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Ines Adornetti

Department of Philosophy, Communication and Visual Arts
Roma Tre University
&
Department of Human Sciences
University of L'Aquila
ines.adornetti@uniroma3.it

Francesco Ferretti

Department of Philosophy, Communication and Visual Arts
Roma Tre University
francesco.ferretti@uniroma3.it

The pragmatic foundations of communication: An action-oriented model of the origin of language

Abstract. In this paper we propose an action-oriented model of language origins that is compatible with the embodied perspective of mind. Specifically, we suggest that a crucial issue for the investigation of the origin of human communication is how language is grounded in the context. In support of our proposal, we maintain that: a) the grounding of language is tied to a specific aspect of the embodied mind, namely the aspect that emphasizes the embedded character of cognition; b) the emphasis posed on this particular character fits well with a model of language origins founded on gesture. The connection of embedded cognition and the gestural model allows us to propose an explanation of language origin capable of overcoming the problems in the classical symbolic framework of cognitive sciences.

Keywords: embodied cognition**,** gestural origin of language, grounding, mirror neurons, pragmatics

1. Introduction[1]

In this paper we propose a naturalistic model of language based on an action-oriented paradigm. By suggesting such a model, we intend to overcome the conceptual contradictions that the classical symbolic framework, of which Chomsky's Universal Grammar (hereafter UG) is a paradigmatic example, have with the Darwinian perspective. Contrary to the classical symbolic point of view, we maintain that a naturalistic model of language has to be evolutionary plausible. In order to justify the evolutionary plausibility of our proposal of a naturalistic model of language, we highlight the strong connection between the embedded perspective elaborated within the general framework of embodied cognition and the gestural theory of language origins. Specifically, our argument is that the origin of human verbal skills must be interpreted in reference to the ability of language to be grounded (anchored) in context and that the capacities that ensure the grounding of language in context are associated with a specific aspect of the motor foundation of human communication tied to the embeddedness of the organism in the surrounding environment.

2. Beyond Universal Grammar

A naturalistic perspective of language is a theoretical approach that considers human verbal skills (as well as any other ability) as a specific feature of an animal as other animals. To adopt a point of view of this type means denying that human beings are exceptional in nature: all abilities that characterize individuals of our species (even those that make us unique among other animals) must be interpreted in reference to the "specificity" that characterizes human beings, never to their supposed status of "specialty" in nature (Ferretti 2007). As it is easy to realize, an approach of this kind is a tribute to the tenet of Darwin (1871), according to which the differences, however great, between the most intelligent animal and the most foolish human being are always a matter of quantity and never of quality. From this point of view,

[1] This paper is the outcome of a collaborative effort between the two authors. For the specific concerns of the Italian Academy, we specify that I. Adornetti wrote sections 4 and 5 and F. Ferretti wrote sections 2 and 3 for the final draft. Both authors wrote the Introduction and the Conclusion.

a naturalistic model of language is a model compatible with the Darwinian perspective from the outset.

Following these considerations, we propose that to be properly naturalistic, a model of language must be compatible with the general framework of the theory of evolution. An assumption of this kind, which might appear to be simply a common sense intuition for those who analyze language from a naturalistic perspective, is a source of many disputes in contemporary debate. Chomsky – and with him the group of the neo-Cartesian proponents of the standard position of cognitive science (e.g., Fodor 2001, 2008) – while showing great attention to the issue of cognitive plausibility, has always revealed a strong skepticism regarding the evolutionary explanations of language and mind (e.g., Bolhuis *et al.* 2014; Chomsky 2005: 58–59; Hauser *et al.* 2014).

