COGNITIVE EVOLUTION

WHY LANGUAGE SYSTEMS ARE SOCIETY-BASED AND USAGE-FRIENDLY ADAPTATIONS

OF ROBUST, AUTONOMOUS, STRUCTURAL SYSTEMS

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Dept. of Linguistics, Univ. Salzburg

Submitted to Adli, Aria & García, Marco & Kaufmann, Göz (eds.) (in preparation):
System, Usage, and Society. Berlin/New York: de Gruyter

Abstract. The short history of linguistics narrowly replicates the intellectual barriers that *evolutionary biology* and (cognitive) *psychology* have overcome in their historical 'childhood'. As for methodological issues, *introspection* was seen as the data highway for theory building in psychology in Wilhelm Wundt's days. Today, psychology is firmly experiment-based and imposes rigid standards of data assessment. Grammar theory still relies to a large extent on introspectively gained data (self-observation), and still waives objective standards of data assessment.

A second parallel is the *basic epistemology*. Does 'intelligent design' presuppose an intelligent designer, as the functionalist conviction takes for granted? Darwin realized already in 1871 ('*The descent of man and selection in relation to sex', part I, p.59*) that evolution is not *substance-bound* and that there is a parallel in the historical development of languages and the biological evolution of species in terms of adaptation as a consequence of random variation and non-random but 'blind' selection. Human language grammars are undeniably adaptive, but this is neither a product of biological evolution nor of social engineering. It is the result of *evolution* on the level of *cognitive, self-replicating* systems. Human languages are neither 'merely' biological nor artifacts. They are of a third kind, namely outcomes of cognitive evolution.

Linguistics has not arrived at firm scientific grounds yet. Strictly *Lamarckian* schools (functionalist; *form follows function*) compete with *structuralist* schools (nativists). The functionalist schools ignore the strong system boundaries, and the structuralist schools are diligently ignoring the adaptive properties in 'language design'. Neither of these two qualities must be ignored since they are undeniable properties of natural language grammar systems. The adaptive properties are merely a consequence of cognitive evolution in the variation + selection game of a (substance-neutral) Darwinian evolution.

Here is the central claim of this paper: The process of evolution is substance-independent, as Darwin (1871:59) indicated. Evolution is at work not only for biological organisms but also for cognitive 'organisms'. In today's diction this reads as follows: *Cognitive evolution* is evolution on the level of cognitive structures (rather than on the level of biological structures, like the genome in biological evolution). Grammars are *self-replicating* systems (that replicate themselves in the course of grammar acquisition). This process is prone to generate *variants* ('mutations'). The variants '*compete'* for restricted resources (viz. the number of brains to be 'infected' by a given grammar variant, with 'ease' of processing as a major selection factor). *Adaptation* is the product of blind selection. Biological and cognitive evolution are identical in terms of the processes (self-replication, variation+selection), but they differ in terms of the substance, of course. Previous accounts that invoked 'evolution' for explaining the 'descent' of languages will be shown inadequate or metaphorical at best.

1. Introduction

In everyday life, we always have been functionalists. Why does the sun move? – It is set in motion by the sun-god. Why do sea-dwelling mammals have fins? – In water, fins are more useful than legs. Why do languages employ acoustic signs? – In order to be able to communicate without sight contact. Why are we fond of functional expanations? – Because our brain has a disposition to understand things in terms of actors, purposes and intentions. It is an eager agency detector.

Functionalism is a deeply entrenched and instinctive every-day life perspective on complex design. The scientific perspective is less intuitively accessible, as can be seen in the history of science. A fairly recently lost bastion of functionalism is life science.[1] The initial entirely

[1] See the anti-Darwinian debates in the 19th century, especially the Lamarckian objections (Ruse 2003).

functionalist viewpoint had to be given up for a less anthropocentric but more explanatory account, namely adaptation by evolution. Curiously, but not surprisingly, the short history of linguistics narrowly replicates intellectual hurdles of historical phases of evolutionary biology and (cognitive) psychology, and the deliberations remarkably resemble those of the old days. What we observe is a replacement of a Lamarckian functionalism by a Darwinian account of adaptation as a consequence of variation and selection.

