

Marcin Rządeczka

EVOLUTIONARY BIOLOGY AND SOME CONTEMPORARY DEBATES ON THE QUESTION ABOUT THE ORIGIN OF LANGUAGE

ABSTRACT

Natural language is one of the most enigmatic and sophisticated human capabilities with regard to both its evolutionary history and the level of complexity. The diversity of positions and debates on this subject clearly demonstrates that it is not yet a part of a science but rather an amalgam of different issues capable of being analyzed philosophically. The scarcity of evidence, restrictions of the comparative method and continuous discussions on the adaptive status of language are only a handful of current issues. The main aim of this paper is to provide a critical analysis of crucial current approaches to the problem of the reconstruction of language evolution and pinpoint the most important methodological and philosophical arguments in the discussion. The paper also supports the view that only the multi-level approach to the problem, which encompasses both the genetic and cladistic levels, can offer a satisfactory explanation.

Keywords: language evolution; comparative method; adaptationism; deep homology.

It is truly difficult to imagine a fiercer controversy in contemporary evolutionary biology than a dispute on the evolution of language and on methods which can be legitimately applied to its problematic type of scrutiny. The issue in question has even been declared as "the hardest problem in science" (Christiansen and Kirby 2003) by some researchers, certainly not with the intention to be interpreted literally, but in order to lay the emphasis on the sparseness of empirical evidence and manifold methodological restrictions imposed on this interdisciplinary problem.

TERMINOLOGICAL DEBATES

An absolute necessity to approach this matter from various scientific and philosophical perspectives has become a source of important debates concerning some crucial technical concepts. Evolutionary biology, cognitive psychology, linguistics, sociology and neurosciences, to name just a few involved disciplines, use the notion of language in a very specific local sense which, despite being easily applicable in their own field of research, is often too narrow or too vague in a broader interdisciplinary philosophy-laden debate. An easily overlookable distinction between I-language and E-language is a very illustrative example of this problem. Although being deeply rooted in Ferdinand de Saussure's *langue/parole* distinction, which appeared in his *Course in General Linguistics*, it was not widely acclaimed until Noam Chomsky's influential work (Chomsky 1986). Chomsky argues that the biologically grounded theory of language should focus on certain neurocognitive aspects of an individual such as the mechanism of language acquisition and be labelled I-language, whereas language studied by historical linguists, called by him E-language, is quite a different issue constituting an aggregated epiphenomenon of the former one. The straightforward conclusion is that the meaning of the phrase "language evolution" strongly depends on this distinction and can mean a biological as well as social process, and in some rare cases even the combination of both.

Even in the very core of the evolutionary-developmental biology, there are certain notional pitfalls, e.g., the term "faculty of language," which without additional predicates are burdened with vagueness equal to that hovering over the notion of "language" itself. It was aptly demonstrated by some scholars (Fitch, Hauser and Chomsky 2005, 179–210) that the term in question needed an extensive clarification. Some general cognitive processes like short- and long-term memory, audition, vocal production, signal learning or even meta-communication (e.g. a dog wagging its tail to signal that its subsequent aggressive behaviour is an element of harmless play) are widely-spread among vertebrates and not uniquely among humans, therefore being only a preliminary for a satisfactory theory of language. This set of cognitive modules and processes involved in understanding and using language can be tentatively called the faculty of language in the broad sense or FLB. Similarly, the faculty of language in the narrow sense or FLN is a subset of FLB mechanisms which are both unique to humans and to language.

