

Ines Adornetti

Cosmic Lab, Department of Philosophy, Communication and Performing Arts,
Roma Tre University, Rome
ines.adornetti@uniroma3.it

Alessandra Chiera

Cosmic Lab, Department of Philosophy, Communication and Performing Arts,
Roma Tre University, Rome
alessandra.chiera@uniroma3.it

Serena Nicchiarelli

Cosmic Lab, Department of Philosophy, Communication and Performing Arts,
Roma Tre University, Rome
serenanicchiarelli@gmail.com

Olga Vasileva

Psychological Foundations Lab, Department of Psychology,
Simon Fraser University, Vancouver
olga_vasileva@sfu.ca

How Did Language Evolve? Biological, Psychological, and Linguistic Perspectives

Introduction

The topic of language origin and evolution has been considered for a long time as a difficult question to address scientifically because of poverty of empirical data and limitations in methodology (Müller, 1861). These considerations have led to the well-known edicts by the *Société de Linguistique de Paris* in 1866 and the *Philological Society of London* in 1872 that forbade all members from presenting speeches on the topic.

Nowadays the situation has profoundly changed and the study of language phylogenesis is at the center of a renewed interest (e.g. Fitch, 2010; Tallerman & Gibson, 2012). A first important step in this regard was in the 1970s when Gordon Hewes (1973) published his seminal paper *Primate communication and the gestural origin of language*. With his work Hewes reopened the way to the studies on language evolution, explaining the origin of human communication in a gestural theoretical framework and synthesizing evidence from primatology, paleoanthropology, and neuroscience. A second milestone was the article by Pinker and Bloom (1990) *Natural Language and Natural Selection*, in which the authors explained the evolution of the language faculty from a Neo-Darwinian perspective, by considering it as an adaptation for communication. From that moment on, many different interpretative models have been proposed to shed light on the communicative capacities of our ancestors that might have led to the development of language as we know it today (e.g. Bickerton, 1990; Donald, 1991; Dunbar, 1996; Corballis, 2002; Hurford, 2007; Tomasello, 2008; Arbib, 2012). What these different models have in common is an inherently interdisciplinary character that has gradually become a default principle in language evolution research (Ferretti et al., 2018; Fitch, 2017; Gong et al., 2013). Among the disciplines involved in the study of language origin there are: archaeology, biology, computer simulation, cognitive and developmental psychology, genetics, linguistics, neuroscience, paleoanthropology, and primatology. As highlighted by Fitch (2017), thanks to this interdisciplinary enterprise,

We have whole new classes of data that provide new insights into key issues and problems (e.g., paleo-DNA). The field also profits from a productive new inter-disciplinary community that is constructively engaging with these problems (centered around the biennial EvoLang conference series), and a flood of more traditional sorts of data (e.g., regarding animal cognition and communication, genetics, and neuroscience). This combination has led to increasingly sophisticated models of language evolution that make multiple testable predictions, and improved evaluation criteria for assessing such models. The result [...] is an ongoing transition of scientific research on language evolution from one dominated by speculation and pet hypotheses to “normal science”. (Fitch, 2017, p. 3)

This special issue of *Theoria et Historia Scientiarum* focuses on the contribution to the study of language evolution offered by three disciplines: biology, psychology, and linguistics. In this Introduction, we will present

some classical examples illustrating how the results coming from them can shed light on the phylogenetic roots of our own typical way of communicating.

Biological Predispositions for Language: The Evolution of the Vocal Tract

Language largely relies on our biology (e.g. Lenneberg, 1967; Caplan, Roch Lecours, & Smith, 1984; Fitch, 2012). The study of the biological predispositions of language can be addressed from different points of view, since stating that language depends on our biology means saying, at a general level, that it relies on our bodies, genes and brains. Therefore, anatomy, genetics and neurosciences can all contribute to point out the main biological features necessary for language to evolve. Here we focus on one specific anatomic feature that for a long time was thought to be crucial for the evolution of speech: the shape of the vocal tract. Research exploring the morphology and physiology of the vocal tract benefits from empirical findings in comparative anatomy and aims “to obtain the evidence of presence or absence of critical conformations associated with unique human behaviors like speech, and assumes that unique behaviors like language must be determined by unique anatomical or physiological arrangements” (Gong et al., 2018, p. 121).

Investigations exploring the evolution of the vocal tract start from a fundamental observation: the human supralaryngeal vocal tract (SVT) is anatomically different from that of other living primates (Lieberman, 2007). The human SVT is divided into two parts: a horizontal portion in the oral cavity including the mouth and oropharynx; a vertical portion in the throat, i.e., the pharynx, which is located behind the tongue and above the larynx, extending from the palate down to the vocal cords. In modern adult human beings, these two portions form a right angle to one another and are approximately equal in length. This anatomic configuration of the vocal tract is crucial for speech as “the supralaryngeal vocal tract acts as an acoustic filter that determines the phonetic quality of the sounds” (Lieberman, 2007, p. 40). On the contrary, in nonhuman primates the larynx is located high in the throat (near the base of the mandible) and the tongue is long and largely restricted to the oral cavity. The result is a disproportionate shape of the SVT in nonhuman primates. For this reason, the range of vocal sounds available to these animals is widely constrained.

