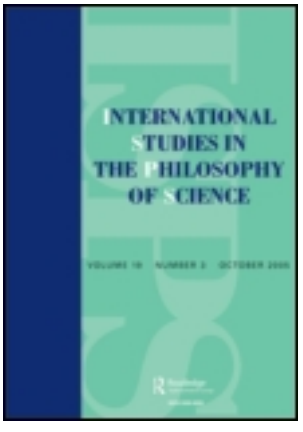

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Selectionist Approaches in Evolutionary Linguistics: An Epistemological Analysis

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Selectionist Approaches in Evolutionary Linguistics: An Epistemological Analysis

Nathalie Gontier

Evolutionary linguistics is methodologically inspired by evolutionary psychology and the neo-Darwinian, selectionist approach. Language is claimed to have evolved by means of natural selection. The focus therefore lies not on how language evolved, but on finding out why language evolved. This latter question is answered by identifying the functional benefits and adaptive status that language provides, from which in turn selective pressures are deduced. This article analyses five of the most commonly given pressures or reasons why presumably language evolved. I demonstrate that these reasons depend on functional definitions of what language is. To undo this bias, I suggest that scholars move away from the 'why' and 'what for' questions of language evolution, and focus on how language actually evolved. The latter project inquires into the distinct evolutionary mechanisms enabling the evolution of the anatomical and sociocultural traits underlying linguistic behaviour.

1. Introduction

The application of evolutionary theory currently extends the realm of biology, for it is applied in domains such as the humanities and the social sciences. During the last 20 years, new interdisciplinary fields have arisen, such as evolutionary psychology, evolutionary linguistics, evolutionary anthropology, evolutionary economics, and evolutionary archaeology. Scholars active within these disciplines turn away from their classic, discipline-bound methodologies, and instead investigate how evolutionary biological methodologies can be implemented in psychology, linguistics, economics, archaeology, and anthropology. Cognition, language, and culture are understood to be the direct outcomes of evolutionary processes.

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Such a shift in research methodology also leads to a shift in paradigms. The way in which paradigms change, or the reasons why certain methodologies are favoured over others, is particularly interesting for the philosopher of science. Unfortunately, only a few philosophers are currently engaged in examining the epistemic questions and paradigm changes that typify the newly emerging evolutionary sciences. This is unfortunate because the rise of these new evolutionary fields provides nothing less than an excellent empirical playground for philosophers of science interested in how theories and methodologies come into existence, expand, change, are borrowed, or fall into disuse. Moreover, philosophers of science can also actively engage in ongoing debates by examining the motivations, scope, and validity of current methodology and research strategies. As such, philosophers of science can also contribute to the development of scientific theory.

In this article, an epistemological analysis is conducted of the field of evolutionary linguistics. Initially, the origin of the field is briefly sketched, as well as how its research framework differs from the more traditional linguistic approaches. Subsequently, from a metalevel, we will closely examine the type of epistemic questions raised by evolutionary linguists, what motivates the claims they make, and how valid their claims are. It will be demonstrated that the majority of scholars active within the field of evolutionary linguistics currently identify *natural selection* as the principal mechanism by which language evolved. Within evolutionary linguistics, research focus therefore lies, not on identifying the mechanisms that cause language to evolve (for natural selection is assumed to be that mechanism), but on identifying the survival and reproductive benefits that language provides to its carriers. Canonical epistemic research questions are: *Why* did language evolve in our species in the way that it did, *for what* reasons? *What* are the *functional adaptations* of language, and *what selection pressures* underlie the evolution of language? This paper reviews and analyses the five most commonly identified selection pressures to account for why language evolved. Thirdly, it is demonstrated how philosophy of science can not only help in contextualizing and analysing the existing research framework, but also contribute to the development of a theory of language evolution by pointing out new research strategies.

2. The Rise of Evolutionary Linguistics: The Adaptationist Approach

Research into the evolutionary origin of language can be traced back as early as the nineteenth century (e.g. Schleicher 1863; see Thorndike 1943 for a discussion). The new field of evolutionary linguistics, however, only originated in the 1990s. The latter field's research program is highly similar to the one endorsed by evolutionary psychology (Cosmides and Tooby 1994) and much can be said for seeing evolutionary linguistics as a direct outcome of that discipline. Over 20 years ago, Pinker and Bloom (1990), two evolutionary psychologists, wrote an article entitled 'Natural Language and Natural Selection' in *Behavioral and Brain Sciences*. In this article, they warranted evolutionary inquiries into language and they asserted that such research needs to be conducted from within a neo-Darwinian, selectionist framework. Pinker and Bloom stated clearly that *only* the selectionist approach could explain how language evolved.

With their article, Pinker and Bloom opposed classic, synchronic linguistic approaches (Saussure 1972; Chomsky 1972, 1975, 1988) as well as historical, diachronic linguistic research strategies (for an overview of the latter, see Lass 1997). But they went further. They also distinguished their selectionist approach to language evolution from the ontogenetically oriented field of biolinguistics (Meader and Muyskens 1950; Lenneberg 1967), as well as from the phylogenetically focused field of comparative psychology that mainly endorsed a behaviourist, instructionist approach to unravelling the mystery of language evolution (Skinner 1986; Gardner, Gardner, and Van Cantfort 1989; Savage-Rumbaugh and Lewin 1996). By contending that language is an adaptation, Pinker and Bloom also countered Stephen J. Gould's (1991) idea, which was later adopted by Noam Chomsky, that language is an exaptation, a by-product of the evolution (by means of natural selection) of other functional, anatomical forms.

Pinker and Bloom suggested that linguists make use of a different methodological framework, namely the selectionist approach. They contended that the faculty of language is innate rather than acquired, that it takes on a module in the brain, and that this language module is adaptive. Language is stated to show 'design' and, following the popular writings of Richard Dawkins (1976), it is claimed that only natural and sexual selection theory can explain the origin of design in nature. For something to be an adaptation and to evolve by means of natural or sexual selection, that something must provide direct survival and reproductive benefit. In other words, language must be 'good' for the individual that has it. And what language is 'good for' is said to provide selection pressures for language to evolve.

Pinker and Bloom's article gave rise to the origin of the inter- and transdisciplinary field that is now known as evolutionary linguistics (Hurford, Studdert-Kennedy, and Knight 1998; Knight, Studdert-Kennedy, and Hurford 2000; Christiansen and Kirby 2003; Botha and Knight 2009). Since 1996, evolutionary linguists organize themselves around biannual meetings called EVOLANG (proceedings of these conferences are published in Desalles and Ghadakpour 2000; Tallerman 2005; Cangelosi, Smith, and Smith 2006; Smith, Smith, and Ferrer I Cancho 2008; Smith et al. 2010).

Evolutionary linguists primarily investigate the biological, individual capacity to have language (Chomsky's I-language) from within a selectionist framework. Because the biological capacity for language is said to evolve by means of natural selection, primary focus does not lie on *how* language evolved (for it is a given that it evolved by means of natural selection), but *why* it evolved (Gontier 2006b). Currently, the epistemic questions raised most within the field concern issues of adaptation: what is language? Why is language adaptive? What, in other words, did language evolve for? Which survival and reproductive benefits do linguistic organisms have? What are the selection pressures that led to the evolution of language?

