

How Primate Mothers and Infants Communicate: Characterizing Interaction in Mother–Infant Studies

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Abstract All methodologies used to characterize mother–infant interaction in non-human primates include mother, infant, and other social factors. The chief difference is their understanding of how this interaction takes place. Using chimpanzees as a model, I will compare the different methodologies used to describe mother–infant interaction and show how implicit notions of communication and social interaction shape descriptions of this kind of interaction. I will examine the limitations and advantages of different approaches used in mother–infant studies, and I will sketch an alternative approach to studying mother–infant interaction in non-human primates that adopts Bruner’s developmental studies on human infant communication.

Keywords Mother-infant interaction • Methods • Primate development • Chimpanzees

In creating the so-called “monster mothers”—mechanical models made of wire and covered in a soft cloth designed to resemble a monkey—Harlow and Zimmermann (1959) offered one of the most powerful images of how essential the mother is for an infant. Harlow described how an infant monkey will wait patiently in a corner for its “monster mother” to pull back its spikes so it can climb back for comfort. This conveys in a single image how essential it is for a primate infant to have a mother or at least a mother figure. Since then the challenge has become how to study the mother–infant interaction to be able to capture this essential relation common to all primates.

All methodologies used to characterize mother–infant interaction in non-human primates include mother, infant, and other social factors. The chief difference is their understanding of how this interaction takes place; that is, each methodology

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selects certain elements of this interaction as relevant. Within each methodological design, researchers explicitly or implicitly answer several questions. First, what is interaction and which is the best way to describe the interaction among these units? Second, what are the mental contents (if any) of the individuals interacting. As a result, each methodology focuses on different presuppositions leading to specific questions and leaving others aside. The aim of this chapter is to show how definitions of communication and social interaction have guided the design of methodologies that describe interaction in non-human primates and the kinds of questions and answers that result from such methodologies. Using chimpanzees as a model, I will compare the different methodologies used to describe mother–infant interaction and show how descriptions of this kind of interaction are shaped by implicit notions of communication and social interaction. The first model I will examine is what I call the *Ecological-Linear* approach, and I will offer as an example one of the most influential methodologies available to study mother–infant interaction, namely that designed by Altmann (1974). This approach focuses on describing the mother–infant interaction in terms of rates of observable behaviors (e.g., contact, proximity) and placing special emphasis on who initiates the behavior and who receives it.

As an alternative approach, I will examine Bruner’s (1990) description of the development of infant human communication. In this approach, the infant’s acquisition of the ability to communicate with others can be explained from the context of the mother–infant interaction without having to address the issue of whether the infant is conscious of the intentions in the communicative process; that is, instead of focusing on what kind of content (if any) is delivered when the mother performs a behavior toward an infant, the focus is placed on how within the mother–infant interaction, we can observe a communicative function. Only through the mother–infant interaction does the infant become proficient in *what* and *how* gestures and utterances can become meaningful in a specific community. Thus, by using Bruner’s approach, I hope to provide a more complex picture of the mother–infant interaction, one that focuses on the infant’s development not only as an interplay between biological and environmental factors but also as one that requires that the mother–infant interaction be observed under the presupposition that the infant’s social, cognitive, and communicative development are tied together. As a result of this analysis, I will show first how the way we think about communication and social interaction shapes the kinds of questions and answers in a research program. Second, I will advocate for an approach to observing the mother–infant not only as a dyad but also as a socially embedded dyad.

1 Ecological-Linear Approach

In the first studies I examine in this chapter, researchers chose mother, infant, and the surrounding social and physical environmental elements as the basic units of analysis. I call this the *Ecological-Linear* approach; researchers who

adopt this approach do not use mental states (e.g., intentionality, beliefs, desires) to explain the interaction between these units. They¹ limit themselves to observable behaviors (e.g., contact, proximity) that take place between these basic units. They also place special emphasis on who initiates the behavior and who receives it; thus, they characterize the interaction between these units as a communicative one. They presuppose that communication is the exchange of behaviors between the different units of analysis. In such a communicative exchange, one unit is the sender and the other is the receiver of the behavior. Such methodologies also presuppose that when the sender provides this information, the information causally affects the receiver. In other words, this set of studies presupposes a model of communication that flows in a linear way from a sender to a receiver which causally affects the receiver. Linearity means that any change in the communication process follows incremental variations.