From the point of view of language evolution, the questions to be addressed are the following: when did fully human vocal tract appear? Did our

hominin ancestors own this anatomical configuration necessary for speech? To answer these questions, it is necessary to reconstruct the anatomy of the SVT of a fossil, and, particularly, the position of the larynx in the throat. The problem is that the SVT is a soft tissue and bones are all that remain in the fossil record. However, there are some indirect clues that can be used to infer the possible location of the larynx in extinct hominins (cf. Fitch, 2010). Among these, the basicranial angle – the base of the skull connected to the vertebral column that in the human beings form a 90-degree angle – and the hyoid bone – the bone supporting the root of the tongue. The first important investigation on this topic was that of Lieberman and Crelin (1971). The authors tried to determine the probable vocal tract of fossil hominins by establishing correlations between the basicranial angle and the vocal tract in living nonhuman primates and then making inferences based on this angle in a fossil. They analyzed the basicranial flexion of a Neanderthal fossil and suggested that it was similar to that observed in modern chimpanzees rather than to that of modern adult human beings. Starting from these observations, the authors proposed that the larynx of *Homo neanderthalensis* was located high in the throat and that, because of this, he was unable to produce fully articulated language. According to the authors, in fact, fully human speech emerged relatively late, about 50,000 years ago, in *Homo sapiens* (who first appeared as species 200,000 years ago) (Lieberman, 2007, p. 59).

The hypothesis advanced by Lieberman and Crelin has been disputed over the years and nowadays the idea that the SVT of *Homo neanderthalensis* was like that of chimpanzee is not supported anymore (cf. Mithen, 2005). An important study in this respect was the analysis of the hyoid bone of a Neanderthal fossil found in Kebara (Israel) (Arensburg et al., 1990). As mentioned above, the hyoid bone, which provides an anchoring structure for the tongue as well as most of the other muscles of the vocal tract, can be used as an indirect clue to infer the position of the larynx (the larynx hangs below hyoid bone). Researchers who analyzed the hyoid bone of Kebara fossil observed that its shape was similar to that of modern human beings. This observation led to conjecture that the larynx was located low in the throat too. This opened the way to the hypothesis that a Neanderthal might have had a vocal apparatus similar, albeit not identical, to that of *Homo sapiens*. Further findings contributed to corroborate such a view. Martinez and colleagues (2008) analyzed two hyoid bones from the middle Pleistocene site of the Sima de los Huesos (Spain) dating back at least 530,000 years. Human fossils found in this site have been assigned to the species *Homo heidelbergensis*, the last common ancestor of *Homo neanderthalensis* and *Homo sapiens*, representing the ancestral European population that evolved

into the Neanderthals. The two hyoid bones analyzed were like to those of modern human being and Neanderthal in both their morphology and dimensions and different from the hyoid bones of chimpanzees and more ancient hominins (i.e., *Australopithecus afarensis*). Thus, as the authors highlighted, “the genus *Homo* has been characterized by a modern-human-like anatomy of the hyoid bone since at least 530 ka” (Martinez et al., 2008, p. 123).

However, it should be noted that prominent researchers in the field of language evolution (e.g. Fitch, 2010, 2017) have suggested that it is the neural control of the vocal tract, rather than the robust morphology of the SVT, which is significantly different between humans and primates, and thus likely contributes to observed differences for speech propensity. To this regard, one of the fossil clues brought into play to reconstruct the neural vocal control of our ancestors is the enlargement of the thoracic canal in *Homo sapiens* relative to earlier hominins and other primates (MacLarnon & Hewitt, 1999). The relevance of such fossil clue for the evolution of the neural basis of speech is related to the fact that in the thoracic spinal cord there are neurons that control muscles involved in breathing. As these muscles are implicated in the fine control of pulmonary pressures during vocal production, it has been hypothesized that an enhanced breathing control (made possible by an enlargement of the thoracic canal) represented an adaptation to fine vocal control and speech. Starting from these observations, MacLarnon and Hewitt (1999) analyzed the thoracic canal diameter in extant primates, modern *Homo sapiens* and extinct hominins, such as *Australopithecus afarensis* and *Homo ergaster*. Their analysis revealed that the thoracic vertebral canal of these hominins was of similar relative size to that of extant nonhuman primates, and substantially smaller than that of modern humans. Interestingly, from this study emerged that Neanderthals had a thoracic vertebral canal of similar relative dimensions to that of modern *Homo sapiens*. Although our fossil evidence for the evolution of thoracic canal size is limited, according to Fitch (2010) the few existing data on that are plausible and well supported. In his opinion, indeed,

The solid data come from living primates and modern humans, from the “Turkana Boy” *Homo ergaster* skeleton, and from several Neanderthal specimens, and indicate that thoracic expansion occurred sometime in the million-year period of evolution after *Homo ergaster* but before Neanderthals (e.g. later *Homo erectus* or *H. heidelbergensis*). (Fitch, 2010, p. 335)

Overall, these findings, in conjunction with a broader range of evidence coming from other disciplines (for a discussion: Dediu & Levinson, 2013), contributed to reassess the antiquity of speech from 50,000/100,000 years to half a million years. Indeed, according to Dediu and Levinson (2013, p. 6), “the number and diversity of clues, taken together, clearly point in the direction of a modern capacity for speech in the common ancestor of Neanderthals and modern humans.”

Psychological Prerequisites for Language: The Role of Mindreading

In addition to investigations centered on the evolution of speech, research on language evolution is also characterized by theoretical models and empirical studies aiming at unveiling the cognitive capacities underlying the evolution of human communication (Tomasello, 2008; Corballis, 2011; Scott-Phillips, 2015; Ferretti, 2016; Ferretti et al., 2017). Attention to comparative cognitive research can be explained by increasing understanding that knowledge of how cognition forms in evolution, what cognitive abilities are required for language (and what is their evolutionary history), along with the relationship between cognition and communication in various species are crucial for understanding the complexity of language evolution. As can be expected, also this kind of research cannot rely on direct evidence: same as speech, cognition does not fossilize. However, it is possible to attempt to reconstruct the cognitive evolution of our extinct ancestors exploiting data coming from primatology and cognitive ethology: the mind of our closest relatives, the great apes, with whom we share a common ancestry dating back six or seven million years, can be used for developing models of cognitive capacities of the last common ancestor with chimps and to make inferences about the psychological equipment of the extinct hominins. Additionally, comparative data from non-primate species allows researchers to model formation of analogous cognitive and communicative traits, which likely contributed to language evolution in humans. Research in various species of vertebrates, ranging from birds to mammals, contributes to understanding which processes and environmental pressures (e.g. intense competition for mating, social environment, altricial offsprings) influenced development of specific features of cognition and communicative systems.