Answers to these questions vary greatly, but most scholars agree that language is a communicative system and that language evolved to enhance communication between different group members. In other words, better communication is assumed to have provided the pressure or reason for why language evolved, because enhanced communication skills are assumed to provide survival and reproductive benefits. Evolutionary linguists therefore differ from Chomsky and from the early philosophers who defined language as a

means to express thoughts and knowledge (see Gontier 2009 for an analysis of the historical roots of both ideas). They also differ from behaviourists because they emphasize that linguistic behaviour is biologically and phylogenetically underpinned, and thus not merely the result of cultural upbringing and social learning strategies.

A significant number of scholars active within the field of evolutionary linguistics also study how natural languages evolve at a cultural level, by analogy with how life evolves by means of natural selection at a biological level. In other words, Chomsky's E-language, and the dispersal of human languages at a cultural level—originally the research topic of anthropologists, historical linguists, and sociolinguists—is also evolutionized.

At least from the 1970s onwards, ethologists, sociobiologists, and evolutionary epistemologists (see Gontier 2006a for an overview) have developed gene–culture co-evolution and dual-inheritance theories (Cavalli-Sforza and Feldman 1981; Lumsden and Wilson 1981; Boyd and Richerson 1985). These theories assert that the 'superorganic' is the direct outcome of evolution, and that the superorganic itself also evolves. In order to 'universalize' natural selection theory to the domain of sociocultural evolution, researchers have sought for cultural analogues of the gene, such as the meme (Dawkins 1976) or culturegen (Boyd and Richerson 1985).

This line of research also found its way into evolutionary linguistics (Deacon 1997). Computational linguists, especially, endorse the view that languages (E-language) are complex adaptive systems (Cangelosi and Parisi 1998; Szathmáry 2000; Steels 2002; Jaeger et al. 2009; Kirby 2011 and forthcoming). Contrary to Pinker and Bloom, who attributed explanatory power solely to the theory of natural selection, computational linguists endorse a more pluralistic account of evolution. They combine cybernetic and systems-theoretical evolutionary approaches with selection theory. Languages are regarded as complex adaptive systems: they are open dynamic systems that are adaptive. They are assumed to be the outcome of positive selection and the systems themselves also evolve independently of biological evolution. Although they incorporate systems-theoretical approaches and evolutionary mechanisms such as the Baldwin and ratchet effects to explain the evolution of languages, they nonetheless principally work from within an adaptationist paradigm, as the concept of 'complex adaptive systems' aptly shows. A small group of historical linguists also try to model the various ways in which languages can evolve socioculturally (Hawkins and Gell-Mann 1992; McMahon 1994; Ritt 1995, 2004; Croft 2000, 2002; Mufwene 2005; Dunn et al. 2011). This line of research also remains focused on selectionist, adaptationist accounts. Like computational linguists, historical linguists follow the tradition set out by evolutionary epistemologists and dual-inheritance theoreticians by trying to find linguistic analogues of 'replicators', 'interactors', or 'memes', such as the 'lingueme'. Nonetheless, this latter activity of searching for the cultural analogues of genes is not representative of the research that mainstream evolutionary linguists engage in.

3. In the Margins of the Evolutionary Linguistic Paradigm

Pinker and Bloom, and evolutionary linguists in general, mainly set themselves off against Chomskyan linguistics, and non-adaptationist, exaptationist evolutionary

views on language as they were formulated by Stephen J. Gould (1991; Piattelli-Palmarini 1989; Gould and Vrba 1998). For most of his career, Chomsky (1972, 1975, 1988) had claimed that language could not have evolved by means of natural selection. He argued that language differed qualitatively from animal communication systems because human language is not exclusively focused on broadcasting information to conspecifics; it is also a means to express creative thought. Following Stephen J. Gould, Chomsky asserted that language evolved as an exaptation instead of an adaptation, and he preferred systems-theoretical approaches to (evolutionary) language research over selectionist ones.

Following Chomsky, a significant number of biolinguists today continue to set themselves off against the idea that language is an adaptation. Contrary to mainstream evolutionary linguists, they persevere in studying how systems theory and its concepts of emergence, self-organization, symmetry breaking, bifurcation, and macro-mutations can possibly provide explanations for how language evolved and how it differs qualitatively from other animal communication systems (Bickerton 1990, 1998; Lass 1990, 1997; Carstairs-McCarthy 2000; Jenkins 2000; Lightfoot 2000; Longa 2001; Givón 2002; Boeckx and Grohmann 2007).

In 2002, and in collaboration with Tecumseh Fitch and Marc Hauser, Chomsky moderated his views and distinguished between the faculty of language in the broad (FLB) and narrow sense (Hauser, Chomsky, and Fitch 2002). What typifies human language and makes it unique and qualitatively different from animal communication is recursion, and the latter represents the faculty of language in the narrow sense. In this 2002 paper, only recursion is contemplated to have evolved by means other than natural selection. All the other aspects of the FLB, which includes the sensorimotor system and the conceptual-intentional system, are now acknowledged to have continuity with certain types of animal behaviour and cognition, and are argued to be explainable from within the sciences of evolutionary biology, anthropology, psychology, and neuroscience. This article therefore mainly revised Chomsky's ideas on there being continuity or discontinuity between language and animal communication, and which aspects of language are uniquely human and therefore qualitatively different (i.e. recursion). In so far as there is continuity between aspects of the FLB and animal communication systems, the natural sciences can provide theories of their evolutionary origin. Recursion, on the contrary, is disputed to be explainable from within an adaptationist account. Although Chomsky accepted the possibility of conducting evolutionary research on the origin of the various aspects of the FLB, he did not endorse Pinker and Bloom's argument that natural selection is the *only* possible mechanism that can account for its evolutionary origin. Rather, he endorsed a more pluralistic view, where both adaptationist and exaptationist accounts, together with other evolutionary mechanisms, explain the origin of the components that make up the FLB.

Evolutionary linguists such as Pinker and Bloom (1990; Nowak and Komarova 2001) assert that *all* aspects of language evolution must be explained by adhering to a selectionist approach, because natural selection is believed to be the only theory that explains design in nature. Disagreements on this issue have led to the famous

polemics published in the 2005 issues of the journal *Cognition* between, on the one hand, Chomsky, Hauser, and Fitch (2005; Fitch, Hauser, and Chomsky 2005), and, on the other, Pinker and Jackendoff (2005; Jackendoff and Pinker 2005).

Studies on how exaptation might account for aspects of FLB, and how systems-theoretical as well as instructionist/behaviourist approaches (Savage-Rumbeaugh and Rumbeaugh 1993) might provide insight into the evolutionary origin of language (I-language), remain an avenue of research mainly pursued by evolutionary biolinguists and primatologists. These fields are still very much alive today and continue to provide valuable data on how the capacity for language evolved. Data on language evolution is also provided by geneticists, neurologists, psychologists, and palaeontologists. But although some of these researchers partake in the EVOLANG publications and conferences, these scholars do not form part of the core of the EVOLANG research community and their work is not considered to be representative of the emerging evolutionary linguistic canon.

4. What Is Language, and Why Did It Evolve?

In the remainder of this article, we focus on the adaptationist framework and how it is applied in explaining the evolution of the human language faculty by all scholars engaged in research on the evolution of language.