An example of this approach to communication can be found in Cheney and Seyfarth's (1990) study of calls in vervet monkeys. All of these calls have similar acoustic structures,² but, depending on the predator (eagle or leopard), a monkey will act as a sender and select a specific kind of call that will elicit a specific escape behavior response. Alternatively, if the call has already been made by another monkey, the monkey may not select the call at all. All the other monkeys act as receivers that decode the call and depending on the sender (i.e., another adult or an infant) will act accordingly (climb a tree or remain in the ground). In this approach to communication, human observers will describe the behavior of a monkey using preset units of information (i.e., predefined calls with a specific acoustic structure).³ They describe one monkey as acting as a sender, choosing a unit and sending it (or not sending it). The observers will also describe how these units are decoded by a receiver(s) who acts accordingly.

¹ Among the examples of how this approach is used in the research of different species we can find the following: Baboons (Altmann 1980), Japanese macaques (Bardi and Huffman 2002; Schino et al. 1995), rhesus macaques (Maestripiéri 1993, 1998, 1999; Maestripiéri et al. 2006), bonobos and chimpanzees (De Lathowres and Eslacker 2004), chimpanzees (Bloomsmith et al. 2003), and in general reviews of vervets, rhesus monkeys, Japanese macaques, and baboons (Fairbanks 1993, 1996; Fleming et al. 2002; Hinde 1983, 1984; Maestripiéri 1999).

² The structure varies in female and male monkeys but does not alter the idea that a call is a unit of information which shares the same structure among individuals.

³ When I describe these units as pre-set, this does not entail that they are not defined through observation. I am describing how a researcher, after hours of observation, divides her observations into categories or units and later uses these units to describe behaviors. In this way, by the time she observes the behavior she is interested in, these units that are already pre-set, ready to be used.

1.1 How This Approach is Used in Most Mother–Infant Studies in Non-human Primates

To understand the presuppositions of communication and mind in the mother–infant interaction, I will focus one of the most influential methodologies available to study mother–infant interaction, namely that designed by Altmann (1974). Although she does not use calls as the units of behaviors, she uses behaviors that are transmitted from a sender to a receiver to describe how animals interact. Altmann claims: “(a) Focal Animal Sample on animal *i* provides a record of all acts in which *i* is either the actor or receiver”⁴(1974, p. 243).

In other words, in Altmann’s approach, to describe the interaction between individuals, it is necessary to describe how they exchange behaviors. These behaviors communicate specific information, and it is necessary to distinguish who initiates and who receives, she argues that: “Most such behavior (social behavior) is directed (“addressed”); I shall distinguish between the actor or sender, and the object or receiver of each social act” (1974, p. 243). The explanation of this exchange does not require attributing the participants’ mental states. Description is limited to the observation of how behavior is exchanged. This methodology presupposes that two animals interact in a communicative way: one is the sender and the other is the receiver; a subject can only perform one role (i.e., actor or receiver) at a time in an interaction. In this communicative process, discrete units of behavior (e.g., call, gestures) are exchanged and are summarized in the ethogram designed by the researcher. These units convey the same information in every context, whether they are found in play or aggression. What changes is the frequency with which these units are exchanged in different contexts. Summarizing the interaction between two or more individuals as the sum of these frequencies presupposes that the changes that take place in this communicative exchange can only change in an incremental way.

Altmann’s (1980) methodology has been applied to different studies in primates where the common characteristic is that, because these units of behavior exchanged do not change in different contexts, all of these studies reduce the mother–infant interaction to the rates of exchanged behaviors. For example, one way in which units of behavior have been used to describe the mother–infant interaction is by describing the mother–infant interaction as parenting styles or variations in the dimension of *protectiveness* (i.e., variation in the degree to which the mother restrains infant exploration, initiates proximity and contact, and provides nurturing behaviors such as grooming) and *rejection* (i.e., degree to which the mother limits the timing and duration of suckling, carrying, and contact).