Linguistics has not yet found its firm scientific grounding. Lamarckian schools (functionalist; 'form follows function', language users as tool shapers) still compete with structuralist schools (nativists). The functionalist schools tend to underweight the strong system boundaries, and the structuralist schools are diligently ignoring the adaptive properties in language 'design', although they acknowledge it.[2]

The two schools more often than not overlook rather than contest each other since their respective premises are by and large orthogonal. What is at the core of one body of persuasions is at the periphery of the other. Structuralist do not appreciate the functionality of grammar systems as a grammatical causality, and functionalists underrate the rigor of the function-independent qualities of grammar systems. Determining what something is good for may be a demanding task, but even if the solution were correct, the utility would not *explain* the structure.

I shall argue that linguistics will not become eligible as a scientific enterprise before linguists have fully accepted the scientific standards for theory construction and falsification that every mature science has accepted. The *structures* of language systems are not fully understood as long as one has not appreciated their *adaptive* qualities as a result of cognitive evolution, and in order to appreciate their adaptive qualities, one has to understand *what determines the systems* that are adapted in the course of diachronic development. I shall argue that the development of language systems is a process of evolution. It is evolution on the level of cognitive representations. Importantly, it is not biological evolution on the level of the genome. It is the very same process of evolution that works in the very same way as evolution works in biology, but the substance is different. In each case, adaptive design is the result of random variation plus non-random selection.

Evolution presupposes an independently determined system that is *replicating*. This is the structural side. Adaptation by selection covers the functional side. What is proposed here combines the structural and the functionalist viewpoint on a novel level of explanation. The orthogonal viewpoints are wrong if maintained in isolation. It is the synthesis in the concept of *cognitive evolution* that does justice to the correct insights of each of the competing standpoints, without trading in their drawbacks.

Linguistics is faced with the very same problem that Darwin has solved in biology. The basic question was this: What explains functional design in the absence of a designer? In other words, as Dawkins (1996) formulated it, in evolution, the watchmaker is blind, but his prod-

[2] Even if functional motivations are undervalued in Generative Grammar, they never have been questioned, as Newmeyer (2001:103) argues: "Surely there are significant connections between structure and function; this is not and has never been in doubt." (Chomsky 1975:56).

ucts are working aptly. There is 'intelligent' design, but there is no intelligence that designed it. This reads like a paradox and the anti-Darwinian position regarded this as a fatal defect of Darwins's ideas. Intuitively, it seems to contradict the second law of thermodynamics. How could a blind process produce order rather than chaos? What this intuition overlooks is this: variation ('mutation') indeed enhances entropy, but selection is the antagonistic feature. It eliminates most of the variation. What emerges is order without an ordering force. The order parameter that happens to emerge is a reflex of the selection process. It is an emergent property and not a pre-designed or intended one, as functionalism would have it.

This paper pursues and advances ideas that were published first in Haider (1998) and Haider (2001) and applied to functional design in syntax in Haider (in press, chapter 1). It is organised as follow. Section 2 recapitulates the fact that functional reasoning is logically invalid reasoning. Functional explanations do not qualify as scientific explanations. Section 3 describes the correpondences between natural and cognitive selection. Section 4 briefly recapitulates how functional efficiency follows, without having to assume a functionalist teleology. Section 5 deals with alternative accounts that attempt to compromise between a Darwinian and a Lamarckinan approach to language change. A brief summary section presents the assumptions and their consequences discussed in this paper, in a nut shell.

2. Functionalist reasoning is logically invalid reasoning

The title of Haider (1998) addressed the issue with an intentionally ambiguous title: 'Form follows function fails'. This should read as *'form follows function' fails* or *form follows, function fails*. This, plus the Gricean implicature of manner yields: The idea that form follows from function is going to fail since form follows, but functions may fail. Purpose or potential for future use does not explain the design, except for artifacts. For self-replicating systems with 'intelligent' design, functions may describe but do not *explain* the functionality of the design. This has become a commonplace in the theory of science (Cummins 1975):

Either a property *P* of a system *S* is taken to be *necessarily* present to guarantee a function *F*, then this premise is empirically incorrect. *F* could be guaranteed by alternative means (cf. Nagel 1961:403). Or, the presence of *P* is taken to be a *sufficient* condition for *F*, then the inference from the function *F* to the necessary presence of *P* in *S* is not valid. All we may infer is that the presence of F contributes to a function (Hempel 1959:310).

