing overtone in the adult mind, around the world, and particularly in certain cultures, that infants have either no feelings, less feelings, or that feelings experienced at this early stage might not be as consequential for lack of memory (infantile amnesia). Such intuitions, however, defy current physiological as well as behavioral evidence.

What is typically recognized as the necessary neuroanatomical underpinning of experiencing feelings like pain is already in place by the third trimester of gestation, even possibly much earlier (8 weeks). Behaviorally, it is also by the third trimester of pregnancy that fetuses demonstrate unmistakable facial expressions of pain or joy (smiling) with corresponding heart rate and other expressions of overall behavioral states like wakefulness or sleep (Hata, Dai, & Marumo, 2010; Hepper, 2002; Prechtl, 1977). In human ontogeny, it is thus reasonable to think that by at least 31 weeks of gestation, almost 3 months before term birth and 6 months after conception, subjectivity and a minimal ability to experience feelings are de facto in place. From this point in prenatal development, and probably even prior, it is not farfetched to be ethically concerned about the comfort and potential suffering of fetuses (see Rochat, 2011, 2014 for more detailed discussion).

Recent progress in fetal psychology research suggests that there are prenatal signs of experiencing feelings. The well-organized emotional expressions, combined with the remarkable continuity of prenatal and postnatal development, supports the idea that first experiences of feelings, and therefore the potential for minimal self-awareness, might emerge 8–10 weeks before birth (30–32 weeks gestational age). Keeping in mind the striking continuity of behaviors observed

during the last 10 weeks of gestation and what can be readily observed and tested after birth (Prechtl, 1984), what can be seen in the newborn could stand also for what is not readily testable in the womb, from at least 32 weeks, when fetal behaviors show all the aspects of what is observed after birth.

Another demonstration that, at least from birth, infants feel and are not just sensing the world, is the fact their behavior involves much more than simple automatic responses triggered by particular stimulations. Infants manifest **(p. 254)** much more than simple reflexes from birth. Rather, they show complex systems of action oriented toward particular resources with *affective values* that they perceive and feel, rather than just sense in some sort of on/off switch or trigger mechanism. From birth, infants are actors and feelers, rather than responders or just "sensors." Newborns are best described as active explorers of a world that has values they feel and experience in reference to particular mental states: satiety, hunger, pain, comfort, pleasure, fear, surprise, or curiosity.

Acting and Feeling by Neonates

Behavior at birth and in the first months of life can be divided in two basic kinds: automatic *reflex systems* and *action systems*. Reflex systems correspond to what pediatricians probe immediately after birth to assess the neurophysiological health of the infant, when they perform typical neurobehavioral tests to see if there are any neurological red flags. Action systems, in contrast, correspond to behavioral patterns present at birth that are much more than triggered responses to specific stimulations. They correspond to actions that are oriented toward functional goals and particular resources in the environment: food, protection, comfort, and so on. Reflex systems entail mere sensing and responding, whereas action systems involve feeling and meaningful perception. Both systems are expressed immediately after birth, yet they involve drastically different capacities.

The beating of the heart, the movements of the lungs in breathing, the shaking of the whole body under a cold spell, the knee jerk response, or the blinking of eyelids in response to an air puff all belong to the first kind of triggered (sensed) bodily movements. They are automatic and reflex responses of the organism. The control of such movements is endogenous and self-contained. These movements consist in highly predictable stimulus-response loops or tight circuits. They are in essence automatic, triggered by particular stimulations.