Against this background, investigating the origin and evolution of language corresponds to examine the cognitive capacities underlying language processing in order to clarify to what extent these capacities are

shared with the great apes. Therefore, the starting point of the perspectives embracing this view is the analysis of the cognitive foundations of human communication. The interpretive perspective better able to account for this aspect is the ostensive–inferential model of communication or relevance theory (RT; Sperber & Wilson 1986/1995). Following Grice’s intuition, according to which an essential feature of most human communication, both verbal and non-verbal, is the expression and recognition of intentions (Grice, 1957, 1969), RT views communication as an inferential pragmatic process in which the generation and the detection of communicators’ intentions are central. Indeed, according to RT, a linguistic interaction is characterized by the speaker’s meaning, a complex communicative intention aimed to achieve a certain effect on the hearer’s mind by means of the hearer’s recognition of the intention to achieve this effect. Scott-Phillips (2015, p. 64) highlighted that “when we communicate with others, we must know something about their minds in order to understand their intended meanings, and indeed to tailor our own utterances to them”. At a general level, identification of others’ intentions is made possible by a specific cognitive system defined “theory of mind” or “mindreading”. These terms are used to describe the ability to attribute mental states such as beliefs, intentions, and feelings to others and to explain and predict the actions that derive from them (e.g. Premack & Woodruff, 1978; Baron-Cohen, 1995; Westra & Carruthers, 2018). Theory of mind allows us to entertain “metarepresentations”: we do not only mentally represent other’s mental states but also process multiple levels of mental representations. In other words, we can think about what you know about what she thinks and so on (Scott-Phillips, 2015). The classical experimental paradigm allowing to evaluate such ability in humans is the so called “false belief task” (Wimmer & Perner, 1983; Baron-Cohen, Leslie, & Frith, 1985), which requires the understanding that others may hold and act on false beliefs.

According to several authors, the mindreading system is not only involved in language processing but had a crucial role in its origins (Sperber, 1995; Dunbar, 1996; Origggi & Sperber, 2000; Tomasello, 2008; Scott-Phillips, 2015). Sperber (1995) proposed that

human communication is a by-product of human meta-representational capacities. The ability to perform sophisticated inferences about each other’s states of mind evolved in our ancestors as a means of understanding and predicting each other’s behavior. This in turn gave rise to the possibility of acting openly so as to reveal one’s thoughts to others. As a consequence, the conditions were created for the evolution of language. Language

made inferential communication immensely more effective. It did not change its character. All human communication, linguistic or non-linguistic, is essentially inferential. Whether we give evidence of our thoughts by picking berries, by mimicry, by speaking, or by writing – as I have just done –, we rely first and foremost on our audience’s ability to infer our meaning. (p. 199)

Stating that human meta-representational capacities are at the foundation of language implies saying that theory of mind has a logical and temporal priority over language. Therefore, to corroborate this view it should be demonstrated that the ability to mentally represent the other’s mental states is also present in our closest relatives. Do the great apes have the ability of theory of mind? This question is at the center of a lively debate (Dennett, 1978; Byrne & Whiten, 1988; Heyes, 1998; Hare, Call, & Tomasello, 2000; Andrews, 2017; Krupenye et al., 2016), which started at the end of the 1970s with the classical paper by Premack and Woodruff (1978) *Do the chimpanzee have a theory of mind?* The authors answered affirmatively to the question suggesting that chimpanzees are able to interpret other’s behaviors (namely, human’s behavior) by attributing mental states. However, despite the positive answer offered by the authors, determining whether non-human primates have a capacity of this kind is a controversial fact. For example, years later Premack (1988), referring to new studies, suggested that “if the chimpanzee have a theory of mind, it will be weaker than the human one. (...) the states of mind the chimpanzee is most likely to instantiate are the sensory ones – seeing, wanting, expecting” (p. 175). A similar conclusion was also endorsed by Call and Tomasello (2008):

there is solid evidence from several different experimental paradigms that chimpanzees understand the goals and intentions of others, as well as the perception and knowledge of others. Nevertheless, despite several seemingly valid attempts, there is currently no evidence that chimpanzees understand false beliefs. Our conclusion for the moment is, thus, that chimpanzees understand others in terms of a perception–goal psychology, as opposed to a full-fledged, human-like belief–desire psychology. (p.187)

However, over recent years the situation has profoundly changed. In this respect, it has been crucial a study promoting a new experimental paradigm (the anticipatory looking test) that allowed to show that chimpanzees,

bonobos, and orangutans recognize that others' actions are driven not by reality, but beliefs about reality, even when those beliefs are false (Krupenye et al., 2016). In other words, this study demonstrated that apes can ascribe a false belief to an agent, challenging the view that this ability is uniquely human (see also Buttelmann et al., 2017).

