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Author
Rossano, Federico

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Social manipulation, turn-taking and cooperation in apes

Implications for the evolution of language-based interaction in humans

Federico Rossano
University of California, San Diego

This paper outlines how the focus on how communicative signals might emerge and how the capacity to interpret them might develop, does not yet explain what type of motivation is required to actually deal with those signals. Without the consistent production of appropriate responses to the production of communicative signals, there would be no point in producing any signal. If language is a tool to accomplish things with others, we need to understand what would lead to cooperation. The first step consists in avoiding the blind belief that all cooperation requires some prosocial attitude. A great deal of cooperation can occur while each participant in the interaction is selfishly attempting to maximize their own benefits or minimizing damaging consequences.

I describe how different types of turn-taking can be achieved via different levels of cognitive complexity and how interpretive turn-taking requires a great deal of cognitive abilities that great apes possess. Finally, I provide empirical evidence of social manipulation in non-human primates. Given our awareness of the occurrence of social manipulation during cooperation among human adults, it seems necessary to reconsider to what degree human communication and language evolution require unique prosocial motivations.

Keywords: communication, cooperation, language evolution, prosociality, social interaction, social manipulation

Imagine walking down the street towards some destination and being stopped by a stranger, asking for directions. Most people would stop and provide the information requested, ultimately helping the requester find their way. While this appears as a normal every day behavior, we should ponder for a second how special this is. First of all, instead of running away from a stranger approaching us (or responding

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aggressively towards them), we stop and listen to their needs. This, by itself, is already remarkable. Human infants start to show a preference for ingroup over outgroup individuals when they are as young as 10 months old (Kinzler et al., 2007). Chimpanzees – one of humans' closest living relatives – fear, attack, kill, and even cannibalize outgroup chimpanzees (Wilson et al., 2014). Yet, humans can become friendly with, and even act altruistically towards, individuals from a different social group. In other words, while we certainly prefer ingroup individuals we are not quite as xenophobic as chimpanzees.

Second, even though the person who is asking us for directions is delaying the completion of our own project (getting to our own destination) we stop and help (helping comes at a cost for us, albeit minimal). Third, we do not have any clear tie to this person and we will likely never see her again, yet we help her (we do not do it because of direct reciprocity, Trivers, 1971). Fourth, knowledge of where things are located and the fastest way to get there can provide a strategic advantage for an individual, yet we are willing to share it with a stranger (we act prosocially, i.e. we engage in a behavior intended to benefit another individual).

I am interested in why the addressed recipient would ever stop and provide the information requested by a stranger. We can hypothesize a few (non-exhaustive) possible motivators: (1) *fear* (the stranger might be scary); (2) *empathy* (the stranger needs help and we feel for her) (3) *coercion* (the stranger might force us to help them); (4) *social reputation* (we might think that we are being observed and want to protect our reputation as cooperative individuals); (5) *prosocial attitude* (we are naturally prosocial and therefore would spontaneously help people in need); (6) *normative expectations* (we follow the rule that we should respond to questions, no matter who asks them); (7) a *Kantian categorical imperative* (we believe in a moral code that transcends the individual and defines us as a species and we abide to it). While one might think that finding the motivation(s) for our cooperative behavior with strangers is a trivial exercise, I argue that understanding what leads a recipient to respond to any communicative signal is key towards understanding language evolution and human communicative abilities. Most importantly, the question of motivation will have to be addressed from an evolutionary perspective.

We know, for example, that human beings are particularly cooperative in conversation in that almost 90% of questions in ordinary conversation obtain some form of response (Stivers et al., 2009). Non-human great apes, on the other hand, are reluctant to respond to requests and begging gestures (chimpanzees and orangutans grant requests for food approximately 1/3 of the times, see, e.g., Silk et al., 2013; Rossano & Liebal, 2014). Moreover, great apes are mostly competitive, as opposed to cooperative (Tomasello, 2009) and they do not seem to engage in shared intentionality like humans do (Tomasello et al., 2005). So how would we

account for the transition from likely highly xenophobic, mostly uncooperative ancestors to modern humans?