The grammars of natural languages are good sources for examples of *alternative* means of implementing identical functions. For instance, 'parts of speech' may be differentiated by morphological means (affixes), by particles, or just by word order. Information structure properties, like focusing, may be coded by particles or word order or both, or merely by intonation.

A particularly instructive case is 'extraposition'. In numerous languages, a phrase may be optionally placed at the very end of the containing phrase or clause.[3] Evidently, this enhances efficient parsing of otherwise centre-embedded structures. A functional explanation postulates that 'extraposition' is active adaptation of grammar by the users for the benefit of parsing (cf.

[3] Example: [The city [that the flood [that the cyclone Katrina had triggered] destroyed]] has been partly rebuilt.
⇒ The city that the flood destroyed *that the cyclone Katrina had triggered* has been partly rebuilt.
⇒ The city has been partly rebuilt that the flood destroyed that the cyclone Katrina had triggered.

Hawkins' (1994) EIC measure). But, crucially, this is not generally the case. First, there are 'strict' OV languages that do not allow 'extraposition' and they have existed for countless generations. This is a flat contradiction for a functional grip on grammar.[4] Second, in extraposing languages, even items may be extraposed that would not pose any problem for parsing.[5] Eventually, there are other means of avoiding centre-embedding[6] that would be sufficient (see above: 'guaranteed by alternative means'). Structures that need compensation by extraposition could be easily avoided by paraphrasing.

So, *ease of parsing* is neither a necessary nor a sufficient condition for the explanation of extraposition. It is not a *necessary condition* because there are strict OV languages that do not admit extraposition, and it is not a sufficient condition either since items may be extraposed that do not matter for ease of parsing. Extraposition is a system's potential of a subset of human language grammars that is exploited for, but not explained by, enhancing the ease of parsing.

In general, *whatever system of grammar* we as humans had at our disposal, we would have to use it willy-nilly, irrespective of its user(un)friendliness, simply because there would have been no alternative. But it is very plausible that nevertheless there would have soon appeared correlations between forms and contexts of usage. Crucially, these correlations are post hoc. Consequently, for natural languages, we find fairly stable correlations between structure and use. But use is not the *causal* factor for shaping structure. Tooby & Cosmides (1990:760) are quite explicit in this respect:

> "[..] *the only scientifically coherent account for the origin of any complexly organized functionality is (ultimately) evolution by natural selection.* […] *All (non-chance) functionality is ultimately attributable to the operation of adaptations - that is, naturally selected innate aspects of the cognitive architecture. Cognitive science and the adaptationist branches of biology are natural intellectual companions*." (Tooby & Cosmides 1990:761). *"It is magical thinking to believe that the 'need' to solve a problem automatically endows one with the equipment to solve it. For this reason, the invocation of social and practical 'needs', pragmatic factors and acquired heuristics, or 'functionalist' hypotheses to explain language acquisition need to be reformulated in explicitly nativist terms"* (Tooby & Cosmides 1990:762).

This statement is too constrained in precisely one point, namely the restrictive reference to *natural* selection, if 'natural' is construed as biologically based. *Natural* selection is not the *exclusive* source of adaptive functionality. It is a selection process operating on *organismic* capacities for successfully reproducing in their environment.[7] Crucially, this is not the type of

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[4] Here are two hard-core functionalist slogans: „Grammar is an automated discourse processing strategy" (Givón 1979). „Syntax is grammaticalized pragmatics" (Langacker 1987).

[5] Example: Er hat nicht *damit* gerechnet ⇒ Er hat nicht gerechnet *damit*. (‚He has not reckoned *with-it*'). ‚*Damit*' (‚with-it') is a single (compound) word. Both variants are equally easy to parse.

[6] Example: The destroyed city has been partly rebuilt. It was destroyed by a flood triggered by the Cyclone Katrina.

[7] "As a causal theory natural selection locates the causally relevant differences that lead to differential reproduction. These differences are differences in organisms' fitness to their environment. Or, more fully, they are differences in various organismic capacities to survive and reproduce in their environment." Stanford Encyclopedia of Philosophy (http://plato.stanford.edu/entries/natural-selection/).

selection that accounts for the functional properties of human languages. In the case of languages, it is selection, but not natural selection. Tooby & Cosmides are pefectly right, if 'natural' is deleted and if *natural* selection in terms of the evolutionary process of organisms is seen as a special case of a general concept of evolution (e.g. Hull 2001) that applies to any (self-)reproductive system. The theory of evolution as developed by Darwin is principally substance-neutral, although it has been developed and explicated as a theory of explaining the 'origin of species by means of natural selection' (Darwin 1859). All it requires is a replicating system that produces variation and that the variants are exposed to selection.

