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Mirror Neuron Systems

The Role of Mirroring Processes in Social
Cognition

From Imitation to Reciprocation and Mutual Recognition

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Abstract Imitation and mirroring processes are necessary but not sufficient conditions for children to develop human sociality. Human sociality entails more than the equivalence and connectedness of perceptual experiences. It corresponds to the sense of a shared world made of shared values. It originates from complex 'open' systems of reciprocation and negotiation, not just imitation and mirroring processes that are by definition 'closed' systems. From this premise, we argue that if imitation and mirror processes are important foundations for sociality, human inter-subjectivity develops primarily in reciprocation, not just imitation. Imitation provides a basic sense of social connectedness and mutual acknowledgment of existing with others that are 'like me.' However, it does not allow for the co-construction of meanings with others. For human sociality to develop, imitation and mirroring processes need to be supplemented by an open system of reciprocation. Developmental research shows that from the second month, mirroring, imitative, and other contagious emotional responses are by-passed. Imitation gives way to first signs of reciprocation (primary intersubjectivity), joint attention to objects (secondary intersubjectivity), the emergence of values that are jointly represented and negotiated with others (tertiary intersubjectivity), and eventually the development of an ethical stance accompanying theories of mind by 4 years of age. We review this development and propose that if mirroring processes enable individuals to bridge their subjective experiences, human inter-subjectivity proper develops from reciprocal social exchanges that lead to value negotiation and mutual recognition, both cardinal trademarks of human sociality.

Keywords Sociality · Reciprocation · Inter-subjectivity · Co-construction

1 Introduction

Human sociality is inseparable from the elusive, yet powerful sense of a shared world made of shared values. This sense arises from the interaction with others via complex 'open' systems of reciprocation and negotiation. It cannot be reduced to imitation and mirroring processes that are, in a strict etymological sense, 'closed' systems, in themselves copying mechanisms like mirrors reflecting whatever is facing them.

In the strict, literal sense, the word imitation derives from the Latin word 'imitatus', the past participle of 'imitati' which means *to copy*. By imitation, we thus refer literally to a mechanism of copying, a system that does not account for any selective process as to *what* is copied, or *why* it is copied; in other words what new meanings might grow out of the copying process. Taken literally, imitation thus stands for a system of direct reflection of what is out there, impoverishing of the process by which we actually relate and understand each other, a process that is in essence, selective, and creative of new meanings (ideas, feelings, values) that arise from on-going social exchanges. Rather than mirroring, or imitation in the strict sense of copying, other metaphors are needed to account for the foundation of human sociality and social cognition.

Imitation and mirror processes are probably important foundations for sociality (i.e., the capacity to relate, interact, and possibly re-present or simulate, hence 'bridge' self with others' experience). But the sense of shared experience and of shared values develops primarily in a process of *reciprocation* that adds to the process of imitation and mirroring as copying.

The inclination to copy and simulate the behaviors of other might provide a basic sense of social connectedness and mutual acknowledgment of existing with others that are 'like me.' But without other mechanisms, the process of reproducing or copying the behaviors of others is essentially not creative, leading nowhere in itself. In a strict sense, imitation and mirroring are closed loop 'tit for tat' systems. More processing is needed to allow for the social construction of meanings that drive human transactions (e.g., shared ideas or values such as trust, guilt, the sense of what's right and what's wrong, who is to be admired and emulated, who is commendable and has prestige, who is to be avoided and despised).

The gist of the argument put forth in this chapter is that for human sociality to develop, imitation, and mirroring processes need to be supplemented by an open system of reciprocation. The reflection arising from mirroring processes needs to be broken down and somehow by-passed. As a case in point, young children, not yet showing any signs of self-recognition, when faced with their own mirror reflection, often try desperately to break away from the perfect contingency of the specular image which is limited in providing only absolute imitation and no conversation proper (Amsterdam, 1972; Rochat & Striano, 2002). We try to show that in early ontogeny, particularly starting the second month, mirroring, imitation, and other contagious emotional responses tend to

become more subtly attuned to interactive others. This first social register of the neonate is by-passed in 'proto' conversation with others, in the context of first reciprocal exchanges that form open, as opposed to closed, loop systems.

In short, here we argue that if mirroring processes might enable individuals to bridge their subjective experiences via embodied simulation (Gallese, 2007), human inter-subjectivity properly develops from reciprocal social exchanges and the constant negotiation of values with others. The general 'developmental' message we would like to get across in the context of this book on the role of mirroring processes in social cognition is that infants and young children develop to become *Homo Negotiatus* (Rochat & Passos-Ferreira, 2008), not just to become *Homo Mimesis*.

Imitation and mirroring processes are necessary but not sufficient mechanisms for children to develop inter-subjectivity and sociality. We argue that human sociality (i.e., the inclination to associate with or be in the company of others¹) entails more than the equivalence and connectedness of perceptual experiences. It entails a sense of reciprocity that is more than the 'like-me stance' or embodied simulation that researchers derive from early imitation (Meltzoff, 2007) or from the recent discovery of mirror neuron systems in the brain (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996; Rizzolatti, Fadiga, Gallese, & Fogassi, 1996; Gallese, Fogassi, Fadiga, & Rizzolatti, 2002; Rizzolatti & Craighero, 2004; Fogassi et al., 2005; Goldman & Sripada, 2005).