If great apes can mentally represent the mental states of others (at least to some extent), it can be expected that they also would be able to exploit this ability for communication. Is there evidence on that? In this respect the results obtained by Crockford and colleagues (2012) on chimpanzees' vocal communication are particularly interesting. Authors 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. 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, p. 145). In other 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." (for a discussion: Adornetti, 2015). Overall, these results (see also Schel et al., 2013) can be used to support the hypothesis mentioned above according to which some level of mindreading abilities might be a pre-requisite for evolvement of human communication; and indeed might represent a homologous trait found in modern day primates. From this point of view, theory of mind represented a crucial psychological prerequisite for language to evolve.

Linguistics Perspectives on Language Evolution: The Case of Syntax

One of the most contentious and controversial debate in language evolution research concerns the origin and evolution of an important linguistic dimension: syntax (Bickerton, 1990; Pinker & Bloom, 1990; Jackendoff, 1999; Hauser, Chomsky, & Fitch, 2002; Heyne & Kuteva, 2007; Berwick, 2011; Hurford, 2012; Boeckx & Benítez-Burraco, 2014a; Tallerman,

2014). Syntax can be described as “the rule-governed combination of small meaningful units (morphemes) into hierarchical structure (phrases and sentences) whose meanings are some complex function of those structures and morphemes” (Fitch, 2010, p. 104). At a general level, researchers aimed at investigating the evolutionary roots of syntax can be positioned along two major views. On the one hand, there are authors who suggested that its emergence happened abruptly, for example via a mutation affecting the *Homo sapiens* brain that gave rise to modern language (e.g. Bickerton, 1990; Chomsky, 2010; Berwick & Chomsky, 2016). On the other hand, there are scholars who proposed that syntax evolved slowly and gradually with a smooth improvement in linguistic ability (e.g. Pinker & Bloom, 1990; Jackendoff, 1999; Tallerman, 2014). In turn, authors embracing this gradualist development of syntax can be ascribed to two lines of thought: those who explained this development by referring to Darwinian biological evolution (e.g. Pinker & Bloom, 1990; Pinker & Jackendoff, 2005) and those who, on the contrary, invoked socio-cultural evolution (e.g., Heyne & Kuteva, 2007; Christiansen & Chater, 2008; Smith & Kirby, 2008).

The best-known exponent of the view according to which syntax emerged suddenly in *Homo sapiens* is Noam Chomsky. Although for a long time Chomsky considered the investigations on language evolution “a complete waste of time” (Chomsky, 1988, p. 183), over the last twenty years he has taken part in the debate (Hauser, Chomsky, & Fitch, 2002; Fitch, Hauser, & Chomsky, 2005; Hauser et al., 2014) suggesting that the faculty of language, namely Universal Grammar (UG) – an innate computational system in the brain specific for language processing –,

seems to have crystallized fairly recently among a small group in East Africa of whom we are all descendants, distinguishing contemporary humans sharply from other animals, with enormous consequences for the whole of the biological world. It is commonly and plausibly assumed that the emergence of language was a core element in this *sudden* and *dramatic* transformation. (Berwick & Chomsky, 2011, p. 20, our emphasis)

According to this perspective, UG appeared quite recently, some 70,000–100,000 years ago in *Homo sapiens*, and does not appear to have undergone modification since then (Bolhuis et al., 2014). An important claim of such perspective is that communication (the element of externalization) is a secondary (if not irrelevant) aspect of language, not its key function. For example, according to Chomsky, language serves primarily as an internal instrument of thought. Therefore, “[T]he earliest stage of language would

have been a language of thought, available for use internally” (Chomsky, 2010, p. 55).

To corroborate their scenario, proponents of the abrupt emergence of UG usually refer to putative proxies for language in the fossil and archaeological records (cf. Chomsky, 2010; Hauser et al., 2014).¹ Specifically, they mention the first signs of symbolic material culture dating back about 100,000 years (Tattersall, 2008, 2018) or even later, around 50,000 the period associated with the notion of the Upper Paleolithic Revolution (Bar-Yosef, 2002). According to the paleoanthropologist Ian Tattersall (2008), in fact, it is only in the period following about 100 thousand years ago that we find undoubted evidence of symbolic behavior patterns among populations of *Homo sapiens*. These patterns include small ochre plaques bearing distinct geometrical designs (Henshilwood et al., 2003) and body ornaments (small shells pierced to be worn as a necklace) (Henshilwood et al., 2004). Then, even if the symbol-ready brain was acquired some 200,000 years ago (when our biological species emerged), it was not used, “until it was recruited by what had necessarily to have been a cultural or behavioral stimulus. (...) given the suddenness with which the new capacity emerged, the most plausible candidate is without question the invention of language” (Tattersall, 2018, p. 294).²

The symbolic revolution model has been confuted by numerous findings (see Henshilwood & Marean, 2003; McBrearty & Brooks, 2000; Wurz, 2010), from which emerged that many patterns of behavior considered typical of the symbolic revolution were more ancient and present in species other than *Homo sapiens*. Specifically, they first appeared (even if in discontinuous and rudimentary ways) during the Middle Stone Age, the period that began around 280,000 years ago and ended around 50,000 years ago. Therefore, as these findings support a new scenario according to which the symbolic thought emerged gradually and was not unique to *Homo sapiens*, they contradict the symbolic revolution hypothesis. In turn, this new scenario also undermines the idea of a sudden emergence of syntax some 70,000–100,000 years ago, given that the proponents of the abrupt emergence of UG usually consider

¹ The idea that the archaeological record can shed light about the emergence of the language faculty has been disputed by some scholars. See, for example, Botha (2008, 2016) and Bouchard (2013).

² When he speaks of language, Tattersall has in mind Universal Grammar: “the possession of articulate language [underpinned by Universal Grammar within the framework elaborated by Hinzen (2012)] is the most immediately striking attribute of *Homo sapiens* today” (Tattersall, 2018, p. 298).

the symbolic revolution as a proxy for language in the archaeological records (cf. Tallerman, 2014).