The Chomskyan model of language is still the dominant paradigm within cognitive sciences. Beyond its cognitive plausibility – which is, in any event an open question (see Evans and Levinson 2009; Evans 2014; Tomasello 2009) – UG does not acquire evolutionary plausibility despite the attempts made by some authors to "darwinize" it (Pinker and Bloom 1990). Chomsky's skepticism regarding language as a biological adaptation depends on UG's incompatibility with natural selection. In spite of the broad debate created by this position (e.g., Botha 2003; Calvin and Bickerton 2000; Christiansen and Chater 2008; Corballis 2011, 2013), Chomsky continues to state that "the human language faculty emerged *suddenly* in evolutionary time and has not evolved since" (Berwick *et al.* 2013: 89, our emphasis). Specifically, he maintains that because language has no external reference (this is a very important point for our purpose to which we will return later), it cannot have evolved through natural selection and, therefore, must have emerged in a single step, perhaps as a result of a fortuitous mutation (Chomsky 2010: 59). As Corballis (2013) highlighted, this position smacks of the miraculous because "from an evolutionary point of view the notion that a faculty as complex as language could have emerged in a single step is deeply implausible" (Corballis 2013: 35). These considerations (strongly inspired from dualistic conceptions) are fully consistent with the Cartesian intent to demonstrate mental superiority and human uniqueness, but constitute a serious obstacle to any real attempt of naturalization of human language (for a discussions, see Ferretti and Adornetti 2014). But that's not all.

Beyond this general problem, UG remains incompatible with the theory of evolution because of two additional specific difficulties. The first critical point is that UG requires a common code (the languages used by communities of speakers) to function appropriately. In fact, the device at the basis

of language operates only assuming the right environmental input: without a common code, UG is like a system for viewing a room without light because it is a device innately specialized for language. However, the existence of a code strongly depends on the existence of UG: in fact, in Chomsky's opinion, natural languages are just superficial products of UG functioning. If we exclude the reference to the preformism hypothesis, the relationship between linguistic code and UG is highly problematic. On the one hand, analyzing the origin of language assuming the existence of a linguistic code (a code is exactly what it is missing in the early stages of language) is not possible; on the other hand, assuming that brains are predisposed to language before humans are able to exploit the symbolic code used by the community of speakers in which they live makes little sense. What follows is that, from an evolutionary point of view, UG rests on a vicious circle (Ferretti 2013). The solution to this problem, as we see in the next section, is offered by the adherence to the model of communication based on clues proposed by Sperber and Wilson (1986/1995).

The critical point at the basis of the incompatibility of Chomsky's model of language with the theory of evolution is the notion that UG is a device inside the mind that is completely detached from the surrounding environment (cf. Ferretti and Adornetti 2014). Even though Chomsky has radically changed his conception of UG over time, from UG's first formulation in the fifties to the recent Minimalist Program (Chomsky 1995), a consistent element in his thought is that language is the device that makes possible the combination of symbols whose functioning is completely independent of the relationship they establish with the reality they represent: according to the generative perspective, what is important is how symbols combine with one another, not how they are related to the external world about which they talk.

Chomsky represents the more orthodox tradition within cognitive science: the tradition in which the mind is considered in reference to the metaphor of a computer and which conceives thought as a form of mental sentences the main character of which is the respect of the principle of formality (Fodor 1975; Fodor and Pylyshyn 1988; Pylyshyn 1985). Indeed, the notion that language competence is a device that analyzes the shape of symbols regardless of their content and the relationship between the uttered expression and its context is part of a broader conception of how to analyze the study of the mind in classical cognitive science (Fodor 1975). To be properly scientific, the notion that analysis of the mind should be driven by the principle of formality and by methodological solipsism (Fodor 1980) continues to be very strong in some interpretative models based on

the classical perspective, despite the fact that the computer metaphor that inspired them is now in sharp decline. In our opinion, proposing a model of language (and mind) completely detached from reality is equivalent to talking about the nature of an organism without referring to its relationship with its external environment. The disembodied and detached nature of language that Chomsky introduced makes it a useful tool for disembodied angels, but hardly for human beings in the flesh. To overcome this problem, we move toward an embodied perspective, and specifically to those interpretative models that within the embodied approach consider the embedded (or situated) nature of cognition to be an essential and fundamental characteristic.

3. Against the code model of communication

The notion of language as a disembodied tool is tied to a specific notion of communication: the code model (Shannon and Weaver 1949). According to the code model, the speaker encodes thought (the message) in a succession of sounds that the listener decodes to be able to share the thought (the message) that the speaker intended to communicate. Adherence to the code model, that Fodor (1975: 106) considered "not just natural but inevitable", means adherence to a form of parallelism between thought and language. Fodor's notion is that language can express thought because language and thought share the same logical form. From this point of view, the device that processes linguistic information must be capable of processing the logical form of the utterances: the logical form of statements is a necessary and sufficient condition for language comprehension. Adherence to this position is clearly at odds with the pragmatic theories of communication that focus on context and the speaker's intention. Indeed, in the classical symbolic framework everything necessary for the comprehension of what the speaker said (in the statement actually uttered) is present–the information content is entirely encoded in the utterance (Fodor 1983). For this reason, the code model works perfectly with the theory of literal meaning and is closely linked to the logical form.