Lastly, it is crucial for a theory of language to separate "language" from "communication." Communication is an indisputably ubiquitous phenomenon in all five kingdoms of living organisms, which is why we are constantly astonished by the variety of adaptations allowing different organisms to make use of chemical, electrical, tactile, olfactory, auditory and visual signals. Whether it is a vervet monkey producing an alarm call or a cuttlefish changing its colour, the purpose of communication is to convey a message in order to scare off a preda-

tor, attract a potential mate or tighten up some social bonds. Human communication also includes a wide range of facial expressions, gestures or body poses which due to their constant meaning and specific purpose can be used to instantly express our intentions, moods and attitudes towards something or somebody. Despite being defined as body language expressions, they certainly lack some important features like an unlimited peculiarity of expression, flexibility of usage in novel circumstances or a possibility of expressing pure nonsense, which are considered the hallmark of language (Fitch 2010, 24–27). In the light of this distinction certain expressions like "the body language" or "the language of cats" should be considered oxymorons rather than legitimate scientific terms. However, it certainly does not imply that all or even some language subcomponents are uniquely human. It was accurately stated by Tecumseh W. Fitch that it can simply be a new arrangement of pre-existent components which made the appearance of language possible.

COMPARATIVE METHOD

A lack of an appropriate and interdisciplinary valid terminology is certainly not the only obstacle to formulate a satisfactory theory of language evolution. The second group of current debates about this problem is dominated by some methodological considerations concerning the use of the comparative approach, reconstructing evolutionary scenarios and the problem of deep homology between humans and other, not necessarily primate, species. The comparative method is undoubtedly one of the central pillars supporting the evolutionary approach to language. Despite being an inestimable information source in other areas of research, fossils cannot provide substantial clues about the communicative behaviour and the use of the proto-language. The anatomy of the hyoid bone and its relative position in the body, although important, settles only the question about the capability of voice production, which is purely potential until accompanied by some unnecessarily detectable neural changes. In spite of a recent discovery of new early hominid fossils in Chad (Brunet et al. 2005, 752–755), which hopefully can shed some light on the Last Common Ancestor or LCA of human and chimpanzee, researchers are severely restricted in their attempts to harness the comparative method to work. Establishing the research upon the ethology of modern *Pan troglodytes* (the "common" chimpanzee) and *Pan paniscus* (the bonobo or the "pygmy" chimpanzee) is burdened with another methodological obstacle, i.e. the reconstruction of the Environment of Evolutionary Adaptedness or EEA. Neither *Pan troglodytes*, which inhabits the equatorial region of Africa, nor *Pan paniscus*, which prefers the thick rainforest of central Africa, live in circumstances comparable to those affecting early hominids. Both major climate changes during the last 5–7 million years and scarceness of evidence, which can be used to pinpoint our latest common ancestor's location, constitute an important dilemma for scientists wishing to

extrapolate environmental pressure of early hominids from the habitats of modern chimpanzee species (Richardson 2007, 141–173). Richardson also remarks the obvious vicious circle in reasoning which can easily appear during such a type of reconstruction. Because of close interconnections between LCA and EEA hypotheses and their strongly speculative nature, it is extremely important to avoid founding the reconstruction process of one hypothesis upon another, which in many cases presents an important challenge.

DEEP HOMOLOGY

While EEA reconstruction puts emphasis on correlations between an environment and adaptive traits, another complementary approach focuses on similar sets of genes which are present in cladistically distant organisms. This type of correlation is called a deep homology.

The basis of this reasoning lays on the hypothesis that the human possesses some regulatory genes which despite having a long evolutionary history are absent in other primates. The vivid examples are Hox genes which are responsible for the proper development of body parts in the correct order. *Drosophila melanogaster* (the fruit fly) with some Hox genes mutations develops an additional pair of legs instead of an antenna or another pair of wings on the thorax, which explains why regulatory genes tend to be very invariable since even minor mutation can lead to a drastic reduction in survival rate. It was, indeed, the duplication of Hox genes which allowed vertebrates to overcome some of the restrictions imposed on regulatory genes and go one step further on the road to complexity. The role of regulatory genes is so universal that they often underlie convergent evolution and can have a similar function in rather unrelated organisms, like Pax-6 involved in development of camera-eyes of both vertebrates and octopuses (Tyack and Miller 2002, 142–184). This phenomenon is called deep homology. There is some evidence suggesting that deep homology plays a crucial role in the development of human language abilities. One of the Fox genes, namely FOXP2, has been demonstrated to contribute to human speech production by controlling motility of the tongue and the lips. A lack of this particular gene causes severe oro-motor dyspraxia and difficulty in acquiring speech. Surprisingly, this gene is absent in other primates and, thus, being the only currently known gene both unique to humans and involved in speech production. Almost unbelievably, the same gene is not only present in birds but also plays an important role in vocal learning and has an impact on similar brain regions (Fitch 2010, 55–57). Language need not to be a completely novel phenomenon in terms of regulatory genes underlying it but certainly can be a new combination of some previously existing elements. Some of these elements are very primitive (e.g. pons which is present even in lampreys), while other are relatively novel (e.g. neocortex), but all of them are determined by each other's history. Evolutionary history of the structure consti-