One of the advantages of adopting this linear model of communication is that using parenting styles allows researchers to make predictions of specific mother–infant interaction exchanges. Because the units of behavior or information are known, whenever it is observed that the sender sends this information in a specific

⁴ Emphasis is not in the original.

context, it is possible to predict the receiver's behavior. For example, if the mother is low-ranking and protective (i.e., higher rate of restriction and initiation of contact), it is possible to predict that the infant will have a low exploratory behavior. Another advantage is that treating interaction as an exchange of fixed informational units allows, according to Altmann's (1974), an unbiased description of the behaviors of individuals. Altmann's methodology guarantees that the resulting data are not a record of only extraordinary events that the observer may choose based on what he/she considers important; rather, the data become a statistically significant description of the everyday behaviors of the mother and infant. Because of these two characteristics, other models have adopted the ecological measurements that presuppose Altmann's linear model of communication. These parenting styles are used to describe the mother–infant interaction in monkeys and apes in the field and the laboratory.

1.2 Notion of Communication

This model seems to follow a mathematical approach to information. In 1948, Claude Shannon suggested that communication can be described as a transmission process that can be treated as a matter of “encoding” the “information” that is contained in the “message” that is being sent. In this context, “information” is something which can be broken down into constituent elements and quantified. This presupposition of information can also be found in Saussure's *Course of General Linguistics*. In Saussure's famous “speech-circuit” diagram, the two speakers using a language are “encoding” and “decoding” the information they wish to convey. That is, linguistic interaction can be described as a code.

In this model of communication, information cannot be confused with meaning; according to Shannon and Weaver, “the semantic aspects of communication are irrelevant to the engineering aspects” (1978, p. 8). This does not mean that meaning is irrelevant. Rather than emphasizing *what* is said, the approach emphasizes what the sender *could* have said: “Information is a measure of one's freedom of choice when one selects a message.” (Shannon and Weaver 1978, p. 9). For that reason, the emphasis in this approach to communication is on the logarithm of the number of available choices in a communicative process and how this choice is coded and sent to a receiver who decodes it. According to Ellis and Beattie (1986), when this model of communication is adopted, the criterion of when communication takes place is: “when one organism (the transmitter) encodes information into a signal which passes to another organism (the receiver) which decodes the signal and is capable of responding appropriately” (Ellis and Beattie 1986, p. 3). That is, if all relevant elements (i.e., sender, receiver, encoded units of information) can be identified, communication takes place. Within this linear model of communication, the roles of sender and receiver are fixed and can only be exchanged once the message has been delivered. The information transmitted can be divided and analyzed in units. Going back to the Cheney and Seyfarth example, the monkey selects from

a repertoire of specific acoustic signals the alarm call for eagle instead of the alarm call for leopard, and a communicative interaction can be measured by the rate of exchange of these units.

2 Limitations of This Model

When this model of communication is used to design a methodology to capture the mother–infant interaction, the interaction has to be reduced to the preset elements. As a result, the methodology will miss much of the complexity present in the mother–infant interaction. It does not consider how the meaning of the units of behavior exchanged may vary depending on how this interaction takes place; that is, how the meaning of each behavior may change depending on the past history of the participants and how the partners respond to each other’s behaviors. Why do we need to go into such detail? To answer this question let’s go back to Harlow’s experiments. He (1959) originally demonstrated how a soft, warm mother was essential for the infant’s development. Later in his work with Harlow and Suomi (1971), he showed that the interactions with peers may compensate for the absence of the mother and absence of early social interaction. This is an example of why we need a model that provides a more textured account of how all the variables (i.e., mothers, peers, and social group) affect the infant’s development. I will show this in more detail using chimpanzees as a model organism and showing the limitations of the Ecological-Linear approach.

Since the 1940s, it has been clear that the absence of the mother plays a significant role in infant chimpanzee social and cognitive development.⁵ Recent studies have shown that early rearing conditions affect the performance of chimpanzees in cognitive tasks, such as the cognitive capacities that underlie gestural communication. For example, subjects exposed to early rearing conditions that include human social–linguistic tasks perform better in *object choice task*. In this task, a human experimenter points to one of the containers that were previously baited with food (out of sight of the ape), and then, the ape can point to request food (Lyn et al. 2010). Apes with enriched rearing conditions also performed better in *directional pointing*, a task in which the apes have to direct humans to a hidden goal in the woods (Menzel and Menzel 2012). Thus, we need to know the elements in this early interaction that have such a profound effect on the infant’s cognitive and communicative development.