How well does a language model of this type actually work? To communicate efficiently, is it sufficient to correctly combine symbols into sentences that reflect the structure and constituents of thought? A good starting point to answer this question is an interesting reflection made by Uta Frith (1989: 115) concerning the communication skills of Ruth, an autistic girl "stuck on the literal meaning."

> Faithful conveying of information is not a trivial accomplishment. It calls for accurate encoding and decoding of speech at input and output stages. Ruth does this. Echolalic children do it too. Nevertheless, in everyday communication one rarely expects that a listener will have to receive and then transmit a bare message as an exact copy. On the contrary, on expects listeners to know that messages are not bare, but usually contain something more. What really matters in everyday communication is the point of the message rather than the message itself. In other words, as listeners, we need to know *why* the speaker conveys *this* thought (rather than another), and as speakers we need to be sure we are understood in the way we *want* to be understood. We have elaborate verbal and nonverbal signals for getting across these intentions.

What emerges in this passage is that the girl is not able to communicate effectively, even if she respects the requirements of the code model. Specifically, Ruth's problem is not understanding what a speaker says, but understanding *why the speaker is saying what she says*. Autism is frequently studied in cognitive pragmatics (e.g., Happé 1993; Pexman *et al.* 2011) as evidence in favor of the role of the speaker's intentions in the processes of language production and comprehension, assuming that a speaker's thought is not explicitly coded in linguistic expressions (Grice 1968). Frith's quote encourages us to think that, in addition to the assessment of the role of intention, the evaluation of why the speaker is saying what she says also involves the evaluation of the *consonance of what the speaker says with respect to the contextual situation*. From a perspective on communication in which what really matters is why someone is saying something and not what someone says, the expressive code assumes a role of secondary importance. A view that fits very well with this perspective is the model of communication based on clues with Relevance Theory proposed by Sperber and Wilson (1986/1995). According to the authors, in communication the speaker simply offers the listener evidence (a clue) of what she intends to communicate (Sperber and Wilson 1986, 2002; Origgi and Sperber 2000).

> Inferential communication is a matter of reconstructing the communicator's informative intention on the basis of the evidence she provides by her utterance. Successful communication does not depend, then, on the communicator and addressee having exactly the same representation of the utterance, but on having the utterance, however represented, seen as evidence for the same intended conclusion (Origgi and Sperber 2000: 167).

For the purpose of our argument, what is important to note is that the question of why the speaker is saying what she says is closely related to the question of *how language is grounded in situation*. Indeed, showing that language production and comprehension rely on the evaluation of why a speaker says what she says means referring to one of the cornerstones of a pragmatic perspective on language: evaluation of how expressions are linked to their context. Such a consideration has profound consequences for the origins of language. In our opinion, the evaluation of why the speaker is saying what she says precedes (logically and temporally) the question of what she is saying. Indeed, in the early stages of human communication (i.e., in the absence of a code through which to express the content to be said), what regulates the processes of production and comprehension is the analysis of why someone is saying something at a given time. As Gärdenfors (2004: 244, our emphasis) claimed "when communication first appears, it is *the communicative act in itself and the context in which it occurs* that are most important, not the expressive form of the act" (see also Gärdenfors 2014).

The assumption underlying our argument is that anchoring language to context represents a specific case of the more general grounding of the organism to the environment. Starting from this assumption, and in order to explain the question of language origins, in what follows we propose a two-step argument. The first step shows that the analysis of the grounding problem has to be considered in reference to the embedded (or situated) model of the embodied theory of mind (cf. Cantwell Smith 1999). The second step shows that the theories of language elaborated within the embodied perspective are in accord with the gestural models of language origins. As a result of this two-step argument, we maintain that the embodied model represents the conceptual bridge of the grounding and the origins problems, without which no naturalistic perspective of language is possible.