From a developmental perspective, by 2 months infants already appear to transcend basic mirroring processes by manifesting first signs of reciprocation in face-to-face exchanges (primary intersubjectivity). They soon engage in triadic intentional communication with others about objects (secondary inter-subjectivity starting approximately 9 months) and eventually begin to negotiate with others about the values of things, including the self as shared representations (tertiary intersubjectivity, starting approximately 20 months). This development culminates with the ethical stance that children begin to take around their fourth birthday when they begin to manifest explicit rationale about what is right and what is wrong, as well as 'theories' regarding the mind of others.

In what follows, we distinguish levels of 'inter-subjectivity' beyond the primary vs. secondary distinction introduced years ago by Trevarthen & Hubley (1978), Trevarthen (1979) and Bruner (1983). We review this development up to 5 years of age when children show explicit understanding of the mental states that drive others in their behaviors, beliefs, and decisions (i.e., 'theories of mind' in Wellman, 2002). This development leads the child from neonatal imitation to the development of reciprocation starting at 2 months of age, and ultimately toward an 'ethical stance' from 4 to 5 years on, according to our own recent research.

¹ This is the first definition of 'sociability' offered by the Unabridged Random House Dictionary (2nd Edition). 'Sociality' is defined as the state or quality of being sociable (third definition). This is the generic sense of these terms used here.

Table 1 Five levels of Social Connectedness in early development

Type	Context	Behavioral index	Process	Age
I Mirroring	Face-to-face engagement	Imitation	Automatic simulation	Birth
II Primary Inter-subjectivity	Reciprocal dyadic exchanges	Proto-conversation, social expectations	Emotional co-regulation	2 months
III Secondary Inter-subjectivity	Triadic exchanges about things	Joint attention; social referencing	Intentional communication and intentional co-experience	9 months
IV Tertiary Inter-subjectivity	Triadic exchanges about the value of things	Self-recognition and embarrassment, use of possessives, claim of ownership, pro-social behaviors	Projection and identification of self onto others	20 months
V Ethical stance	Decision regarding the value of things, what is right vs. wrong	Sense of property, sharing, distributive justice, theories of mind	Value negotiation with others, narration, meta-representation of reputation	From 4 years

Table 1 summarizes the various levels of social connectedness associated with this development in relation to context, behavioral index, putative underlying process, and chronological age. It is a proposed road map that would take the healthy child, starting the second month after birth, beyond the basic endowment of mirroring and imitative processes. It leads toward reciprocation, social negotiation, and ultimately the sense of mutual recognition and the explicit moral sense that is unique to our species (i.e., reasoned codes of conducts toward others and other juridical rationales).

2 Imitation as Source of Innovation

The idea that imitation plays a central role in human psychic and social life is perennial in the history of social sciences. Psychologists and sociologists of the 19th-early 20th centuries offer theories which state that the propensity of individuals to copy and echo each other is a cornerstone of what makes individuals understand and feel for each other and is also a major source of learning and novelty. Developmental and comparative theorists see imitation as the basic mechanism by which children develop empathy and the capacity to represent, think and speak. Imitation has also been considered for a long time as a mechanism by which children develop theories of mind, in addition to being the source of social connection and affiliation. It is also seen as the source of behavioral synchronization among individuals as well as a major social learning mechanism, a source of innovation in group living. Early on, theorists understood the importance of imitation, not only as a strict copying mechanism, but also as the source of innovation and developments that are unique to our species.

In his account of human evolution, Merlin Donald (1991) writes: "Human children routinely re-enact the events of the day and imitate the actions of their parents and siblings. They do this very often without any apparent reason other than to reflect on their representation of the event. This element is largely absent from the behavior of apes" (1991, p. 172). The idea that imitation or mimesis and the ability to simulate are at the core of what distinguish humans from other animals is a recurrent theoretical proposal in philosophical, psychological, and comparative theories.

Over a century ago, sociologist and social psychologist Gabriel De Tarde (1843–1904) emphasized the central role played by imitation in the dynamic and reorganization of group living. The basic propensity of the human individual to imitate reverberates and impacts on a more macro, 'societal' level via the formation of normative opinions, blind group beliefs, propaganda, and other crowd behaviors. More importantly for Tarde, imitation would be the mechanism by which group customs and traditions, but also novel ideas, propagate over time. A more modern version of this account is proposed by Sperber who draws an analogy with epidemiological models in biology to account for the 'contagion' of ideas in cultural evolution (Sperber, 1996).

It is worth noting that contrary to the assumptions of political economists of the 19th century like Marx and Engels who posited that human society was born with the first exchange of goods, Tarde in his book “‘Les lois de l’imitation’ (1890/1993) proposes as an alternative to these theories that society began from the moment one individual copied another. Tarde considered imitation as the matrix of all principles in sociology, a mechanism that reverberates from the individual to the group at large, and is the driving force behind cultural evolution and societal changes, thus innovation.

There is a fundamental paradox between imitation as an act of reproduction and imitation as the creation of changes, hence variation that is the essence of evolution. This is what Tarde was interested in, in his research, trying to reconcile repetition and reproduction with innovation. He placed imitation in an open loop transmission of customs, beliefs, and desires.