Following the physiologist Sherrington's first account of this kind of bodily movement, the control is encapsulated and rigidly prescribed within the organism as reflex arcs. It typically involves low-level, sub-cortical neural networks: surgically decorticated animals continue to express such movements (Sherrington, 1906). What controls such movements are closed feedback systems that are similar to thermostats controlling for constant temperature

inside a house. Those mechanisms are simple when considered in isolation, but they are complex when considered in interaction with each other, each calibrated to respond to particular ranges of stimulation from the environment that are internal as well as external to the body. Each system, which controls a particular autonomic/reflex response, is also adapted to interact with myriad other similar systems that, in concert, maintain the integrity of the organism **(p. 255)** as a whole living and adapting system. But they do so in a very mechanistic way, with no reference to any sorts of mental states, controlled by closed-loop feedback systems (i.e., autonomic reflexes) ensuring basic physiological functioning (like breathing, digesting, or swallowing). They keep the individual organism alive, but such movements do not involve any perception, or any particular higher-order treatment of basic physiological signals or sensations that are sensed but not felt in reference to mental states. The infant regurgitating an object that obstructs the wind pipe does it automatically, not feeling the danger but sensing the obstruction, in the same way that a thermostat senses automatically the crossing of a temperature threshold, without feeling temperature change. In a way, this kind of bodily movement is sensitive but psychologically blind to the environment to which it responds. Such movements are triggered by nonspecified circumstances.

Action systems, in contrast, correspond to bodily movements that are more than autonomic or reflex responses. Also expressed from birth and prominent during the first 6 weeks of life, they are distinct on two basic grounds. First, they are movement systems consisting of actions that are oriented toward specific functional goals. These systems are by definition adapted to tap into available resources that exist outside the individual organism, in the surrounding environment: food, surfaces, objects, or people. Second, these movements are organized into systems that are *flexible*, capable of changing based on previous experiences, and adjusting to novel circumstances. They allow room for learning, controlled by open-feedback loop systems. Action systems do entail perception (feelings) and learning. Contrary to reflexes, they entail some psychology and meaning making (perception), presumably reflecting higher-order cortical involvement. In support of this second kind, numerous research studies indicate that infants at birth show more than autonomic/reflex arcs.[1]

For a long time, newborn sucking, grasping, stepping, rooting, and head turning were merely construed as reflexes or automatic responses triggered by nonspecific stimulations. Multiple studies now exist showing in fact that such movements need to be construed as actions rather than reflexes—actions that are already oriented toward particular features and resources in the environment, such as faces or objects with a certain shape, texture, consistency, or smell. Newborns, immediately after birth, track with their eyes and even show attempts at reaching toward objects that move close by in their field of view. More impressive is the fact that they do so preferentially when the object consists, for example, of a schematic face-like display. Old research, validated

multiple times since then, indicates that newborns tend to track more canonical face-like displays (two adjacent dots for eyes above vertically aligned two dots for nose and mouth) compared to non-canonical face-like displays with the same features but scrambled (Morton & Johnson, 1991). Similarly, newborns **(p.256)** tend to suck differentially on pacifiers that are more or less mimicking the biological nipple of the mother. They suck less and tend significantly to increase oral exploration as a function of the eccentricity of a pacifier compared to the biological nipple in terms of texture and consistency (Rochat, 1983).

We found the same kind of results when recording newborns' grasping of objects varying in texture and consistency that are placed in one of their palms (Rochat, 1987). In more recent years, researchers have even established that newborn infants are significantly more inclined to orient their face toward gauze impregnated with their own mother's amniotic fluid or breast milk as compared to gauze impregnated with the amniotic fluid or the breast milk of another woman who just gave birth (Marlier, Schaal, & Soussignan, 1998). If newborns orient and root to smells or face-like displays, if they suck and grasp at objects introduced in their mouth or in their hands, they do so with discrimination and preference.

This kind of movement is not made of autonomic, reflex responses triggered by nonspecific stimulation. It is under the control of previous experiences (learning) and is intrinsically oriented toward particular environmental resources. It calls for some psychology that engages more than sub-cortical structures. Even if we cannot qualify these movements as being intentional (another loaded term), it is reasonable to qualify them, not as automatic response-like reflexes, but rather as adaptive actions generated in relation to objects that infants perceive, and hence feel as agents, rather than simply sense as a physiological machine. Such experience of feeling is the personal possession of the child by which minimal, implicit self-awareness is expressed, based on embodied perceptual competencies including innate synesthesia.

