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Competition and cooperation in language evolution: a comparison between communication of apes and humans

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Abstract
This paper analyzes the topic of conflict in reference to the evolution of language. Specifically, it examines two key elements involved in conflicting interactions, competition and cooperation, and shows how they are involved in the evolution of linguistic skills. According to a model of language origins recently proposed by Michael Tomasello competition and cooperation are crucial to explain the transition from ape communication to human language. The idea is that ape communication is mainly individualistic because of the competitive nature of nonhuman primates; on the contrary, human language has an intrinsically cooperative nature and this makes human communication qualitatively different from animal communication. The aim of this paper is to call such a model into question by pointing to an "altruism of knowledge" in apes by discussing some recent experimental data on chimpanzee vocal communication.

1. Introduction

In this paper we analyze the topic of conflict in reference to the evolution of language. Specifically, we examine two key elements involved in conflicting interactions, competition and cooperation, and show how they are involved in the evolution of linguistic skills. We discuss a model of language origins recently proposed by Tomasello (2008) according to which human language is an evolutionary product of the cognitive systems underlying cooperation among individuals in the social group. The core assumption of this model is that the aforementioned fact makes human language qualitatively different from ape communication, which is mainly individualistic because of the competitive nature of nonhuman primates. Our aim in this paper is to call such a model into question by pointing to an "altruism of knowledge" in apes by discussing some recent experimental data on chimpanzee vocal communication. This data allows us to shed light on the evolution of the cognitive mechanisms that underlie the origin of human communication and to develop a more gradualistic and continuistic model of language evolution. We conclude with some general consideration of the necessity to integrate the cooperative model of communication with a wider and more complex conception of human language and cognition.

2. Why do we communicate? Some answers from evolutionary biology

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Theories of the origin of language are necessarily speculative. However, in recent years, the range of acceptable speculation has been narrowed by the recognition that any account of language origins must be consistent with the principles of Darwinian evolution by natural selection (e.g. Corballis 2011; 2013a; Fitch 2010; Hurford 2007; Pinker and Bloom 1990). One of the main problems with an evolutionary account of human language is the apparent level of altruism involved (Desalles 2007; Noble 2000). According to the orthodox position of evolutionary biology, organisms are indeed products of their selfish genes: they do not do things for the good of the group or the species but rather in order to propagate copies of their own genetic material (Dawkins 1976). In such a perspective, language (and cooperative behavior in general) can be difficult to account for. Specifically, the problem is the following: why do speakers freely exchange valuable information when the theory of natural selection predicts selfishness and competition among individuals? In addition, speaking or signaling always has a cost in terms of time and energy and may involve more indirect costs such as exposing the signaler to greater predation risk. Therefore, reaping the benefits of the informative signals of others without paying the costs of signaling themselves could have more advantages (for a discussion, see Noble 2000).

As is well known regarding cooperative behavior in general, evolutionary theory has answered these problems in terms of kin selection (Hamilton 1964) and reciprocal altruism (Trivers 1971). According to the theory of kin selection, an organism supports another (even at a cost to the organism's own survival and reproduction) because it is helping a relative: through cooperative behaviors, the helper contributes to the survival of part of its own genetic heritage, depending on the degree of genetic relatedness with the relative. According to reciprocal altruism theory, an organism offers support to others by behaving in a manner that temporarily reduces its fitness while increasing that of another organism with the expectation that the other organism will act in a similar manner at a later time.

The evolution of cooperation in relation to communication has also received several explanations (e.g. Ackley and Litman 1994; Brinck and Gärdenfors 2003; Knight 1998; Gärdenfors 2003; Noble 2000). Knight (1998), for example, maintained that the main problem in this regard is to explain the evolution of honest signals. Following Krebs and Dawkins (1984), the author started from the assumptions that animals have conflicting interests and that they seek to exploit and deceive rather than share reliable information. Communication can evolve only if there is some mechanism that makes it trustworthy for the other members of the group. In such a case, in which the advantages of defection overtake the costs of cooperation, the only reliable signals are those that are costly to fake because they cannot be imitated by free riders (Zahavi and Zahavi 1997). According to Knight, signals of this kind are rituals: group members demonstrate their allegiance to a common cause by performing costly rituals, allowing the group to believe their signals in future.