For Tarde, behaviors and ideas transmitted by imitation are not just copied as mirrors copy the world in their reflections. Imitation is active in the sense of being selective. It is intentional, not just a source of contamination by reproduction, the main source of *novelty and discovery* characterizing the rapid evolution of modern human societies (e.g., the making and use of tools, new knowledge, myths, skills, or customs).

In a dissertation defended in 1911, Icelandic sociologist Gudmundur Finnbogason (1873–1944) came out with a theory on ‘sympathetic intelligence’ that is, a remarkable intuition of all the current simulation and imitation theories in social cognition that now find neurobiological validation in the discovery of mirror neuron systems. Finnbogason laid down a theory that reduce imitative motor acts to perception, a theory that explicitly posits that performing a motor act or seeing it performed by a model can *de facto* be the same. This is basically what the discovery of mirror neurons tells us today. Finnbogason already had the intuition of the core ingredients of modern simulation theories (Goldman & Sripada, 2005; Gallese et al., 2002; Meltzoff, 1995, 2007; Harris, 1992).

In ‘*The Mind and the World Around Us*’ (1912), Finnbogason writes:

“The expression, way of acting and all apparent behavior of other people could be echoed in us if we observed them closely, and that from this echo, this involuntary miming or tendency to mime others, originated our comprehension of the mental life of our fellow men; we could sense their expression acquire a grasp on our own faces and simultaneously become aware of their personality entering us.” Finnbogason goes on: “This also opens the possibility of interiorizing the individual characteristics of others, for if we manage to simulate their expressions, posture, motions and actions – in fact everything external about them – then we will have positioned ourselves in the same manner toward the outside world and can to some extent acquire the same perspective and same feelings about it” (Finnbogason, 1912, pp. 250 and 262; cited by Hauksson, J. 2000, *Acta Sociologica*, 43, 307–315).

In relation to cognitive development, Piaget (1962) places the ontogenetic origins of mental imagery, symbols, and representations in the act of reproducing events perceived by the child; hence, in imitation. These copying acts

eventually become internalized to form representations and objects of thoughts. Piaget writes for example: "Mental imagery or the symbol as internalized copies of an object is a product of imitation" (1962, p. 71). In Piaget's view, imitation in the broad sense is at the core of what allows children to become symbolic and what enables them to eventually learn and communicate via the abstract sign systems that are human languages.

In all, for a long time theorists have seen in imitation a central mechanism, *the* mechanism driving children's development, the evolution of human societies, and those abilities that set us apart as a species (e.g., complex abstract languages, explicit ethics, empathic feelings, technological inventions, and their cultural transmission). What these theories all stress one way or another is that *imitation is not only a copying capacity, it is but also a source of novelty, a source of innovation*. It allows individuals to connect, builds intersubjectivity and ultimately feels what other individuals feel, as suggested by Finnbogason a century ago. It also allows people to transmit and to create new knowledge and new skills as suggested by Tarde a few years earlier. For Piaget (1962), imitation is a source of major progress in cognitive development, no less than the origin of mental imagery, pretend play, and symbolic functioning. It is much more than the ability to mirror the world. For Tarde as well as for Piaget, imitation is action and selection. It is intentional, not just automatic. If imitation is a source of novelty, then it is much more than mirroring or mimicking in the strict sense. The mirror metaphor should be replaced by the dynamic, open ended, and relational concept of *reciprocation*.

3 Reciprocation

In reproducing the behavior of others we create inter-subjectivity, bridging self, and others' experience as suggested by Finnbogason and current simulationist theories that find validation in the discovery of mirror neurons. If imitation in the strict sense is a source of vicarious experiences that give individuals the opportunity to get 'into the shoes of others' and possibly empathize with them, it is also a source of discovery and learning. New skills can be learned by imitation following periods of passive observation. In Japan, for example, it is said that the apprentice cook watches the Sushi Master cutting fish for months before he is handed over a knife and allowed to do it himself. In most Non Western small-scale traditional and rural communities from all over the world observational and imitative learning prevail. Children learn primarily by observing, via observational and imitative learning, rarely if not at all, via the explicit instruction that prevails in Western cultures (Odden & Rochat, 2004; Rogoff, 1995; Boggs, 1985; Lancy, 1996). What is important to note is that observational and imitative learning is *selective* and *intentional*. New skills are not just learned by accident, or rarely so, typically scaffold by more advanced individuals who transmit their skills and knowledge to the apprentice or novice

learner (Lave, 1988; Rogoff, 1990), a process that contributes to cultural learning in general (Tomasello, Kruger, & Ratner, 1993).

For novelty to emerge and knowledge to be transmitted via observation and imitation, as in the case of the apprentice and his Sushi Master, entails more than passive 'random' and incidental learning. It entails *reciprocation* in the following basic sense. For learning to take place there is a mutual willingness on the part of the novice to observe the expert and on the part of the expert to be observed by the novice. Both protagonists meet in the reciprocal willingness to share attention toward each other, the novice observing the expert, and the expert modeling for the novice. When imitative learning cannot be considered as purely incidental and automatic like in instances of crowd behaviors, there is indeed a mutual, reciprocal willingness to either imitate or model on the part of the protagonists, each acting one side of the same process.

The reciprocal willingness to learn and to teach that is constitutive of imitative learning, when not purely incidental, makes the process break away from imitation in the strict sense of copying, mirroring or the direct "'shadowing' of the other. Mutual attention and intention are involved. This is expressed in the reciprocal sharing of attention, each protagonist aware of and monitoring the other.