As mentioned above, against the idea of an abrupt origin, other scholars proposed that the development of syntax can be explained through gradualist processes. The first attempt in this regard was that by Pinker and Bloom (1990). Adhering to the neo-Darwinian research program of evolutionary psychology (Barkow, Cosmides, & Tooby, 1992) and starting from the assumption that communication is the main function of the language faculty, the authors maintained the UG has to be considered as a biological adaptation for communication shaped by natural selection. They wrote:

For universal grammar to have evolved by Darwinian natural selection, it is not enough that it be useful in some general sense. There must have been genetic variation among individuals in their grammatical competence. There must have been a series of steps leading from no language at all to language as we now find it, each step small enough to have been produced by a random mutation or recombination, and each intermediate grammar useful to its possessor. Every detail of grammatical competence that we wish to ascribe to selection must have conferred a reproductive advantage on its speakers, and this advantage must be large enough to have become fixed in the ancestral population. And there must be enough evolutionary time and genomic space separating our species from nonlinguistic primate ancestors. (Pinker & Bloom, 1990, p. 721)

Over the years, Pinker and Bloom model has been challenged (e.g. Botha, 2002) both by authors who are within the UG paradigm (e.g. Boeckx & Benítez-Burraco, 2014b) and scholars who do not embrace Chomsky model of language (Christiansen & Chater, 2008; Kirby, Cornish, & Smith, 2008; Smith & Kirby, 2008; Kirby, Griffiths, & Smith 2014; Kirby, 2017). In recent years, indeed, a growing body of work has begun to show that many aspects of language structure are the result of cultural transmission, rather than being genetically encoded biological traits, as the UG model assumes (cf. Thomas & Kirby, 2018). For example, Christiansen and Chater (2008) advanced the idea that language evolution has to be considered as a process of cultural change, in which syntactic structures are shaped through repeated cycles of learning and use by domain general mechanisms (instead of domain-specific innate computational system in the brain for language processing). They state:

We propose that language has adapted through gradual processes of cultural evolution to be easy to learn to produce and understand. Thus, the structure of human language must inevitably be shaped around human learning and processing biases deriving from the structure of our thought processes, perceptuomotor factors, cognitive limitations, and pragmatic constraints. Language is easy for us to learn and use, not because our brains embody knowledge of language, but because language has adapted to our brains. (Christiansen & Chater, 2008, p. 490)

This view of language evolution is at the center of numerous empirical studies aimed at clarifying how language is passed on via social-cultural transmission, using, for example, formal modelling and iterated learning paradigm (for a discussion: Smith, 2012; Kirby, 2012). What these studies have been revealing is that the structure of language emerges from the process of cultural evolution that, in turn, affects the fitness of the learners acquiring that language. In other words, language seems to be the results of a complex co-evolutionary dynamics, the characteristics of which are the subject of current research.

The Present Issue

The issue opens with Domenica Bruni article, which is devoted to the presentation of the research program of the evolutionary psychology (EP). EP is a Neo-Darwinian theoretical approach to psychology that explains human cognitive traits as mental adaptations shaped by natural selection. As we mentioned above, EP's main assumptions also inspired the model of language evolution advanced by Pinker and Bloom. Bruni discusses the case of emotions showing as they are biological adaptations evolved to solve specific ancestral problems faced by our ancestors.

The contribution by Alessandra Chiera lies within the context of a psychological investigation, as it is interested in identifying the cognitive prerequisites for human language to evolve. The paper focuses specifically on the issue of language evolution from a protoconversational perspective. Indeed, starting from the assumption that face-to-face communication represents the most natural setting for language, Chiera states that also in an evolutionary perspective conversation has to be recognized as the central unit of analysis. Against this background, a set of low-level mechanisms of alignment are acknowledged as critical for linguistic communication to evolve in the absence of a full-fledged code. The focus on this kind

of mechanisms frames the discussion within a sensorimotor account of language evolution.

Alessandra Falzone analyses the peripheral and central structures of vocal articulation in the framework of the Evo-Devo (evolutionary developmental biology) perspective, discussing the main biological constraints that might have acted as necessary “mechanical triggers” upon which language function could have evolved. The biological framework also characterizes the contribution from Piera Filippi who focuses on the role of emotional communication in the emergence of language. The author suggests that emotional modulation of the voice may have prompted the emergence of language abilities and that, following co-evolutionary dynamics, these abilities retro-act on each other, pushing the evolution of language forward.

Marek Placiński and Monika Boruta-Żywiczyńska examine language evolution from the perspective of linguistics. They present an empirical research aimed at investigating the topic of the natural word order by means of the silent gesture paradigm developed by Goldin-Meadow et al. (2008). That study revealed that participants tended to produce Subject-Object-Verb (SOV) word order of a transitive event, regardless of the syntax of their native language. Placiński and Boruta-Żywiczyńska obtained different result compared to this previous finding and discuss possible interpretations for them. A linguistic approach is also the framework of Katarzyna Rogalska-Chodecka article, which is centred on the presentation and comparison of the results of some experiments about the transmission of linguistic structures conducted with the use of the iterated learning methodology. Taken together, results of these studies suggest that the common-sense intuition that communication might constitute a key factor in language evolution should be approached with caution.