Natural selection (that is based on the reproductive success of the phenotype) could not explain the intricate grammar-internal details of languages.[8] Nevertheless, the idea of a piece-by-piece *natural* evolution of grammar was ventured by Pinker & Bloom (1990). Evolutionary success in natural evolution is reproductive success. It is hard to see, however, what an accidental change in a cognitively encapsulated system of formal operations for symbol recombination could contribute to the reproductive success of those whose brain supports the change compared to those whose brain does not:[9] For everyday life purposes of language use (including cognitive operations on propositionally structured knowledge representations) a much more primitive system of grammar seems to be flexible enough a language tool for all the purposes of the hard life of (the predecessors of) stone-agers. The luxury of grammar systems of natural languages is by far underdetermined by the functionality of use:

> *"Human language is an embarrassment for evolutionary theory because it is vastly more powerful than one can account for in terms of selective fitness. A semantic language with simple mapping rules, of a kind one might suppose that the chimpanzee would have, appears to confer all the advantages one normally associates with discussions of mastodon hunting or the like. For discussions of that kind, syntactic classes, structure dependent rules, recursion and the rest, are overly powerful devices, absurdly so."* [Premack (1985:30)].

Why are grammars luxurious[10] and diverse? They are luxurious because the neural substrate freely provides processing capacities for this luxury. What appears to be a superfluous complexity is but the costless exploitation of the system's potential of the human brain that happens to be available for free. The 'programmer' of this potential is not an 'invisible hand' and

[8] In the early days, (Friedrich) Max Müller (1862) tried to make a strong point against an all-encompassing concept of evolution. He emphasized the impossibility of biological evolution of language as a strong argument against Darwin's theory of evolution: "*Language is the Rubicon which divides man from beast, and no animal will ever cross it* [...] *the science of language will yet enable us to withstand the extreme theories of the Darwinians, and to draw a hard and fast line between man and brute*." (Lecture from 1861, published 1862 in: Lectures on the Science of Language. London: Longman, Green, Longman, and Roberts).

[9] See Bierwisch (2000) for a detailed discussion of the conundra and paradoxa of attempts to explain the emergence of language as a direct product of biological evolution.

[10] See Haider (2001) for the following *arbitrary* and merely illustrative list of communicatively immaterial details:

i) a language with(out) fronting of finite verbs (cf. Germanic vs. Romance languages vs. strikt OV languages)
ii) a language with(out) a case system consisting of subsystems that correlate with the inflection class of the verb (e.g. Georgian Nom-Acc & Nom-Ergative system vs. languages with a plain case system)
iii) a language with(out) clitic pronouns (e.g. Romance vs. Germanic languages)
iv) a language with(out) gender agreement (in the article system: English vs. Dutch vs. German)
v) a language with(out) negative concord
vi) a language with(out) multiple fronting of wh-expressions (e.g. Slavic vs. Romance or Germanic languages).

it is not a society-based net of needs. It is an ongoing process of cognitive evolution (cf. Heylighen et als. (1999)). Just like natural selection produces luxurious organisms – fantastically colored butterflies or fish populations in coral reefs, to name just two instances – cognitive evolution produces luxurious systems of grammar. Their luxury may sometimes even hamper acquisition or usage and gets cut back in the course of the diachronic changes (e.g. the loss of the sumptuous system of inflectional morphology, both in terms of the inventory and the categories, of Latin as result of the changes that lead to present-day successor languages).

In sum, a functional analysis of the inventory and processes of the grammars of human languages may *describe* their functionality, but it does not *explain* it. You may correctly *describe* the functionality of the human eye as a component of visual perception, but you cannot *explain* it in terms of this functionality. An instructive example is the anatomy of the *human* eye, and in fact the vertebrate eye. It suffers from an evident 'constructional' defect. Unlike the octopus (cephalopod) eye, its wiring is tinkering design. The nerves approach the retinal cells from the side at which the light arrives. The smarter 'engineer' of the octopus eye correctly placed the nerves on the 'dark' sides of the cells. As a consequence of this design, the human eye has a blind spot (scotoma).[11] Functional reasoning may account for the advantage of vision, but it cannot *explain* the structures that enable vision and how they developed. Analogously, functional analysis may classify linguistic structures in terms of their contexts of use, but this does not explain how they developed and why exatly these structures are used and not others that would serve the same function.