4. Embedded cognition and action-based language

The conceptual foundation of our perspective can be tracked to the ecologic approach elaborated by Gibson (1979). Criticizing the idealistic conception of vision, Gibson proposed that perception is strongly connected to the movement of the organism in the environment and that, as a consequence, perception is in itself a form of acting. Gibson's approach represents one of the main theoretical points of reference for the perspectives of embodied cognition (EC) (e.g., Barsalou 2008; Engel *et al.* 2013; Lakoff and Johnson

1999; Wilson 2002). The main assumption of EC is that cognition is not a representation of the world but is strongly tied to action in the world (Clark 1997; Varela *et al.* 1991). As Engel and colleagues (2013: 206) maintain, "cognition is fundamentally action-bound, subserving the planning, selection, anticipation, and performance of actions. Thus, cognition and action are not only closely interrelated – cognition seems fundamentally grounded in action". From such a perspective, for example, knowing what an object is does not automatically imply having an internal abstract and amodal representation of the object but having sensorimotor skills and possible actions to use the object.

We do not intend to discuss the validity of EC compared to classical computational models and the various formulations of embodied theories (see Wilson 2002). For our argument, what is important to note is that the central assumption of EC is the rejection of the symbolic framework, according to which the cognitive processing requires a small set of rules that operate on a vast set of arbitrary, amodal and abstract symbols: and the mind is conceived as a computational system of abstract symbols detached from the reality they represent (cf. Fodor 1975; Pylyshyn 1985; Turing 1950). As we noted by discussing Chomsky's and Fodor's positions, within the computational framework the relevant aspects of linguistic (and in general mental) processes concern how symbols combine with one another, not how they relate to external reality. As Meteyard and colleagues (2012: 789) stressed:

> the thorny problem of how symbolic representations refer to things in the world was explicitly recognized (Fodor 1987; Pylyshyn 1985; Newell 1980) but never explained within the symbolic framework. Determining the organization of cognitive processes was more important than establishing its content.

Putting aside the question of whether such criticism is valid for all the authors who Meteyard and colleagues cite, it must be stressed that, contrary to the symbolic paradigm supporters', the authors moving within the theoretical framework of EC consider the symbol grounding problem as the central issue to account for the nature of human language and cognition. Originally formulated by Harnad (1990), the symbol grounding problem is posed to answer to the following question: how can the meaning of the meaningless symbol tokens (as those postulated by the symbolic models of the mind), manipulated solely on the basis of their arbitrary shapes, be grounded in anything but other meaningless symbols?

Regarding this issue there are two considerations. The first is that even though in Harnad's original formulation, and in the debate that followed,

the symbol grounding problem posed a typical semantic problem, in this paper we propose a cognitive-pragmatic notion of grounding. The issue of using language in a manner contextually appropriate, namely in a way consonant to the situation, in effect, is all we need for a model of functioning (see section 3) and origin of language (see section 5) elaborated within EC. The second consideration is that, in line with the importance of the problem of the grounding of language to context as a specific case of the relationship between organism and environment, our adhesion to EC is in the first place an adhesion to the action-oriented models which exalt the embedded nature of cognition (Shapiro 2010). Indeed, such models, as Pouw and colleagues (2014) emphasize, could be considered "more embodied" because of the fact that they conceive cognition "as being on-line, that is, being tightly coupled with, embedded in, if not extended over, the body and the environment" (Pouw *et al.* 2014: 1). Indeed, the aspect more relevant to the embedded perspective is *situatedness*: the organism's immediate environment has a central role in its behavior; such environment is not only a rich source of constraints and opportunities for the organism, but also a context that gives meaning to its actions (Beer 2014). So much for the grounding problem. Now we have to take into account the second point of our argument: the ability of the action-oriented models to explain the origin of language with reference to gesture.

