# LANGUAGE AND PATHOLOGIES: AN EPISTEMOLOGICAL REFLECTION

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**Abstract**

Primate communicative skills, child language, pathologies, and Pidgin and Creole languages are often used to study the origin and/or evolution of language. Language pathologies today are often broadened to include just these primate communication skills, child language, and Pidgin and Creole languages.
Both tendencies will be discussed from an epistemological point of view. It will be examined why it is presumed that primatology, child language, and Pidgin and Creoles can lend insight into the origin and evolution of language on the one hand, and why these disciplines are often invoked to discuss pathological forms of language. It will be shown that common assumptions regarding the quantitative-versus-qualitative debate, the ladder of increasing complexity, Haeckel's biogenetic law, and specific definitions of what it means to be human, are implicitly or explicitly adhered to by different researchers in the field.
This creates epistemological problems concerning the methodologies used, and alternatively, views that are less historically charged will be suggested for how exactly these different disciplines can help in the study of language evolution.

## 1. Introduction

When one is interested in the origin of language, the problem is that one can only work with secondary, and hence circumstantial evidence, such as archaeological findings. Genes, nor brains are preserved long enough throughout history to examine them for possible language capacities. Even if this were the case, we would not to date know where to look either within the genome, or the brain for a "language faculty" (recent findings about the *FOXP2*-gene (Lai, 2000, 2001) and common knowledge that the areas of Broca and Wernicke are involved in the production and processing of speech (Saffran, 2003) included).

Therefore, scientists concerned with the origin and evolution of language turn to different disciplines, hoping that these can shed new light upon the origin of language. I will discuss 4 such disciplines: the study of primates, human children, Pidgin and Creole languages, and pathologies.

It will be argued from an epistemological stance that at the basis of the idea that all these disciplines can help language-origin studies, common assumptions involving the quantitative-versus-qualitative debate, the ladder of increasing complexity, Haeckel's biogenetic law, and specific definitions of what it means to be human, are implicitly adhered to. It will be demonstrated that all these assumptions are interrelated with each other on the one hand, and, on the other hand, that these commonly defended assumptions therefore also relate the disciplines involved. This creates epistemological problems concerning the methodologies used, and alternative, less historical charged views will be suggested for how exactly these different disciplines can help the study of language evolution and its origins.

## 2. Continuity/Discontinuity

> "Many structural properties that are universal in human language are known to occur in various species of non-human primates, some of which combine several of these properties. Inadequacies in the available data on social communication among non-human primates make it impossible to say whether any species or

> primate other than man combines all of these properties. Consequently, it is not yet possible to test Charles Darwin's contention […] that the behaviour of man differs from the behaviour of other animals in degree, not in kind." (Altmann, 1967: p. 358)

Language is regarded as a unique human capacity. Every philosophical, linguistic, anthropological, or biological investigation into the origin and evolution of language, is still connected to the question what makes humans unique and hence different from other animals. Therefore, this quest is equalized with answering the question whether the differences between hominids and non-human primates are of a qualitative or a quantitative nature. Moreover, one could argue that "the origin and evolution of language" as a scientific discipline on its own, evolved out of the quest for the true nature and essence of men, a quest that is answered by the search for the differences between humans and other animals.

If we were to consult all philosophical, (socio)biological, sociological, or anthropological books ever written, we would most probably find in all of them a sentence that states that humans differ from other animals because the former have e.g. language or reason, consciousness, rationality, intentionality, craftsmanship, sociality, culturality, and so on, while the latter are emotional, instinct-driven unconscious organisms (Note 1).

Only at the beginning of the 20th century, when ethologists first started the scientific study of the differential behaviours visible in various animals, these assumptions got truncated. Every researcher interested in the origin and evolution of language -or any other human behaviour for that matter- therefore, needs to deal with the following 4 dichotomies.

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| Continuity | versus | Discontinuity |
| Gradualism/Neodarwinism | | Non-Gradualism/ Emergentism |
| Selectionism | | Instructionism |
| Quantitative differences | | Qualitative Differences |

More recently Aitchison (1998: p. 22-23) argued for the replacement of the old continuity-discontinuity debate by the introduction of three newer dichotomies into language-origin studies: the "slow haul" hypothesis versus the "pop hypothesis", the single-versus-the-multiple emergence, and the selectionist versus the instructionist dichotomy. Here it will be argued that these "newer" dichotomies as Aitchison calls them, are not innovating at all, but are a direct derivate of the continuity-discontinuity debate.

It is simple: either one can adhere to the view that language arose gradually, by means of natural selection and hence according to selectionist accounts, which means that the origin of language can be regarded as a continuous process; or one can adhere to the view that language arose suddenly, and thus not according to slow and gradual selectionist processes, which automatically leads to a discontinuous view of the origin of language. There does not exist a middle ground.

If language evolved by means of natural selection, it could only have evolved stepwise and hence slowly and gradually. Natural selection is a stochastic process, where small, random mutations sometimes -and surely not all the time- lead to better-adapted organisms, individuals that are able to survive and reproduce more than others in a certain environment. Selectionist accounts by definition can only work when one assumes gradualism, for the whole point of selectionist accounts is that the organism, with its genes, "proposes", and the environment "disposes" of the maladaptive organisms, thereby naturally selecting those that are better able to survive in an indirect way. Neither the environment, nor the organism, can do anything about what is being proposed, for mutations are random, stochastic events. Since mutations are always mutations of already existing genetic material (*de novo* mutations are extremely rare), natural selection can only built with, and upon, elements that are already in existence (Gontier 2004). A mutated individual will therefore show a high resemblance with the non-mutated parents. Thus

intermediates must evolve that show this continuation and hence show mere quantitative differences.

Moreover, in this view, language can only evolve once. If natural selection would have slowly and gradually, and hence accumulatively "designed" (Note 2) language once, it would be highly unlikely that natural selection would design such complex behaviour twice. The random mutation steps are just too random and too unlikely to occur twice in the same sequence in the same or within different species. It is like the metaphor Jacques Monod introduced, where a strong wind would blow the pieces of a Boeing 747 together: supposing it could happen, it will most definitely not happen twice.

If language evolved by other means than natural selection, depending on the theory, it could be that these evolutionary mechanisms happen slowly as well, or language evolution can occur fast. If language evolved quickly, and thus with few or no intermediate forms, it is more likely that it led to qualitative differences, because the difference with the former form would be enormous. If it would only take one or two unlikely evolutionary events, for example, for language to evolve, it are only a few unlikely events that need to accidentally happen twice, in order for language to evolve multiple times. So if language evolved quickly and hence has led to qualitative differences, it could have evolved multiple times, because it requires the repetition of only one or two unlikely events.

The puzzle that then needs to be solved when in search for a middle ground, is the following: can small random mutations cause giant leaps and qualitative differences; we shall come back to this question in Section 7.2.

## 3. Primatologists and the Continuity Theory

When one is interested in the origin of language, one possibility is to test primates and their capacities for language, by using Yerkes or American Sign Language. Experimenting with Yerkes or ASL implies that:

(a) there are only *quantitative* differences assumed between human language and primate communication systems or artificial communicative systems that these primates learned,

(b) This in turn implies that there is a *continuation*, a gradual accumulation from primates to humans, and that the uniquely human capacities for language were (because of the accumulation part of natural selection) *added onto* primate capacities.

This however is a strange kind of reasoning: primate communication is to be understood as a pathological and deviant form of human language. It is as if one would say that being a tetrapoid organism is pathological compared to bipedal organisms. In other words, this is a category mistake: pathological organisms are usually distinguished from normal individuals within the *same* species, organisms belonging to *different* species are not called pathological from one another, they just differ (otherwise they would not be classified as belonging to different species in the first place).

Konrad Lorenz, the founder of ethology, was the first to study the external, visible behaviour of organisms in a systematic fashion. Later on, primatology was born, which takes as its topic of investigation the behaviour of primates in natural and artificial settings.

The primary question asked was whether the distinction between non-human primates and hominids involved an abrupt or a gradual change, and hence whether humans and their unique capacities could be explained from within biology, or not.

If human capacities can be studied from within biology, and if we take Neodarwinian theory as the point of departure for that biological study, then there must have been a gradual evolution from primates to humans, and the differences must have been merely quantitative. This in turn implies that we should find

indications for a beginning language, reason, creativity, craftsmanship, sociality, and culture within non-human primate and hominid societies.