Olga Vasileva discusses the longstanding debate prevailing in language evolution and comparative psychological research, namely the problem of continuity and discontinuity in animal and human communication. This debate remains an important meta-theoretical assumption in the field of language evolution. The paper first provides a brief overview of the debate by discussing examples of prominent research work in comparative communication. It further discusses how the problem of continuity can be approached in light of more general evolutionary thinking. Finally, it is suggested that the problem of continuity can be partly resolved by focusing on cognitive and behavioural trait distribution both between and within species. Specifically, it is proposed that conceptualising given traits (e.g. pointing gesture) as habitual, rather than human-unique, is informative for modelling the process of language evolution in humans.

Valentia Deriu provides a discussion of a book that recently has been at the center of a lively debate within language evolution research: “Speaking our Minds” by Thom Scott-Phillips (2015). In the book, Scott-Phillips embraces the model of language advanced by Sperber and Wilson who, as we have seen, consider human communication as an exercise of mindreading. Deriu gives an overview the book’s major claims and ideas, along with the discussion of the debate that followed its publication.

Przemysław Żywiczyński presents a review of the book “From Bacteria to Bach and Back” by Daniel Dennett (2017). As is often the case with Dennett’s works, the book deals with the major philosophical problems addressed in a Darwinian perspective. Żywiczyński discusses some of the main points – the emphasis on eliminativism and the new way of conceiving evolution with regard to the concept of Darwinian Spaces, among others – by highlighting the strength and the shortcomings of Dennett’s explanations. A particularly debated issue concerns that of language evolution, which is framed within a mem-centric perspective.

Acknowledgements

We would like to thank Sławomir Wacewicz for giving us the opportunity to edit this special issue. We also thank Julia Trzeciakowska for her support during the preparation of the issue.

References

- Adornetti, I. (2015). Competition and cooperation in language evolution: A comparison between communication of apes and humans. In F. D’Errico, I. Poggi, A. Vinciarelli, & L. Vincze (Eds.), *Conflict and multimodal communication: Social research and machine intelligence* (pp. 91–101). Cham: Springer.
- Andrews, K. (2017). Chimpanzee mind reading: Don’t stop believing. *Philosophy Compass*, 12(1), e12394.
- Arbib, M. A. (2012). *How the brain got language: The mirror system hypothesis*. New York: Oxford University Press.
- Arensburg, B., Schepartz, L. A., Tillier, A. M., Vandermeersch, B., & Rak, Y. (1990). A reappraisal of the anatomical basis for speech in Middle Palaeolithic hominids. *American Journal of Physical Anthropology*, 83(2), 137–146.

- Barkow, J. H., Cosmides, L., & Tooby, J. (Eds.). (1992). *The adapted mind: Evolutionary psychology and the generation of culture*. New York: Oxford University Press.
- Baron-Cohen, S. (1997). *Mindblindness: An essay on autism and theory of mind*. Cambridge: MIT Press.
- Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a “theory of mind”? *Cognition*, 21(1), 37–46.
- Bar-Yosef, O. (2002). The upper paleolithic revolution. *Annual Review of Anthropology*, 31(1), 363–393.
- Berwick, R.C. (2011). Syntax facit saltum redux: Biolinguistics and the leap to syntax. In A. M. Di Sciullo & C. Boeckx (Eds.), *The biolinguistic enterprise: New perspectives on the evolution and nature of the human language faculty* (pp. 65–99). New York: Oxford University Press.
- Berwick, R. C., & Chomsky, N. (2011). The biolinguistic program: The current state of its development. In A. M. Di Sciullo & C. Boeckx (Eds.), *The biolinguistic enterprise: New perspectives on the evolution and nature of the human language faculty* (pp. 19–41). New York: Oxford University Press.
- Berwick, R. C., & Chomsky, N. (2016). *Why only us: Language and evolution*. Cambridge: MIT Press.
- Bickerton, D. (1992). *Language and species*. Chicago: University of Chicago Press.
- Boeckx, C. A., & Benitez-Burraco, A. (2014a). The shape of the human language-ready brain. *Frontiers in Psychology*, 5, 282.
- Boeckx, C. A., & Benitez-Burraco, A. (2014b). Biolinguistics 2.0. In K. Fujita, N. Fukui, N. Yusa, & M. Ike-Uchi (Eds.), *The design, development and evolution of human language: Biolinguistics explorations* (pp. 7–30). Tokyo: Kaitakusha.
- Bolhuis, J. J., Tattersall, I., Chomsky, N., & Berwick, R. C. (2014). How could language have evolved? *PLoS Biology*, 12(8), e1001934.
- Botha, R. P. (2002). Did language evolve like the vertebrate eye? *Language & Communication*, 22, 131–158.
- Botha, R. (2008). Prehistoric shell beads as a window on language evolution. *Language & Communication*, 28(3), 197–212.
- Botha, R. (2016). *Language evolution: The windows approach*. Cambridge: Cambridge University Press.
- Bouchard, D. (2013). *The nature and origin of language*. Oxford: Oxford University Press.
- Buttelmann, D., Buttelmann, F., Carpenter, M., Call, J., & Tomasello, M. (2017). Great apes distinguish true from false beliefs in an interactive helping task. *PloS One*, 12(4), e0173793.
- Byrne, R., & Whiten, A. (Eds.). (1988). *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes and humans*. Oxford-New York: Oxford University Press.
- Call, J., & Tomasello, M. (2008). Does the chimpanzee have a theory of mind? 30 years later. *Trends in Cognitive Sciences*, 12(5), 187–192.