Second, non-human primates exhibit cultural/social conventions. Research in chimpanzees, done by Whiten et al. (1999), has emphasized that communication is sensitive to the different practices of different communities within the same

⁵ For chimpanzees, the effects of a mother’s absence have been observed in chimpanzees raised in isolation (for reviews see Yerkes 1943; Menzel 1964; King and Mellen 1994) and under captivity in enriched environments (for reviews see Clarke et al. (1982), Brent et al. (1991), Baker (1996) and van Ijzendoorn et al. (2009)).

species. For example, Whiten et al. show how the behavioral signal used to request grooming in chimpanzees from the Mahale and Kasakela communities (two communities that are not far apart) varies from hand-clasp to branch-clasp; there are no ecological explanations for this difference. A more complex notion of communication would be able to incorporate how the community-specific type of communication acquired by the infant through the interaction with its mother.

It may be argued that these questions are better answered in the context of experimental conditions rather than in the wild. There have been wonderful studies that described these conditions in controlled settings (see, for example, Matzusawa 2006); however, it is important to consider how these conditions may vary from captivity to social interactions in the wild. Moreover, if we are already observing differences in the outcomes produced by rearing conditions in captivity, it would seem important to know how this same mechanism works in the wild.

Let me illustrate the limitations of the *Ecological-Linear* approach with an example. As part of a larger study, Botero et al. (2013) examined the anxiety levels and social interactions of two orphan and four mother-reared adolescent chimpanzees (*Pan troglodytesschweinfurthii*) in the Kasekela community at Gombe National Park, Tanzania. The two orphan adolescent chimpanzees (Flirt and Titan) differed from other adolescents of a similar age, exhibiting higher levels of anxiety and lower levels of play. The findings of this study are at odds with observations done in laboratories and sanctuaries. Bloomsmith et al. (2005) found that laboratory infants orphaned after age 2 and then reared by peers behaved similarly to mother-reared infants as juveniles. Studies of wild-born chimpanzees orphaned by the bush and pet trade have also shown that individuals can successfully adapt to life in the wild (Humle et al. 2011; Beck 2010) or show no long-term signs of stress when raised in sanctuaries (Wobber and Hare 2011). Meanwhile, even though the orphans observed by Botero et al. were orphaned much later than 2 years of age, they still exhibited behavioral differences as juveniles.

The effects of a mother's absence in the wild, where an infant chimpanzee has the opportunity to be adopted and/or to interact with other members of its community, have been studied much less, and some of the findings are also contradictory. Some have found that orphans exhibit negative behavioral consequences (Pusey 1983; Goodall 1986), but others have found that orphan chimpanzees do not exhibit any behavioral problems (Boesch and Boesch-Ackerman 2000; Boesch et al. 2010). Thus, it seems that not only does variation exist in captive/sanctuary conditions and wild conditions but also social variations across different communities may influence orphan survival and behavior. For example, Boesch et al. (2010) found higher levels of adoption among the group members of the Tãï Forest community than in other chimpanzee communities. Boesch et al. hypothesized that this behavior may be the result of unique within-group solidarity exhibited as a response to the threat posed by the population of leopards that coexists with the group.

Finally, even within the same community (e.g., Kasekela community), Botero et al. found that after losing their mothers at different ages, the subjects in this community developed somewhat different patterns of abnormal behavior. There

may be a relation between the age at which a chimpanzee is orphaned and the behavior that follows; such a relation between age of being orphan and behavioral outcomes has also been found in observations of the rehabilitation process of wild-born animals (Carter 2003). However, it has also been found that different kinds of interaction between the infant and its mother seem to correlate with the different ways in which the infant behaves after its mothers' death (see Botero et al. in preparation). This is in accordance with previous studies that show how the kind of interaction the infant has with its mother affects the way the infant reacts to being separated from her (for a review, see Fairbanks, 1996.)

These results are intriguing and warrant further investigation to establish more fully whether age of orphaning, social characteristics, or the kind of interaction with its mother is a determining factor in the later development of abnormal behaviors. A linear account of these variations will be able to provide a description of ways in which infants in captivity and infants in the wild differ in terms of rates of behavior and the ways in which different orphans in different communities differ in terms of rates of behaviors such as contact or grooming. However, two questions remain, how do the different ways in which the mother–infant interaction takes place in different communities or within the same community come into existence in the first place? How do these differences affect the behavioral outcomes observed in the infant's development? Thus, we need an explanation that acknowledges not only different kinds of mother–infant interactions (such as parenting styles) but also how mother–infant interactions are situated in the specific social practices of the community in which the infants are born and how this affects the infant's development of social, cognitive, and communicative abilities. To include these elements, we need an explanation that allows us to go beyond the summary of rates to explain how the mother–infant interaction may affect the infant's behavior. We need to adopt a different notion of communication, one that is closer to the idea of pragmatics.