Therefore, primatologists started to study primates in the wild (de Waal 2002; Goodall, 1986) while psychologists developed artificial settings and tried to cross-foster chimpanzees and bonobos (Gardner, Gardner and Van Cantfort 1989; Rumbaugh, 1977).

The primatologists discovered that non-human primates develop beginning social structures and socially-based communities. In chimp-society, alpha males and females can be distinguished that lead the group, and other members of society can climb the social ladder and gain status by making coalitions with these individuals; while in bonobo society females lead the group and form coalitions. These strategies adopted by chimpanzees and bonobos imply that primates can show signs of goal-oriented behaviour, and thus rudimentary forms of rational thought.

All of this was taken as evidence that language, culture, sociality, rationality, and so on, have their biological roots in primates, and that the capacities that were formerly conceived to be specifically and uniquely human, not only originated, but also evolved from non-human primates onwards. The difference between these animals and humans was hence comprehended as a mere quantitative difference.

Furthermore, it was shown by primatologists that non-human primates and monkeys in the wild commonly use vocal calls, or sometimes combinations of calls, as symbols to communicate different meanings. Vervet monkeys, for example, have 36 different vocal calls (Aitchison, 1995: p. 3). Some of them are used as alarm calls and are expressed voluntarily, but some calls are also made involuntarily, when they are in pain, or angry, or hungry. In these aspects humans do not differ from their evolutionary predecessors, since we too make uncontrollable sounds when we are scared, or in pain.

Besides vocalization calls, monkeys and apes often use different hand signs to communicate meaning, indeed again like us. Almost all of these arbitrary animal signs are made voluntarily.

Psychologists, on the other hand, tried to cross-foster chimpanzees and bonobos in human settings. If, as the argument goes, primates show rudimentary forms of culture, sociality and craftsmanship, and thus an ability to learn symbolic behaviour, which in turn implies that the difference is merely quantitative and hence of a continuous kind, then they might as well be able to learn elements of human behaviour if fostered this way. And indeed, chimpanzees were capable of learning "polite" human behaviour, such as eating with knife and fork, and were able to make use of human crafted tools (such as vacuum cleaners that sometimes even were put to use during masturbation) (Fouts & Mills, 1997). However, due to the anatomy of their larynx, these primates cannot articulate sufficiently, as needed for speaking, but they are apparently able to easily comprehend a spoken language, even without instruction (Slobin, 2005, p. 258).

In natural settings, primates often make hand sings to communicate intentional behaviour towards each other, and therefore, a second attempt wherein primates were taught American Sign Language, better suited the purpose to find out whether these animals could learn presumed specifically human behaviours (Gardner, Gardner & Van Cantfort, 1989; Fouts & Mills, 1997). Non-human primates are able to link events in the world to arbitrary hand signs and can communicate with humans and other primate species by using these signs. In experimental settings they were able to acquire a lexicon of about 300 words, but they did not by far show any signs of grammar for ordering these words into sentences. The succession of e.g. the signs "give me" "banana" "banana" "give me" are to be regarded as "normal constructions". These non-human primates are not able to form a well-defined grammatical, orderly sentence. Furthermore, although 3- and 4-sign combinations have been reported, when repetitions are excluded, apes mostly combine only two hand signs (Terrace 1979 et al.). It is argued by e.g. Bickerton, 1990, pp. 106-110) that this might resemble a proto-language (we shall come back to this in Section 4.2.).

Experiments with *Yerkes* (Rumbaugh, 1977: Savage-Rumbaugh & Lewin, 1996) -an artificial language especially designed by Yerkes for experiments with non-human primates, existing of visual tokens that can be broken up just as words, and that can be used to form sentences- show the same results: they can learn the lexicon, but do not use grammar to order this lexicon.

These experiments are partly responsible for the negativity created around behaviouristic and instructionist models: although language is to be comprehended as a partly cultural and social phenomenon - for we learn the language we speak from the community we live in - language cannot merely be understood from within these communities. Rather, a biological, innate element must lie at the basis of our linguistic behaviour, an element that probably causes a qualitative difference, so the argument goes.

Nevertheless, according to adherents of the continuity hypothesis, these experiments show that "… the great apes can employ, at the very least, a rudimentary manual sign language when constrained to do so, demonstrating that the capacity is there to be selected, as it appears to have been in humans." (Kimura, 1993: p. 8, original emphasis deleted)

## 4. Child Language

It is often argued that child development, and the acquisition of a first and second language (rather than normal adult language competence or use), can give insight into the origin of language in general (Bickerton, 1990, pp. 110-115; Givón 2002: pp. 151-161). This may be considered to imply that the language of a child is regarded as deviant from "normal" adult language (use), or even as pathological, even though, as we shall see, this is not always explicitly stated as such.

One assumes that the language of children is "underdeveloped" and therefore, we often see:

a) that scientists who adhere to a *discontinuous* view of the origin of language (Chomsky 1965), assume that child language differs qualitatively from adult language;
b) scientists who adhere to a *continuous* view of the origin of language, make either a comparison of child language with chimpanzee "language": it is not unusual to read that Lana (Rumbaugh 1977), Washoe (Gardner, Gardner, and Van Canfort 1989; Fouts 1997), or Kanzi (Savage-Rumbaugh and Lewin 1996) have a language competence that can be compared with a 2-year old child; or
c) scientists argue that child language resembles a proto-language assumed to be present in early hominid life (Bickerton 1990, 2003). This results in a final possibility:
d) that the language of "undertwos", trained apes and hominid proto-language are all basically the same thing (Bickerton 1990).

However, this implies that the researcher takes a few assumptions for granted:

a) when it is assumed that child language differs *qualitatively* from adult language, it begs the question how human the infant really is;
b) when we are able to compare chimpanzees or early hominids with children, we again argue for an evolutionary *continuation* from chimpanzees over hominids to humans, and that the difference is a quantitative instead of a qualitative one.
c) We also assume that the development of a child runs through the development of the species, also known as Haeckel's biogenetic law (see section 6) : ontogeny recapitulates phylogeny. Again this is only possible if we adhere to the view that there is a ladder of increasing complexity, where new evolutionary behaviours are *added onto* older behaviours (also know as *terminal addition*), and therefore that there is continuity.

### 4.1. Structural Linguistics and the Discontinuity Hypothesis

Within structural linguistics, it is assumed that the language of a child differs *qualitatively* from adult language. As an example we shall discuss the *child-based theory of language change* (Croft, 2000: pp. 44-53), that developed in the 19th century, and that today is part of generative and structuralist linguistics. According to this model, languages change when younger speakers use different grammars and the older generation dies out, thereby causing a shift in the grammatical rules used. Generative and structural linguistics of course assume an innate component of grammar (Chomsky 1965). In this essentialist model, the idea is defended that the core features of grammar are innate and take on the form of a language faculty in the brain (the language acquisition-device - LAD). It is assumed that this LAD is a human universal and hence invariant, while the variant parts of language, the parts that make a language change over time, are explained by the assumption that adults retain certain language errors they made as children. When these adults become full members of society, the language changes and what were formerly understood to be grammatical errors become the basis for new grammatical rules.

> "In the essentialist model, language change is treated as inherent change, not replication […]. Language change is treated as the introduction or loss of grammatical oppositions in the system, or of rule addition or deletion." (Croft 2002: p. 76).

Basically, according to this theory, language change should be a very *rapid* phenomenon. Because language can change from one generation to the next, and within a community we should be able to distinguish between the "old" grammar used by the elderly and the "new" one used by younger individuals, that is to say, we should be able to pinpoint which grammatical rules got deleted or added.

An example would be that the current past tense of "help" is "helped" while it used to be "holp", just as the past tense of "thrive" is now "thrived" but used to be "throve" (Slobin, 2005, pp. 267-268). This remarkably looks like language mistakes made by children that overgeneralize a certain grammatical rule.

Croft (2000: pp. 44-53) criticizes the child-based theory of language change on the basis of firmly based evidence coming from sociolinguistics: children are not recognized as innovators in society, on the contrary, only when individuals reach the adolescent phase, they can begin influencing language variation. But by the time they reach adolescence, most individuals learn to use the "correct" grammar. This triggers the following problem: children, even without positive or negative feedback, learn to conform to the language rules of the community they live in rather than that they act as innovators of grammatical change.

Furthermore, another sociological factor is ruled out by the views defended by generative linguists who assume a homogenous language community: that "holp" became "helped" might just as well be a result of immigrants who speak English as their second language. Even if children or adolescents at one time or another use different language rules, once they become part of the elderly members of society, they adjust to the language rules used by persons of that age. So at the level of the community, within the different age classes, there can be variation, but mere variation alone does not lead to language change.