In this context, imitation becomes a source of selective transmission and learning, not just a mechanism by which individuals can create an inter-subjective bridge by simulating the subjective experience of others. Once again, when not accidental or linked to automatic contagion as in the case of irrepresible yawning after witnessing someone else's yawn, our tendency to open our own mouth while spoon-feeding someone else, or the echoing of individual behaviors to those of a crowd, imitation becomes more than an automatic mirroring process. It is a source of learning and novelty that is *co-created*, based on exchanges that are reciprocal. Imitation is transformed into reciprocation.

George Herbert Mead (1934) emphasized the mutual aspect of communication in which he saw the origins of how individuals construct an explicit sense of self. For Mead, self-identity (who one conceives as 'Me') is the product of what we see in others responding to us, where others are viewed as the social mirror in which the self can be objectified and eventually conceptualized. But the social mirror is a two-way mirror reflecting an image that is not on its surface but rather at the intersection or meeting point between others as mirror of the self and the self as mirror of others. It is an image that is *co-constructed*, reflecting back simultaneously to all the interacting individuals.

This process of co-construction that Mead applies to self-identity which can be generalized to all meanings arising from reciprocal communicative exchanges, whether these meanings correspond to ideas, gifts, instructions, requests, or insults. They are products of complex on-going mutual monitoring processes that entail much more than mirroring. It is an open loop, dynamic, and creative system. It is creative because new meanings are constantly ratcheting up,

feeding on each other, and finding new equilibrium until some kind of agreement is reached.

Reciprocal exchanges consist canonically in an exchange of bids and counter-bids until some agreement is reached. Closure is reached when the protagonists recognize themselves in the agreement that, for example, the instruction is followed or understood, the gesture acknowledged, the gift received, and appreciated. In general, closure is reached when a meta-agreement (agreement on agreement) is expressed by all concerned, hands are shaken, papers are mutually signed, or hugs unfold in mutual recognition. Hand shakes considered as prototypical sign of agreement might be a mirroring gesture, in which each hand becomes simultaneously agent and patient of the shake, motor, and perceptual like mirror neurons. But the agreement they express in a mirroring way does not arise from straight mirroring. It always arises from an on-going, open process of reciprocation, and negotiation. Handshakes punctuate such process in which meanings are always put back on the table for further negotiation.

4 Mutual Recognition

Hands that are shaken as a mutual, mirroring gesture punctuating negotiation is nothing more than the explicit (public) expression of a shared understanding regarding the value of things. In such a public manifestation of agreement, reciprocal understanding is temporarily reached as to the relative value of two or more things, be there material or non-material things, such as ideas, beliefs, or feelings. In general, constant on-going negotiation characterizes most of our social exchanges, aimed primarily at co-constructing a shared sense of equivalence among things with others. In human social affairs, most time is spent adjusting and readjusting bids and counter-bids to reach an elusive sense of equity, the latter being the main motor of human transactions.

Early anthropologists like Mauss (1967) or Malinowski (1932), following the pioneer work of Franz Boas on native North American tribes, demonstrated that small scale traditional societies from all over the world tend to be organized around gift systems. In such systems, individuals acquire properties for the sole purpose of relinquishing it following particular rituals. By way of elaborate gifting rituals, individuals, and groups build social ties and reputation. Ritualized gift systems provide ways of establishing a sense of mutual trust and also a means to monitor this trust on the assumption that each gift will be *reciprocated*, their sole function being to circulate among individuals and groups of individuals. For example, in traditional cultures that still prevail in the South Pacific, there is a class of objects that are endowed with the sole function of being offered and received. In these cultures, many daily activities are dedicated to the time consuming confection of gift objects like the fine straw mats of Polynesia (Shore, 1982). These objects have essentially an affective rather than a monetary value.

In their circulation, individuals and groups can monitor and control their social situation, in particular how they are recognized and valued by others. Following the assumption of reciprocity, when one gives an item demonstrating a particular value in the amount that is given, it is expected that others will return the same amount or more. They are challenged to do the same when it comes to be their turn (e.g., the famous 'potlatch' ceremonies found in native North American tribes described by Franz Boas in the early 20th century). The tallying of such exchanges becomes an objective measure of social affiliation. It is also a way to measure the regards others have for the self and to what extent there is some equivalence between these regards, whether they are mutual and represent a comparable value; in other words, whether they tend to 'mirror each other' and express a two-way, *mutual recognition*.

Sociality or the quality of being sociable is inseparable from the elusive feeling of being included and having a causal role or impact on the life of others (Rochat, 2008/in press). It is about being 'connected', visible rather than invisible, and recognized rather than ignored or ostracized (see Honneth, 1995, for a philosophical elaboration of the idea). In this view, sociality rests on *mutual recognition*. The dramatic experience of trying to engage and interact with a person suffering from a lack of sociality gives clinical support to such account.