tutes the set of anatomical and physiological constraints which have a profound influence on a process of adaptation. This is why some researchers (Jacob 1977, 1161–1166) use the metaphor of tinkering which clearly illustrates how every evolutionary novelty is interwoven with older structures. Tinkering is an accurate word because it points out both the lack of a pre-existent project and a high risk of developing possible “flaws” in the structure—“flaws” which are unavoidable because of existing constraints. A scotoma or a blind spot is a classic example. In vertebrates it was formed as a direct result of the optic nerve piercing the retina, but it is non-existent in cephalopods, which developed camera-eyes independently on the basis of a different body plan where the optic nerve is completely hidden behind the retina.

The deep homology phenomenon also reformulates some basic assumptions of the comparative method, which not only can now be applied to anatomical changes of phenotypes in closely related species but also gives clues about some genetic components regulating homological features in different clades.

EPIGENESIS AND PHENOTYPIC PLASTICITY

Positions in the debate about the language evolution are frequently dichotomously classified as either “nativism” or “empiricism” without giving a proper consideration to the variety of factors involved in this process. The adequately stated questions should read as follows: “to what extent is language innate?” or “what kinds of external stimuli are necessary to trigger our instinct to learn language?”. It is nearly a universal rule that most aspects of complex behaviour, especially in vertebrates, have both environmental and genetic components (Marler 1991, 37–66). The former, composed of the sensory input and the channelling process, is crucial for activation and proper timing and can substantially alter survival chances of an organism. The later constitutes necessary constraints which frame the overall result of exposition to a stimulus. For instance, the length of the critical period for language acquisition is severely constrained by the process of myelination, which is crucial for brain maturation and in the long run affects survival. However, the complete absence of vocal stimuli during that period squanders the only possible opportunity to acquire language. The same is true for certain species of birds which, despite being wired for sound emission, must be allowed to listen to their parents' calls at least once. These are clear examples of the process of epigenesis which can easily supersede some nature/nurture artificial distinctions (Ridley 2003). The study of epigenesis encompasses heritable changes in gene expression caused by factors other than DNA sequence. Epigenesis is a truly ubiquitous phenomenon and plays an important role on every level of organisation starting from cellular processes. Cell differentiation is, as well as language learning, regulated by both genes and environmental input. Substances excreted by cells constitute a kind of input which instructs neighbouring cells to go a certain pathway and transform into,

e.g., epithelial or adipose tissue. Ridley clearly points out that genes do not provide an unalterable blueprint for an organism or an organ. It is a product of the gene-expression which regulates the expression of other genes and their products in a complex cascade of mutual interactions which are often influenced by manifold environmental inputs. The epigenetic perspective on the language evolution tries to mediate between strong oppositions and to avoid any one-sided and depauperate views by paying equal attention to both genetic and environmental factors affecting developmental aspects of language and the process of language acquisition. Epigenesis underlies the so-called phenotypic plasticity which is the ability of an organism to alter its phenotype in response to some environmental stimuli. The set of possible phenotypic changes encompasses not only anatomical and physiological alternations but also modifications of behaviour.