It may be argued that the users of the linear model frequently add another layer to this view of communication, a layer that includes how these exchanges can be influenced by other variables such as audiences, features of utterance, responses, and the modes for the correlation. To include these variables, the users of the linear model adopt Grice's (1989) idea of *reflexive intention* in which the speaker's intention is prior to communication and is directed to the listeners. According to Grice, the speaker attempts to produce an effect on the listeners partly by making them recognize his intention to produce this communication. In Grice's words: "U utters x M-intending that A produce r" (Grice 1989, p. 105). Adopting Grice approach in animal communication is not problematic since, according to Grice utterances may include, not just sounds and marks but also gesture, grunts, and groans. Thus, non-human animals are able to signal M-intentions without the use of verbal language. This characteristic can be found in the Cheney and Seyfarth reports of audience effects, such as a case when one the group disregards a call if it is emitted by an infant or a case when a member of the group fails to emit the signal when another member has already given the call. Moreover, in a more recent account, Cheney and Seyfarth (2007) argue that baboons have a language

of thought, a language-like representational medium that allows them to deal with their complex social environment. This last point presents a problem for the observation of animal communication. If semantics can be reduced to propositional attitudes, then it is necessary to include a broader discussion of mental states, such as beliefs, desires, and intentionality, and most authors are not comfortable attributing these mental faculties to non-human animals.

Instead of focusing on internal mental states, I will argue for an approach that focuses on external observable behaviors. To include the different signals that mother and infant use to communicate and the way the infant learns how these signals are used in its community, we need to adopt a notion of communication that extends the meaning of the signal to external elements, to the social practices where these communicative interactions take place.

3 An Alternative Approach

One of the distinctive characteristics of mother–infant studies is that they deal with communication within the context of the mother–infant interaction and how this interaction is part of the infant’s development. Bruner offers an approach to communication that highlights how communication is a developmental process that takes place within the context of the mother–infant interaction. Even though his approach focuses mostly on the development of human infants, it is possible to extrapolate it to other primates that share similar characteristics with the human caregiver–infant interaction, mainly with species in which the infant has a period of dependency on its mother allowing for the kind of interaction necessary to help the infant develop its social, cognitive, and communicative abilities.

Bruner’s (1975) approach is useful to the observation of non-human primates in two ways. First, instead of describing only how complex linguistic abilities such as grammar develops, he focuses on what he calls the prespeech communicative acts. These acts are a set of complex, transferable skills that the child has to master to obtain a particular level of linguistic mastery. These skills are perceptual, motor, conceptual, social, and linguistic and allow the child to move from prespeech communication to the uses of language proper. The focus of this approach to communication concentrates on describing how the child exhibits a grasp of a basic form of understanding that becomes a prerequisite to a more complex utterance.

Second, in Bruner’s (1990) approach, meaning is always a “culturally mediated phenomenon.” For that reason, in development, “the child is not learning simply *what* to say but *how*, *where*, *to whom*, and *under what circumstances*” (1990, p. 71). In other words, for Bruner language is always used in a social behavior and as such, communication depends upon a mastery of cultural conventions.

According to Bruner, the mother–infant interaction is the context where social understanding becomes a form of practice. In each of these interactions, the child becomes a protagonist—an agent, a victim, an accomplice—and learns what is permissible and what leads to outcomes through action. These interactions usually

take place in a conventionalized way, for example in a game of peekaboo. In these kinds of interactions, the mother attributes intention to the child's behavior, and the child learns how her efforts evoke a response. The child also learns that he/she can modify her responses to achieve a desired outcome. In these conventionalized interactions, the mother shows the child the ritual conventions in which the infant's gestures and utterances can help her achieve the child's desired outcomes. These different conventions vary between mothering styles and in socio-economic settings. Through this practice, the child understands: first, the interchangeability of roles between communicator and recipient and second, the link between the gesture and utterance in these conventions. This link makes the child's gesture or utterance meaningful.