Kanner (1943), in his description of 'infantile autism', notes that these children appear to have "an innate inability to form the usual biologically provided affective contact with people, just as other children come into the world with innate physical and intellectual handicaps." Kanner goes on insisting on what he sees as the 'extreme autistic aloneness' of these children, their social isolation. Interestingly, for novice, yet well intended healthy adults who might try to engage a child diagnosed with autism, there is always a great deal of discomfort, frustration, and the sense of being 'thwarted,' of becoming unsettled and unsure of themselves (Sigman & Capps, 1997; Greenspan & Wieder, 2006). These children are difficult to figure out, removed, unpredictable, un-reachable. Looking through or beside you, they behave as if you were transparent, *invisible*, non-existent, *non consequential*, an experience that is a typical source of great discomfort for the well intended parent or caretaker, and presumably a permanent discomfort for the autistic child withdrawn into his world.

The symptomatic trademark of autistic children is the depleted 'sociality' experience by anybody trying to engage them and connect with them. The social current and co-creation of meanings that normally arise among communicating individuals are either hindered or plainly absent. It takes a great deal of expertise and exercises from parents, educators, and therapists to contact these children, a difficult and courageous enterprise that requires sometimes infinite patience (e.g., Greenspan & Wieder, 2006).

What makes the raising of an autistic child so much more difficult and exhausting compared to raising a healthy, even hyperactive child is the fact that there is no room for mutual recognition, no room for reciprocal

acknowledgment of each other. The love parents of autistic children might express, often inexhaustibly, remains unmatched in its return. In this context, parents have difficulties recognizing themselves in the impact they have on their child. Inversely, the child is impaired in recognizing himself in what he does to his parents. Autism causes *mutual* blind mindedness, mutual invisibility, and it is a source of great discomfort, obviously for the trying parents, but also for the disconnected child.

5 From Basic Mirroring to Reciprocation and Social Expectations

The sense of reciprocity is expressed very early in the life of the healthy child. By two months, infants start to engage in face-to-face proto-conversations, first manifesting signs of socially elicited smiles toward others (Wolff, 1987; Sroufe, 1996; Rochat, 2001). Such emotional co-regulation and affective attunement are more than the mirroring process underlying neonatal imitation and emotional contagion evident immediately after birth (Meltzoff & Moore, 1977; Simner, 1971; Sagi & Hoffman, 1976). From this point on, infants express a new sense of shared experience with others in the context of interactive, typically face-to-face plays, what Colwyn Trevarthen (1979) first coined as 'primary intersubjectivity.'

When infants start to engage in proto-conversation, they are quick to pick up cues regarding what to be expected next from the social partner. In general they are quick to expect that following an emotional bid on their part, be it via a smile, a gaze, or a frown, the other will respond in return. Interestingly, adult caretakers in their response are typically inclined to reproduce, even exaggerate the bid of the child. If the child smiles or frowns, we are inclined to smile or frown back at her with amplification and additional sound effects. There is some kind of irrepressible affective mirroring on the part of the adult (Gergely & Watson, 1999).

The complex mirror game underlying social cognition does manifest itself from approximately two months of age and from then on, infants develop expectations and representations as to what should happen next in this context. The still-face experimental paradigm that has been extensively used by infancy researchers for over 30 years provides good support for this assertion (see the original study by Tronick, Als, Adamson, Wise, & Brazelton, 1978). Infants are disturbed when the interactive partner suddenly freezes while staring at them (Rochat & Striano, 1999). They manifest unmistakable negative affects, frowning, suppressing bouts of smiling, looking away, and sometimes even starting to cry. In general, they become avoidant of the other person, presumably expecting them to behave in a different, more attuned way toward them.

This reliable phenomenon is not just due to the sudden stillness of the adult, as the infant's degree of negative responses varies depending on the kind of

facial expression (i.e., happy, neutral, or fearful) adopted by the adult while suddenly still (Rochat, Striano, & Blatt, 2002). Also, it appears that beyond seven months old, infants become increasingly active, rather than avoidant, and unhappy, showing initiative in trying to re-engage the still-faced adult. Typically, they touch her, tap her, or clap hands to bring the still-faced adult back into the play, with an intense gaze toward her (Striano & Rochat, 1999).

Numerous studies based on this still-face paradigm and studies using the double video paradigm, in which the infants interact with his mother seen on a TV (either live or in replay) (Murray & Trevarthen, 1985; Nadel, Carchon, Kervella, Marcelli, & Réserbat-Plantey, 1999; Rochat, Neisser, & Marian, 1998), all show that early on, infants develop social expectations as to what should happen next or what should happen while interacting with others. The difficult question is what do these expectations actually mean psychologically for the child. What does it mean for a 2-month-old to understand that if he smiles toward an individual, this individual should 'normally' smile back at him? What does it mean that he picks up the fact that amplified and synchronized mirroring from the adult is an invitation for more bouts of interaction?

One could interpret these expectations as basic, possibly sub-personal and automatic. Accordingly, face-to-face interactions are information-rich events for which infants are innately wired to pick up information, attuned, and prepared from birth to attend to and eventually recognize familiar voices and faces (e.g., DeCasper & Fifer, 1980; Morton & Johnson, 1991). From birth, infants would be attuned to perceptual regularities and perceptual consequences of their own actions, wired to prefer faces, human voices, and contingent events as opposed to any other objects, any other noises, or any other random events. Accordingly, this would be enough for young infants to build social expectations and manifest apparent eagerness to be socially connected as shown by studies using the still-face experimental paradigm or the double video system. But there is more than what meets the eyes of an 'engineering look' at the phenomenon (Rochat, 2008/in press). It is more than just mechanical and requires another, richer look to capture its full psychological meaning.