According to many scholars, the fundamental difference between humans and non-human great apes lies in our increased prosociality. Four theories out there focused on how altruism could evolve and can be summarized as follows:

1. The *Big Mistake* hypothesis (humans lived in small groups mostly surrounded by kin for a long time, so increased prosociality developed in that setting and we continue to be prosocial now that we are surrounded by non-kin; Burnham & Johnson, 2005);
2. The *Cultural Group Selection* Hypothesis (groups with more altruists ultimately outcompeted groups with more selfish individuals, but the selection for altruistic behaviors would be cultural and not genetic; Richerson & Boyd, 2005).
3. The *Interdependence* Hypothesis (at some point humans became obligate cooperative foragers and hunters and this led to pressure on selecting for cooperative individuals first and altruistic behaviors next for survival and procreation; Tomasello et al., 2012)
4. The *Cooperative Breeding* Hypothesis (humans, like other primates but not great apes, are cooperative breeders and the capacity and motivation to cooperate to raise offspring could have generalized to other domains and social relationships; Hrdy, 2011; Burkart, Hrdy & Van Schaik, 2009)

While humans do appear more prosocial than other great apes (and probably other primates in general), I believe that the emphasis on altruism and prosociality has prevented us from seeing how much successful cooperation is possible via social manipulation. Similarly, many developmental studies testing children's prosociality lack proper controls to satisfactorily rule out selfish motivations for children's cooperative behavior. In this paper, I first review some findings about the structure of human communication (in particular turn-taking, sequence organization and action formation). Then I report on how it integrates with current approaches to animal communication divided between a *communication as manipulation* perspective (Dawkins & Krebs, 1978; Owren et al. 2010) and a *communication as transfer of information* perspective (Smith, 1977; Seyfarth and Cheney, 2003). I will further present recent empirical evidence from orangutans and chimpanzees showing how successful cooperation can be achieved without altruistic or prosocial motivations and will outline how it integrates with the perspective on the importance of social manipulation and mind-reading for communication developed by Krebs and Dawkins (1984). Finally, I will extract suggestions for factoring these findings into a new road map for the evolution of the language-ready brain.

Cooperation and human communication

Cooperative activities do not have to be things such as building a house together or draining a meadow (a la Hume). Simply engaging in a conversation is a cooperative act, and we do so every day, multiple times a day and for an extensive amount of time. The key importance of cooperation among participants for the success of communication during social interaction has a long scholarly tradition in the social sciences (see, e.g., Grice, 1975; Bruner, 1975). Human communication (and children's capacity to acquire a language's lexicon and grammar) rests crucially on (i) our ability to successfully cooperate with each other and (ii) the implicit assumption that our interlocutors are trying to be cooperative while communicating with us, i.e., deception and manipulation is the exception, not the default. These assumptions are meant to facilitate inferential processes while processing communicative signals, including the relevance of potential deviations from what is otherwise expected (e.g. if in response to a suggestion to go out for a walk the recipient responds with "it's raining"). The key problem here is how do people make sense of each other signals and know how to properly respond. Conversation analysts (Sacks, Schegloff & Jefferson, 1974; Schegloff, 2007) have labeled this problem (i.e., producing and comprehending communicative moves) the *action formation* (from the speaker's point of view), and the *action recognition/ascription* problem (from the recipient's point of view). It concerns the resources that participants deploy in social interaction to make their actions (e.g. requests, offers, invitations, complaints, sanctions, compliments) recognizable and intelligible to co-participants so that they can obtain what they wish (Schegloff, 2007; Levinson, 2013). The way we design our communicative signals has to take into account how recipients will perceive, interpret and likely respond to those signals. The cooperative assumption, as outlined for example in the Cooperative Principle by Grice (1975), facilitates this process by assuming that our interlocutors are being cooperative in designing their communications for us. Recent research on epistemic vigilance in children shows that only by age 4 they seem to understand that others might be actively trying to deceive them and therefore they should stop trusting them (see Mascaro & Sperber, 2009).