Evolutionary linguists that work within the selectionist paradigm proclaim that language shows design and therefore language must be an adaption that provided our species with direct survival and reproductive benefits. The evolutionary origin of adaptations are claimed to be explainable only by natural selection theory. Research subsequently revolves around finding the various selection pressures that made it possible, if not necessary, for language to evolve. Instead of focusing on the how question, and asking for the mechanisms that enabled language to evolve, the primary focus lies on answering the questions, 'What did language evolve for?' and 'Which survival and reproductive benefits are provided to linguistic creatures?' (Gontier 2006b).

In the 1960s, Niko Tinbergen (1963), one of the founding fathers of ethology and famous for his article on causal explanations in ethology, explained that from within a selectionist framework, answering the question 'What did *x* evolve for?' implies studying *x* in its actual, present form. Extended to language evolution, this means that we need to study an existing language, or several languages, to investigate what the current function(s) of language are.

This line of thought is indeed adhered to by evolutionary linguists. Morten H. Christiansen and Simon Kirby (2003, 14), for example, note: 'There is a general consensus that to understand language evolution we need a good understanding of what language is.' The selectionist approach is therefore also called a functionalist approach, because it also asks 'what' language is, in order to know 'what' it evolved 'for' (Gontier 2006b).

Adhering to neo-Darwinian theory furthermore implies that the function(s) of language must be invariant and they must be the exclusive reason(s) why language

was originally selected. Otherwise language would not be an adaptation (but an exaptation; Gould and Vrba 1998). Stated otherwise, the selection pressure(s) for language evolution must remain constant over many years.

Unfortunately, scholars currently disagree on *what language is*, and *what it evolved for*. In trying to find an adequate definition of *what language is*, Botha (2000, 151) analysed the works of several (evolutionary) linguists and found that language is defined differentially as 'a human behaviour', 'a case of mosaic evolution', 'a process', 'a gigantic meta-task', a 'special human skill', 'an activity', 'a species-specific capacity', 'a sort of contract signed by members of a community', a 'hard-wired (individual) competence', an 'application', 'a mass phenomenon actualized by different agents interacting with each other', something that 'spontaneously forms itself', and a 'complex system of labels for concepts and conceptual structures'.

Given these diverse definitions of language, it is not at all surprising that an equally diverse set of selection pressures are suggested for *what language evolved for*. Nonetheless, most evolutionary linguists will agree that existing languages come in two modalities, signed and spoken languages. Both are built up out of two components: a lexicon and a grammar. Arbitrary words or hand signs (symbols) are combined in a non-arbitrary, syntactic fashion to form sentences. And these sentences are used to communicate in social settings, to give meaning to our everyday life, and to obtain knowledge of the world. A child learns the particular language it speaks or signs from the community it is born in, and the child also has a neurobiological constitution to stand receptive towards an existing language.

This characterization of language too contains many elements, and therefore, it is not clear which element provided the selection pressure(s) for language to evolve. Depending on what aspect of the above definition of language one focuses on, different reasons or selection pressures are given for what language evolved for. In what is to follow, the five most accepted selection pressures/reasons for language evolution are reviewed (see also Bickerton 2002; 2007, 514). These are the political, Machiavellian, social, cultural, and symbolic reason. Although in the past, researchers have argued that every single one of these pressures suffices to explain the evolution of language, the distinction between these five selection pressures is somewhat artificial. Many scholars today do not assume that it was a single selection pressure that enabled the evolutionary origin of language. Rather, theories often combine several of these selection pressures and thus assert that language has multiple 'design' features and serves multiple purposes. For clarity and epistemic analysis, these selection pressures are first discussed separately. We will inquire into what aspects of language evolution can and cannot be explained by referring to a certain selection pressure. Afterwards, we examine the explanatory power of theories that endorse a combination of various selection pressures.

4.1. The Political Reason

Language is a human-specific trait: it is a behaviour typical of our species and it requires the evolution of certain anatomical features, such as the descent of the

larynx. Investigations into the origin of language are therefore often accompanied by archaeological and palaeoanthropological studies on the origin of our species. Focus lies on when our species started to demonstrate modern behaviour (sedentariness, the use of fire, the division of labour, tool making), and when we reached a modern anatomy.

Cultural material remnants such as stone tools and personal ornaments provide us with a general outlook on the cognitive and symbolic capacities of humans and other hominins. Scholars such as Mithen (1996), Mellars (1998), Ambrose (2001), d'Errico et al. (2003), and Bracinha Vieira (2010) therefore reason that these remnants also indirectly lend insight into the origin of language. Botha (2003) has indicated that such cultural remnants provide 'windows' on language evolution: the origin of artefacts and ornaments is not necessarily directly relevant for language evolution, but their presence allows us to draw indirect inferences on the presence or absence of elements directly relevant to language evolution, such as cognition.

Stone tools and personal ornaments are intentionally modified artefacts. In other words, they were manufactured by thinking organisms. Throughout hominin evolution, tool and ornament manufacturing techniques also become more refined, and different techniques are combined to develop more complex, compositional tools and ornaments. This might indicate an increase in cognitive complexity that in turn is required for language to evolve.

Tool manufacture and tool use possibly reflect the language skills of hominins (but for a critique see Wynn 1999). The rise of distinct tools is claimed to reflect the emergence of different mental categories that are verbally labelled by a lexicon (e.g. Mellars 1998); and the rise of composite tools is said to demonstrate the evolutionary emergence of syntax (e.g. Ambrose 2001; d'Errico et al. 2003; Bracinha Vieira 2010). In these accounts, the advanced cognition required to manufacture tools is reasoned to be either a cause (in the form of a selection pressure) or an effect of the evolution of language, and sometimes tool use and tool manufacture by itself is said to provide a stimulus for language evolution.

That tool use and manufacture provide insight into the origin of language is an idea that outdates the current field of evolutionary linguistics. Pioneering archaeologists of the late 1800s and early 1900s interpreted the stone tools they retrieved to be weapons. Bifaces, for example, were originally called 'hand axes'. It was thought that these tools were exclusively used by men during hunting and warfare (Toth and Schick 2005, 61–79). The rise of stone tools therefore was theorized to mark the rise of hierarchically structured political societies, where language became the glue that kept society together. That is why I label this reason political.

Hierarchically structured societies in which there is warfare and a division of labour (men are supposed to hunt and engage in warfare, and women are supposed to gather fruits and raise children) require good communication among all parties involved and it is theorized that this might provide a selection pressure to account for why language evolved.

But the political reason for language evolution has several flaws. That stone tools were weapons that provide insight into the origin of hierarchical societies was

overthrown by Binford in the 1980s (Mithen 1996, 109–117). Binford rejected the idea that early hominins lived in organized campsites and that they engaged in intentional hunting activities. On the contrary, hominins mostly scavenged and roamed the landscape.

The original idea that only humans live in complex societies is nowadays no longer tenable. From the 1960s onwards, primatologists discovered that non-human primates live in communities structured according to social rules. Gorillas are led by male silverbacks (Fossey 1983). They live in small families where one of these silverback males takes care of several females and their infants. In chimp society (de Waal 1983; Goodall 1986), alpha males and females can be distinguished that lead the group. Other members of society can climb the social ladder and gain in status by forming coalitions with alpha individuals. In bonobo society (de Waal and Lanting 1997) it is the females that lead the group and form coalitions. The social strategies adopted by non-human primates imply that these animals can show signs of goal-oriented behaviour and thus portray rudimentary forms of rational thought. A hierarchical societal structure, taken on its own, cannot therefore provide the sole defining selection pressure to account for why language evolved. If it did, other primates that live complex social lives would have developed language, and though they have highly complex communication skills, human language portrays several traits not included in these skills.