Most important for the purpose of this article however, is that within the child-based theory of language change, it is assumed that children are the innovators and hence the actors that make languages change. The innate component as defended by structuralists and generative linguists, assumes that children are equipped with a universal grammar, and the core of this component is invariant, while other parts that are prone to change are changed during the acquisition of a certain language.

The emphasis in these theories lies on the acquisition part: Why is the acquisition of language different from the language (use) of adult individuals? Here generative and structuralist linguists make use of the fact that there are different critical thresholds and critical periods where children can learn languages more fluently as opposed to second-language acquisition that is acquired in a later stage in ontogeny.

These critical thresholds are assumed to lie at the basis of qualitative differences, that according to the phase, restructure the brain in a qualitative manner. Once these critical periods shut down, the individuals are not as receptive to the languages they learn as they once were during childhood.

So basically, what is assumed here is that children are *qualitatively* different from adults, so different that they are even, in a way, regarded as pathological. A pathology basically is a deviation from a standard pattern, the latter is understood to be "normal". But pathologies are not necessarily regarded as negative. If pathologies were always conceived as being negative and maladaptive for the organism, Neodarwinian theory would not by far carry the positive connotations that it carries today. Mutations in the end are pathologies: deviations of a formerly acquired genetic pattern, and these pathologies (mutations) are sometimes positively used, enhancing survival and reproduction of the individual carrying the deviation.

The same holds for the ideas defended by generative and structural linguists: the deviating child language, although full of language errors, is regarded as a positive actor for language variation and language change, giving the child the possibility to change languages, a characteristic adult individuals do not have.

Of course, as stated, this position has already been strongly criticized (Aitchison 1995; Croft 2002; Slobin, 2005). However, one could argue that because of the assumptions made by structural linguists, the idea that child language differs qualitatively from adult language, paved the way to compare the language of undertwos with primates and early hominid ancestors.

But as Slobin (2005, p. 264) points out, one crucial thing is forgotten here, namely that:

> "The child or symbol-trained chimpanzee is sampling from an existing language, and not creating without input. The structures of early language production are not independent of the structures of the exposure language. … Although the ways in which children sample from existing languages tells us a great deal about the workings of the human mind, it is not evident that any generalizations can be drawn about pre-human minds from such evidence."

### 4.2. Proto-Language, Symbolic Practice, and the Continuity Theory

> "Human communication is most clearly distinguished from the communication of other primate species by its use of (1) symbols and (2) grammar. This means that progress on questions of language-origins and evolution depends crucially on a proper understanding of these two phenomena. … I believe that we will make the most rapid progress if we investigate first and in detail extant systems of communication that are simpler than full-blown human language – specifically, those of human children and those of our nearest primate relative, the chimpanzee." (Tomasello, 2003: p. 94)

At the age of six months children start babbling, and at 15 months, they start using single words, which are combined in two-word combinations at around 18 months. At around 2 years of age, they start to use inflections (Aitchison, 1995: p. 5). Bickerton (1990, pp. 110-115) argues that the single-and-two-word phases of children under the age of two, resemble a sort of proto-language -characterized by words that lack (hierarchical) grammatical orderings, rather they depend upon fixed word order instead, to mark differential meaning- that precedes full-blown language.

> "… Language acquisition amongst modern human infants universally exhibits single unit and dual-unit stages, each usually of several months' duration. It seems asking a lot to suppose that the language-using and language-interpreting capacities of early hominids would have exceeded the capacities of modern 1-2 year-olds …" (Bickerton, 2002a, p. 216).

Bickerton's model implies that language is a continuous (although saltational) process, that developed as a proto-language from apes, over to hominids and, according to Bickerton (1990, 104-129), is still visible today in child language, in

second-language acquisition, and in Pidgins and Creoles which are regarded as "the fossils of language".

Moreover, Bickerton proposes that this proto-language is the *sine qua non* for all language development and evolution, thereby making no distinction between ontogeny and phylogeny, for according to Bickerton (1990: p. 115):

> "We may conclude that there are no substantive formal differences between the utterances of trained apes and the utterances of children under two. … the ontogenetic development of language partially replicates its phylogenetic development."

Slobin (2005, pp. 258-261), however, argues convincingly that the claim that all children only start using inflections and hence grammatical rules at the age of two, cannot be universalized, because children who's languages are highly inflected, such as Turkish or Inuit, start using inflections at 15 months. And bilingual children on the other hand differentiate the used word-order according to the language they speak.

> "Reliance on word order, therefore, is not a universal of early child language, although it has been proposed as characteristic of the 'proto-language'". (Slobin, 2005, p. 260)

Tomasello (2003: pp. 95-98) on the other hand, argues that the main difference between human children and chimpanzees is that the latter mostly use their vocal calls or communicative gestures to regulate dyadic social interactions such as bonding or fights, but they almost never use them to draw attention on outside events in a referential, or declarative manner; while turning two, human children start paying attention to intentional events that surpass themselves, and the dyadic relations they engage in with their caregivers turn triadic. Learning to use tools, artefacts and symbols means that "… children must come to understand why, towards what outside end, the other person is using the tool or symbol, that is to say, the intentional significance of the tool use or symbolic practice." (Tomasello, 2003: p. 96).

In a way therefore, one could argue that Tomasello is one of the defenders of the "dance metaphor" as introduced by Shanker and King (2002).

Language research today is subjected to a paradigm shift, where older ideas about communication comprehended as "the dualistic transmission of information", are being replaced by the systems-theoretical "dance metaphor": the idea that every act of communication is the result of a process of co-regulation and interaction between the communicators, a process that I will here call the *information-emerging paradigm* as opposed to the *information-transmission paradigm* (termed the information-processing metaphor by Shanker and King, 2002: p. 607).

> "The shift from the transmission metaphor to a dance metaphor represents, we believe, a fundamental shift in communication theory from an information-processing to a dynamic systems paradigm. In an information-processing system, communication, whether between cells, mammals, prosimians, apes, or humans, is said to occur 'when one organism (the transmitter) encodes information into a signal which passes to another organism (the receiver) which decodes the signal and is capable of responding appropriately'… In a dynamic system, all of the elements are continuously interacting with and changing in respect to one another, and an aggregate pattern emerges from this mutual co-action. … Thus, whereas the information-processing model looks at communication as a linear, binary sequence of events, the dynamic systems model looks at the relation between behaviours and how the whole configuration changes over time." (Shanker and King, 2002: p. 607)

The assumption that language is the evolutionary product of an earlier proto-language, supposedly deducible from primate-communication experiments, assumed present in early hominids and which today is supposed to lie at the beginning of child development and children's language acquisition, or is presumed present in younger languages such as Pidgin and Creole languages, is part of the information-

transmitting paradigm. Language, and proto-language, are all about conveying information: it is about regarding oneself as an actor that can transmit and receive intentional meaning.

> "Before … language could exist, … there had to be comprehension of some kind, however primitive; pre-humans at some stage had to start trying to figure out one another's intentions. (Bickerton, 2003: p. 80)

The question thus becomes: How did the recognition of meaningful signals begin? According to Bickerton (2003), the transmission and recognition of symbolic meaning is more important than the modality used to convey this meaning (e.g. signs or vocalisation); and it is more important to donate or receive this meaning loosely, than in an ordered structure. This leads to the idea of a (signed or vocalized) proto-language, where such units of meaning are supposed to make their appearance. Only when the lexicon grew too big, syntax became necessary to hierarchically order this information. Therefore, according to Bickerton, at an evolutionary level, there is a primacy of the symbolic over the structural.

> "They [the symbolic and the structural] are actually dissociated in several forms of development that can still be observed in the world around us: in early-stage pidgins, in early stage second-language learning, and in the production of trained apes and other animals." (Bickerton, 2003: p. 81)

Somehow this always brings a sketch to my mind of two Belgian actors/comedians (Peter Van den Begin and Staney Crets) who give us an imaginary view of the life of the cavemen. One caveman says: "What is it you have in your hand there", and the other one says "I'm calling it 'chair'"; which makes the first caveman reply "Oh good, that will fit in perfectly with my table".

It is a popular view to assume that somehow, a while back, our hominid ancestors started naming objects and hence started to convey meaning onto others and outside objects. "… what language uniquely does: transmitting (purportedly) factual information." (Bickerton, 2002a, p. 210). The naming game they seem to have played, is the development of the lexicon, the proto-language.