This proposal is based on evidence of major developmental changes in the ways that children appear to connect with others and reciprocate. Infants rapidly go beyond mirroring and imitation to reciprocate with others in increasingly complex ways, adding the explicit social negotiation of *values* to the process. This development corresponds to the unfolding of primary and secondary (i.e., triadic exchanges of the infant with people in reference to objects in the environment by 7–9 months), and also a *tertiary* level of inter-subjectivity from at least 3 years of age.

Next, we focus on this latter level that we introduce as a major extension of the first two, both well accounted for in the literature (Bruner, 1983; Trevarthen & Hubley, 1978; Trevarthen, 1979; Tomasello, 1995; see Table 1). At the tertiary level of inter-subjectivity, objects and situations in the environment are not just jointly attended to (secondary inter-subjectivity), they become also *jointly*

evaluated via negotiation, until eventually some kind of a mutual agreement is reached.

6 From Secondary to Tertiary Inter-Subjectivity

With the intentional communication about objects that emerges by 9 months via social initiatives and explicit bouts of joint attention (secondary inter-subjectivity), infants break away from the primary context of face-to-face exchanges. They become referential beyond the dyadic exchanges to include objects that surround the relationship. Social exchanges also include conversations about things outside of the relationship, becoming triadic in addition to being dyadic. Exchanges become object oriented or objectified, in addition to being the expression of a process of emotional co-regulation. Infants now willfully try to capture and control the attention of others in relation to themselves via objects in the environment. At this point, however, the name of the game is limited to the sharing of attention just for the sake of it. Children measure the extent to which others are paying attention to them and what they are doing. They begin to check back and forth between the person and the object they are playing with (Tomasello, 1995); or they begin to bring an event to the attention of others by pointing or calling for attention to share the experience with them. However, such initiative ends there, and is typically not followed through in further conversation or co-regulation. For infants, secondary inter-subjectivity in triadic exchanges is a new means to control their social environment, in particular the proximity of others as they gain new degrees of freedom in roaming about the environment (Rochat, 2001). By becoming referential, infants also open the gate of symbolic development. They develop a capacity for dual representation whereby communicative gestures stand for and become the sign of something else (e.g., a pointing gesture as standing for a thing out there to be shared with others). Communication becomes intentional, transcending the process of emotional co-regulation and affective attunement that characterizes early face-to-face, proto-conversational exchanges (i.e., primary inter-subjectivity). Yet, it remains restricted to the monitoring of whether others are, or are not, co-experiencing with the child.

Nevertheless, with the emergence of intentional communication and the drive to co-experience events and things in the environment, infants learn and begin to develop shared meanings about things. To some extent, they also begin to develop shared values about what they experience of the world, but this development remains limited. For example, when facing dangers or encountering new situations in the environment, they are now inclined to refer to the facial expressions of others that are paying attention to the same events (Campos & Sternberg, 1981; Striano & Rochat, 2000). The meaning of a perceived event (e.g., whether something is dangerous or threatening) is now referred to others' emotional responses, to some extent evaluated in relation to others, but it ends

there. The process does not yet entail any kind of negotiation regarding the value of what is experienced. The world is essentially divided into either good (approach) or bad (avoidance) things and events. Such basic social referencing emerges at around 9 months, in parallel to the propensity of infants to share attention with others and to communicate with them intentionally (Tomasello, 1999; Rochat & Striano, 1999).

By the middle of the second year, triadic exchanges develop beyond basic social referencing and the sense of co-experience with others that is the trademark of secondary inter-subjectivity. The child now begins to engage in active negotiation regarding the values of things co-experienced with others. They manifest *tertiary inter-subjectivity*, a sense of shared experience that rests on complex on-going exchanges unfolding over time: things that happened in the past are manifest in the present and are projected by the child into the future. The prototypical expression of this new level of inter-subjectivity is the expression of secondary emotions such as embarrassment or guilt.

In relation to the self, by 20 months, children begin to represent what others perceive of themselves and gauge this representation in relation to values that are negotiated. If they see themselves in a mirror and notice a mark surreptitiously put on their face, they will be quick to remove it and often display coy behaviors or acting out (Amsterdam, 1972; Rochat, 2003). They begin to pretend and mask their emotions (Lewis, 1992). In general, they become self-conscious, negotiating, and actively manipulating what others might perceive and evaluate of themselves (Lewis, 1992; Rochat, 2008/in press). From this point on (18–20 months), children project and manipulate a public self-image, the image they now identify, and recognize in the mirror. It is an image that is objectified and shared with others, a represented 'public' self-image that from now on will be constantly updated and negotiated in relation to others. Interestingly, by 20 months, children's linguistic expressions begin also to include the systematic use of possessives, children starting to claim ownership over things with imperative expressions such as "mine!" (Bates, 1990; Tomasello, 1998). Such expressions demarcate the value of things that are jointly attended in terms of what belongs to the self and what belongs to others. This value begins to be negotiated in the context of potential exchanges, bartering, or donations. With the explicit claim and demarcation of property, the child develops a new sense of reciprocity in the context of negotiated exchanges of property, whether objects, feelings, or ideas. At around the same age, children also begin to demonstrate pro-social behaviors, engaging in acts of giving and apparent benevolence by providing help or spontaneously consoling distressed others (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). Self-concept, ownership claim, and a new concern for others bring the child to the threshold of moral development and the progressive construction of an explicit sense of justice (Damon, 1994). What follows in development is a new level of social reciprocity that is increasingly organized around an ethical stance taken by the child. But this ethical level of reciprocity develops between 3 and 5 years of age,

and beyond as shown by our recent investigation of young children's sense of fairness in sharing across cultures.