A very instructive example is a rising incidence of coronary heart diseases which is caused by a mismatch between a metabolic phenotype determined by poor feeding during early childhood and subsequent adult nutritional environment rich in saturated fats and processed fibre-depleted food (Hales 2001, 5–20).

IS LANGUAGE AN ADAPTATION OR A BY-PRODUCT?

The third important group of debates on the evolution of language raises the problem of the major evolutionary force which affected vocal tracts and neural connections of the early hominids. The “selectionist” position states that it is the natural selection which shaped the whole process, which is a reason why language should be considered as an adaptation to EEA. There are several difficulties of this position. First of all, the process of inferring adaptive advantages of a certain trait is often founded upon methods of reverse engineering, which purpose is to establish links between anatomical structures and their possible adaptive importance, and forward engineering, which is concerned with modelling possible adaptations on the basis of the environment. Despite being a highly sophisticated method of inquiry, reverse engineering is not universal and can give false results if applied to traits which are not an outcome of adaptation (Sterelny and Griffiths 1999, 215–253). If a trait is a result of constraints rather than an adaptation it is still conceivable to formulate a credible explanation for its existence. The more complex the trait is the more convoluted the reasoning may be, and therefore the language evolution serves as a model example. It is the case not only because of its intricacies but also because of a high number of possible scenarios for its reconstruction. The ideal situation would be the utilization of a meta-criterion capable of assessing the plausibility of the evolutionary scenarios, but clearly such a criterion exists currently only in the sphere of wishful thinking.

Defending the position of sexual selection as a major factor in the language evolution is even more difficult. A peacock tail is a very straightforward result of sexual selection because it clearly hinders survival by its sheer weight and high nutritional costs. Nevertheless, it is also a good criterion of the owner's general health status and access to food sources, both of which are extremely important for potential mates and consequently affect a probability of genetic material expression. One variation of this reasoning, namely Red Queen Hypothesis, which was created by Leigh Van Valen (Van Valen 1973, 1–30) and recently popularised by Matt Ridley (Ridley 1995), states that this colourful tail is simply a result of arms race between parasites and their hosts, and signals a potential mate that the peacock immune system is capable of exterminating harmful foreign organisms. An effective immune system is usually an objective measure of the overall health and, thus, a good reason for mating. However, the action of sexual selection usually leads to some type of sexual dimorphism; as mentioned in the case of peacock (hens are mostly grey and lack a beautiful tail) or bighorn sheep (ewes have significantly smaller and less twisted horns). Apparently, sexual dimorphism in humans does not include the use of language, which is equally mastered by both sexes.

Unfortunately, assuming that language is a by-product of certain constraints does not provide any firmer ground. In fact, the adaptation/constraint dichotomy is slightly superficial and prone to abuse, and therefore the problem needs some clarification (Endler 1986, 224–243). Natural selection acts exclusively on present phenotypes, and is completely powerless to select anything beyond them. The fact that red fur is an optimal adaptation for certain environment is completely meaningless if the gene pool contains only genes coding a white and black fur variant. Selection must patiently “wait” for the appearance of a red-fur mutant. Still some mutations are simply impossible because of physicochemical ramifications. These are the reasons why constraints cannot be perceived as an independent evolutionary force but rather as a simple consequence of following certain evolutionary pathways. For instance, an insect body plan is both a successful adaptation and an important constraint preventing them from reaching a large size. Explaining language as a result of certain constraints is also founded upon a proper understanding of adaptations which produced these constraints.

Some researchers (Lewontin 1998, 107–131) consider these difficulties serious enough to adopt methodological scepticism and claim that a certain question like that concerning the evolution of language must remain unanswered. Lewontin denies neither the importance of adaptations in biological explanations nor the possibility of language being indeed an adaptation, but rejects adaptationism as a justifiable methodological position.