Primatologists further demonstrated that non-human primates are able to use and manufacture tools in the wild (e.g. Matsuzawa 2001; Matsuzawa et al. 2001). Under experimental conditions they can manufacture tools that resemble the Oldowan technocomplex (Toth and Schick 1993, 2005). But again, even though other primates manufacture tools, they do not develop human language. Therefore, tools and the cognition required to manufacture tools, taken on their own, cannot be the sole reason for the evolutionary emergence of language. These tools and underlying cognitive processes cannot be understood as the sole selection pressure.

Finally, that the emergence of more elaborate mental categories always requires syntax or a lexicon is far from proven. Rather, current research demonstrates that mental categories do not necessarily carry linguistic labels and that mental categories are not always organized according to or in line with a lexicon (e.g. Damasio 1999).

Nonetheless, the idea that there might be a cognitive relation between the manufacture of compositional tools and ornaments, and composite language is intriguing (Mellars 1998; Ambrose 2001; Vanhaeren and d'Errico 2006; Bracinha Vieira 2010). Toth and Schick (1993) give neurological as well as cognitive arguments to relate the production of tools to that of language. They assert that with the emergence of Acheulean tools (and thus at least one standardized tool form: the biface), archaic *Homo* species, from *Homo habilis* onwards, possessed cognitive representations of these tools without the tools themselves needing to be present. Furthermore, the tools themselves show signs that they were mostly produced by right-handed hominins (Toth and Schick 1993, 349). This indicates a left-hemispheric dominance for the tool manufacturing skills and the mental categories their makers formed of them. Language is based primarily in the left hemisphere. Tools and ornaments can

therefore be understood as evidence for the presence of language and right-handedness and left-hemispheric dominance can, possibly, be considered as preadaptations for language (but then left-handedness becomes an anomaly, see e.g. McManus 2003 for a discussion). D'Errico et al. (2003) further argue that tools themselves can also carry symbolic meaning. Tools can be part of a communicative system. As such, tools and ornaments serve as possible examples of 'extended' or 'embodied cognition' (Clark and Chalmers 1998).

4.2. The Machiavellian Reason

Binford's idea that hominin society is not hierarchically structured was inspired by incoming ethnographic data showing that current hunter-gatherers mostly live in egalitarian societies (see e.g. Ingold 1986). This finding, together with the fact that all present-day hunter-gatherers that live in egalitarian societies possess language, discredited the hypothesis that it was a hierarchical, socio-political structure that necessitated language evolution. As noted, even primate societies demonstrate hierarchically organized social structures and they did not evolve human language. Hierarchical social organizations can therefore not be hypothesized as being the sole selective pressure or reason for the evolution of language.

Chimpanzee societies can be hierarchically structured because these non-human primates can track and influence the social status of themselves and others. This requires Theory of Mind (ToM) as well as the development of, and adherence to, Machiavellian strategies (Byrne and Whiten 1988; Whiten and Byrne 1997). An 'I will scratch your back, if you will scratch mine' strategy, for example, can be dubbed a 'Machiavellian strategy'. Chimpanzees tend to share their food more often with individuals that previously groomed them, or helped them during fights. And vice versa, chimpanzees that helped certain individuals during fights will more likely receive food from these individuals (de Waal 1983).

These data are often used to speculate upon the origin of our hominin ancestors' *social* structures. A paradigm shift took place from the earlier focus on the hierarchical political structures themselves to the means by which these structures become and remain established. Machiavellian intelligence strategies therefore became one of the dominant research topics in evolutionary linguistics. It is investigated how these social strategies could have evolved and how they could have led to the origin of language.

Machiavellian intelligence requires ToM (Tomasello and Call 1997; Dennett 1998). Applied to social strategies this means that a chimpanzee has to know that another individual knows that he was previously groomed by him. And, vice versa, the other individual needs to know that the first chimpanzee knows that he groomed the other. It is only when such cognitive reasoning is in place that one can keep track of one's own and the other's behaviour as well as intentionally help or deceive another individual.

> Having a Theory of Mind means being able to understand what another individual is thinking, to ascribe beliefs, desires, fears and hopes to someone else, and to believe that they really do experience these feelings as mental states. (Dunbar 1996, 83)

Traditionally, ToM was considered to be a human-specific trait, and it was reasoned that 'good' ToM required language. In this account, ToM could lend insight into the evolutionary emergence of human-specific language. The edited volumes of the primatologists Richard Byrne and Andrew Whiten (1988; Whiten and Byrne 1997), however, have aptly demonstrated that non-human primates too already posses a developing ToM (which nonetheless remains countered by Tomasello and Call 1997 and Tomasello 2000; but these theories are in turn countered by Leavens, Hopkins, and Bard 2005). Daniel Dennett (1998) acknowledges that chimpanzees and bonobos already demonstrate third-order intentionality (i.e. they know that you know they know), while humans are attributed fifth-order intentionality (i.e. you know that we know that he knows that she knows that you know something).

The fact that third-order intentionality is present in these non-human primates demonstrates that there was an initial ToM that could (continue to) be the target of gradual positive selection. Therefore, both ToM and the Machiavellian strategies enabled by ToM are often understood as preadaptations, if not as the main reason for why language evolved.

But although both Machiavellian strategies and ToM might be necessary for the evolutionary emergence of language to take place, again problems arise when the view is endorsed that they suffice for language to evolve. In fact, the finding that ToM and Machiavellian strategies are present in non-human primate communities demonstrates that: (1) Machiavellian strategies, taken on their own, do not necessarily lead to the emergence of language (this is so because non-human primates have them and they still do not have language); and (2) one does not need language to develop ToM (since non-human primates possess a rudimentary ToM associated with their Machiavellian strategies and yet they still do not have language).

The first point does not exclude the possibility of Machiavellian intelligence contributing to the rise of language; it only says that it cannot be the necessary and sufficient reason for language to evolve. The second conclusion, however, implies that ToM does not require language, and thus that one can have thought processes without language (without a lexicon and without syntax) that categorizes and structures these thoughts. Thinking can thus be non-linguistic. As such, there is no necessary evolutionary relation between ToM and the rise of language, although this does not exclude the possibility that such a contingent (perhaps co-opted) relation might exist in our species' linguistic evolution.

4.3. The Social Reason

Intentionality and ToM do not necessarily require a social context. One can also know for oneself that a lifeless object does not know. In other words, ToM can be used in non-social contexts (during e.g. the representation of objects).

And the Machiavellian strategies, although applied in social contexts, are basically applied in a single individual's self-interest rather than in the interest of the group.

As such, Machiavellian sociality is not necessarily the reason why intentionality and ToM evolved and potentially led to language. It can and has been maintained that every strategy that a chimpanzee makes use of in social life, even those strategies where he bonds with other individuals to share food, or to help in fights, can be understood as primarily selfish acts. This is so because the individual that acts 'socially' will in the long run directly benefit from this Machiavellian behaviour. This behaviour is therefore also characterized by the game-theoretical concept 'tit-for-tat' (Axelrod 1981) and tit-for-tat is contrasted to truly altruistic behaviour.