The problem of explaining the evolution of honest information is also recognized by Dessalles (1998, 2000, 2007). He proposed a political account for the origins of language. In his opinion, in order to explain the evolution of linguistic communication, it is necessary to start from the fact that ancestral humans were capable of forming large coalitions (Dunbar 1996). Among humans, coalitions are essential to the survival of individuals (they offer some security to their members) and have an important political dimension. The power of single individuals, in fact, will depend on the number of allies they can acquire. Leadership of a group cannot be exercised without support from at least some of its members. As a consequence, when coalitions are established, individual competition for leadership is replaced by competition among the several coalitions within the group. In this context,

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according to Desalles, what is important is not physical strength but the ability to enter a successful coalition. The idea is that speech emerged in this context as a way for individuals to select one another when forming alliances. Relevant information may have replaced physical strength as a determining factor in the decision to join a coalition and remain in it. By living in a social group, indeed, individuals gain status from pointing out salient and correct information (about neighbors, about imminent danger, about food) in the environment. Therefore, the original motivation of human language was to trade relevant information for status (for a discussion, see Hurford 2007; Machery et al. 2010)

3. In search of a cognitive explanation: Tomasello's cooperation model

The models presented briefly so far explain the evolution of communication by pointing mainly at the possible selective pressures that could have driven the evolution of language. It is not our intention here to discuss the evolutionary plausibility of these hypotheses. What we want to highlight is that any naturalistic model of human language origins has to be formulated also in reference to cognitive systems involved in the genesis and evolution of linguistic faculties (e.g. Corballis 2011; Gärdenfors 2003; Ferretti 2013a; Ferretti and Adornetti 2014; Origgi and Sperber 2000; Sperber et al. 2010). One important model for the cognitive foundations of human communication has been recently elaborated by Tomasello (2008). It is centered on the key role of cognitive systems underlying cooperation as the elements that explain the transition from ape communication to human language.

According to Tomasello, human beings are able to communicate because they have unique cognitive ways of engaging with one another socially in general. In particular, human beings cooperate with one another in species-unique ways on the basis of processes of shared intentionality. Shared intentionality can be conceived as behavioral phenomena that are both intentional and intrinsically, irreducibly social because the agent of the intentions and actions is the subject "we" (Gilbert 1989; Searle 1995; Tomasello and Carpenter 2007). The basic psychological underpinning to participating with others in acts of shared intentionality is the ability to understand others as cooperative agents. As Searle (1990:415) maintained, this ability "is a necessary condition of all collective behavior". According to Tomasello, the ability to understand others as cooperative agents can be broken down into two elements: the cognitive skills for creating joint intentions and attention (a common conceptual ground with others), and the social motivations for helping and sharing with others.

Common ground represents the context of communication, that is to say, what is relevant to social interaction (Clark 1996; Levinson 1995). It includes shared knowledge among participants in social interactions, facts about the world, what people generally find salient and interesting, and so on. Common ground is necessary for the receiver to determine both what the communicator is focusing his attention on (his referential intention) and why he is doing it (his social intention). The critical point is that to construct common ground, people have to put aside their own egocentric perspective on things. Indeed, in the construction of common ground, people have to pursue a common goal together in order to know that together they are focusing on certain things relevant to the common goal.

The other element of shared intentionality is represented by humans' cooperative social motivations. Tomasello's idea (2008, 2009) is that humans have cooperative

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motivations because they have cooperative motivations for communication in the first place[1]. There are three such fundamental motivations that emerge earliest in ontogeny and that are products of phylogenetic processes. These motivations are:

1. *requesting*: I want you to do something to help me (requesting help or information);
2. *informing*: I want you to know something because I think it will help or interest you (offering help, including information);
3. *sharing*: I want you to feel something so that we can share attitudes/feelings together (sharing emotions or attitudes).