- Caplan, D., Lecours, A.R., & Smith, A. (Eds.). (1984). *Biological perspectives on language*. Cambridge: MIT Press.
- Chomsky, N. (1988). *Language and problems of knowledge: The Managua lectures*. Cambridge: MIT Press.
- Chomsky, N. (2010). Some simple evo devo theses: How true might they be for language. In R.K. Larson, V. Déprez, & H. Yamakido (Eds.), *The evolution of human language. Biolinguistic Perspectives* (pp. 45–62). Cambridge: Cambridge University Press.
- Christiansen, M. H., & Chater, N. (2008). Language as shaped by the brain. *Behavioral and Brain Sciences*, 31(5), 489–509.
- Corballis, M. C. (2002). *From hand to mouth: The origins of language*. Princeton, NJ: Princeton University Press.
- Corballis, M. (2011). *The recursive mind. The origins of human language, thought, and civilization*. Princeton, NJ: Princeton University Press.
- Crockford, C., Wittig, R. M., Mundry, R., & Zuberbühler, K. (2012). Wild chimpanzees inform ignorant group members of danger. *Current Biology*, 22(2), 142–146.
- Dediu, D., & Levinson, S. C. (2013). On the antiquity of language: The reinterpretation of Neandertal linguistic capacities and its consequences. *Frontiers in Psychology*, 4, 397.
- Dennett, D. C. (1978). Beliefs about beliefs. *Behavioral and Brain Sciences*, 1(4), 568–570.
- Dennett, D. C. (2017). *From bacteria to Bach and back: The evolution of minds*. New York City, NY: W. W. Norton & Company.
- Donald, M. (1991). *Origins of the modern mind: Three stages in the evolution of culture and cognition*. Cambridge: Harvard University Press.
- Dunbar, R. (1996). *Gossip, grooming and the evolution of language*. Cambridge: Harvard University Press.
- Ferretti, F. (2016). The social brain is not enough: On the importance of the ecological brain for the origin of language. *Frontiers in Psychology*, 7, 1138.
- Ferretti, F., Adornetti, I., Chiera, A., Nicchiarelli, S., Magni, R., Valeri, G., & Marini, A. (2017). Mental Time Travel and language evolution: A narrative account of the origins of human communication. *Language Sciences*, 63, 105–118.
- Ferretti, F., Adornetti, I., Chiera, A., Cosentino, E., & Nicchiarelli, S. (2018). Introduction: Origin and evolution of language: An interdisciplinary perspective. *Topoi*, 37(2), 219–234.
- Fitch, W. T. (2010). *The evolution of language*. Cambridge-New York: Cambridge University Press.
- Fitch, W. T. (2012). Innateness and human language: a biological perspective. In M. Tallerman & K. Gibson (Eds.), *The Oxford handbook of language evolution* (pp. 143–156). New York: Oxford University Press.
- Fitch, W. T. (2017). Empirical approaches to the study of language evolution. *Psychonomic Bulletin & Review*, 24(1), 3–33.
- Fitch, W. T., Hauser, M. D., & Chomsky, N. (2005). The evolution of the language faculty: Clarifications and implications. *Cognition*, 97(2), 179–210.

- Goldin-Meadow, S., So, W. C., Özyürek, A., & Mylander, C. (2008). The natural order of events: How speakers of different languages represent events nonverbally. *Proceedings of the National Academy of Sciences USA*, 105(27), 9163–9168.
- Gong, T., Shuai, L., & Wu, Y. (2013). Multidisciplinary approaches in evolutionary linguistics. *Language Sciences*, 37, 1–13.
- Gong, T., Shuai, L., & Wu, Y. (2018). Rethinking foundations of language from a multidisciplinary perspective. *Physics of Life Reviews*, 26–27, 120–138.
- Hewes, G. W. (1973). Primate communication and the gestural origin of language [and comments and reply]. *Current Anthropology*, 14(1/2), 5–24.
- Grice, H. P. (1957). Meaning. *The Philosophical Review*, 66(3), 377–388.
- Grice, H. P. (1969). Utterer's meaning and intention. *The Philosophical Review*, 78(2), 147–177.
- Hare, B., Call, J., Agnetta, B., & Tomasello, M. (2000). Chimpanzees know what conspecifics do and do not see. *Animal Behaviour*, 59(4), 771–785.
- Hauser, M. D., Chomsky, N., & Fitch, W. T. (2002). The faculty of language: What is it, who has it, and how did it evolve? *Science*, 298(5598), 1569–1579.
- Hauser, M. D., Yang, C., Berwick, R. C., Tattersall, I., Ryan, M. J., Watumull, J., ... Lewontin, R. C. (2014). The mystery of language evolution. *Frontiers in Psychology*, 5, 401.
- Henshilwood, C. S., & Marean, C. W. (2003). The origin of modern human behavior: Critique of the models and their test implications. *Current Anthropology*, 44(5), 627–651.
- Henshilwood, C. S., d'Errico, F., Yates, R., Jacobs, Z., Tribolo, C., Duller, G. A., ... Wintle, A. G. (2003). Emergence of modern human behavior: Middle Stone Age engravings from South Africa. *Science*, 295(5558), 1278–1280.
- Henshilwood, C., d'Errico, F., Vanhaeren, M., Van Niekerk, K., & Jacobs, Z. (2004). Middle Stone Age shell beads from South Africa. *Science*, 304(5669), 404–404.
- Heyes, C. M. (1998). Theory of mind in nonhuman primates. *Behavioral and Brain Sciences*, 21(1), 101–114.
- Heine, B., & Kuteva, T. (2007). *The genesis of grammar: A reconstruction*. New York: Oxford University Press.
- Hinzen, W. (2012). The philosophical significance of Universal Grammar. *Language Sciences*, 34(5), 635–649.
- Hurford, J. R. (2007). *The origin of meaning*. Oxford: Oxford University Press.
- Hurford, J. R. (2012). *The origins of grammar: Language in the light of evolution II*. Oxford: Oxford University Press.
- Jackendoff, R. (1999). Possible stages in the evolution of the language capacity. *Trends in Cognitive Sciences*, 3(7), 272–279.
- Kirby, S. (2012). Language is an adaptive system: The role of cultural evolution in the origins of structure. In M. Tallerman & K. Gibson (Eds.), *The Oxford handbook of language evolution* (pp. 589–604). New York: Oxford University Press.