3. Uniform theory of evolution – different fields of selection: *natural* or *cognitive*

Already in his book from 1871, Darwin pointed out that the theory of evolution is not substance-dependent and that consequently, the development of language appears to be parallel to biological evolution in terms of adaptation and 'struggle for life' as a consequence of variation and selection. In this publication on human physical and cultural characteristics, evolution of culture, differences between sexes, to name but a few topics, Darwin (1871, I:59) made it clear that his theory of evolution is substance-neutral:

> *"The formation of different languages and of distinct species, and the proofs that both have been developed through a gradual process, are curiously parallel.* […] *The survival or preservation of certain favored words in the struggle for existence is natural selection."*

Intriguingly, linguists of those days (and in fact this is true until our days, with the exception of a few researchers mentioned above) did not take up this eye-opener.[12] Instead, some attacked Darwin precisely on linguistic grounds, in complete misappreciation of the nature of the problem (see Max Müller's attack, quoted in fn. 8). In hindsight, this is understandable. In the second half of the 19th century, linguistics did not command of a concept of grammar as a cognitively real knowledge system, nor of an understanding of how this knowledge system is structured, acquired and put to use. Linguistics was mainly concerned with developing the

[11] There is a blind spot at the back of each eye at the place where the optic nerve passes through the eyeball and in this region there are no receptor cells. The brain compensates the blind spot so that we are not aware of it.

[12] But scientist of today did. See Fitch (2007) for quantiative relationships between how frequently a word is used and how rapidly it changes over time.

comparative method of investigating the (lexical as well as inflectional) morphology of Indo-European languages of the past. It was a thoroughly historical science.

Darwin had to convince his audience that the mainstream opinion of his days was wrong. This opinion was a Lamarckian viewpoint and thereby a functionalist theory. Lamarck's transformationalist theory of evolution incorporated three ideas that in his days were considered to be generally true (Gould 2002):

The first idea was '*l'influence des circonstances*', an adaptive force by which the *use* or disuse of characters led organisms to become more adapted to their environment. This would make organisms adapted to their environment, taking them sideways off the path from simple to complex. The second idea was '*le pouvoir de la vie*' as a complexifying force. This would drive organisms from simple to complex forms. Movements of fluids would etch out [sic!] organs from tissues and lead to more and more complex constructions regardless of the organ's *use* or disuse. The third and crucial ingredient was the idea that an organism can impart on its offspring characteristics that it has acquired during its lifetime (also known as heritability of acquired characteristics).

Darwin's theory, on the other hand, is not functionalistic, although it explains adaptation. The following brief exposition is based on Mayr (1991 ch.4) who points out that Darwin's theory consists of five independent subtheories. I shall briefly summarize them and append an outline of the linguistic implications for each subtheory.

i. *Evolution as such*: The objects of the theory are not seen as constant or recently created nor perpetually cycling, but rather as *steadily changing*, and that organisms are transformed in time.

   Grammars of languages are steadily changing, if not impeded by normative efforts (schooling, script culture). Trivially, the lexicon is steadily changing, but grammar is changing too. Imperfect acquisition is a source of grammar change, and so is language contact. An internal source of change is the desire for in-group differentiation.

ii. *Common descent*: This is the theory that every group of organisms descended from a common ancestor, and that all groups of organisms, including animals, plants, and micro-organisms, ultimately go back to a single origin of life on earth.

   Indo-European studies are a success story that illustrates this point. Languages that descended from a single proto-language have spread till Iceland in the North-West and till the Far East, into today's province of Xinjiang, in China's North-West (Tocharic). Today they are different beyond superficial recognition, but they all are in a descendant relation to a single 'mother tongue'.

iii. *Multiplication of species*. This theory explains the origin of the enormous organic diversity. It postulates that species multiply, either by splitting into daughter species or by 'budding', that is, by the establishment of founder populations that evolve into new species, if geographically isolated.