The first motivation is a characteristic of the intentional communication of all apes. Informing and sharing, on the contrary, according to Tomasello, seem to be uniquely human. Particularly relevant to the aim of this paper is the second motivation: informing. This motivation (together with the capacity of creating common ground), indeed, is crucial for the evolution of language and represents the element that, according to the author, makes human communication qualitatively different from ape communication.

Informing comes about because individuals often want to offer help to others without even being requested to; they inform others of things even when they themselves have no personal interest in the information. Informing is a way of offering help because typically I inform you of things that I think you (not I) will find helpful or interesting given my knowledge of your goals and interests (Tomasello 2008: 85). This ability emerges early in ontogeny. An experiment by Liszkowski and colleagues (2006) showed that human infants prelinguistically informed others from as early as twelve months of age by pointing. Specifically, infants used the gesture of pointing to inform another person of the location of an object that the person was searching for. This result suggests that from very early on, humans are capable of conceiving others as intentional agents with informational states and that they have the motivation to provide such information communicatively (see also Tomasello 2009). On the contrary, according to Tomasello (2009: 15-16):

> While infants consistently demonstrate understanding of informative pointing, the same is not true of apes. Apes do not point for one another, and when they do point for humans, they do so mainly to get humans to fetch food for them. Indeed, in all observed cases of apes pointing for humans, the motive is directive (imperative). Also, apes who have learned some kind of human-centered communication use it to communicate only with humans, not with one another, and they do so almost exclusively for directive purposes.

The reason for this lies in the fact that apes that are our closest relatives—chimpanzees in particular—are extremely competitive, and their competitive nature makes it very difficult for them to share a common goal and to participate in collaborative activities (such as communication). Specifically, Tomasello's (2008) idea is that chimpanzees understand their own action from a first-person perspective and that of the partner from a third-person perspective, but they don't have a *bird's-eye view* of the interaction with the joint goal and complementary roles all in a single representational format. So while humans are capable of

[1] This idea recalls Paul Grice's principle of cooperation (Grice 1975), which has been a theoretical milestone elaborated in linguistic pragmatics (e.g. Sperber and Wilson 1986). The principle of cooperation can be formulated in the following way: make your conversational contribution what is required at the stage at which it occurs by the accepted purpose or direction of the talk exchange in which you are engaged. On this point see also Castelfranchi and Poggi (1998) in which Grice's cooperation principle is conceived as an instantiation, in language, of Triver's reciprocal altruism: namely, they posit the existence of an altruism of knowledge. Incidentally, the importance of beliefs for human Agents, as their primary route to planning, decision, and action, accounts for why deception is viewed as an aggressive act, a violation of the fundamental principle of *altruism of knowledge*, and of the *natural right* of humans to come to know beliefs relevant for their goals.

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shared intentionality, chimps do not have the basic psychological underpinning to participate with others in acts of shared intentionality: they are not able to understand others as cooperative agents. As a consequence, chimpanzees are capable of only individual intentionality.

From this perspective, the group activities of chimps, such as group hunting, are only apparently collaborative activities. In the wild, chimpanzees sometimes hunt in small groups to capture the red colobus monkey (Boesch and Boesch 1989; Boesch 2005). According to these Authors, chimps have a common goal in their hunting and play complementary roles: one individual has to chase the prey in a particular direction, others have to climb the trees to prevent the prey from changing direction, and so on. In Tomasello's (2008; Tomasello et al. 2005) opinion, this explanation is misleading. He maintained that in this process, each participant is attempting to maximize its own chances of catching the prey without any prior joint goal or establishment of roles. In addition, he affirmed that when chimpanzees engage in group hunting, they do not communicate intentionality about the ongoing activity, either to set a goal or to coordinate roles. Since they are competing in this activity, they do not engage in any intentional communication. Tomasello (2008: 181-184) wrote:

> If my most immediate goal is that I capture the monkey unbeknownst to you, then I will not be doing much communicating […] and so, chimpanzee group hunting would not seem to be a highly facilitative context for the emergence of cooperative communication because it is not a truly collaborative enterprise in the narrow way we have defined collaboration here, as joint goals with coordinated plans/roles.