In general, the low price that we place on most of our talk during ordinary conversation makes us underestimate how cooperative human communication is. It also makes most contemporary scholars forget that most animals communicative systems do not require quite the level of cooperation that is observed in human communication. I already mentioned how almost 90% of questions in ordinary conversation obtain some form of response (Stivers et al., 2009). Moreover, in face-to-face interaction, the average time it takes to transition between a question and a response is only about 0.2 seconds (Stivers et al., 2009; Levinson, 2016).

Recently, psycholinguists have paid special attention to the timing between utterances (turn-taking) (see, e.g., Garrod & Pickering, 2004; Christiansen & Chater, 2016; Levinson, 2016). We now know that participants need to start planning their responsive turn *before* the previous turn is complete (see Levinson, 2016). In other words, the inferential processes at work in social interaction must be extensive. On the other hand, researchers interested in animal communication have begun making claims about the similarity between human turn-taking and turn-taking in the vocalizations of non-human primates (Chow et al., 2015, see also Burkart, this issue) and different species of birds (see, e.g. Henry et al., 2015). While this research brings forward important information about the possible precursors to human turn-taking in conversation, it is important to emphasize that turn-taking should not focus just on auditory signals but rather include also visible actions/gestures. Moreover, there are at least 4 types of turn-taking systems easily identifiable across the animal kingdom (see Figure 1).

The first type, 'mimetic', can be found in multiple species and basically occurs whenever two animals produce the same vocalization while interacting (e.g. a pant-hoot for chimpanzees or vervet alarm calls) but minimize overlap. This type of turn-taking does not require any special inferential process and can be elicited (primed) by the production of the first vocalization.

The second type, 'alternating', can also be found in several species (see e.g. marmosets, Burkart, this issue) but especially in birds. It occurs whenever animals take turns in producing their own song, for example. This is cognitively more complex in that it requires the production of a different vocalization compared to the one perceived and still requires the capacity to minimize overlap and produce (mostly) non-overlapping vocalizations. It is an open question to what degree alternation is a necessary precursor of the interpretative stage.

The third type, 'simple interpretative', has been clearly documented both in human (Schegloff, 1992) and non-human great apes (see e.g., Rossano, in press; Rossano, 2013; Hobaiter & Byrne, 2011). This occurs when animal 1 produces signal A that is not responded adequately by animal 2 (signal B) and consequentially leads to a pursuit/repair of the initial signal by producing a modified version of the initial signal (signal A1). This usually results in animal 2 next providing a different response (turn C). Here multiple signals are not only produced alternatively, but signal A makes relevant a specific type of response and in case of misunderstanding or inapposite response, a signaler can flexibly modify the signal to solicit the appropriate response.

The fourth type, 'complex interpretative', goes beyond the capacity of repairing misunderstandings or pursuing missing responses and rather reflects the capacity to achieve interactional projects that take multiple turns and require extensive turn exchanges. Humans indeed can converse for hours. This type of turn-taking can

unfold via a long sequence of questions and answers (4a), like one would do when ordering food for delivery or booking a flight over the phone or via the exchange of long tellings (4b), like when friends are catching up after the holidays. In the latter case, especially if in a multy-party situation, the following speakers might self-select and volunteer tellings that retain some similarity to the story just told and convey the recipient's understanding of what has just been told (on second stories, see Sacks, 1992). Notably, the production of these stories and congruity with the previous story is less normatively constrained than in question answer sequences.

Differently from the mimetic and alternating type, in interpretative turn-taking systems individuals must deal with an ever-changing environment in which every new utterance is simultaneously "context shaped" and "context renewing" (Heritage, 1984).