Bruner claims that it is not necessary to focus on the question of whether and when a child is conscious. Instead, as researchers, we should focus on how communicative functions are shaped and how they are fulfilled. Even with human primates, according to Bruner (1975), the observer has to focus on the continuity between functionally equivalent forms of communication before and after the onset of speech and how these occur through the different ways in which the infant continually experiences and acts in the world, using language in different contexts. I will argue that to achieve a more detailed level of observation, following Bruner's ideas, we need to focus on the functional aspects of communication that can be observed in the way that the infant non-human primate interacts with its mother.

4 Application of this Definitions of Communication to Non-Human Primates Studies

Adopting this approach to the study of communication in mother–infant studies has several consequences for the design of such studies. First, it offers a different conception of the link between mind and communication. Traditionally, one of the main arguments against the ascription of mental states, such as intentionality, is that since animals do not have linguistic behavior, there is no way for the mental states to be manifest. In other words, thought and language go together, and the absence of the later makes it impossible to understand the mind (Davidson 1982). As stated, an approach to communication inspired by Grice, where the intentions of the communicator are fundamental to the communicative process, requires ascribing intentionality to the mother and infant even though there is no linguistic exchange.

If we adopt Bruner's approach to communication, the infant's acquisition of the ability to communicate with others can be explained in the context of mother–infant interaction without having to address the issue of whether the infant is conscious of intentions in the communicative process. That is, instead of focusing on what kind of content (if any) is delivered when the mother performs a behavior toward an infant, we will focus on how, within the mother–infant interaction, we can observe a communicative function. It is only through the mother–infant

interaction that the infant becomes proficient in *what* and *how* her gestures and utterances can become meaningful in a specific community. Following Bruner, our emphasis would not be whether or not the infant has a conscious understanding of the intention; rather, we would focus on the function of communicative interactions.

The second and most important consequence of adopting Bruner's approach is that it forces us to understand how the child works at becoming a member of her linguistic community. To become part of the community, the child has to understand the social means to interact with others in her social environment. Bruner explains this through two fundamental concepts. First, the origins of language can be traced back to the child's earliest communicative and affective interactions with her mother. Bruner (1975) argues that the infant starts in demand modes, communicative routines where the infant uses different patterns to express discomfort, hunger, and demand for social interaction or fatigue. If these modes are attended by the mother, they create an expectancy of response. Once this expectancy is established, the next stage is the exchange mode. According to Bruner, this exchange mode in humans starts as early as two weeks of age, as infants will imitate facial gestures (Moore and Meltzoff 1977). Finally, the mother–infant interaction will be transformed into a reciprocal mode where the two participants enter a task with reciprocal non-identical modes where the roles between communicator and receiver are exchanged. Even though this model is designed for human primates, it is possible to extrapolate to other non-human primates based on the similarities found across primates in the way mothers interact with their infants. For example, early imitation of facial features as described by Moore and Meltzoff has also been found in chimpanzees (Takeshita et al. 2006) and monkeys (Ferrari and Fogassi 2012).

The idea of emphasizing the mother–infant interaction as a unit of observation is not new and has been illustrated among others in the attachment paradigm described by Bowlby (1958). The caregiver's face provides the infant a secure base that is used when exploring the world. The infant signals to let the caregiver know that she needs her, and the caregiver responds to these signals. The facial signals of the caregiver and the infant become synchronized. These ideas apply to both human and non-human primates. According to Suomi et al. (1995), Robert Hinde introduced Bowlby to the work of Harlow at the time that Bowlby was writing "The nature of the child's ties to his mother." In that paper, Bowlby included a footnote of Harlow's not-yet-published study of surrogated mothers. According to Bowlby, Harlow's work confirmed his hypothesis that it is "proximity and close bodily contact with a mother figure that cements the infant's attachment rather than the provision of food" (1991, p. 5). These observations have been made not only of monkeys but also of chimpanzees as well. From the beginning of attachment studies, chimpanzees have been used as examples of how non-human primates exhibit attachment behaviors. For example, Bowlby (1958), citing work by Yerkes and Tomilin, shows how behaviors necessary for the attachment bond, such as sucking, clinging, and crying, also take place in chimpanzees. Work by Masaki Tomonaga (2006) shows that one-month-old infant chimpanzees have the ability

to discriminate their mothers' face from others.⁶ Okamoto-Barth et al. (2007) describe how gaze is used as way of increasing proximity and how the infant chimpanzee uses its mother as a secure base.