So, since chimpanzees—and apes in general—have forms of only individual intentionality, their communication is mainly individualistic: they communicate only in an imperative way in order to request things relevant to their own scopes and not to freely exchange valuable information. They do not communicate to inform others (chimpanzees are not capable of helping by informing), and they do not comprehend pointing when it is used in an informative manner: they do not seem to grasp an informative communicative intent. For example, when apes were searching for hidden food and a human pointed to a cup to inform them of its location, the apes did not understand (Tomasello 2006). This occurs because "Chimpanzees do not operate with anything like a Gricean principle of cooperation—fittingly, in their natural worlds—and thus they have no basis for making the appropriate relevance inference" (Tomasello 2009: 18). The same is true for ape alarm calls and food calls. They are not generated by an informative intent because when apes detect a predator, for example, they give their alarm calls even if all of the other members of the group are right there looking at the predator and screaming themselves. Similarly, they give food calls when they discover a rich source of food, even if the whole group is with them already. According to this interpretation, apes do not use calls to help others since they give alarm independently of what others know.

4. Toward a more continuistic view: altruism of knowledge in chimpanzees

Although cooperation among humans clearly differs from cooperation among animals, recent more naturalistic studies suggest that the contrasts are not as severe as initially proposed (Brent et al. 2013; De Wall 2009; Seyfarth and Cheney 2012, 2013). For example, chimpanzees in the wild engage in several cooperative actions with long-term social partners that sometimes are risky activities (Mitani 2006). Concerning cooperation in communication,

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recent studies by Crockford and colleagues (2012) and Schel, Townsend, and colleagues (2013) on chimpanzees' vocal communication highlighted that some of the assumptions of Tomasello's model do not apply in general.

Crockford and colleagues (2012) used an alarm-call-based field experiment, observing the response of members of a group of wild chimpanzees to a snake model, a viper, positioned on their path of travel. Although snakes are not predators of chimpanzees, they are nevertheless highly dangerous to them. Therefore, providing information about the presence and specific location of a viper will be valuable to others. At the same time, vocal production is costly and may be inhibited if it attracts the attention of predators or hostile individuals. The results showed that chimpanzees were more likely to give alarm calls in response to a snake in the presence of unaware group members than in the presence of aware group members. According to the authors "chimpanzees keep track of information available to receivers and intentionally inform those who lack certain knowledge […]. [They] communicate missing information that is *relevant and beneficial to receivers*" (Crockford et al. 2012: 145, our emphasis). In others words, chimpanzees are able to monitor the information available to others: they recognize knowledge and ignorance in others and control vocal production to selectively inform them. They inform ignorant group members of danger with such reasoning as "I know something that you don't know, and I know that this information is useful to you". At the same time, the receivers are able to understand the informative intent of the signalers, even if not directed to themselves. After an individual produced alert calls to inform another individual that was behind his shoulder and some 10 m away and that had not seen the snake, the ignorant chimp stopped traveling, revealing to have grasped the communicative intent of the signaler.

Similar results were obtained by Schel, Townsend, and colleagues (2013). The authors presented wild chimpanzees with a python model and found that most alarm calls met key criteria for intentionality. Specifically, the results showed that the alarm calls were produced in the presence of socially important individuals: production was significantly mediated by the friendship between the caller and the arriving individual, with the arrival of friends more likely to be associated with an increase in calling (see also Schel, Machanda et al. 2013). Furthermore, the production was often preceded by visual monitoring of the audience with gaze alternations, and individuals were likely to persist in emitting calls until all group members were safe from the predator. As in the experiment by Crockford and colleagues (2012), chimps in this case seemed to be capable of informing others with such reasoning as "I know something that you don't know, and I know that this information is useful to you". Chimpanzees' vocal behavior seems to be, indeed, influenced by prosocial motivations that are intentionally informing others of a danger.