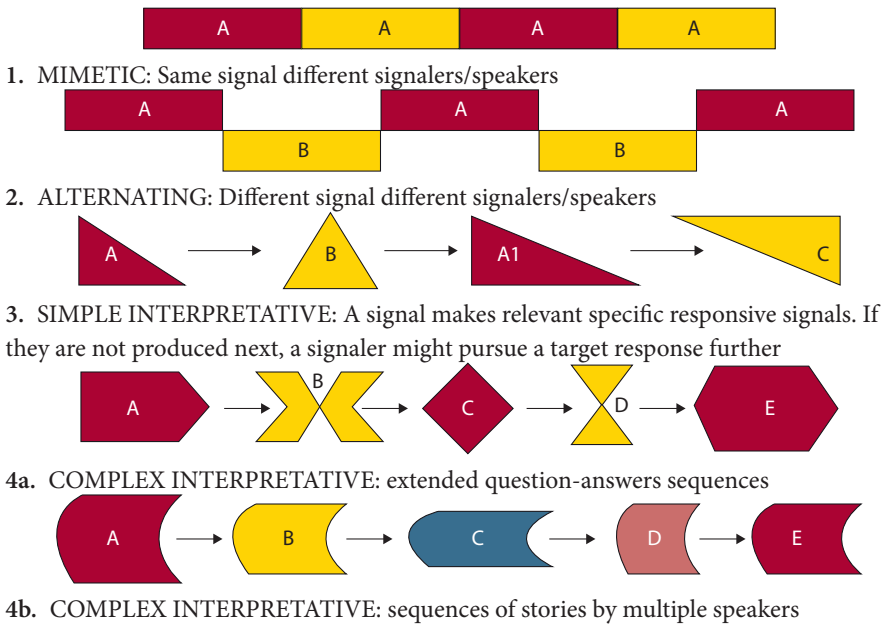

Figure 1. Different types of turn-taking in the animal kingdom. Different colors represent different signalers/speakers and letters identify signals (i.e. A is different from B that is different from C, etc.)

There is no current comparison nor evolutionary theory accounting for the transition from one type of turn-taking system to another. Similarly, we do not know how widespread each type is in the animal kingdom. If we adopt a cognitive perspective in our approach to animal communication, producing an interpretive type of turn-taking is significantly more cognitively demanding than the other two and will be most likely rare. Indeed, the sequentiality of the turns is also meaningful.

To understand what an animal is trying to communicate, it would not be sufficient to identify the *composition* of the signal but also its *position* in a sequence of signals within an interactional bout (Schegloff, 2007).

Animal communication, manipulation vs. information

The study of animal communication is divided between two main perspectives: the Manipulation and the Information perspective. The former mostly focuses on how evolution through natural selection has selected signals that are designed to influence others and believes that communication is fundamentally competitive in nature (Dawkins & Krebs, 1978; Owren et al., 2010). Scholars that adopt this perspective mostly reject the idea that signals convey information (in particular semantic meaning, see Krebs & Dawkins, 1984).

In contrast, the information perspective heavily relies on the Shannon and Weaver's (1949) model of communication and on Wiener's (1948) cybernetic theory of communication and feedback control. The idea is that communication consists in encoding and decoding information via the production and perception of signals. Signals encode information and the main task of the perceiver is to decode the signal. The Information perspective took hold with the advent of the cognitive revolution and the use of computational metaphors to describe animal communication. Smith (1977) famously suggested that a one-to-one meaning-signal mapping was too simplistic and rather perceivers must invest effort to interpret the signals they are exposed to. Around the same time, the discovery that vervet monkey alarm calls might have clear semantic meanings (Seyfarth et al., 1980) provided further strength to a perspective that believed in the possibility of developing species typical lexicons, especially for non-human primates.