The idea that humans all of a sudden started to name objects and events is a rather old philosophical idea, that states that language is about donating and receiving knowledge, and hence valuable information. This idea still widely prevails today:

> "[…] the human language faculty is a complex biological adaptation that evolved by natural selection for *communication* in a *knowledge-using*, socially interdependent lifestyle." (Pinker, 2003: p. 16, my emphasis)

The joke with the cavemen, however, shows that it is only possible to give meaning to objects when a meaningful referential framework already is in place (what Bickerton (1990) calls the primary representational system, basically a nonverbal categorisation/conceptualisation system).

Moreover, according to Haverkort and Stowe language is not an optimal means for communicating valuable information:

> "Ambiguities at the lexical and syntactic level abound and in general there is no isomorphism between form and meaning. […] If language, more particular syntax, had developed because of communication, one would expect a development towards less ambiguity, contrary to what can be observed. The neurolinguistic evidence […] suggests that the system has developed in a non-adaptive, exaptationist fashion, integrating different neural subsystems that could be profitably co-opted for a new function." (Haverkort and Stowe, 2002: p. 34)

Even Border-collies appear to be able to understand the naming game up to 400 words (Kaminski 2004), although these dogs cannot produce the words. So, how far back in evolutionary history does the proto-language reach, and are the ideas of adherents of a proto-language scenario only applicable when meaning is given, or does the proto-language start when meaning is adequately received?

When proto-language is regarded as the forbearer of full-blown language, it is understood to be a pre-adaptation to full-blown language (or an exaptation, terms introduced by Gould and Vrba, 1998). More specifically, proto-language evolves into full-blown language by *terminal addition*. Only when the lexicon grows too big, grammatical sequencing becomes necessary, but all this grammatical ordering seems to do is structure the available lexicon some more, it does not alter it. We shall return to this in section 6.

Here I want to focus on the status of the human child, the early hominid and the current speaker of a Pidgin or Creole language; are these individuals under- or super-human? Because language differs from proto-language according to Bickerton and it is proto-language that is shared by non-human primates and human children, Bickerton (1990: 114) states that children at the two-word stage don't actually speak language:

> "[Sign language experiments with Washoe do] not prove that Washoe was acquiring human language, as long as we accept that the children concerned were not acquiring language either."

When it is argued that a child is comparable with a chimpanzee or an early ancestor, because all of them presumably speak a proto-language, what does this do to the humanity of the child? How human-like is the child?

The answer is that the proto-language of the child transforms into full-blown language when the child ages and learns to use the language it hears properly. Here one can only assume a continuity hypothesis where *terminal addition* of certain characteristics makes up the full-blown language, without these terminal additions being able to either influence or change all the previously developed structures, because then we would have qualitative differences. This type of continuity however does not exclude an abrupt evolutionary event that, at once, causes proto-language to change into full-blown human language.

According to Bickerton, this is exactly what happened: a part of the brain that did not have a previous function yet, was used to develop syntax: the latter being a terminal addition that did not change the functional parts already present in the brain.

> "… Proto-language probably originated with *Homo erectus*. We assume that, to have this capacity, there must have been a portion in the brain potentially available for it (and probably for other tasks as well); a portion, in other words, that was not irrevocably committed to monitoring digestion or blood flow, … . … the brain would require a substantial increase to bring it even within reach of syntax, but only a small additional increment to make full human syntax potentially available." (Bickerton, 2002b, p. 114).

This brings us to Haeckel's Biogenetic Law where it is generally (albeit often falsely) assumed that species evolve by *terminal addition* (under 6). But let us first look into Pidgin and Creole languages.

## 5. Pidgins and Creoles

Pidgin and Creole languages too, are often invoked to speculate about the origin and evolution of language. Here we can assume two possibilities:

(a) we can adhere to the view that they are a form of proto-language, and hence can give insights into the first language ever spoken by humans. This implies that there is a proto-language, from whereon all other languages developed. This also implies that Pidgin and Creole languages are regarded as deviant from "normal" adult languages. This is the popular view defended by Bickerton (1990: pp. 118-122), for example. Stating that something is deviant, does not immediately imply that the deviating element is in a lesser or more advanced state, but here it is often assumed that Pidgin and Creole languages deviate from other languages because they are underdeveloped (in

the sense that they can still develop and evolve further, whereas it is somehow implied that other current languages cannot).

(b) We can however also adhere to the view, to my knowledge not defended at all, that Pidgin and Creole languages not so much give insight into the evolution of *the* human language per se, but that they show how *a* language can evolve and change and vary (and speciate). In this view, Pidgin and Creole languages give insight into the mechanisms of language change and evolution, but not into the evolution of language taken on its own.

Pidgins are subsidiary language systems used when no common language is available to communicate with one another, while Creoles are languages that evolved out of Pidgins and have become first languages (Aitchison 1995: p. 6-7).

Both are based on, and influenced by, existing languages, and hence developed after language in itself came into existence, that is to say, the input is quite often richer than the Pidgin or the Creole is in itself (Slobin, 2005, p. 270). More importantly, Pidgin speakers already have a first language, while children learning a Creole language as their first and only language, learn an, according to some theorists, "impoverished language". According to Bickerton (DeGraff, 2003: pp. 396-400), it are again the children that learn these impoverished Pidgins and Creoles as their first and often only language, that will turn the Pidgin into a Creole and finally into a full-blown language, because of their LAD or "innate bio-program for language" as he calls it.

But here again the sociological factor is ruled out: namely, at the sociological level, children are not recognized as language innovators.

> "A Creole language develops over time, in contexts of expanding communicative use of a limited pidgin language. Child learners help to push the process forward, arriving at a grammar that is more regular and automated-but they do not appear to be the innovators." (Slobin, 2005, p. 272)

Thus according to Slobin (2005, pp. 272-278), the interaction of different language users lies at the basis of the development of full-blown languages, rather than that individual children act as innovators, a claim that he firmly bases on findings about the recently developed Nicaraguan sign language. The creation of home signs by deaf toddlers - used when there is no sign language available because these children have hearing parents - stagnates. It is only when different signers form an interactive community that evolution towards a fuller language emerges. All children seem to do is automate the newly developed grammatical rules, thereby accelerating the process that was already going on due to interactions older group members engage in.

According to DeGraff (2003: p. 396), another difficulty arises when it is assumed that Pidgin and Creoles are "living linguistic fossils". The assumption implies that they are regarded as outside history, and that they are neither comparable to present languages, nor to the languages that influence the Creole that emerges, thereby denying any evolution whatsoever.

> "In twentieth-century linguistics, the abnormal/broken-transmission dogma posits that Creole genesis falls outside the scope of the comparative method … and takes … Creoles to represent new linguistic phyla altogether, outside … language families. Thus, Creoles are considered to be phylogenetically unrelated to the languages whose contact triggered Creole genesis." (DeGraff, 2003: p. 397).

This abnormal/broken transmission dogma implies that Pidgins arise suddenly, without there being any transmission from previous language structures onto the next generation. That is why, according to adherents of the innate bio-program position, they make good candidates to compare them with the origin of proto-language: the speakers of this proto-language too could not rely on previously obtained knowledge from the elderly.

> "… one sui generic process that supposedly 'breaks' *Stammbaumtheorie*-friendly 'normal' language transmission and leads to exceptional and catastrophic language genesis *ab ovo* is some form of radical pidginization, which is

postulated as the first step of a hypothetical pidgin-to-creole life cycle. … Taken together, the broken transmission and linguistic fossils myths turn Creoles into languages with no historical past and with extraordinarily simple structures." (DeGraff, 2003: p. 398).

Here too, this view can only be defended when one adheres to the view that the evolution of language is of a continuous kind, where *terminal addition* makes a hominid proto-language turn into a full-blown human language, supposedly comparable to how a Pidgin turns into a Creole, without this addition changing the previously (ontogenetically or phylogenetically) evolved brain structures.

"If the transition from homo erectus proto-language to homo sapiens human language is a reflex of brain reorganization, then Bickerton's hypothetical pidgin-to-Creole cycle has nothing to say about such brain reorganization in the course of human evolution." DeGraff, 2003: pp. 398-9).

Rather, it is assumed that what makes language human, is added onto this process, by terminal addition, which again brings us to Haeckel's biogenetic law.