However, the way in which interaction takes place in the mother–infant dyad can be examined in different ways. Vicedo (2013) shows that, when Harlow's experimental work is analyzed as a whole, it becomes clear that experimenters, experiments, and rhesus monkeys influenced each other. Many societal pressures, such as journalists, mothers, woman's clubs, and psychoanalyst's, influenced the interpretation of Harlow's findings. The monkeys overtime revealed a degree of plasticity and resilience that forced Harlow to reinterpret his description of primate developmental needs. Vicedo also shows that these changes in Harlow's conclusions were ignored by Bowlby when Bowlby was developing his attachment theory.

Thus, it becomes clear that first, to account for Harlow's research, it is necessary to use a model that offers a more complex description of social elements. Second, the presuppositions held by researchers on choosing the relevant elements when observing the mother–infant interaction have a profound effect in their theories; for Harlow outcomes in infant development depend on different social variables, as opposed to Bowlby who focused on instinctual interactions in the mother–infant dyad.

I claim that the Ecological-Linear approach also limits the mother–infant interaction to a reductionist view that describes the mother–infant dyad in terms of adaptive instinctual responses. Moreover, the Ecological-Linear approach attempts to describe how certain initial conditions of the mother–infant pair correlate with some aspects of the infant's outcome behavior but do not provide an explanation of *how* the mother–infant interaction affects the infant's development. As a consequence, researchers are unable to explain how the infant is affected by the mother–infant interaction. For example, the birth of a new sibling may be correlated with a decrease in contact between mother and infant and with more exploratory behavior on the part of the infant. This correlation may be explained in terms of cost and benefit for both mother and infant, how it creates or disrupts the attachment bond or how adaptive these behaviors are. But it does not explain how the decrease in contact causes the infant's exploratory behavior or why the birth of a new sibling may not cause a decrease in contact in other individual mother–infant pairs facing the same environmental conditions and with the same rank, or why this decreases in contact may not trigger exploratory behavior in other infants. These questions remain unanswered if the explanation is limited to a report of the correlations between rates of different behaviors observed.

What makes Bruner's approach an alternative to these previous descriptions is what he considers the second fundamental element in the acquisition of language, that is, language as the vehicle for the child's socialization. As Shanker and Talbot

⁶ This behavior is important for forming an attachment bond because, as Bowlby (1958) notes, the infant chooses only one object of attachment. Thus, it needs to be able to discriminate among faces to be able to form its attachment bond.

(2001) claim, the central message of Bruner's approach to language development is that language and culture cannot be separated from one another. As part of her process of socialization, the child becomes a skilled participant in the culture-specific forms of communicative behavior used in the community where she is born. According to Shanker and Talbot, the acquisition of language is the gradual development of a set of practical, interactional techniques to engage with those in her social environment.

Following Bruner, Shanker and Talbot claim that when developing language, a child learns how to do things with words; thus, she learns not a simple behavior but a cultural technique that has meaning within that specific culture. For example, when a child truly learns the meaning of "I am sorry" she has learned the appropriate circumstances in which to express this sentence. For example, the apology has to be related to something she did rather than something that occurred in a movie. The child has also learned how to behave when expressing this sentence, for example, she learns that she needs to behave in a way that conveys that she really means it. The child also learns what she is doing by expressing this sentence. Finally, she has to understand that an apology has to be directed to the right person, and she has to be able to recognize when an apology is directed to her.

How does this translate to the study of mother-infant interaction in chimpanzees? Bruner's approach can be applied to a series of methodological decisions. Adopting this approach has consequences for the kinds of units we would be observing when studying the mother-infant interaction. Instead of observing mother, infant and rates of behavior exchanged, we would look at the interaction itself and how it unfolds in the specific cultural practices of the community observed. This approach will start where the linear method stops. That is, we can use as our starting point the different kinds of conventionalized mother-infant interaction as described by the parenting styles of non-human primates (Altman) such as protective (high in protectiveness and low in rejection), controlling (high in both protectiveness and rejection), rejecting (low in protectiveness and high in rejection), and laissez-faire. However, we will take a step further and describe in more detail how the infant learns within these conventionalized forms of interaction and how his/her gestures/utterances have meaning in the community where she lives.