In general, ethologists and behavioral ecologists have long tried to avoid the use of cognitive terminology to make sense of animal communication, basically avoiding terms such as intentionality or theory of mind. This has led to a fascinating side effect: when ethologists talk about animal communication, there are really two types: human communication vs. all other animal species. While the idea of a single framework for all animal species but humans might on the surface seem appealing, it blinds researchers to the fact that the cognitive abilities and social life of a chimpanzee do not resemble those of moths, ants, spiders, etc. For example, we know that great apes recognize each other's goals by inferring them through others' behaviors. Great apes know what other individuals can see from their position (Hare et al., 2000) and know what others know (Hare et al., 2001). Furthermore, a recent study has shown that great apes can also pass the implicit version of the false-belief task (Krupenye et al., 2016). In other words, great apes exhibit all the basic skills related to what has been called *Theory of Mind* (Premack & Woodruff,

1978). In what way is this relevant for our theories about language evolution? And most importantly, how do these abilities map onto a cooperative vs. a competitive view on animal (and human) communication?

Social manipulation, mind-reading, ontogenetic ritualization

Modifying their original chapter on information vs. manipulation in animal signals (1978),Krebs and Dawkins (1984) connect the ability to manipulate objects to the ability to manipulate the behavior of other individuals and most importantly add the capacity to mind-read others, i.e. recognizing other intentions and desires and anticipating how they will behave when confronted with different contextual situations, as key for the development of successful animal communication. They write: "Mind-reading and manipulation are not isolated phenomena. They are intimately locked together in evolutionary arms races and feedback loops. Mind-reading is a prerequisite for the evolution of manipulation. Manipulation evolves as an evolutionary response to mind-reading. Mind-reading and manipulation coevolve, and signals are the results of this coevolution." (1984: 283) They also add that it is not surprising that communicative signals are usually derived from activities and behaviors that were not communicative to begin with. Indeed, this is an easy way to deal with the issue of recognizability of the signal. If one can read other's intentions or recognize some basic behavioral pattern and its consequences, then just seeing the beginning of that sequence should allow to project what is going to happen next and lead to a reliable response. While at the time of their writing they were talking about phylogenetic ritualization (Tinbergen, 1952; Huxley, 1966), it is now clear that this same process can be observed in non-human primates within their own life span. Tomasello and colleagues (1994) proposed that the learning process involved in great ape gestural development was ontogenetic ritualization, in which individuals learn their gestures in the context of regularly occurring dyadic interactions such that parts of fully functional social behaviors become ritualized (see Caselli et al., 2012 for similar claims concerning human children). Recent work by Rossano and colleagues (Halina, Rossano & Tomasello, 2013; Rossano, under review) has not only shown evidence for this process in the gestural development of young bonobos, but also shown how fast this process can be, contrary to general expectations (as fast as 2 or 3 weeks, according to Rossano, under review). Arbib and colleagues have further shown that this process is computationally plausible once dyadic brain modeling and mirror neurons are taken into account (Arbib et al., 2014) and roboticists have shown that it is easier for robots to converge on a shared communicative repertoire by relying on ontogenetic ritualization than on imitation (Spranger & Steels, 2014).

One interesting suggestion posited by Krebs and Dawkins (1984) is that communicative signals might develop both in a competitive and in a more cooperative (e.g. among kin) context and one way to tease apart what led to development of a signal consists in focusing on whether the signal is amplified, loud and redundant (probably a competitive origin) or rather reduced (probably a cooperative origin). As they phrase it: "the evolution of cooperative signaling should lead not to loud, exaggerated, repetitive, conspicuous signals, but to cost-minimizing conspiratorial whispers." (Krebs & Dawkins, 1984: 319).

Following Krebs & Dawkins' model, gestures developed through ontogenetic ritualization should develop in cooperative situations and indeed current evidence suggests that mother-infant interaction and play situations between juveniles are the main contexts in which ritualization of gestures has been documented. But what about other contexts? How are signals learned or developed between non-kin? It is clear that ontogenetic ritualization is not sufficient by itself to develop the kind of lexicon typical of human languages nor would it be ideal for one-off interactions with strangers. Are signals between non-kin part of their biologically predisposed repertoire (see Byrne et al., 2017 for a recent review) or rather the byproduct of other processes? And are they produced to exchange information or to manipulate others? The answer is most likely in the middle and some of my ongoing research suggests that manipulation (and not just information transfer) might be equally at play in social interaction between great apes. The goal here is to outline some of these findings to revise our understanding of what was likely in place with LCA-a (apes).