Reciprocal altruism demonstrated towards non-kin members is declared to be a uniquely human characteristic (Trivers 1971). A significant number of evolutionary linguists (e.g. Dunbar 1996, 1998; Knight 1998, 2000; Power 1998; Wang and Steels 1998; Worden 1998; Noble 2000; Tomasello 2000; Tallerman 2008) have therefore claimed that the socialism that results from human reciprocal altruism, and social and emotional intelligence in general, is what is required to evolve language. Granted that language evolved for communication in a social environment, a prerequisite for such social communication is that one must be willing to share information freely and one must instantly trust the received information. Otherwise, such a social communication system based upon altruistic information sharing cannot emerge.

Altruistic behaviour towards non-kin members allows humans to live in bigger societies and this in turn would have caused an evolutionary pressure to develop better communicative strategies, which would result in the evolution of language. Dunbar (1996), for example, defends the claim that it is the growing social pressure of living in bigger communities that triggered the evolutionary shift from 'manual' to 'vocal grooming'. Vocal language is understood to socially bond the group in the same manner that grooming binds primate social relations. Dunbar, however, does not explain *how* language actually evolved, he merely gives one possible selection pressure for *what* language possibly evolved *for*.

Adherents of a social reason for the origin and evolution of language do not oppose themselves to adherents of the political and Machiavellian reasons, rather, the work of the former can be understood as an elaboration of the latter group of ideas. Increasing quantities of tools, innovative techniques, and a greater variety of tool types are all taken as evidence that hominins started to live in bigger societies. And living in bigger societies required that our hominin ancestors adjust to new social strategies to ensure the social cohesion of the group. The changes in social life are alleged to have changed the ecological niche into a social niche (e.g. via Tomasello's ratchet effect; Tomasello 2000, 2003), and this is what triggered the evolutionary development of a new communication strategy so that this new social niche could function properly.

> The near synchrony in human prehistory of the first increase in brain size, the first appearance of stone tools for hunting and butchery, and a considerable reduction in sexual dimorphism is not a coincidence. These changes are interdependent. All are symptoms of a fundamental restructuring of the hominin adaptation, which resulted in a significant change in feeding ecology, a radical change in social structure, and an unprecedented (indeed revolutionary) change in representational

> abilities. The very first symbols ever thought, or acted out, or uttered on the face of the earth grew out of this socio-ecological dilemma ... (Deacon 1997, 401)

In sum, within the social approach it is argued that either socialization caused or pressured language evolution, or language caused socialization. It is quintessential, however, to realize that our ancestors' turn towards a social lifestyle, even if it provides a selection pressure, taken on its own, does not suffice to explain *how* language originated. A (social) selection pressure does not provide scholars with insight into the actual mechanisms of language evolution. That social life might have necessitated language to evolve (if it did and if, on the other hand, it was not the evolution of language that enabled more complex social lives) does not explain how a larynx got descended, how the orofacial region changed to allow for more articulate speech, or how the brain developed more refined motor areas to control manual and vocal gesture. In other words, research simply cannot end here, because answering the 'what for' question does not suffice to explain—and might altogether not even relate to—*how* language actually evolved.

4.4. The Cultural Reason

The social reason paved the way for the idea that language primarily evolved because of our hominin ancestors' overall culture-based community living. According to scholars belonging to this tradition, the emphasis should lie on how language is culturally transmitted from one generation to another in a faithful manner (Cangelosi and Parisi 1998; Tomasello 2000; Smith and Kirby 2008; Hruschka et al. 2009; Chater and Christiansen 2010; Dor and Jablonka 2010; Kirby 2011 and forthcoming).

Learning strategies that enable a ratchet effect (Tomasello 2000) or a Baldwin effect (Baldwin 1896; Deacon 1997), and imitation processes (Arbib 2005), mimesis (Donald 1993; Zlatev 2008), and rites and rituals (Knight 1998; Power 1998), all are put forward as likely candidates to have caused language to emerge and subsequently to evolve. And the field of memetics (Blackmore 1999), for example, is put to use to develop methodologies to investigate the faithful transmission of language. It is assumed that memes have a neurological and/or cognitive underpinning which enables a faithful transmission via imitation.

Mimesis, the ability to use the whole body as a representational device, is one of the basic concepts that underlies Merlin Donald's (1993) theory of the origin of the modern mind. In Donald's assessment, both the (cognitive) realization that one can use one's body to convey meaning and the recognition that others can do so as well are necessary requirements for both language and culture to originate.

In this regard, the recent discovery of mirror neurons in the monkey brain (Rizzolatti et al. 1996; Rizzolatti and Arbib 1998; Rizzolatti, Fogassi, and Gallese 2001; Fadiga and Craighero 2003) is also important.[1] Mirror neurons fire when a monkey sees someone grasp an object in a specific manner (e.g. the grasping of a nut between the thumb and the index finger) and when the monkey itself grasps the object in the same specific manner. Thus, the same neurons are fired during the visual observation as well as during the execution of a specific action. What is

interesting about mirror neurons is that they are only activated when that action is conducted in a specific manner: 'mirror neurons do not discharge in response to object presentation; in order to be triggered they require a specific observed action' (Rizzolatti and Arbib 1998, 188). Furthermore, these mirror neurons also become activated when the monkey does not see but only hears a certain action (Kohler et al. 2002).

Mirror neurons are located in the F5 region of the monkey brain. Within primate neurobiology, it is commonly agreed that Broca's region is the human homologue of the F5 region of monkeys and thus that there is an evolutionary connection between these species-specific neurological regions. Preliminary experiments have demonstrated that just as with the F5 region of the monkey brain, Broca's region too (especially areas 44 and 45) is active during the execution and observation of certain actions. This also hints at the presence of mirror neurons in the human brain. Research on mirror neurons therefore has recently taken on the challenge of investigating whether mirror neurons are involved in the expression and execution of human facial emotions.

Mirror neurons might also have consequences for the evolution of language. They might provide the first biological link between a sender and receiver, which is necessary for intentional communication to occur. Lieberman (1984) was one of the first to emphasize that a theory of language evolution must not only provide answers to the question of how an individual can produce meaningful messages; it must also provide an answer to the question how messages are recognized as meaningful (Rizzolatti and Arbib 1998). Stated otherwise, for language to evolve as a communicative system, not only the production of meaningful symbols by a sender, but also the recognition of meaningful symbols by a receiver, is required. Mirror neurons, according to Rizzolatti and Arbib (1998; Arbib 2005), can produce such a connection between the actor and the observer (the sender and the receiver). And according to Gallese (2003), this connection enabled by mirror neurons is the neural substrate of empathy.

Although the monkeys' mirror neurons fire during both the observation as well as the execution of a certain behaviour, during the *observation* of specific actions, especially, there is a strong inhibition of neurons to enable the execution of the observed actions. This inhibition disables the involuntary imitation of the observed action.

Nonetheless, because exactly the same neurons are fired during the observation and execution of the same action, it is possible that an empathic understanding of the action occurs (Gallese 2003). If during the evolution of hominids and hominins, this repression acting upon the actual performance of observed actions was loosened, hominins would have immediately started to imitate each other's actions. This would have enabled empathic understanding, not only at the level of the brain, but also at the level of the whole body. Or alternatively, if our hominins learned to voluntarily conduct these behaviours, imitation would become intentional and this would result in empathic communication. In both cases, an involuntary or voluntary mimetic, imitational communication system would emerge.