## 6. Ontogeny Recapitulates Phylogeny

The ideas that primate communication, child language, or Pidgin and Creole languages can provide us an insight into the origin and/or evolution of language, are all more or less based on Ernst Heinrich Haeckel's idea that ontogeny (the development of an individual from conception until death) recapitulates phylogeny (the development and evolution of species), a principle he developed in the 19th century. Haeckel suspected that this principle was part of a general law still to be discovered, which he coined the Fundamental Biogenetic Law. Today, this Biogenetic Law is commonly rejected as a law, but discussion continues about whether specific characteristics or whole developmental stages are repeated during phylogeny.

Adherents of the idea that ontogeny recapitulates phylogeny in human evolution state that primates appear to be in a less advanced stage than hominids, and hence it is assumed that the former give insight into the evolutionary development of the latter, while children are understood as less advanced adults of the same species and Pidgin and Creole languages in itself (not the individuals that speak the language) are regarded as less advanced languages.

The different applications of Haeckel's biogenetic law in language-origin and evolution studies is thus quite remarkable: it is applied at an interspecific level (between species) when it is argued that hominid development recapitulates primate development; while in the child-adult comparison it is proposed to be at work at an intra-specific level (within the same species). In the Pidgin and Creole application, "species" are replaced by "different languages", which makes us raise the question whether languages are understood as analogical to biological species (interspecifically) or individual organisms (intra-specifically) – a question that in itself makes us raise the evolutionary epistemological question whether to apply evolutionary theories to species (e.g. humans) or species' products (e.g language) (Gontier, 2005a).

Let us therefore begin with clearly outlining what Haeckel intended to capture when introducing his law, for common misinterpretations and misrepresentations of the principle prevail, language-origin studies included.

Basically, Haeckel's main intention was to include taxonomy and embryology into what has become known as Neodarwinian theory (a combination of de Vries' mutation theory, Darwin's natural selection, and Mendelian hereditary laws), because these disciplines are not, even today, part of the Modern Synthesis (Gontier 2004). In order to obtain this goal he drew parallels between individual development and the evolutionary development of the species. Contrary to Linnaeus, species in Haeckel's view were related by descent and this relation was seen, and could even be studied in ontogenetic processes of different species. Haeckel thus was first and

foremost working on a method to reconstruct phylogeny by developing a comparative framework. In this framework all species should be comparable and relatable to each other (to show descent and hence evolution) by studying the organisms of these different species in their embryonic form (Richardson and Kneuck, 2002: pp. 496-7).

He conceived of evolution and hence phylogeny as a series of forms, which he compared with the alphabet running from A to Z where each letter stands for a certain form (Richardson and Kneuck, 2002: pp. 499-10). An individual of a certain species was a fragment of this alphabet, "carrying" the letters (forms) ABC, or CDE, for example. In Haeckel's view, deletion of forms could occur (e.g. ADE), thereby erasing phylogenetic resemblance (a phenomenon today called caenogenesis), a process he understood to simplify and accelerate ontogenetic development. Replacements of certain forms by different alphabets (e.g. A turning into alpha) could also occur. By this he meant that specific traits of one species, could all of a sudden appear in another species where it could replace a trait completely. Lastly, Haeckel assumed that different sequences of form formation could set off earlier or later in development (although not part of Haeckel's alphabetic metaphor, but an example would be ZANB) and thus he described what today is called heterochrony and heterotropy (the order and location in which certain organic forms (e.g. organs) appear in time: the developmental sequences of different stages of form formation.

Thus ontogeny he assumed to be a rapid and short summary of a long and slow phylogeny. The process whereby forms were formed more rapidly because of caenogenesis or heterochronic mechanisms he described as embryonic adaptations. This means that we can only partly reconstruct phylogeny by using ontogeny, because caenogenesis and heterochronic processes blur phylogenetic evolution. Since recapitulation is never complete because of deletions and the insertion of different sequences (different letters from different alphabets) it is impossible to adhere to the view that the embryonic forms of a certain species resemble and recapitulate the whole evolutionary history of a species. So using Haeckel's biogenetic law does not imply that when we study a human embryo, we would see all the intermediate species from whereon humans developed (Richardson and Kneuck, 2002: pp. 499-500).

To be sure, Haeckel did launch the metaphor of a portrait gallery: the idea that if one studies the embryonic development of a certain individual, we would see all the ancestors pass by. However, he emphasized that this would be the ideal way, if there weren't any heterochronic processes involved that blur the picture.

> "If [recapitulation were] always complete it would be a very easy task to construct the whole phylogeny on the basis of ontology. … one would only need to follow the chain of forms of his individual development from the eggs onwards; then one could consider each of the existing morphological stages as representative of an extinct ancient ancestral form. … But in the great majority of animals, including man, this is not possible because the infinitely varied conditions of existence have led the embryonic forms themselves to be changed and to partly loose their original condition." (Haeckel in Richardson and Kneuck, 2002: p. 500).

The reason these embryos differed was that they were adapted to embryonic life, because of heterochronic processes that led to caenogenesis (the introduction of new and foreign shapes, that according to Haeckel did not exist in earlier forms) (Richardson and Kneuck, 2002: pp. 500-1).

This is important, because unlike the Modern Synthesis, that stresses that the *unit* of selection is the phenotype and the *level* of selection is the environment (Gontier, 2005a and b), Haeckel assumed that the embryo was the unit of selection (the unformed individual) and the level of selection was the embryonic environment.

Current evolutionary psychology (Barrett et al, 2002), for instance, explains grown-up individuals of our species to be adapted to the *environment* of our adult hominid ancestors that existed 2 million years ago, while primatologists that defend the continuity theory stress that we resemble primate *species*, *individuals* from which we split off 5-7 million years ago.

However, what Haeckel was saying was: forget the external environment that indirectly selects a phenotype, and forget the individual member of a species, look at embryos and the internal embryonic environment. For according to Haeckel, phylogeny *causes* ontogeny (Richardson and Kneuck, 2002: p. 504-5): the way species evolve causes the way in which embryos will develop later on, and the way embryos develop is a result of answering selection pressures from the embryonic environment. It is neither driven by selection pressures of the adult form nor by the environment in which this adult lives.

Considering this state of affairs, it is fair to ask whether we are at all allowed, according to Haeckel's view, to compare embryos with adult forms (phenotypes). All he seemed to be saying was that we need to compare embryos of one species with embryos of another. Haeckel "found the strongest resemblance amongst embryos of different species, not between ancestral forms and descendant embryos." (Richardson and Kneuck, 2002: p. 504).

According to Haeckel, we can understand phylogeny by looking at conserved developmental sequences, whereas today we would say that the difference of developmental sequences give us the ability to reconstruct phylogeny (because of important findings concerning the workings of regulatory genes see 7.2.).

Adherents of the continuity idea say that we need to study primates or human children for that matter, and see whether they can obtain adult-like human behaviour such as adult language competence and/or use. Because it is assumed that there is continuity by means of *terminal addition*, one would be able to draw the line between primates and humans on the one hand, and children and adults on the other. Hence the cross-fostering of primates, and the testing of children by means of adult measures to search for the differences.

However, if we would follow Haeckel's law, the question is neither how "human-like" we can make primates, nor how "adult-like" we can make children, but how "primate-like" we can make humans, and how "childlike" we can make adults.

If we were to succeed in making adult humans childlike or primate-like, we would see whether there is continuation or not at certain ontogenetic levels. The work of Jonas Langer, however, shows, that heterochronic processes blur the picture (as Haeckel already predicted):

> "The consequence of heterochrony is that physical and logicomathematical cognition can interact from the start in human babies, whereas logicomathematical capacities are not available to apes and monkeys during early phases of establishing physical cognition. … Second-order cognition appears early and synchronously in both domains for humans, allowing for immediate interaction between two types of cognition at a higher level. By contrast, second-order cognition in chimpanzees emerges for physical cognition when the animals have just begun to work out first-order cognition for classification …" (Slobin, 2005, p. 264-265)

## 7. Pathologies

A final possibility is to look into pathologies. Again there are a few options.

(a) One can assume that pathologies involve the malfunctioning of a certain aspect of language, thereby implying that they give insight into a certain proto-language (as explained in 4.2) that misses the final touch.

(b) One can assume that pathologies are caused by mutations which are disadvantageous for the carrier. As a consequence these individuals will not make it in the long run, given that natural selection continues its work. Or we can assume that these mutations are somehow advantageous for the individual and that the carrier of these genes will make it in the long run.