First, from a longitudinal project on gesture development in non-human great apes we are finding compelling evidence for imitation of non-communicative behavior between juveniles and adult females that they spend a large amount of time with. While these juveniles do not imitate much of mother's behavior, once they begin spending more time away from mother and interacting more with others (especially non-kin), they can be observed picking up idiosyncratic behaviors of their adult partners (e.g. rolling sideways to move from one location to another rather than walking but only when the non-kin adult female is co-present), and to reproduce them while being observed by these partners (Rossano, in preparation). These behaviors resemble what recently documented by Blakemore in her studies on the social brain of human adolescents (2012) and fit nicely with the homophily theory of cultural evolution put forward by Haun and Over (2015), in that it suggests that juveniles would imitate other adults not just in their communication but also in their non-communicative behavior to facilitate their social integration and increase social interconnectedness. This is similar to the claim that the goal of imitation in human children is not just to acquire successful techniques but also behaving like a group member and therefore learning to fit in (see Over &

Carpenter, 2012 and all research on over-imitation in preschoolers, e.g. Nielsen & Blank, 2011).

Second, from a longitudinal food sharing project in orangutans conducted at Leipzig zoo over 10 sessions each year in 2010, 2012, 2014 and 2016 (see Rossano & Liebal, 2014; Liebal & Rossano, 2017; and Kaufhold & Rossano, in preparation), we found that not only is requesting very rarely used to access food controlled by another individual (less than 5% of the times in each year instantiation of the food sharing task) but it is also less effective by far than stealing (approximately 33% effective vs. 80% of stealing). In this respect, the question is not why do apes steal but rather why would they ever request? A closer look at the data shows that the individuals requesting are either adult females towards the male or, less likely, juveniles towards their own mothers at a time when they have begun spending more time away from them. In this respect, it appears that requesting is a social test for the strength of a relationship and as such the granting of the request is a measure of that strength. In this respect, instead of looking at requesting as a display of deference or as evidence of an orientation towards property norms of any kind, requesting is a manipulative test to decide how to behave next – granting of a request does not lead to the end of harassment or of requesting but rather to a further request (see Kaufhold & Rossano, in preparation).

Third, in a series of studies aimed at testing how orangutans, the least gregarious genus of great apes, interact with each other when presented with cooperation problems, we observed clear evidence of social manipulation and social tool use, both between mother and infants but also between adult individuals (see Völter, Rossano, & Call, 2015; 2016). In a first study we presented three orangutan mother-offspring dyads with different situations in which we placed a food reward outside their enclosure. Crucially, the offspring (all juveniles were of similar age, $M_{Age} = 4$ years), unlike their mothers, could reach the food reward due to their smaller body size. All orangutan mothers not only stole food from their offspring once they had obtained it but they even proactively manipulated their offspring's actions. The orangutan mothers actively coerced their offspring into retrieving the food by carrying their offspring to the locations where the offspring could access the food, pushing their hands and bodies toward the food and pulling them back once they had grabbed the food. Crucially, this *social tool-use* depended on their offspring's willingness to complete the required actions (i.e. grabbing the food). That is to say, orangutan mothers could only coerce their infants into performing parts of the solution but they could not force their infants into grabbing the food. Their actions, therefore, resembled physical tool use (e.g. using a stick to rake in an out-of-reach reward) but could not be reduced to it because they had to take the self-controlled actions of the social tool into account. Next, we presented three adult orangutans with a cooperative problem-solving apparatus. One individual