Scholars emphasizing the significance of culture in language evolution either profess that culture is the reason that language evolved or vice versa, that it was language that enabled culture to evolve. Culture was first defined in 1871 by the anthropologist and evolutionist Edward Tylor as 'the complex whole which includes knowledge, belief, art, law, morals, custom, and any other capabilities and habits acquired by man as a member of society' (quoted from McGrew 2001, 233). Ever since, many different definitions of culture have been proposed, but common to all is that culture is comprehended as acquired behaviour (as opposed to innate). More specifically, it is acquired from societal members such as parents, siblings, teachers, and peers who are already cultured in a certain society.

The problem that arises with the cultural approach is that non-human primates too already demonstrate rudimentary forms of imitation (Byrne and Whiten 1988)[2] and learned cultural behaviour. Chimpanzees on the island of Bassa use stone hammers to crack nuts (McGrew 2001, 237), while the chimpanzees of Gombe modify sticks and leaves to fish for termites (Goodal 1986). And in 1953, Imo, a female Japanese monkey, started to wash the dirt off her sweet potatoes in a nearby pond. This behaviour has subsequently been imitated or learned (depending on the theory) by other members of the tribe in relation to the increasing social status of the female that started it (Matsuzawa et al. 2001). If such behaviour were merely instinctive, all newborn monkeys and apes should demonstrate such behaviour in a uniform manner. But monkeys and chimpanzees are not born with the behaviour they imitate. Rather, certain types of chimpanzee behaviour are culturally learned and specific to the group they are encultured in. Nonetheless, even though they show signs of culture and even though they demonstrate the ability to learn (independently and/or from their conspecifics), they do not develop language. Therefore, even though it might be a necessary condition or even if it provides a necessary pressure, culture too cannot be sufficient to explain the origin and subsequent evolution of language.

4.5. The Symbolic Reason

The final reason provided in response to the question of what language evolved for is the symbolic one. What characterizes language the most, according to adherents of this position, is that it allows humans to name things and events in an arbitrary and symbolic way. Hurford, for example, states the following:

> There are two features of human language (including manual sign language) that are simply absent from natural communication systems of any other species. One is learned arbitrary symbols, and the other is recursive, semantically compositional, syntax. (Hurford 2004, 552)

Human language is made up of symbols expressed in at least two modalities: speech and gestures (and research on co-verbal gesturing demonstrates that both are often combined). Scholars that defend the view that language evolved for symbolic reasons can be divided into two categories: those defending the vocal-origin view of language, and those defending the gestural-origin view of language. Within both

schools, it is mostly endorsed that there is an evolutionary continuity with, respectively, the vocal calls and the gestural communicative acts of the non-human primates.

The adherents of the *vocal-origin view of language* can be further divided into (1) scholars who endorse the view that it is primarily the lexicon, rather than syntax, that is symbolic and that therefore the lexicon evolved first, as a protolanguage (e.g. Bickerton 1990[3]); and (2) scholars who do not make such a distinction and thus defend the view that both the lexicon and grammar co-evolved from primate calls onwards (e.g. Fitch 2000; Ramus et al. 2000). The recent discovery of the *FOXP2* gene (Lai et al. 2001; Vargha-Khadem et al. 2005), which is associated with verbal dyspraxia, is often used as evidence for the vocal-origin view of language.

Adherents of the *gestural-origin view of language* (Kimura 1993; Armstrong, Stokoe, and Wilcox 1995; Fouts and Mill 1997; Hewes 1999; Corballis 2002) find evidence for their theories in the many gestural communicative acts demonstrated by non-human primates in natural settings as well as in experiments where ASL (American sign language) was taught to chimpanzees. These studies demonstrate that chimpanzees can link events in the world to arbitrary hand signs. And the chimps use these signs to communicate with humans as well as with conspecifics. Chimpanzees can acquire a manual lexicon of about 300 words. The above described mirror systems, together with the late origin of vocal speech, also plead in favour of the gestural-origin view of language. According to these scholars, manual signs were first combined with, and eventually overtaken by, vocal speech.

Terrance Deacon (1997) combines the social with the cultural and the symbolic approach. For him, the origin of language is typified by a double inheritance system: it is partly the result of the expansion of the neocortex (especially the prefrontal cortex) which enables symbolism; and it is partly the result of cultural transitions which enable arbitrary symbols to be faithfully transmitted over many generations through cultural learning.

The search for the origin of language, according to Deacon therefore equals the search for the *Homo symbolicus*. The latter is a theoretical concept (not a genuine species) that denotes all the hominins capable of using symbols. The term *Homo symbolicus* is not Deacon's invention though. As early as 1944 the philosopher Ernst Cassirer characterized the human being as an *animal symbolicus* to refer to his cultural nature (Ingold 1986, 193).

Deacon (1997, 341; see also e.g. Tomasello 2000) emphasizes that human or hominin symbolization cannot be merely or exclusively understood from within biology and neurology. Rather, the capacity to symbolize underpins as well as enables culture. In line with dual-inheritance and co-evolutionary theories, Deacon pleads for a dialectics of a double inheritance, one biological and one cultural. Cultural inheritance is described as evolving according to processes such as the Baldwin effect.[4]

Contrary to the unidirectional neo-Darwinian view that culture cannot influence biological evolution, the psychologist James Baldwin (1896) introduced a more dialectical evolutionary scenario whereby culture can also influence the course that biological evolution will take. Deacon applies Baldwin's ideas to language evolution.

The Baldwin effect is not that different from the ratchet effect (Tomasello 2000), for it explains how social and/or cultural lifestyles can influence the biological evolution of a species.

Finally, also the symbolic reason encounters several problems. The idea that symbols are human-specific inventions and that *only* humans can learn to use such symbols is overruled by several lines of evidence. Vervet monkeys are already able to use arbitrary calls to refer to a specific predator (Seyfarth, Cheney, and Marler 1980a, 1980b); trained bonobos can understand spoken English and thus symbolic words (Savage-Rumbaugh et al. 1993); and bonobos and chimpanzees can use visual arbitrary symbols (Yerkes) and manual arbitrary symbols (ASL) to refer to outer events and emotional states. These traits are therefore not human-specific, while human language is considered to be specific to our kind. On the other hand, the fact that these traits are not specific provides strength to the idea that they might be preadaptations for language.

Even dogs are able to understand human words. Kaminski, Call, and Fischer (2004, 1682; Fischer, Call, and Kaminski 2004) report on a dog that can learn up to 200 human words. Rico, a Border collie, knows the names of 200 objects (mostly toys and balls) and brings these toys when he hears the names. Thus, this dog can understand human lexical concepts: it is able to link an event in the world to an arbitrary symbol. Rico is also able to couple new words to previously unnamed objects and can thus learn by exclusion. Learning based upon exclusion is assumed to also partly underlie the way in which human children learn new words.

Nonetheless, neither dogs nor non-human primates develop a protolanguage or fully syntactic human language. Therefore, the ability to understand symbols and perhaps even the ability to produce symbols is not sufficient for human language to evolve (although it probably is a necessary condition). The dog study, especially, also makes one wonder how far back in time we could feasibly look for preadaptations for language (but see Fitch 2000 for such a discussion in relation to descended larynges in non-human animals).