The previous two points of course are problematic, because we have to answer the philosophical question how under- or super-human these individuals with language pathologies are; thereby causing deontological and moral questions.

(c) Therefore one can assume a third position regarding pathologies: assuming that language is the result of a complex pattern of different highly intertwined structures, one can say that a pathology does not so much give insight into the evolution of language per se, as that they show which aspects or structures are necessary and sufficient, to evolve human language.

### 7.1. Language Pathologies and Neodarwinian Theory

Pinker and Bloom (1990) suggested -in line with Richard Dawkins' (2000) view of natural selection- that natural selection is the only mechanism that can explain functional design. Evolution, according to these theoreticians, is a highly complex process that will, given enough time and by making use of pre-adaptations, "design" a language faculty that obeys to an algorithmic process because it is assumed that natural selection itself is such an algorithmic process (Dennett 1995). Therefore, Pinker and Bloom (1990) say that natural selection will cause a parent with an n-rule grammar to have a child with an (n+1)-rule grammar. The carrier of an (n+1)-rule grammar will look odd and strange and perhaps incomprehensible to the parents, but in the long run the child is, according to Pinker and Bloom, the one with the "better", more adapted grammar (Note 3).

> "No single mutation or recombination could have led to an entire universal grammar, but it could have led a parent with an n-rule grammar to have an offspring with an n+1 rule grammar, or a parent with an m-symbol rule to have an offspring with an m+1 symbol rule." (Pinker and Bloom 1990: p. 753)

However, this also means that the child with the (n+1)-rule grammar is more human than his parents and that it is evolving towards a better-adapted condition or even a better-adapted species. This in turn implies that the adaptation is an adaptation directed towards the future, because the child (and it's children), although it might be the one with the better language in the long run, is not adapted to the present conditions: his parents do not understand him quite as well as all the other members of the community, and for all they knew, the child was pathological, a deviant form of the normal population, perhaps even, for all they knew, subjected to some strange witchcraft. The question that arises now, is what the survival benefit of the child (this little hopeful monster) with that better grammar was at the time it was living its strange life.

But then again, this is how natural selection works, adherents of this position would say. In the long run, better-adapted individuals survive and sometimes lead to the evolution of new species. After all, the point that the Modern Synthesis made (contrary to Darwin himself by the way), was that deviations (mutations) are the driving force of evolution (Gontier 2004).

This however has implications for how we should understand pathologies today. Are individuals with language impairments the ones with the better grammar of the future, are they super-human? Or, do they, instead of progression, show retrogression or forms of atavism? Darwin and Neodarwinians adhere to the optimistic view that there is progression: an increasing ladder of cone, going from the less complex to the more complex and better adapted individuals. According to Darwin, atavism could sometimes appear (one of his examples being the counting on your fingers), but all in all, evolution was progressive. So are pathological individuals examples of retro- or progression?

Neodarwinians would say: the question is posed wrongly. First of all it is not deontological or moral to think of pathologies as showing a lesser or more advanced form of humankind. However, evolution is not moral, humans are.

Secondly, they would answer that we can just not know whether they are a lesser or a more progressed form, it will show in the long run whether the individuals die out or produce more offspring. This creates a serious problem, because scientific thinking is all about being able to form predictions. This means that it is not enough to answer the question how language once evolved (and hence how a possible proto-language might look like), you must also be able to predict how language will

evolve in the future (and hence what a further developed language might look like). If you cannot do this, you cannot call what you're doing scientific.

Answer here will be: biological evolution is a contingent and arbitrary process. Mutations occur randomly, they are stochastic events. But this leads to a problem with the uniformity and universality of the claims that are being made. Deontologically, we feel that it is not correct to say that current language pathologies show (mal)adaptations, because it raises the question about how under- or super-human these individuals are. Most of us however do not pose these deontological questions when we look at the past, there it is all right to say that the child with the n+1 grammar rule is the child with the better language. This however implies that natural selection does not work in a uniform way: the origin of language differs from pathologies once language evolved.

If one agrees with this, one also logically states that natural selection is not a universal process, that happens at all stages in (language)evolution. Therefore, we must consider an alternative theory: let us look at systems theory.

### 7.2. Pathologies and Systems Theory

As already mentioned (under 4.2.), there is a paradigm shift going on in language-origin studies (Shanker and King 2002) that involves a shift from an information-transmission to an information-emerging process. Here it will be argued that this shift transcends the mere study of language-origin and evolution studies, rather it is visible at all levels of evolutionary science. Namely, the information metaphor is also applicable to how genetic material is conceived and this has implications for how we relate genetic material or genetic mutations to certain characteristics, such as possible pathologies that are presumably caused by such genetic mutations.

Neodarwinians (those that formed the Modern Synthesis, e.g. J.B.S. Haldane, Ronald Fischer, Sewall Wright, Ernst Mayr, …) and Postneodarwinians (e.g. Manfred Eigen, George Christopher Williams, Richard Dawkins, …) both adhere to the view that genes correspond with certain physiological or behavioural characteristics of the individual. The main difference between them is that Neodarwinians adhere to the view that genes encode for the form (the eye, legs, the brain), while Postneodarwinians mainly *internalized* natural selection. The latter defend the view that genes not solely encode for forms, but also for functions (vision, walking, thinking) (Gontier, 2004).

However, the main point is that, according to (Post)neodarwinians, genes have the inherent property to encode for certain characteristics.

Contrary to Neodarwinian theory, systems theory defends the view that genes not so much encode for certain characteristics, but that they make the difference.

> "It seems neither adequate nor possible to dissect into discrete 'properties' the pattern of an organism which is essentially a unity, a 'whole'. [...] What we locate in the chromosome is the seat of the difference. (We call it, in technical language, a 'locus', or, if we think of the hypothetical material structure underlying it, a 'gene'.) Difference of property, to my view is really the fundamental concept rather than property itself, notwithstanding the apparent linguistically and logical contradiction of this statement. The differences of properties actually are discrete, [...]."(Schrödinger, 2000: pp. 28-9)

According to systems theory, genes do not inherently carry information, rather information is understood to be an exherent property of genes, that emerges only when these genes interact with each other because of heterochronic processes. Only when different genes are combined, information emerges.

To make this view clearer, let us consider one often-used example: the eye. One of the most difficult problems Neodarwinian theory has to cope with is how it is possible that complex structures, such as the eye that provide for vision, emerge. More specifically, how can natural selection, through random small mutations over a long period of time, lead to a functional eye and most importantly, what would the

adaptive or the survival benefit be of organisms who carry non-functional, unfinished eyes?

> "[…] natural selection remains the only evolutionary force capable of generating complex design, in which a feature of an organism (such as the eye or heart) has a non-random organization that enables it to attain an improbable goal that fosters survival and reproduction […]. (Pinker, 2003: p. 24, my emphasis)

Richard Dawkins' (2002) answer to this question is by now of course well-known: using Neodarwinian theory it only takes 400,000 generations to explain how natural selection, by random and blind mutations, can design a functional eye.

A criticism here of course is:

> "Curiously lacking … was any discussion by Dawkins of the selection pressure that would have set the process in motion and of the selective advantage of members of more than 399,000 generations of their species would have enjoyed as they served as conduits for this ever-invagination, liquid-filled pair of pockets in their head region. But, once the process had taken off on this trajectory, there was, as Dawkins saw it, no turning back. For, in his view of evolution, '[u]nlike human designers, natural selection cannot go downhill, not even if there is a tempting higher hill on the other side of the valley.'" (Schwartz, 1999: pp. 361-2)

According to Dawkins, once selection starts selecting for functional eyes, the process cannot go downhill. Let us dig somewhat deeper into this last point made. Where does he get this idea from? Basically it originates with Manfred Eigen (1996). I cannot develop the argument fully here, because it would take us too far (see Gontier 2004), but Eigen showed that the *unit* of selection is not the wild type (the dominant genetic sequence in a population) but the quasi-species: the random mutations of this sequence. Since the wild type -it being the dominant genetic sequence- reproduces the most because it is the one maximally adapted to the environment, the wild type is also the sequence most probably making the most random mistakes during copying. When a maladaptive gene is only copied once, it can only once undergo a random mutation. An adaptive gene is copied several times, across different generations, because it enhances the adaptive value of the carrier. But because it is copied so many times, random mutations will occur more frequently. According to Eigen, natural selection only focuses on mutations that involve mutations of the wild type, and although these mutations are still stochastic events, it is more likely that these mutations pose more adaptive alternatives to the wild type, than a random mutation occurring in genes that are not part of the wild type. If such a mutation would be more adaptive, this mutation would replace the former dominant sequence and become itself the wild type of the population.