   'Species' and 'subspecies' translate as 'language' and 'dialects'. Latin, for instance has developed into a huge number of languages (= species). As linguists we know that there are many more descendant languages of Latin than merely the 'official' Romance lan-

guages and the already extinct ones (like Dalmatian), from Sicilian, Neapolitan, Istriot, to Friulian and Piemontese, to name just a few languages on the Apennine peninsula. What biologists call 'budding' developments, is dialect split in linguistics. Geographic isolation and cross-fertilization (language contact in bilingual brains) is a catalyst for 'budding'.

iv. *Gradualism*. According to this theory, evolutionary change takes place through the gradual change of populations and not by the sudden (saltational) production of new individuals that represent a new type.

Again, this is commonplace in linguistics. Languages change over generations. Changes typically develop out of communities with dialects co-existing for a long time.

v. *Natural selection*. According to this theory, evolutionary change comes about through the proliferation of genetic *variation* in every generation. The relatively few individuals who survive, owing to a *particularly well-adapted* combination of inheritable characters, give rise to the next generation.

The last point is the crucial point. Linguists who would subscribe to i.-iv. would not simultaneously assume natural selection as the source of language change and the emergence of new species (= languages). What would it mean that 'individuals' survive and become the founding individuals of a new 'species' of language? All we have to do here is to step back and rethink the analogy carefully. Of course it is not a question of survival and reproductive success on the level of the human phenotype. However, there is an exact parallel to biological evolution on a different level. This has been overlooked. It is the level of cognitive evolution of cognitive representations of replicating cognitive algorithms like grammar.

According to Gould (2002), classical Darwinism comprises three core commitments, namely *agency, efficacy, and scope*. 'Agency' is the unit upon which natural selection acts. For Darwin, this unit was the organism. 'Efficacy' is natural selection at ecological scales. 'Scope' is the degree to which natural selection covers and explains biological diversity at the macro-evolutionary level.

The *agency* of cognitive evolution of languages is grammar as a self-reproducing cognitive system. A grammar is a cognitive virus. Like a virus, it needs a host for reproduction. The core grammar G of a language L is acquired by the child. Actually, the child's brain is infected by the grammar. The child is exposed to language and cannot help but get engaged in language processing. As a consequenc, the brain gets 'enslaved' by the grammar of this language. The grammar corresponds to the genotype, the language is the phenotype. The more brains are 'infected' by a given variant of grammar, the higher is the reproduction success of this grammar. It will determine the language used by the speaker and this contributes to the basis of language acquisition for other brains. Like in biology, the copy-mechanism is not perfect. This is one of a number of sources of variation that feed the pool of variation of grammars for L.

Efficacy is at stake when a choice has to be made between grammar variants that coexist in a given language environment. The selector is the brain, and in particular, the brain resources recruited for language processing. The grammar will win that turns out to have an adaptive advantage. This is selection.

Evolution is *adaptation* by *selection* out of a pool of variants. For grammars, the selector is the (kid's) processing brain that has to acquire the grammar of a given language by merely being exposed to the language. Like in biological evolution, the winner is the variant of grammar for the given language that 'infests' more brains than the other competing variants. The winning variant multiplies itself more often. And just like in biological evolution, the emergent result is an adaptive quality.

What are adaptive qualities? The adaptive quality, as in biological evolution, is a quality that becomes effective in the environment of the system/organism. The environment of grammars is language processing. Grammar is the procedural knowledge system that the brain employs for language processing, both in reception and in production. As in biology, selection becomes a crucial issue once there is competition for limited resources.

A limited resource, for instance, is the amount of processing time for a given structure (Haider 1997). This is a limited resource for *reception*. The production process may use as much time as it wants, but as a listener my brain must be finished with processing when the next utterance arrives. If 'extraposition' saves processing time, the competing grammar that allows 'extraposition' is likely to win. However, just as in biology, the need by itself does not create the variant it would prefer. An organism may remain in the same form in its environment for any amount of time, if the environment does not change and no competitor species arrives that struggles for the available resources. In other words, ease of processing cannot turn Japanese into an 'extraposing' language as long a Japanese does not produce a grammar 'mutation' that allows extraposition. Adaptation is a question of *scope*. The higher the rate of mutation, the higher is the potential for adaptive changes.