5. Concluding remarks and future directions

Considerations made so far seem to contradict some assumptions of Tomasello's cooperative model, specifically the idea that chimpanzees have forms of only individual intentionality and are not able to help others by informing. The results of the studies discussed so far allow one to argue for continuity from apes to humans by pointing at a kind of altruism of knowledge in apes. It is possible to maintain, indeed, that the ability to communicate in a cooperative way is not uniquely human but has its roots in the communicative abilities of chimpanzees to help by offering information to others. These results are also particularly

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relevant to debates about the evolution of a theory of mind and the relationship between mental state attribution and language origins. It is not our intention to discuss the long-standing dispute on the possession by apes of a theory of mind (e.g. Call and Tomasello 2008; Hare et al. 2000; Heyes 1998; Povinelli and Vonk 2003, 2004; Premack and Woodruff 1978; Premack 1988; Seyfarth and Cheney 2013; Whiten 2013). We simply underline the fact that the studies discussed so far on chimps in the wild have explored apes' mind-reading capacities in altruistic contexts rather than in competitive situations. Most previous research, in contrast, was conducted on the basis of the idea that it is the competitive element (generally created in the laboratory) that helped their comprehension. Such an idea was clearly inspired by Humphrey's (1976) "The social function of intellect" (or the Machiavellian intelligence hypothesis). The core idea of Humphrey's proposal is that primate intelligence is primarily an adaptation to the special complexity of social life, such as forming optimal coalitions, and that the evolution of primate cognition should be interpreted in the context of social competition. Taking a similar position, Dawkins and Krebs (1984) argued that animals indeed evolved to best guess the minds of others to manipulate them better. The results of Crockford and colleagues (2012) and Schel, Townsend, and colleagues (2013) cast new light on this hypothesis or at least suggest that future research on apes' cognitive abilities take greater account of experimental contexts other than competition.

The ability of chimps to inform others is also relevant to the relationship between mental state attribution and language evolution. The fact that a theory of mind has a key role in language origins is not controversial (e.g. Corballis 2011; Dunbar 1998; Gardenförs 2003; Seyfarth et al., 2005; Sperber and Origgi 2010). Indeed, several scientists have argued that a crucial stage in the evolution of language occurred when individuals began producing vocalizations with the goal of informing and thereby reducing ignorance in others (e.g. Pinker, 1994; Seyfarth and Cheney, 2010). As we have seen, chimpanzees are capable of it. However, chimpanzees don't speak. The question that arises from what has been discussed so far is the following: why did apes not develop language despite the fact that they are able to communicate to inform others? Trying to respond is, of course, extremely complex, and it would deserve another paper. To delineate just a schematic answer, we can posit that although a theory of mind is a cognitive device necessary for the origins of language, it is not a sufficient condition to explain the transition from animal communication to human language. In our opinion, to explain this transition, it is necessary to focus on a specific element that distinguishes human language from animal communication, namely its flexible and creative use (language is more than informing others). Recently, it has been recognized that to explain this aspect, it is necessary to refer to an integrated network of cognitive systems such as, for example, mental time travel (the ability to project oneself into the past and future) (Corballis 2011; 2013b) and mental space travel (the ability to navigate space) (Ferretti 2013b). From this perspective, the transition from animal communication to human language would rely on the adaptive reorganization of this particular cerebral network (Ferretti and Adornetti 2014) that today has a crucial role in language processing (Ferretti et al. 2013; Ferretti and Adornetti 2011; Ferretti and Cosentino 2013). Therefore, in future research on language evolution, the cooperative model should be integrated with a more complex and articulate view of human language and cognition.

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