CONCLUSION

This analysis of crucial debates on the evolution of language clearly demonstrates that this problem is not fully regarded by researchers as a part of a science. Philosophical debates over the nature of language and methodological limits of the evolutionary process reconstruction constitute a crucial field of research. In my opinion, it is also an illustrative example of the methodological approach of evolutionary biology which is radically different from that used in physical sciences. It is, in fact, the comparative method, which is a foundation of the evolutionary way of thinking, allows biologists to organise the historically variable results of natural selection. Examples and arguments cited in the paper demonstrate that the evolution of language, like a multitude of other evolutionary processes, should be analysed on different levels of complexity. The author's position is that both the evolutionary biology (LCA and EEA hypotheses) and genetics (the deep homology phenomenon) offer an important insight into the problem. A rapidly developing field of epigenetics also provides some important clues in the debate. The complementarity of these approaches clearly demonstrates that, like in the case of every historical phenomenon, the reconstruction of the language evolution cannot blindly follow the ethos of physical science. It is the comparative method which can encompass the diversity of phenomena connected with the evolution of language and offer a satisfactory synthesis.

Contrary to some common beliefs, the evolutionary view of language is definitely not thoroughly reductive. The phenomenon of epigenesis with regard to language undoubtedly shows that it is the complicated cascade of both genetic and environmental factors (like cultural learning) which initiates the process of acquiring language consequently, and at the same time evokes the traditional philosophical question about the emergent properties. The problem of deep homology is also of high philosophical importance because of its close connections with the debate on the genetic versus organismal approach to natural selection.

REFERENCES

- Brunet, Michel. et al. 2005. "New material of the earliest hominid from the Upper Miocene of Chad," *Nature* 434, 752–755.
- Chomsky, Noam. 1986. *Knowledge of Language: Its nature, origin, and use*, Westport: Praeger.
- Christiansen, Morten, and Kirby, Simon. 2003. "Language Evolution: The Hardest Problem in Science?", in *Language Evolution*, M. Christiansen and S. Kirby, eds., Oxford: Oxford University Press.
- Endler, John. 1986. "The Newer Synthesis? Some Conceptual Problems in Evolutionary Biology", in *Oxford Surveys in Evolutionary Biology* 3, 224–243.

- Fitch, Tecumseh, Hauser, Marc, and Chomsky, Noam. 2005. "The evolution of the Language Faculty: Clarifications and implications." *Cognition* 97, 179–210.
- Fitch, Tecumseh. 2010. *The evolution of language*. Cambridge: Cambridge University Press.
- Hales, Nicholas. 2001. "The thrifty phenotype hypothesis." *British Medical Bulletin* 60, 5–20.
- Lewontin, Richard. 1998. "The evolution of cognition: Questions we will never answer." In *An Invitation to Cognitive Science: Methods, models, and conceptual issues*, D. Scarborough and S. Sternberg, eds., Cambridge: MIT Press.
- Marler, Peter. 1991. "The instinct to learn." In *The Epigenesis of Mind: Essays on biology and cognition*, S. Carey and R. Gelman, eds., Hillsdale: Lawrence Erlbaum Associates.
- Richardson, Robert. 2007. *Evolutionary Psychology as Maladapted Psychology*. Cambridge: Massachusetts Institute of Technology Press.
- Ridley, Matt. 1995. *The Red Queen: Sex and the Evolution of Human Nature*. Penguin Books.
- _____. 2003. *Nature via Nurture: Genes, experience, and what makes us human*. New York: HarperCollins.
- Sterelny, Kim, and Griffiths, Paul. 1999. *Sex and Death: An Introduction to Philosophy of Biology*. Chicago: Chicago University Press.
- Tyack, Peter, and Miller, Edward. 2002. "Vocal anatomy, acoustic communication, and echolocation." In *Marine Mammal Biology: An evolutionary approach*, A. R. Hoelzel, ed., New York: Blackwell.

ABOUT THE AUTHOR — doctoral student, Faculty of Philosophy and Sociology of the Maria Curie-Skłodowska University (UMCS), Lublin. Areas of study: philosophy of biology, metaphysics and history of biomedical sciences.