A well-known mutation-prone situation for grammars is language contact with extensive bilingualism (cf. Heath (1984), Winford (2003)). Take for instance modern Persian. Many of the grammar changes that separate modern Persian from its kin languages like Pashto occurred after the Arab conquest with an ensuing Persian-Arabic bilingualism, accompanied by the introduction of Arabic script for Persian.

Finally, the selecting filter of the processing brain is responsible for the *complete absence* of many simple, easy to understand potential rules of grammar across languages. For instance, there is no language that employs word-by-word mirroring, that is mirror-image inversion, as a grammatical rule.[13] The reason seems clear. Our brain does not support this type of symbol manipultation. Hence, no language employs this relation for coding a grammatical rule. It is easy to program on a computer but very hard to perform with our own 'wet' ware.

After this brief presentation of the theory of evolution in biology and cognition, let us now briefly compare Lamarckian functionalism with Darwinian evolution theory and its relevance for linguistics.

[13] For example: 'Auch sie lachte' (declarative) – ‚Lachte sie auch?' (interrogative)
also she laughed laughed she also?

Ch. Darwin (1809-1882)	**J. B. de Lamarck** (1744-1829)
i. Variations of *inheritable* features which already exist	i. *'Drive'* to change is directed to meet and serve the organism's needs.
ii. *Passive adaptation*: the environment 'screens out' (selects) features contributing to survival/thriving, and tends to eliminate the others (indirectly)	ii. *Active adaptation*: The organism actively develops (invents) new features, in order to survive/thrive.
iii. *No heredity of acquired traits*. Thriving organisms have more off-springs, who inherit the adaptive qualities of this variant.	iii. *Heredity of acquired traits*: Newly acquired traits get passed down to off-springs somehow.
iv. New species, eventually.	iv. New species, eventually.

The Darwinian kind of change in biology contrasts with a widely held conception that all of human culture changes on a Lamarckian basis. The biologist Gould (1996: 221-22) for example, expressed the idea that cultural change works Lamarckian as follows:

> *Why can't organisms figure out what would do them good, develop those adaptive features by dint of effort during their lifetimes, and then pass those improvements to their offspring in the form of altered heredity? We call such a putative mechanism 'Lamarckism'. […] Natural evolution would go like gangbusters if heredity happened to work in this manner. But, unfortunately, it doesn't.* […] *But cultural change, on the radical other hand, is potentially Lamarckian in basic mechanism. Any cultural knowledge acquired in one generation can be directly passed to the next.*

People who take the language faculty for granted and regard languages as cultural entities only (because they are not familiar with the neuro-cognitive substrate on the one hand and the algorithmic intricacies of grammar on the other hand) tend to subsume languages on the Lamarckian side of the box shown above. But language change, like natural evolution '*would not go like gangbusters*', that is, with great speed and exitement. It is not Lamarckian.

Let me repeat one more: if language change was Lamarckian the grammars of languages would differ unpredictably and in arbitrary ways, just like our cultural products differ in unpredictable ways (see De Vogelaer (2007) for a careful analysis of an empirical study along Lamarckian versus Darwinian lines). The dynamics of fashion & style change is Lamarckian, the dynamics of grammar change is Darwinian. Grammars evidently do no change the way our dressing or eating habits change.

4. Functional efficiency without functionalism

The degree of functional efficiency is a function of variation. Only if selection can get hold of a variant that enhances efficiency, the language has a chance of a change. No variation, no change. Second, change is local. Languages are functionally efficient in some respect and dysfunctional in others. These are the finger prints of evolution by mutation and selection, but not the sigantures of the needs of the speech community that improves its tool. Evolution is

always local optimization, but what is locally advantageous may be a disadvantage on a higher level of the system since the local improvement may hamper other functions.Take for instance the grammaticalization of expletive subjects in English.

'There' as an expletive is bound to co-occur with a postverbal nominal subject, and 'it' as expletive is the antecedent of a postverbal subject *clause*. As a consequence, English has no expletives left for the subject position in subjectless clauses. So, English is the only Germanic language that has no passive for intransitive verbs (1d), since there is no expletive. VO languages, however, require a lexicalized subject position, unlike OV languages (1c). The alleged communicative need of being able to leave the subject argument unmentioned is patently ignored by the grammar of English.