The gestural-origin theories are also problematic, since they need to give arguments for why vocalizations, in their scenario, would have originally not accompanied symbolic gestures. A critique often given of gestural-origin theories is that they tend to complicate the problem because they need to give an explanation, first, for how gestural sign language emerged, and second, for how sign language was overtaken by vocal language (and thus, the origin of vocal language remains a problem). Furthermore, why—so the critique generally goes—would hominins capable of hearing make use of gestural signs to communicate?

This critique, however, is unwarranted. Chimpanzees and bonobos tend to use their hands much more to voluntarily communicate than vocal calls, which they mostly cannot express voluntarily. In so far as evolutionary continuity is assumed, adherents of the gestural-origin view argue that it is more likely that manual gestures, which were already under voluntary control, were initially used for intentional communication. Both speech and gesturing require fine motor control at a neurological level and it is hypothesized that voluntary manual control actually enabled vocal control.

This is a very plausible scenario, but voluntary symbolic vocalizations, although they appear to be an exception rather than a rule, are already distinguishable in the alarm calls of vervet monkeys. Thus, there is no reason to completely exclude vocalizations from the originally developing language(s), even though they might have been less numerous than signs.

In sum, an increase in manual and verbal symbols and the overall capacity to symbolize might have caused a selective pressure for language evolution, or it might have been the direct outcome of language evolution. If increased symbolization is an outcome of language evolution, it cannot explain how language evolved (unless theories take evolutionary feed-back loops into account). And even if it provided a necessary selective pressure for language to evolve, the rise of symbolization is not in itself sufficient to explain how certain aspects of language evolution actually evolved (such as the anatomy that underlies vocal and manual speech).

4.6. The Five Selection Pressures Combined

If it is endorsed that language is an adaptation, like Pinker and Bloom propose, then all aspects of language must be adaptive, and all must have evolved by means of natural selection. This also means that all units that make up the language faculty, such as Machiavellian intelligence, intentionality, ToM, reciprocal altruism, imitation, vocal and manual gestures and learning, concept formation, etc., must have been selected for the functions they now perform within language. Otherwise, they would not be adaptations for language and communication, but exaptations, which either means that these elements evolved as adaptations for other types of behaviour, or that they evolved by other evolutionary mechanisms (e.g. drift) that, once evolved, became the target of natural selection.

Assuming that language exclusively evolved by means of natural selection is a very severe restriction to uphold. But suppose, for the sake of argument, that this claim is true. Do the proposed selection pressures, when taken on their own, suffice to explain the evolution of language by means of natural selection? The above analysis has proven the answer to this question to be 'no'. Many evolutionary linguists today therefore assume that it was a combination of selection pressures that caused language to evolve.

The question addressed in this part is therefore, 'Do the various selection pressures, when combined, suffice to explain the evolution of language?' The answer to this question is also negative. If the listed elements are reasoned to be a side effect or outcome of language evolution, they hold no explanatory power whatsoever to account for why language evolved. If the above pressures provide the ultimate reasons why language evolved, then the presence of most of the named elements in non-human primates proves that we need additional explanations for why language evolved in our species and not in any other, and why these various elements were combined in the biological and cultural phenomenon we call language.

Listing these different elements moreover proves that 'language' is not a homogeneous structure that holistically evolves for 'communication', and communication too is heterogeneous. With language, we can communicate many different kinds of

information (political, social, cultural, symbolic, etc.). It is highly unlikely that all these elements evolved together, and that all are the outcome of a single or combined selection process (where the several pressures together made language evolve). If we accept that language is heterogeneous, we need to accept the possibility that the various elements that today make up language, first evolved separately, and possibly evolved by a multitude of evolutionary processes. In that case, we also need to explain how the various elements were combined during the course of evolution.

And even if the above list of pressures comprises all the ultimate causes needed to account for why language evolved in our species in the way that it did, identifying those pressures does not suffice to explain *how* language evolved by means of natural selection, or by any other evolutionary mechanism. Evolution by means of natural selection is not explained by merely pointing out the why and what for of evolution. Evolution by means of natural selection is caused by more than functions. Ernst Mayr ([1961] 1997) and Tinbergen (1963), for example, distinguished between proximate and ultimate causes of the evolutionary process. Ultimate causes relate to questions of what and what for, but proximate causes respond to the how question and require ontogenetic and physiological explanations. It is only when traits and functions evolve, that natural selection can work on them by favouring the most adaptive ones. Even if we assume that natural selection shaped the ontogeny and morphology of functional traits, then we still need to explain how natural selection can work on these ontogenetic and morphological units.

Suppose we know what language is (we are able to give a solid definition of what language is), and suppose we know what language evolved for (it evolved for political, Machiavellian, social, cultural, or symbolic reasons, or a combination thereof), then we still do not know how the anatomical and sociocultural structures that underlie linguistic behaviour got their current structure. That language evolved for social reasons does not explain how the larynx was descended by means of natural selection or by any other evolutionary mechanism. Answering how the larynx was descended requires anatomical explanations and in so far as anatomy is genetically determined, it requires genetic explanations. We need to identify the various units of the supralaryngeal vocal tract, and demonstrate how and where they can form the basis of selective retention. In so far as all these units are not the direct result of genetic mutations and chromosomal rearrangements, we need to contemplate how natural selection can work on non-genetic units. And we need to investigate how other evolutionary mechanisms, such as phenotypic plasticity, drift, or epigenetics, might have shaped the larynx.

That an existing language is culturally transmitted does not explain how one is able to mentally symbolize. For this, neurological and cognitive explanations (and again, in so far as both are genetically determined, genetic explanations) need to be given for *how* our brain is able to produce and process symbols, where and by which mechanisms these traits evolve.

The evolutionary linguist's typical focus on the 'what' and the 'what for' questions results in the fact that the 'how' question, which asks about the evolutionary mechanisms of language evolution, is currently understudied. Somehow, natural selection is

supposed to make it all happen, but it is not explained how exactly natural selection can act upon the various elements language consists of, and where this selection occurs.

For natural selection to work, all these functions must be reducible to genetic mutations and random chromosomal recombinations evolving at various levels, such as the genetic, phenotypic, or environmental level. Or, we must develop theories that explain how natural selection can work upon non-replicating units and at socio-cultural levels of society. Evolutionary epistemologists (Campbell 1977) and scholars engaged in the debate about units and levels of selection (Dawkins 1976; Cavalli-Sforza and Feldman 1981; Lumsden and Wilson 1981; Boyd and Richerson 1985; Gontier 2010a) tackle exactly these questions. They investigate how natural selection works on genes at the level of the environment, and how natural selection can be conceived to work on non-replicating units such as those of culture or language. A minority of scholars engaged in evolutionary language research, such as Deacon (1997), Croft (2000, 2002), Szathmáry (2000; Szathmáry and Jablonka 1995), Steels (2002), Mufwene (2005), and Kirby (2011), are currently implementing the results of these debates in evolutionary linguistics. This research should have the highest priority.