Obviously, the embedded perspectives (insofar as they are more embodied), first and foremost, are action-oriented models of cognition. It is exactly the attention to action that illuminates the link existing between such embodied-embedded perspectives and the gestural theories. The starting point is the link between action and language. The problem of creating contextually-appropriate behaviour is not only a linguistic issue, but it is also an issue endemic to action systems (Gallese and Lakoff 2005; Glenberg and Gallese 2012). The motor system has solved the problem of producing contextually-appropriate behaviour by being functionally organized in terms of goal-directed motor acts, and not in terms of movement (cf. next section) (Rizzolatti *et al.* 2000). According to Glenberg and Gallese (2012: 911) "the brain takes advantage of the solution of one difficult problem, namely contextually-appropriate action, to solve another difficult problem, namely contextually-appropriate language". This bond between aspects of language processing and the organization and activity of the human motor cortex has been demonstrated by numerous neuroscientific and behavioral studies (for a review, see Meteyard *et al.* 2012). For example, Pulvermüller (2005) found that when subjects simply read the word signifying an action, the motor system activates and represents its meaning: verbs for head, arm, and leg actions produce head, arm, and leg simulation in the respective areas of the motor

system. Glenberg and Kaschak (2002) found that participants more quickly responded to sentences if the response was compatible with the direction of the action implied in the sentence (sentence: "open the drawer"; action: hand moves toward the body). Similar results also came from patients with brain injury. For example, it has been shown that subjects with motor neuron disease or lesions in the left inferior frontal cortex have deficits in action-verb comprehension and in understanding pictures depicting actions (Bak *et al.* 2001, 2006). The connections between action systems and language processing characterize not only the processing of single words or single sentences, but also the processing of discourse and narratives (e.g., Chow *et al.* 2014; Kurby and Zacks 2013). The comprehension of stories might lead to the formation of modality-specific grounded representations: readers activated sensorimotor regions relevant to the perceptual information described in the text (i.e., secondary somatosensory and premotor cortex were associated with the reading of clauses that imply motor information [Kurby and Zacks 2013]). Studies of this type highlight that "our understanding of linguistic expressions is not solely an epistemic attitude; it is first and foremost a *pragmatic attitude toward action*" (Glenberg and Gallese 2012: 96, our emphasis).

5. Action-based communication and gestural origin of language

In the previous section we considered a generic relationship between language and action. Now it is time to deal with evolutionary issues showing the relationship between action-oriented models of cognition and gestural models of language origin. Indeed, the recognition that the motor system has a crucial role (beyond, of course, that tied to the motor control) in higher cognitive function and, specifically, in language comprehension and production, has also provided new views on the involvement of motor system in language evolution, supporting the hypothesis that human language first originated in a gestural-based system of communication (for a review, see Fogassi and Ferrari 2012).

Particularly relevant in this scenario is the discovery of mirror neurons, a specific class of sensorimotor neurons found for the first time in the F5 area of the premotor cortex of macaque's brain (di Pellegrino *et al.* 1992; Gallese *et al.* 1996), and then in area PFG in the rostral part of the inferior parietal lobule (e.g. Gallese *et al.* 2002). The presence of a mirror system has also been established in the human brain (Grafton *et al.*, 1996; Mukamel *et al.*, 2010). These neurons are defined as mirror because they allow a kind

of mirroring between perception and action. Specifically, they discharge when a monkey performs an intentional, goal-oriented act with the hands or the mouth (such as attempting to grasp, bite and tear an object) and when it observes another individual (human or monkey) accomplish a similar intentional act. This activity of the mirror neurons is unlike the so-called canonical neurons, which respond only to the presentation of the object. What is important to stress is that according to this perspective, the motor system is not involved in movement, but in action: "Unlike movement, action is defined by a goal and by expectancy. Movements are the final outcome of action and are programmed and controlled as such only when action is set" (Rizzolatti *et al.* 2000). In this sense, through its links between action and perception, the mirror system provides a mapping of external reality onto our own internal representations (Aziz-Zadeh and Ivry 2009).