7 Emergence of an Ethical Stance

There is a developmental trend from a reluctance to share, to subtle, more reciprocal exchanges. For example, children between 3 and 5 years of age become significantly more flexible and systematic in adjusting their successive bids while engaged in bartering exchanges of stickers or toys. They are increasingly inclined to up their bids until an agreement is reached. This developmental trend is also associated with an increased understanding by the child of others' mental states, a trend that appears to cut across cultures (Callaghan et al., 2005).

As children start to claim explicit ownership and invest affects into objects of devotion, they do so by first manifesting unmistakable exclusivity in their possession, a blunt reluctance to exchange. They show overwhelming egocentrism. When the child begins to say "mine!" she does not only imply that "it is not yours." It is also an explicit statement of defensive exclusivity, a reluctance to even contemplate sharing, and an unmistakable claim that they want to keep it for themselves.

In recent cross-cultural observations (Rochat et al., 2008, in press), we confirmed that this 'egocentric' trend is a universal trend. We found it in 3 year-olds and to a lesser extent in 5 year-old children from all over the world, growing up in highly contrasted physical, social, economical, and cultural environments. It happens in children living in rich or poor neighborhoods and in cultures fostering radically different values regarding private property. We observed this trend in children from small, highly collectivist villages of rural Peru, or from small isolated fishing communities in Fiji. This same trend occurs in children growing up in violent and lawless as well as affluent neighborhoods of Rio de Janeiro; unschooled kids begging and living on the streets of Recife in Brazil, as well as young children attending a Communist Party controlled preschool in Shanghai, China, or in middle class North American children of Atlanta.

In general, we found that across cultures, between 3 and 5 years, there is a robust developmental trend toward more equity in sharing. In conditions, where the child was one of the two recipients, 3 year-olds tended to distribute overwhelmingly more candies to themselves, whether equity was possible or not. By 5 years, however, this trend was still evident but significantly tamed. Children continued to favor themselves and are selfish but markedly less. Interestingly this trend was the same in children from all cultures, but reduced in children growing up in small rural and collective communities (i.e., Peru and Fiji in our sample). In development, there is thus a universal drift in active sharing from massive to reduced selfishness between 3 and 5 years of age, a trend that is moderated by the cultural environment of the child. Despite the

significance of cultural factors, the trend toward increased altruism/pro-sociality in sharing is remarkably robust from the time children begin to be explicit in claiming ownership.

Culture appears to play a role in the developmental pace at which the child becomes inclined to share with greater equity, but the general trend is there regardless of marked variations. In China, children were tested in a preschool that emphasized primarily group activities and sharing. Children always play, sing, and learn as members of a group, rarely as individuals isolated from the group. Such attempts are much less frequent in middle class North American preschools, such as those of the children we tested in Atlanta. In Fiji, or in Peru, the tested children lived in small, close knit communities where public and shared properties dominate over ostentatious private ownership. When they exist, preschools in these regions are known to emphasize synchronized group activities in children.

The stability of this developmental trend is particularly striking when considering the three groups of Brazilian children. Each group grows in highly contrasted economical and social circumstances within the same national and cultural borders. A group of children lived in the poor and insecure environment of a favela in Rio de Janeiro, an environment dominated by young drug lords that terrorize and dictate law and order. Another group was composed of privileged children, of the same age, from an affluent private preschool situated just a few miles away from the favela. The third group of Brazilian children was composed of 3 and 5 year-old unschooled street kids from the city of Recife, a few hundred miles North-East of Rio. These children spent their days unsupervised by adults, begging on the street, collecting refuse, and typically spending the night with an extended family living in precarious, unsanitary slums close to public dumps.

One could easily presume that the drive to own, and not to share, in the young children of the favela, and particularly the street kids of Recife, might be different compared to the privileged children of Rio. Our research shows that it is not the case. All of these children demonstrate the same developmental trend toward a significant decrease in selfishness and increase in more equitable sharing between 3 and 5 years. But why is that?

Young children develop to become more equitable in their sharing, regardless of their economical and cultural circumstances because they enter the culture of their species (*Homo Negotiatus*), a culture that is fundamentally based on reciprocal exchanges. Hoarding and coercion are antithetical to this culture. If it exists, it is an anomaly, due to particularly stressful circumstances (war, disaster, rebellion, madness). It is not cardinal to the culture of *Homo Negotiatus*, unlike any other animal species that are not designed to have others in mind in their social exchanges and their sharing of resources.

We construct equity as well as agree on values by an active process of approximation and mutual monitoring. This process takes form within reciprocal exchanges. We do so by negotiation and ultimately by caring about reputation, namely our relative proximity with others. What happens between

3 and 5 years, is a marked progress in this process that channels children away from greed and immediate gratification. The product of this development is the emergence of a moral space in which children begin to care about reputation.