Implementing the results of the debate about units, levels, and mechanisms of evolution in evolutionary linguistics will prove to be a very fruitful endeavour. It will enable us to move beyond the vague delineation of selection pressures and language definitions and to develop frameworks to systematically search for the various units, levels, and mechanisms of language evolution (how this can be achieved is explained in Gontier 2010a, 2010b).

Evolutionary linguists need to move away from the assumption that natural selection explains the how and why of evolution. Numerous evolutionary mechanisms can be distinguished today, and natural selection is only one amongst many that provides valid scientific explanations of how something evolved. In the margins of the evolutionary linguistic paradigm, several scholars therefore argue that aspects of language might have evolved by other means than natural selection. They might have evolved through self-organization, by drift, horizontal transmission, epigenetics, or the ratchet or Baldwin effects. This research should also be brought to the forefront of scientific inquiry: investigating how numerous the mechanisms are that underlie language evolution should become an autonomous research strategy, independent of adaptationist studies.

5. Conclusion

Evolutionary linguistics is a newly evolving discipline that distinguishes itself from other linguistic approaches, such as structural linguistics, biolinguistics, instructionist, and systems-theoretical (evolutionary) linguistic approaches. The field was founded on the idea that only adaptationist accounts can explain how and why language evolved, and today the field remains characterized by its overall emphasis on selectionist and adaptationist accounts of language evolution. All scholars endorse the view that

language evolved to enable communication that enables the transmission of political, Machiavellian, social, cultural or symbolic information. Language is defined as a communication device that allows for sociocultural cohesion between conspecifics. The latter is argued to make language adaptive, and these adaptive functions are reasoned to have evolved by means of natural selection.

In other words, it is an unquestioned truism that language is a form of social communication and that this is the reason why it evolved. This has direct consequences for how language is defined and how selection pressures are identified. Unquestioned truisms are hardly ever proven scientifically, and are therefore often prone to be biased towards certain theories or towards an overall *Zeitgeist*. Scholars should be aware of this historical bias and try to prove that language is indeed a communication device, rather than take this statement as a given (Gontier 2009).

We have seen that within selectionist accounts, the epistemic focus lies almost exclusively on the 'what did language evolve for' question. This question is often answered by pointing out selection pressures or current uses or characteristics of language. The current uses and characteristics of language are derived from language definitions, definitions obtained by asking the 'what question'. As was already demonstrated by the great Aristotle many years ago, the what and the what for questions coincide. Ultimately, both lead to the same answer and what is more, a combination of both questions leads to a teleological approach. Philosophers of science, especially those engaged in philosophy of physics, commonly assume that ever since the introduction of Newtonian physics, science has focused solely on finding mechanistic explanations. It is assumed that the primary concern of every scientist, biological or otherwise, is and should be *how* something came into being or evolved, i.e. by which mechanisms something came into existence. Therefore, only Aristotle's efficient cause remained valid. But ever since its conception, selectionist evolutionary theory (Mayr [1961] 1997; De Laguna 1962; Tinbergen 1963) has focused on functional approaches because certain traits indeed have functions and appear to have actually evolved to enable these functions. As a consequence, evolutionary scholars have constantly faced the difficulties created by asking the what and what for questions. Complex structures such as eyes appear to have evolved for vision, and vision is also what characterizes the eye. In Aristotelian terms, the final cause appears to coincide with the formal cause. It appears 'as if' nature works with foresight. But evolution by means of natural selection does nothing of the kind. Colin Pittendrigh (1958) introduced the term 'teleonomic' to refer to these apparently purposeful evolutionary events and argued that there can be 'end-directed mechanisms' without the end being either the essence of the thing that evolved (the formal cause), or without it necessarily being the final cause. George C. Williams, one of the most famous evolutionary thinkers, even considered renaming sociobiology as the science of teleonomics (Schwartz 1999). And Mayr ([1961] 1887) engaged in numerous discussions with both physicists, who disputed whether biology was a science at all, because it could not predict how something would evolve, and post-neo-Darwinians such as Williams and Dawkins, who contended that the what for questions are of primary concern to the evolutionary biologist.

It is not our goal here to reopen the validity of teleonomic or teleological approaches to evolution. Suffice to say that even if one adheres to either or both, the 'what' and 'what for' questions, in and of themselves, can never suffice to explain the 'how' of things. How something evolved requires that we raise a different type of question and look for the mechanisms that cause evolutionary change to occur, the morphological features and sociocultural units upon which they are active, and the place or level where these mechanisms are active on these units.

An exclusive or overwhelming focus on the 'what for' question disables rather than advancing progress in the field. It encourages speculations on the most important use or adaptive value of language (its essence or goal) and takes scientists away from examinations of the *mechanisms* whereby language actually evolved. Neither functions nor evolutionary pressures necessarily lend insight into the *mechanisms* by which something evolved. Even if one assumes that natural selection is the single mechanism that can explain language evolution, then it should still be theorized how language is caused to evolve, and this question is not sufficiently answered by pointing out the adaptive functions of language. For that, insight into the various units and levels of selection is required.

In sum, research set out by evolutionary epistemologists and scholars engaged in the debate about the units, levels, and mechanisms of evolution should be integrated into evolutionary linguistics. Rather than taking it as a given that language evolved by means of natural selection, evolutionary linguists should ask the how question, and systematically investigate which evolutionary mechanisms underlie which aspects of language evolution. Scholars such as Tomasello who introduced the ratchet effect, Deacon who applied the Baldwin effect, Dor and Jablonka who introduced ideas of phenotypic plasticity and epigenetics, and the computational linguistics who applied systems, dual-inheritance, and co-evolutionary theory in their models of language evolution are already investigating the how, what, and where of evolution. These promising research agendas should come to the foreground of evolutionary linguistics research, and applied evolutionary epistemology (Gontier 2010, 2010a, 2010b) can advance insight into these approaches.

At a time when evolutionary biologists have embraced the extended synthesis, nothing justifies the exclusive adherence of evolutionary linguists to a selectionist view. Rather, the primary concern should be which evolutionary mechanisms, besides natural selection of course, can explain the evolution of language.

Finally, I hope that the above examination of the epistemic questions asked by evolutionary linguists proves the role that philosophers of science can play in these newly arising evolutionary fields. The time when philosophy stood above and beyond science is long gone. Nonetheless, philosophers of science, when they are willing to work from within the sciences they study, can contribute significantly to the overall success of the sciences they study. In collaboration with scientists, philosophers can examine the validity of certain claims, help point out new research avenues, and even help develop new methodologies to do science. This in turn will enhance our overall knowledge of the knowledge-gaining process and thus how we define the field of epistemology. This paper is also therefore a plea for philosophers of science to more actively

engage in the questions and avenues of research raised and set out by the newly evolving evolutionary fields.

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Notes

[1] It is presently unknown whether mirror neurons are genetically underpinned, or whether they develop during neurogenesis or ontogenesis. Nonetheless, they are often used to demonstrate how imitation, including cultural imitation, can occur.

[2] This idea is countered by Tomasello and Call (1997), who deny that imitation is present in non-human primates.

[3] Bickerton (1981) endorses a vocal-origin theory, while in his later works (Bickerton 2002, 2007) he argues that the first symbols might also have been gestures. Bickerton does not endorse a continuity between animal, non-human primate calls, and human language.

[4] See e.g. Lachapelle, Faucher, and Porrier (2006) for a more thorough overview of Deacon's use of the Baldwin effect in language evolution.

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