Newborns' Objective Perception

Infancy research of the past four decades has changed our views on the starting state of mental life, namely what is it like to be a newborn. Until then, developmental theorists tended to endorse the view, in their own ways, of an initial state of confusion with the environment, the famous initial "blooming, buzzing, confusion" proposed by William James (1890). Neonates were essentially construed as stimulus-bound, sensing but not feeling the world, their behavior primitively reduced to ready-made, evolved automatisms (reflexes or pulsions). The newborn's world was envisioned as not yet objectified or differentiated, the child born in a state of confusion with the environment. At the beginning, subjectivity and objectivity were seen as confounded and in need of progressive integration through experience (e.g., cognitive distancing and

construction in the case of Piaget (Piaget, [1936] 1952), ego development in the case of Freud's pulsion theory (Freud, [1905] 2000).

(p.257) More recent research shows that, in fact, healthy newborns do perceive the world objectively and are not in a state of subject-object confusion. From birth they express a difference between what pertains to their own body and what pertains to the world "out there."

Although babies are born with poor contrast sensitivity and grating acuity (Banks & Shannon, 1993), infancy researchers investigating newborn vision demonstrate that despite the obvious developmental lag of the modality, active perceptual processing does take place at birth. For example, and relevant to our discussion, by using habituation and novelty preference paradigms, researchers have established that newborn infants, only a few hours old, when awake and alert, perceive the real (distal) size of objects, not the varying (proximal) sizes projected onto the retina. Newborns perceive size constancy of objects (Granrud, 1987), most likely via visuo-proprioceptive convergence cues from both eyes as they line their gazes and focus on the distal object (Kellman & Aterberry, 2006). In all, this kind of empirical evidence suggests that newborn infants have feeling experience, and are not just limited to sensing what is recorded at the proximal level of the receptors (i.e., the retina). Early perceptual competency of perceiving a world that is distal and objectified in relation to the self forms the necessary core for the perception of self-agency: the perception and control of self-produced action in relation to "non-self" things in the world.

Perceived Self-Unity at Birth

Synesthesia corresponds to the spontaneous, implicit "metaphorical" experience of a sensation or percept in one modality that is simultaneously experienced in another. For example, one might experience the particular timbre or pitch of a sound with the vivid experience of a specific color, the experience of time duration corresponding to the obligatory experience of a particular spatial layout or form (Simner et al., 2006). Neuroscientists have now established the embodied (neurobiological) reality of such "synesthesic" experiences that, according to existing surveys, are part of the life of approximately 5% of all adults (Hubbard, Arman, Ramachandran & Boynton, 2005; Spector & Maurer, 2009).

An intriguing idea is that adult cases of synesthesia might in fact be remnant and magnifying cases of inter-sensory connections that are present at birth, pruned and somehow inhibited in the course of typical perceptual development (Spector & Maurer, 2009). Accordingly, these connections would be expressed in "muted forms" in *all adults* (but see Deroy & Spence, 2013, for a critique and alternative account). In this view, synesthesia could be the natural starting state of all subjective sensory experience. We would indeed **(p.258)** start off with a "conflation" of all sensory modalities, as suggested by William James in his

statement about “blooming, buzzing, confusion.” However, this experiential conflation (what James refers to as the “pure sensory experience” of newborns), rather than being the symptom of a major incompetence, as it has been taken by most infancy researchers over the past 30 years, would be rather the sign of a competence to reinforce a basic, *innate* potential to experience self-unity.

An abundance of research shows that infants are born with the ready-made opportunity to link experiences from the various sense modalities, experiences that co-occur and tend to be qualitatively linked, corresponding to particular feeling tones and profiles. From the start, intermodal systems might exist that allow these sensory experiences to coalesce into the “affective” core of subjective experience that ultimately gives it *values*: values in rudimentary polarized terms such as pleasure or displeasure, stress or calm, soothing or enhancing, attunement or disharmony, bonding or estrangement. All these represent affective meanings (good or bad feelings) that are at the core of what would be a unified subjective experience at birth. But what kind of empirical evidence is there that supports the assertion of a rich primitive sensory conflation, a conflation that would harmonize, rather than confuse, early experience?