The functional role of mirror neurons is relevant to the origin of language. Several authors noted that the primary function of mirror neurons is related to an implicit, pragmatic, and non-reflective understanding of manual actions (Rizzolatti and Sinigaglia 2008). The idea is that when an individual observes an action performed by another, there is an activation of the neurons that represent (through simulation) that action in the premotor cortex. This (motor) simulation of the observed action induces the recovery of the internal motor circuit that represents that action. The consequence of this recovery is that the observer acquires the knowledge of the objective associated with the action. The mirror system, in this way, transforms visual information into knowledge (Rizzolatti *et al.* 2001). This process may underlie some aspects of communication. Indeed, a communicative gesture made by an individual (the sender) retrieves in the observer (the receiver) the neural circuit encoding the motor representation of the same gesture and, in this way, allows the receivers to grasp the message (gesture) of the sender (Rizzolatti and Arbib 1998). Because of the mirror system's functional role, it was proposed that it may have played a key role in the evolution of a communication system based on hand gestures that paved the way to human language (Arbib 2005; Corballis 2010; Gentilucci and Corballis 2006; Rizzolatti and Arbib 1998; Zlatev 2014). One of the key elements at the basis of this hypothesis is the fact that area F5 of the ventral premotor cortex of the macaque brain is homologous to Broca's area in humans (specifically to the dysgranular area 44, the posterior part of Broca's area) (Rizzolatti and Arbib 1998), traditionally considered as a 'speech area' (Broca 1861; Embick *et al.* 2000), but also involved in motor function unrelated to speech (e.g., complex hand movements and sensorimotor learning and integration, Binkofski and Buccino 2004). As Broca's area developed from

an area originally involved in the processing of action, from this perspective it is assumed that the ability to recognize and perform actions related to praxis, such as those involving the manipulation of objects, provided the basis for the development of the ability to perform and recognize communicative hand gestures that, in turn, provided the evolutionary basis for the development of the brain mechanisms that support spoken language. The extension of the brain systems at the basis of spoken language has been a consequence of the fact that the precursor of Broca's area was equipped, before speech, with a mechanism for recognizing actions made by others. This mechanism was the neural prerequisite for the development of the inter-individual communication, first based on hand-gesture, and finally on speech (Rizzolatti and Arbib 1998: 190).

This gesture-first account is confirmed by several studies on monkeys and apes that have shown the existence of significant differences between vocal and gestural communication (and, more generally, bodily communication) among these animals. Specifically, it is widely attested that, in nonhuman primates, gestural communication systems are more flexible than vocal ones. The vocalizations of nonhuman primates are, for the most part, genetically determined. Each species has a relatively limited repertoire of calls whose acoustic characteristics are mainly fixed at birth and show minimal change during development (Cheney and Seyfarth 2010; Hammerschmidt and Fischer 2008). In addition, neurological evidence suggests that the vocal productions of monkeys and apes are mainly related to their emotional states (e.g., fear, excitement, etc) and this fact limits the communicative power of vocal calls (although see e.g., Clay and Zuberbühler 2014). In contrast, hand gestures in nonhuman primates can be produced voluntarily by the animals and because of this they can be used in a more flexible way than vocalizations. Great apes use gestures in different contexts to communicate different things (cf. Pollick and de Waal 2007). Apes' gesture production takes into account the attentional state of the recipient: visual gestures (gestures that are not accompanied by any sound) are frequently used when the receiver is paying attention to the indicator (Tomasello and Call 2007), while auditory and tactile gestures are produced to attract the attention of an individual who are not looking at the signaller (Tomasello *et al.* 1994). So, although vocalizations are an important mode of communication for most primates and despite that, the vocal mode of communication intuitively is often considered a precursor of speech, the vocalizations of nonhuman primates have little in common with human language (Eberl 2010; Hammerschmidt and Fischer 2008; Ploog 2002; Tomasello 2008).

The experimental evidence and the theoretical arguments discussed in this section allow us to maintain that the embodied mind (specifically, the attention to action that characterizes this approach to cognition) represents a plausible conceptual framework to account for the gestural foundation of language in a phylogenetic perspective. In accord with this result, we can say that even the second step of our argument becomes clearly plausible.

6. Conclusion

In this paper we showed that the interplay between the grounding problem and the theories of gestural origins of language can be used to elaborate a naturalistic model of human communication. In a model of language that conforms with the principle of evolutionary plausibility, in fact, the relationship of language with external environment is a fundamental characteristic (a specific characteristic of the more general relationship between organism and environment). From this point of view, the embedded model of cognition offers a fruitful conceptual framework for a naturalistic approach to the study of language. Given the close relationship between the embedded model and the gestural theories, it is possible to argue that the embodied cognition represents the conceptual bridge to put together the gestural origins of language with the grounding problem. Such a standpoint opens the way to a truly naturalistic perspective of human language.

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