So if there somehow were selection to occur for functional eyes, even if these eyes are nonfunctional at the time, natural selection cannot go downhill, it can only select for more adaptive eyes until you have vision.

The crucial step one has to take for granted here, is that there exist genes that encode for certain properties necessary for eye formation and perhaps even for vision. In other words, one has to take for granted that genes encode for certain properties (physical forms and functions, instead of mere amino acid formation). In other words, it is stated that these characteristics an organism can have are *inherent* properties of the gene(s): one must assume that there exist genes that specifically encode for an eye and that this is the reason they got selected for in the first place. (Remember the citation of Kimura earlier, who developed a similar argument involving language, under 3).

If we turn to the systems-theoretical point of view, a whole different eye-story is given, namely that: "A single gene can turn on a cascade of some 2,500 genes that are required to "build" an eye." (Gehring, 1998: p. 203)

It has been scientifically proven (Gehring 1998) that one regulatory gene can turn on 2,500 other genes; when this occurs, a functional eye develops. Moreover, this one gene does not in itself carry the property to develop a functional eye (all it

can do is activate a series of other genes through the proteins it encodes for), and neither do any of those 2,500 other genes carry an inherent property to develop a functional eye. Rather, when these different genes start interacting in a certain way, a functional eye will develop. Hence, the information to build an eye emerges because of the genes that start interacting at a certain time and in a certain place. Thus, heterochronic processes (amongst other processes) are involved.

The main difference between the two paradigms is that Neodarwinians need to ask and answer the "what"- and the "what for"-question: *what* does this gene encode for and *what* did it evolve *for*, while adherents of the second position must answer the "how-question": *how* is it that one gene can turn on 2,500 other genes and *how* do these genes interact to form a functional eye?

(Post)Neodarwinians adhere to the view that genes encode for certain properties, that they carry information, while system theoreticians subscribe to the view that genes do not encode for properties, rather they make the difference of properties, because of different activation processes of genes going on in the genome because of e.g. heterochronic processes.

Now what is most curious about all of this, is that there are two sorts of genes that make up our genome (besides the 80% of Junk DNA): structural and regulatory genes. Structural genes are genes that encode for certain properties. Make no mistake about it, there are genes that encode for certain properties such as blue eyes or brown eyes. These properties can be directly traced back to certain genes, here there is a 1-1 correspondence between genes and characteristics of an organism. And it are these genes that are studied the most by Neodarwinians: what Dawkins e.g. is implying is that there was selection for structural genes that make up an eye.

Besides structural genes, there are also regulatory genes, genes that make the difference (Gehring, 1998; Davidson 2001). Regulatory genes do not encode for specific proteins that form tissues that make an organism, rather through the proteins they encode for, they return to the helix and turn other genes on or off, and as such they are directly responsible for e.g. the body plan of a species or certain complex organic forms (Gontier 2004).

Exactly the same thing is going on during eye formation: there are structural genes involved that make the eye blue or brown, but it is a regulatory gene that turns on 2,500 genes in order to develop an eye altogether. Moreover, in the genome of almost all eukaryotic animals (=everything but bacteria and Archae) a Homeobox of regulatory genes is found that, through the different interactions they engage in because of heterochronic processes, are responsible for a species-specific body plan. Thus we share with all eukaryotic beings a Homeobox of regulatory genes. This also means that the different eyes of different species and different taxa all evolved because of homologous instead of analogical processes: the same genes are involved, just the heterochronic processes differ.

Here we find the answer to our question posed previously: can small mutations lead to giant leaps? Yes they can, the turning off of this one gene that normally leads to the development of an eye, immediately leads to an organism without eyes, or in the case the gene is activated in the right place at the right time, one has a functional eye.

Why is this so important in a discussion on pathologies of language and whether it is possible to draw evolutionary conclusions based on pathologies? Because of the findings of the *FOXP2* gene (Lai 2000, 2001; Enard, 2002).

The *FOXP2* gene is a regulatory gene (not part of the Homeobox but of the *FOX*-genes –the Forkhead Domain Box, basically the same thing when it comes down to the regulatory properties of *HOX* and *FOX*-genes). Thus the *FOXP2* gene switches other genes on or off, and it is presumed that this gene is somehow involved in language *development* (since affected members of a British family, named the KE-family, that carry a missense mutation in one copy of this gene suffer from Specific Language Impairment (Vargha-Khadem 1995, 1998); and language *evolution* (since comparative DNA-sequences show that the human FOXP2 protein differs in two locations from the FoxP2 protein present in chimpanzees and bonobos (Enard 2002).

Returning to our earlier discussions of continuity/ discontinuity, and under/ super humanity, the following questions arise: if language is specifically human and even that what makes us human, and if language is encoded for in our genes (in a structural manner and hence if it is an inherent property of the *FOXP2* gene), then we need to conclude that the affected members of the KE are either super- or under-human (the problem discussed when we discussed Pinker and Bloom's work). Indeed, a rather silly question to ask and neither deontological nor moral. Luckily however, it is the wrong question to ask ourselves, because we do not need to raise the question *what* the *FOXP2* gene is *for* (the answer being e.g. language).

Rather, given the fact that the gene is somehow also responsible for the development of the heart and lungs, laterality and so on, because of its regulatory properties, the question is *how* this gene, by interacting with other genes, on the one hand, helps the development of the heart and the lungs, and on the other hand the development of language. Since language is an emerging property, most likely because of the -at a genetic level- workings of several regulatory genes such as the *FOXP2* gene, this one-point mutation (or several for that matter) does not do anything about the humanity of the affected members of the KE-family.

Basically, what pathologies such as these show, is how the different elements interrelate and work together, by showing what happens when one of these interactions fail. It shows how the interactions (should) take place and what happens when they do not, thus leading to the necessary and sufficient conditions for the evolutionary emergence of language.

## 8. Conclusion

One can either adhere to a view of continuous language evolution or a discontinuous one. In both positions it is assumed that child language differs (either quantitatively or qualitatively) from adult human language.

Adherents of the continuity hypothesis often compare primate communication skills, and Pidgin and Creole languages on the one hand, with child language on the other hand. Here it is assumed that all of them resemble a presumed proto-language from whereon human language evolved or develops (in the case of children).

However, caution is required when one uses these different disciplines, because these ideas are often based on false representations of Haeckel's biogenetic law and these positions often raise questions about the under- or super-humanity of children or the speakers of Pidgin and Creoles, a problem we encounter when pathologies are used to understand language evolution as well.

It has been argued that a systems-theoretical view, where language is regarded as a complex process that emerges because of the interaction of different individuals; and that regards genes not as something that inherently carries information, but rather something that makes information emerge because of the interaction between different genes; is a position also preferred to be taken when one looks at different pathologies. For the latter do not show under- or super-humans, pathologies lend insight into how different interactions lead to the emergence of language.

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**Notes**

1. It is of course impossible to read all these works in one lifetime, therefore, I would recommend the works of Hewes (1977), de Waal (1981, 1983) and Ingold (1996) who give a critical analysis of all the above mentioned assumptions.

2. Here I am referring to Pinker and Bloom (1990). They base their theory on Richard Dawkins' view (2000) of evolution, where apparent purposeful "design" is explained as the result of evolution by means of natural selection. These authors are discussed under 7.1.

3. The question that arises here, but that is not answered by Pinker and Bloom (1990), is to what this child with the "better" language is adapted. In Neodarwianian theory, "being adapted" means that an organism is able to survive long enough in a physical environment so that it can reproduce and the fitness of an organism (how many times it is able to reproduce) therefore is a quantitative measure for the adaptive value of an organism. It is however highly unlikely that a language with more complex grammatical rules would be an adaptation towards the physical environment. Probably, the authors had the future language community in mind, or the future language in itself, where complex grammar allows the individual to convey more meaning. But the evident problem here is that neither of them existed at the time the child with the n+1 rule grammar was selected.

**References**


Aitchison, J. (1995), Chimps, children and creoles: the need for caution, In: Puppel, S. (Ed.), The biology of language, John Benjamins publishing company, Amsterdam, 1-19.

Aitchison, J. (1998), On discontinuing the continuity: discontinuity debate, In: Hurford, J., Studdert-Kennedy, C. Knight, C. (Eds.), Approaches to the evolution of language, Cambridge University Press, Cambridge, 17-29.