That is, when understanding how an infant acquires a set of behaviors, we will not be limited to describe the rates of different behaviors, but we will emphasize how the infant acquires a meaningful set of behaviors that belongs to the community where he/she is born. These meaningful behaviors include any kind of behavior that is necessary for the social functioning of the community, such as aggressive displays, consolation, and gestures for requesting grooming or food. In other words, we will focus on any behavior that requires social partners to negotiate an outcome. We will also include expressions of emotional states among this set of meaningful behaviors. As Botero (2012) argues, variations in communication can be extended to the expression of emotions: the way emotions are expressed and how others understand these expressions are going to be specific to the groups where these emotional expressions were developed.

All of these different behaviors may be unique to the community, as described by Whiten et al. (1999), or more subtle behaviors that reflect the unique way in which the group interacts. This new emphasis requires that the researcher who is

designing a study of mother–infant interaction in primates has to become familiar not only with species-typical behaviors but also with behaviors that are typical for the community being observed as well as the social hierarchies and patterns of interaction found in that community. These must be introduced in the design of his/her study.

Moreover, this approach requires that the researcher includes a description of the particular social interactions that the infant is exposed to in his/her community, especially those that involve a negotiation among two or more partners that will depend on who is present in the interaction and the context of the interaction. This is an important point because being part of a primate community means that communicative practices in a community may differ depending on the context, who is present, and the specific behavior being performed. For example, Slocombe and Zuberbühler (2005) show that chimpanzee vocalizations change depending on the information chimpanzees have about the specific social relationships of victims and aggressors and the severity of an attack; the call of the victim who is attacked may change if there is an equal or higher hierarchy subject than the aggressor in the audience. Therefore, to understand communication, it is not enough to describe it in terms of frequency of exchange of units of information. It is necessary to describe what kind of activity goes on in a community, how the communicative exchange happens, and how it is developed within a community. For a full description of a social event unfolding in the moment, it is necessary as King and Fox (2002) suggest to understand both particular interactions and community interactions.

As part of her development, the infant chimpanzee needs to understand all of the social variables in his/her community. She needs to learn how to become part of this community and to interact with the members of this community in meaningful ways. This learning/developmental process is done within the context of the interaction with her mother. Thus, following Bruner, a methodological design that attempts to follow the nuances of the mother–infant interaction and can account for variations across individuals and community will base its units of observation on how the infant gradually acquires these interactional techniques to engage with those in her social environment. This approach will provide us with a more complex picture of how the mother–infant interaction unfolds in a community and has an effect on the infant’s cognitive, social, and communicative development. This picture will offer a more complex map of how individual differences in mother–infant interactions in a community and different mother–infant pairs in different communities result in different developmental outcomes for the infant.

5 Conclusion

The way we define communication and social interaction has a deep impact on the way we study human and non-human primates. In this chapter, I presented an analysis of different methodologies used in the study of mother–infant interaction

in primates, and using chimpanzees as an example, I have shown how changing our understanding of communication and social interaction can have an effect on the design of the methods, the kinds of questions asked and the kinds of answers accepted when studying primates. I have also shown how a change in the definition of communication and social interaction, such as the one offered by Bruner, can lead to a more textured description of the mother–infant interaction. Adopting Bruner’s approach to mother–infant studies entails focusing on the pragmatics of communication, how the infant acquires the capacity of understanding, how gestures, calls, or other forms of communicative expressions are meaningful in the community where the infants are born. This analysis starts with the findings of what I have called the *Ecological-Linear* method and takes them to a more detailed level. Even though this new level of detail requires more labor and cannot produce large samples of ecological measures, such as the ones produced by parenting styles, it allows us to understand in more detail how the infant learns to communicate through the interaction with its mother and how it becomes sensitive to the unique aspects of the interaction with its mother in its community.

Finally, I would like to suggest that even though this chapter has focused on mother–infant interaction in chimpanzees, it is plausible to think that these same conclusions can be extrapolated to other kinds of research in primates, that is, that the choice of definitions of communication and social interaction held in any research project that involves social interactions in a community of human or non-human primates will have similar effects in the way these primates are described.

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