In relation to *synesthesia*, there is an abundance of empirical evidence showing that infants from birth are readily able to process information across sensory modalities. One-month-old infants are reported to discriminate an object they see projected on a screen based on the previous experience of an analogous object explored with their mouth only (i.e., a smooth spherical pacifier or a bumpy spherical pacifier texture; Meltzoff & Borton, 1979). In another series of highly controlled, careful psychophysical studies on newborns in the early 1980s, Lewkowicz and Turkewitz (1980) demonstrated that neonates transfer learning from the auditory to the visual modality. Following visual habituation to either a bright or a dimmed light, they responded differently to corresponding soft or intense sounds in the auditory domain.

In support of such unitary or common functioning of the senses at the outset, an even older neurobehavioral study by Wolff and collaborators (1974) showed that the tactile stimulation of the newborn’s wrist evokes activation of the somatosensory cortex. Moreover, this activity is significantly enhanced when the infant hears also a white noise. Such auditory-tactile interaction is not found in adults, a phenomenon that appears to be specific to the perceptual experience of newborns. As additional neuro-developmental evidence on an early unitary functioning of the senses, Neville and collaborators show that if infants respond to spoken language with, as expected, enhanced activity in the auditory cortex, unlike adults and children, they also respond with enhanced activity in the visual cortex (Neville, 1995).

(p.259) In further support of the natural primacy of synesthetic experience, Mondloch and Maurer (2004) show in a series of studies that 2–3-year-old children tend to be naturally inclined to perceive the same pitch-lightness, color-letters, or sound-shape correspondences typically expressed by synesthetic adults (but also, to some extent, by non-synesthetic adults). Young toddlers, for example, perceive that a higher pitch sound goes with a brighter color; a nonsense word made of rounded vowels goes with a jagged shape (e.g., te-ta-ke goes with a sharp edged form, or that the letter A goes with the color red).

In all, these findings, among many others, support the idea of a highly organized intermodal and resonating embodied experience at birth. Early perceptual experience is made of rich sensory correspondences and implicit "a-modal" representations that can be said to be metaphorical because they transcend the particularities of the sense modalities as singular perceptual systems. It is an experience that carries rich conflation and correspondences, not the cognitive confusion that has been assumed by many infancy researchers, including myself, since James's misconstrued "blooming, buzzing confusion."

Perceived Self-Agency in Infancy

From birth, infants are capable of perceiving their own body as an entity among other entities—an entity that has unity, is differentiated, occupies space, and is substantial. In addition, from at least 2 months of age, there is good evidence that infants have a sense of their own agency on objects; they are aware of themselves as embodied agents in the world (Rochat, 2001).

For example, we were able to show that newborn infants do discriminate between self-stimulation and stimulations coming from the outside world, suggesting that they are not in a state of confusion with the world outside. They root (i.e., orient head and mouth) significantly more toward the finger of an experimenter touching their cheek than their own hand spontaneously brought in contact with the peri-oral region of the face (Rochat & Hespos, 1997). We also showed that 2-month-olds are attentive and systematically explore the auditory consequences of their own action while sucking on a sound-producing pacifier (Rochat & Striano, 1999). They differentiate between sounds that are perfectly contingent but that are or are not linked to the physical pressures they apply on the pacifier. In the context of our research, from 2 months of age (though not at birth) infants show clear signs that they perceive themselves as an *agent* of what they hear.