Children between 3 and 5 years develop an understanding that they are potentially liable and that they build a history of transactions with others. Needless to say that parents and educators foster this development in all cultures, but this fostering is essentially the enforcement of the basic rules of reciprocity, the constitutive elements of human exchanges. Children are channeled to adapt to these rules they depend on to maintain proximity with others. From this, they begin to build a moral space in relation to others, a moral space that is essentially based on the basic rules of reciprocity (Rochat, 2008/in press). It is a moral space that is constantly in the making, constantly revised, and in which equity is endlessly approximated by way of negotiation.

8 Conclusions: Human Sociality Buds in Imitation But Blossoms in Reciprocation

In this chapter, our intention was to show that basic mirroring processes expressed in neo-natal imitation and emotional contagion at birth are necessary, but not sufficient, to account for the early development of reciprocal exchanges that takes place from the second month. Imitation and emotional contagion, taken literally as close-loop automatic mirror systems, are soon transformed into dynamic, ultimately creative exchanges that take the form of open-ended proto-conversations ruled by principles of *reciprocation*.

The basic mirror processes expressed at birth probably correspond to innate social binding mechanisms. They are basic resonance processes (Gallese, 2003) that allow the child, from the outset, to match self and others' experience. These mechanisms allow for a necessary starting state of implicit inter-subjective equivalence. Endowed with, and capable of such processes, infants from birth would automatically perceive others as 'like them.' This basic, obligatory perception would be mediated by sub-personal innate mirror mechanisms (i.e., neural mirror systems). However, we tried to show that the way infants and young children connect to the social world develops dramatically with the emergence of active, creative, and increasingly complex reciprocal exchanges.

We argued that from approximately 2 months following birth, there is a major qualitative shift that can be equated to a functional 'transcendence' of the mirroring processes expressed at birth. These basic processes soon become integrated into complex, open-ended systems of *reciprocation*, first in dyadic exchanges from the second month, and eventually in triadic exchanges that include objects from 9 months. Active emotional co-regulation, as opposed to strict mirroring, underlies the first open-ended reciprocal exchanges that emerge by 2 months in the healthy child. Intentional communication and the drive to include others in the experience of the physical world underlie the

triadic reciprocal exchanges emerging by 9 months. It is in the development of reciprocal social exchanges that infants learn and eventually find their way in a world not only made of objects and people, but more importantly, a world made of 'shared values.'

Beyond 9 months, and in particular by the end of the second year, children become increasingly conceptual in their reciprocation. They recognize themselves in mirrors and become explicit about what is theirs as opposed to others, starting to use possessives and manifesting ostentatious acts of appropriation. They also start to show concerns, embarrassment, as well as signs of guilt. In short, from this point on, not only do they interact with others in reciprocation for the sake of co-experiencing things, but they begin also to represent how others perceive and evaluate them in the process. They become newly self-conscious and *co-evaluative* in their social exchanges.

From the time children begin to show concerns regarding the extent to which they are recognized for what they do, feel, and what they achieve, they enter a world of values that are constantly negotiated in interaction with others. It is in this context that children develop an ability to construe what is happening in the mind of others. Theories of mind emerging by 4–5 years are probably by-products or spin offs of the tertiary inter-subjectivity developing by the second year (see Rochat, 2006a, for further discussion).

Following the roadmap proposed in the introduction (Table 1), by the end of the second year, children show signs of active projection and identification with others. For example, they begin to display active empathic feelings (e.g., Zahn-Waxler et al., 1992) and to detect when others are intentionally mimicking them (e.g., Agnetta & Rochat, 2004). They perceive others as disposed in certain ways toward them, but also whether they deserve contempt, help, or comfort. From this time on, the child's social binding becomes deeply evaluative, beyond the mere drive to interact harmoniously with others, or to share and synchronize attention toward things. In becoming evaluative, children develop the need to agree with others on the values of things via open-ended negotiation, a process that from now on dominates reciprocal exchanges and is arguably the trademark of all human cultures (Rochat, 2006a,b).

By 4–5 years, universally, children begin to predict the behavior of others based on their construal of what's on their mind: what they might feel, think, or believe (e.g., Theories of mind, Callaghan et al., 2005). More importantly, they also begin to construe others in their vulnerability to be unjustly treated and feel hurt, anticipating potential long-term reprisal over un-equitable treatment.

Our research shows that between 3 and 5 years children develop to inhibit their inclination to maximize their own gain when asked to share desirable goods such as candies. This appears to be a universal trend across highly contrasted cultures (Rochat et al., submitted). Compared to 3 year-olds, children at 5 manifest more explicit fairness in distributive justice. They develop an ethical stance toward others and are increasingly concerned with what is right and what is wrong within the particular context of their culture. Reciprocal exchanges now take place within a moral space in which children develop their

own situation, constantly negotiating with others the value of things, in search of mutual agreements that are endlessly re-examined and revised. From then on, this process will dominate social exchanges throughout the lifespan.

To conclude, if mirroring processes form a necessary basis for social binding, they are in themselves not sufficient to account for the rapid development of open-ended and creative levels of reciprocation that take place starting the second month after birth. Mutual recognition in a moral space is arguably the measure of human social affiliation. Such recognition might find its roots in imitation and mirroring processes. However, we argue that these basic processes are only a seed that can only grow in the context of reciprocal exchanges with more advanced and cultured others.

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