Altmann, S. A. (1967), The structure of primate social communication, In: Altman, S. (Ed.), Social communication among primates, Chicago, the University of Chicago Press, 325-62.

Barrett, L., Dunbar, R., & Lycett, J. (2002), Human Evolutionary Psychology, Palgrave, Hampshire.

Bickerton, D. (1990), Language and Species, Chicago, Chicago University Press.

Bickerton, D. (2002a), Foraging versus social intelligence in the evolution of language, In Wray, A. (Ed.), The Transition to Language, Oxford University Press, Oxford (NY), 207-225.

Bickerton, D. (2002b), From protolanguage to language, In: Crow, T. J. (Ed.), The speciation of modern Homo Sapiens: Proceedings of the British Academy **106**, Oxford University Press, Oxford (NY), 103-20.

Bickerton, D. (2003), Symbol and structure: A comprehensive framework, In: Christiansen, M. and Kirby, S. (Eds), Language Evolution, Oxford University Press, Oxford (NY), 77-93.

Chomsky, N. (1965), Aspects of the Theory of Syntax, MIT Press, Cambridge (MA).

Croft, W., (2000), Explaining language change: an evolutionary approach. Pearson, Essex.

Croft, W. (2002), The Darwinization of linguistics, Selection **3**, 75-91.

Davidson, E. H. (2001), Genomic regulatory systems: Development and evolution, Academic Press, San Diego (CA).

Dawkins, R. (2000), The blind watchmaker, Penguin Books, London.

DeGraff, M. (2003), Against Creole exceptionalism, Language **79** (2), 391-410.

Dennett, D. (1995), Darwin's dangerous idea, The MIT Press, Cambridge (MA).

Eigen, M. (1996), Steps towards life: a perspective on evolution, Oxford University Press, Oxford.

Enard, W. et al. (2002), Molecular evolution of FOXP2, a gene involved in speech and language, Nature **418**, 869-72.

Fouts, R. & Mills, S. (1997), Next of kin: My conversations with chimpanzees, Perennial currents, HarperCollins Paperbacks, New York (NY).

Gardner, A. R., Gardner, B. T. & Van Cantfort, T. E. (Eds.). (1989), Teaching sign language to Chimpanzees, State University of New York Press, New York (NY).

Gehring, W. (1998), Master control genes in development and evolution: the homeobox story, Yale University Press, London.

Givón, T. (2002), Bio-linguistics, John Benjamins Publishing Company, Amsterdam.

Gontier, N. (2004), De oorsprong en evolutie van leven: 15 van het standaardparadigma afwijkende thesen, van voorwoord en nawoord voorzien door Philip Polk en Jean Paul Van Bendegem, VUBPRESS, Brussels.
[in Dutch. Title: The origin of life – 15 non-Neodarwinian theses]

Gontier, N. (2005a), Introduction to evolutionary epistemology, language and culture, In: Gontier, N., Van Bendegem, J., and Aerts, D. (Eds.), Evolutionary epistemology, language and culture, Springer, Dordrecht, 1-29.

Gontier, N. (2005b), The origin and evolution of language: taking symbiogenesis seriously, In: Gontier, N., Van Bendegem, J. and Aerts, D. (Eds.), Evolutionary epistemology, language and culture, Springer, Dordrecht, 195-226.

Goodall, J. (1986), The chimpanzees of Gombe: patterns of behaviour, Harvard University Press, Cambridge (MA).

Gould, S. J. & Vrba, E. S. (1998), Exaptation: a missing term in the science of form, In: Hull, D. and Ruse, M. (Eds.), The philosophy of biology, Oxford University Press, Oxford, 52-71.

Haverkort, M. and Stowe, L. (2002), The evolution of language: A neurolinguistic perspective, In: Brisard, F. and Mortelmans, T. (Eds.), Language and Evolution, Antwerp Paper in Linguistics, University of Antwerp, 27-37.

Hewes, G. W. (1977), Language origin theories, In: Rumbaugh, D. M. (Ed.), Language learning by a Chimpanzee: the Lana project, Academic Press, New York (NY), 3-53.

Ingold, T. (1996) Social relations, human ecology and, the evolution of culture: and exploration of concepts and definitions. In A. Lock and Peters, C., Handbook of human symbolic evolution, Blackwell Publishers, Oxford (NY), 178-203.

Jablonski, N. and Aiello, L. (Eds.) (2002), The origin and diversification of language, California Academy of Sciences, San Franscisco (CA).

Kaminski, J. et al. (2004), Word learning in a domestic dog: evidence for fast-mapping, Science **304**, 1682-1683.

Kimura, D. (1993), Neuromotor mechanisms in human communication, Oxford University Press, Oxford.

Knight, C. Studdert-Kennedy, M. Hurford, J. (Eds.), (2000), The Evolutionary emergence of language, Cambridge University Press, Cambridge.

Lai, C. et al. (2000), The SPCH1 region on Human 7q31: genomic characterization of the critical interval and localization of translocations associated with speech and language disorder, American Journal of Human Genetics **67**, 357-68.

Lai, C. et al. (2001), A Forkhead-domain gene is mutated in a severe speech and language disorder, Nature **413**, 519-23,

Lock, A. and Peters, C. (Eds.) (1999), Handbook of human symbolic evolution, Blackwell Publishers, Oxford (NY).

Pinker, S. & Bloom, P. (1990), Natural language and natural selection, Behavioural and Brain Sciences **13** (4), 707-84.

Pinker, S. (2002), The evolution of the human language faculty, In: Jablonski, N. and Aiello, L. (Eds.) (2002), The origin and diversification of language, California Academy of Sciences, San Franscisco (CA), 127-170.

Pinker, S. (2003), Language as an adaptation to the cognitive niche, In: Christiansen, M. and Kirby, S. (Eds), Language Evolution, Oxford University Press, Oxford (NY), 16-37.

Richardson, M. K. and Keuck, G. (2002), Haeckel's ABC of evolution and development, Biological Review **77**, 495-528.

Rumbaugh, D. M. (Ed.), (1977) Language learning by a Chimpanzee: the Lana project, Academic Press, New York (NY).

Saffran, E. (2003), Evidence form language breakdown: Implications for the neural and functional organisation of language, In: Banich, M T. and Mack, M. (Eds.), Mind, brain and language, Lawrence Erlbaum Associates, Mahwah (NY), 251-282.

Savage-Rumbaugh, S. and Lewin, R. (1996), Kanzi: the ape at the brink of the human mind. Wiley, London.

Schrödinger, E. (2000), What is life?, Canto, Cambridge University Press (MA).

Schwartz, J. H. (1999), Sudden origins: fossils, genes, and the emergence of species. John Wiley and sons incorporate, New York (NY).

Shanker, S. G. and King, B. J. (2002), The emergence of a new paradigm in ape language research, Behavioural and Brain Sciences **25**, 605-656.

Slobin, D. I. (2005), From ontogenesis to phylogenesis: What can child language tell us about language evolution?, In: Parker, S., Langer, J., and Milbrath, C. (Eds.) Biology and Knowledge revisited: From neurogenesis to psychogenesis, Lawrence Erlbaum Associates, Mahwah (NJ), 255-286.

Terrace, H.S., Petitto, L.A., Sanders, R.J. & Bever, T.G. (1979), Can an ape create a sentence?, Science **206**, 891-902.

Tomasello, M. (2003), On the different origins of symbols and grammar, In: In: Christiansen, M. and Kirby, S. (Eds), Language Evolution, Oxford University Press, Oxford (NY), 94-111.

Vargha-Khadem, F. et al. (1995), Praxis and nonverbal cognitive deficits in a large family with a genetically transmitted speech and language disorder, Proceedings of the National Academy of Sciences USA **92**, 930-3.

Vargha-Khadem, F. et al. (1998), Neural basis of an inherited speech and language disorder, Proceedings of the National Academy of Sciences USA **95**, 12695-12700.

Waal, de, F. M. (1981), Het menselijke voetstuk: gedragsovereenkomsten tussen de mens en andere primaten, In: de Waal, F. M., Sociobiologie ter discussie, Bohn, Scheltema & Holkema, Antwerp, 201-213.

Waal, de, F. M. (1983), Chimpanzee politics: power and sex among the apes, Harpercollins, London.

Waal, de, F. M. (Ed.) (2002), Tree of origin: what primate behaviour can tell us about human social evolution, Harvard University Press, Cambridge (MA).

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