Other empirical observations demonstrate further the minimal subjectivity of neonates, who seem to experience the world with an implicit differentiated sense of themselves as embodied perceivers. For example, there is some **(p. 260)** evidence that from birth, infants differentiate movements of the own body (*ego* motions) from movements of objects and things in the world that occur independently of the self (*allo* motions). Newborns pick up visual information

that specifies ego-motion or movements of their own body while they, in fact, remain stationary (Jouen & Gapenne, 1995). This kind of observation points to the fact that from birth, infants are endowed with the perceptual, qua inter-modal, capacity to pick up and process meaningfully *self-specifying* information. It includes the early experience of a body that is substantial and occupies space. For example, 2-month-old infants are documented showing protective and avoidant behavior by raising their hands in front of their face as they perceive a solid object (e.g., a ball) looming toward them (Ball & Tronick, 1971). Numerous studies show that from at least 5 months of age, infants perceive their own embodied self-unity. For example, they react and pay more attention to images of themselves that violate the calibrated sense of their own body, the canonical way one limb typically looks and feels as it moves in relation of another (e.g., one leg configuration and movement in relation to the other). If this canonical calibration of the body is optically tricked via inverted or delayed video feedback, the infant tends to show surprise and explore the novelty of the embodied experience, moving and looking at their limbs significantly more and longer (Bahrick & Watson, 1985; Rochat & Morgan, 1995; Schmuckler, 1996).

Overall, all these observations suggest that from birth, infants possess minimal, implicit self-awareness, hence subjectivity in terms of first-person perspective. Once again, we are not born in a state of confusion with the environment, but rather possess a sense of ourselves as differentiated and situated entities among other entities in the world. Newborns perceive objects as distal and distinct from their own body, thus showing the potential for engaging in object relations, and as a byproduct *the capacity to exert control over them*. It is thus reasonable to posit that from the outset, all conditions are in place for the development of first feelings of self-agency.

Innate Pleasures and Frustrations of Self-Agency

From an affective and motivational perspective, among the most robust findings of infancy research of these past 40 years is the emotionally disruptive effect of an interrupted loop between perception and action. This is true in the context of both physical and social interactions. From the age of 2–3 months, infants are capable of instrumenting their body to produce effects on objects or people: pulling a string attached to one of their wrists or ankles to activate a music box or move a mobile above their crib (Watson, 1995; Rovee-Collier & Hayne, 2000). This kind of instrumental learning is **(p.261)** not only highly reinforcing for the young infant but also a source of frustration and anger during an extinction phase. A series of infant studies using a hand-pulling and audio-visual consequence paradigm document that from 2 months of age, children express interest and joy while learning about their own agency. Inversely, they express a frustration-like emotion corresponding to anger based on the Maximally Discriminative Facial Movement Coding System, or MAX (Alessandri, Sullivan & Lewis, 1990; Sullivan & Lewis, 1989). Infants from the outset *expect* consequential events to happen following self-generated actions. If these events

do not follow, frustration and negative affects emerge. This is particularly evident in the social realm when children begin to manifest primary intersubjectivity (Trevarthen, 1980). This corresponds to the first explicit signs of a shared experience in the context of dyadic face-to-face exchanges. By 6 weeks, infants manifest socially elicited smiling in such context and enjoy the give-and-take pragmatics of proto-conversation (Bruner, 1983), quickly expecting particular responses from engaging social partners. If the latter become non-responsive by displaying a sudden still face (Tronick et al., 1978) or show slight lack of timing in their affective bids and attunement, the infant's social engagement is shown to systematically drop. This is often associated with unmistakable signs of *displeasure* like fussing and even crying. Such robust findings of displeasures linked to the sudden violation of social as well as physical expectations are unmistakable signs of the innate affectivity in terms of a basic polarized pleasure-displeasure dichotomy. This is revealing of the underlying drive of what we can reasonably construe as innate signs of the human embodied experience of self-agency.

It is from this experiential capacity and the dynamics of the affectivity associated with it that children learn and grow consciousness of their relation to the world. As many pioneer developmental psychologists proposed, the sense of self-agency is at the core of mental development. It is, for example, the cornerstone of Jean Piaget's seminal infancy works (Piaget, [1936] 1952, [1938] 1955). The subject's sense of efficacy and self-generated exploration would indeed be the main engine behind the ontogenetic growth of consciousness.

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Notes:

(1) For a general review, see Rochat (2001).