- Kirby, S. (2017). Culture and biology in the origins of linguistic structure. *Psychonomic Bulletin & Review*, 24(1), 118–137.
- Kirby, S., Cornish, H., & Smith, K. (2008). Cumulative cultural evolution in the laboratory: An experimental approach to the origins of structure in human language. *Proceedings of the National Academy of Sciences*, 105, 10681–10686.
- Kirby, S., Griffiths, T., & Smith, K. (2014). Iterated learning and the evolution of language. *Current Opinion in Neurobiology*, 28, 108–114.
- Krupenye, C., Kano, F., Hirata, S., Call, J., & Tomasello, M. (2016). Great apes anticipate that other individuals will act according to false beliefs. *Science*, 354(6308), 110–114.
- Lenneberg, E. H. (1967). *The biological foundations of language*. New York: John Wiley and Sons.
- Lieberman, P. (2007). The evolution of human speech: Its anatomical and neural bases. *Current Anthropology*, 48(1), 39–66.
- Lieberman, P., & Crelin, E. S. (1971). On the speech of Neanderthal man. *Linguistic Inquiry*, 2(2), 203–222.
- MacLarnon, A. M., & Hewitt, G. P. (1999). The evolution of human speech: The role of enhanced breathing control. *American Journal of Physical Anthropology*, 109(3), 341–363.
- Martínez, I., Arsuaga, J. L., Quam, R., Carretero, J. M., Gracia, A., & Rodríguez, L. (2008). Human hyoid bones from the middle Pleistocene site of the Sima de los Huesos (Sierra de Atapuerca, Spain). *Journal of Human Evolution*, 54(1), 118–124.
- McBrearty, S., & Brooks, A. S. (2000). The revolution that wasn't: A new interpretation of the origin of modern human behavior. *Journal of Human Evolution*, 39(5), 453–563.
- Mithen, S. (2005). *The singing neanderthal*. London: Weidenfeld & Nicholson.
- Müller, F. M. (1861). The theoretical stage, and the origin of language. *Lectures on the Science of Language*, 7–8.
- Origg, G., & Sperber, D. (2000). Evolution, communication and the proper function of language. In P. Carruthers & A. Chamberlain (Eds.), *Evolution and the human mind: Language, modularity and social cognition* (pp. 140–169). Cambridge: Cambridge University Press.
- Pinker, S., & Bloom, P. (1990). Natural language and natural selection. *Behavioral and Brain Sciences*, 13(4), 707–727.
- Pinker, S., & Jackendoff, R. (2005). The faculty of language: What's special about it? *Cognition*, 95(2), 201–236.
- Premack, D. (1988). Does the chimpanzee have a theory of mind? In H. Byrne & A. Whiten (Eds.), *Machiavellian intelligence: Social expertise and the evolution of intellect in monkeys, apes, and humans* (pp. 160–179). Oxford-New York: Clarendon – Oxford University Press.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences*, 1(4), 515–526.

- Schel, A. M., Townsend, S. W., Machanda, Z., Zuberbühler, K., & Slocombe, K. E. (2013). Chimpanzee alarm call production meets key criteria for intentionality. *PloS One*, 8(10), e76674.
- Scott-Phillips, T. (2015). *Speaking our minds: Why human communication is different, and how language evolved to make it special*. New York: Macmillan International Higher Education.
- Smith, K. (2012). Why formal models are useful for evolutionary linguistics. In M. Tallerman & K. Gibson (Eds.), *The Oxford handbook of language evolution* (pp. 581–588). New York: Oxford University Press
- Smith, K., & Kirby, S. (2008). Cultural evolution: Implications for understanding the human language faculty and its evolution. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, 363(1509), 3591–3603.
- Sperber, D. (1995). How do we communicate. In J. Brockman & K. Matson (Eds.), *How things are: A science toolkit for the mind* (pp. 191–199). New York: Morrow.
- Sperber, D., & Wilson, D. (1995). *Relevance: Communication and cognition*. Cambridge: Harvard University Press. (Original work published 1986)
- Tallerman, M. (2014). No syntax saltation in language evolution. *Language Sciences*, 46, 207–219.
- Tallerman, M., & Gibson, K. R. (Eds.). (2012). *The Oxford handbook of language evolution*. New York: Oxford University Press.
- Tattersall, I. (2008). An evolutionary framework for the acquisition of symbolic cognition by Homo sapiens. *Comparative Cognition & Behavior Reviews*, 3(1), 99–114.
- Tattersall, I. (2018). Language origins: An evolutionary framework. *Topoi*, 37(2), 289–296.
- Tomasello, M. (2008). *Origins of human communication*. Cambridge: MIT Press.
- Thomas, J., & Kirby, S. (2018). Self-domestication and the evolution of language. *Biology & Philosophy*, 33(1–2), 9.
- Westra, E., & Carruthers, P. (2018). Theory of mind. In T. H. Shackelford & V. A. Weekes-Shackelford (Eds.), *Encyclopedia of Evolutionary Psychological Science* (pp. 71–76). Cham: Springer.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13(1), 103–128.
- Wurz, S. (2010). Middle Stone Age tools from Klasies River main site, conventions and symbolic cognition. *The Cutting Edge: Stone Tools and the Evolution of Cognition*, 135–158.