received the tool but only another individual in the adjacent compartment of the enclosure could insert it into the apparatus. We found that the orangutan females passed the tool spontaneously and reliably to each other and maintained cooperation even when they knew they would not receive food in some trials. Yet when we presented the individual with the tool with a nonsocial alternative (i.e. an apparatus that allows the individual to obtain food only for herself, without cooperating with conspecifics), orangutans passed the tool on to their partner only if they could obtain a higher value food reward by cooperating with the partner and the overall passing of the tool went from 100% to 35% overall and most importantly to only 9% when the food that they could access by themselves was equal to what they could get by collaborating with the others (note that in the latter case, cooperation would lead the others to also get a reward). In other words, the apparent altruism between orangutans observed in the initial study turned out to be simply the consequence of the lack of alternatives. Once an alternative with an equal payoff was provided, all concerns for others' welfare disappeared and the behavior changed dramatically.

Towards a new road map

In this paper I have tried to outline some of the open questions concerning some key steps towards language evolution that I believe are either currently neglected or that deserve further attention. In particular I outlined how just focusing on how signals (and participants capacity to interpret them) might develop does not yet explain what type of motivation is required to actually deal with those signals in a way that would be somehow beneficial for both the signaler and the perceiver of the signal. Without the consistent production of appropriate responses to the production of communicative signals, there would be no point in producing any signal. If language is a tool to accomplish things with others, we need to understand what would lead to cooperation and ultimately to the willingness to engage in a conversation. The first step consists in avoiding the common misconception that given the cooperative nature of human communication, language use requires some prosocial attitude. A great deal of cooperation can occur while each participant in the interaction is selfishly attempting to maximize their own benefits or minimizing damaging consequences. Cooperation ultimately requires working together towards a goal and while it requires understanding the complexity of the task and some basic planning abilities (e.g. understanding that the help of another individual is needed to successfully obtain food), it does not require taking into account the benefits for the other individual(s) involved in the process nor being motivated by the other individual's welfare.

I have claimed that turn-taking can be achieved via different levels of cognitive complexity and conveyed that interpretive turn-taking requires a great deal of cognitive abilities that great apes seem to possess, at least to some degree. But the evolutionary roots of human turn-taking should not be searched just in primates vocalizations but also in their gestural exchanges, which are significantly more flexible and adaptive. Also, human communication is clearly not just about conveying information nor just about manipulating others and indeed achieving social affiliation via sharing emotional states (especially displaced ones, like how excited we felt yesterday, how concerned we are about tomorrow) might be another key functions of language use (see Semendeferi, this issue). Hence a more complex model that takes into account the interplay of different communicative and social motivations seems necessary.

Here I have only provided a glimpse of the current research that is showing plenty of evidence of social manipulation in non-human primates. Most importantly, given our awareness of the occurrence of social manipulation in human adults, it seems necessary to reconsider to what degree cooperation by young children is manipulative. When Krebs and Dawkins presented a theoretical model of communication as manipulation by including mind-reading and ritualization into the picture, there was little empirical evidence to support their claims for non-human primates. Now we are beginning to see multiple facets of manipulation and social tool use in great apes and this capacity should be further studied in other non-human primates and social animals.

The last two decades have also seen a growing number of studies suggesting other-regarding preferences in nonhuman primates (that are not limited to kin), in particular, in brown capuchin monkeys and chimpanzees. Long-term characteristics of social relationships (including friendships, dominance, and kinship) appear to have a larger impact on prosociality than short-term interactions, for instance in the form of calculated reciprocity (Amici et al., 2014). However, the robustness of these findings is weakened by many non-replications. Considerable inter-individual and inter-group variance seems to be a contributing factor for the low replication rate together with methodological differences across studies. Identifying the precise determinants of this high variance in results across studies will be a tedious but critical endeavor in future research. A more thorough investigation of the motivation for the cooperation (especially during social interaction and in response to communicative signals) will be a key endeavor towards developing a more compelling model of what lead to language evolution and human-like social interaction and socio-cognitive abilities.

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Address for correspondence

Federico Rossano
Department of Cognitive Science
University of California, San Diego
9500 Gilman Dr.
La Jolla CA 92039
USA

frossano@ucsd.edu

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