(1) a. Ofte vart *det* telefonert — Norwegian
often was *it* telephoned
b. Ofte telefoneres *det*
often telephons$_{\text{-Passive}}$ *it*
c. Oft wurde (**es*) telephoniert — German
often was (*it*)
d.*Often it/there was phoned

Another apparently dysfunctional trait of VO languages, compared to OV languages, is the exclusion of 'why' or 'how' in combination with a wh-subject (see Haider 2010, ch. 3).

(2) a. *It is unclear who left why
b.*It is unclear why who left
c. Es ist unklar *wer weshalb* weggelaufen ist — German
it is unclear who why left has
d. Es ist unklar *weshalb wer* weggelaufen ist

Grammars are highly efficient, nevertheless they contain dysfunctional traits. The search for the optimal grammar would be in vain, just like the search for the optimal animal. Efficiency is a matter of degree because the selectors in the environments pursue conflicting demands. What is optimal for production may be suboptimal for perception, and vice versa. What is optimal on the phonological level (e.g. cluster reduction), may be suboptimal on the morphological level (e.g. cluster reduction that produces non-distinct forms). This is a well-known and typical situation for adaptation by selection that is likely to produce many descendants.

A strong case for adaptation by evolution and against environment & society-driven functionalism is the irreversibility of change. Needs of a society may come and go, like trends in fashion. Language change, however, is generally irreversible. When case morphology is gone it is not re-introduced by the next-but-one generation. When a language becomes verb second, like all Germanic languages (except English), the V2 grammar is not given up for the previous grammar again. It is this strong drift that is characteristic of evolution, and not characteristic at all for fluctuating changes in a society.

Haspelmath (1999:180) suggests a compromising position between functionalism and evolution. Linguistic 'evolution' is a diachronic process but it is based on *intentional* actions rather than on selection.

> "*As in biology, observed adaptive patterns in language can be explained through diachronic evolutionary processes as the unintended cumulative outcome of numerous individual intentional actions*".

The reference to *intentional* actions makes this position incompatible with Darwinian evolution. Of course, one may use the term evolution in a non-technical sense, but the alleged parallel to biology becomes a mere equivocation. What is taken for granted in this particular case is an invisible synchronization of the 'individual intentional actions'. The typical behaviour of individual entities in a closed system is governed by the statistic law of growing entropy (i.e. the second law of thermodynamics), however. Not synchronisation but a dissipative development is the normal process when a system may be continuously changed locally.

What is crucially missing in this conception is a precise notion of selection. Evolution is selection. There is no adaptive change without selection. Adaptability is relative to the *selection* mechanisms and these are diverse if conceived of as 'intentional actions'. Without a precise characterization of selection, evolution is as insignificant a notion as percentage figures without baseline.

Linguistic evolution cannot be based on intentions. Intentions can be served by many different means, and intentions are volatile. They may change repeatedly, and they cannot be assumed to be uniform over a large group of individuals. The selector for the selection process behind linguistic evolution is not a homogenous 'grammar council' of users who formulate their annual motions. It is as blind as the selector in natural selection.

The only *constant* selector is the *uniformity* of our language processing brains. Every child processes language by the same brain structures and resources. This is the uniform selection environment. When is it exposed to language variation, grammar variation is the pool for selection. In an abstract sense, the variant grammars are competing for a hosting brain as a replicator of the specific grammar variant. The brain is the replicator because the grammar determines the language the human will use, and this language is the medium that embodies the grammar that will be picked up by the next language acquiring brain.

The selector is blind. Whatever grammar makes reception or production easier than a competing grammar will win. It will win because the brain will acquire this grammar more easily than the less efficient, competing grammars, and the winner takes them all. There is no intention at issue, and it could not be. Ease of processing is of course not the only selection filter. Storage and retrieval is selective, too, and many other factors at the neuro-cognitve interface. The structure of grammar is cognitively encapsulated. As a speaker I have no idea how the grammar in my head is structured, and I have no idea how I could change its structure in order to change is usability properties.

Linguistic evolution is fed by two sources of grammar 'mutations'. One source is internal. It is the *imperfect transmission* of grammar by the language structure it determines. This is parallel to imperfect transmission of the genetic information. The other major source is external. The transmission of a grammar is deranged by external influences. For the language learning brain, a disturbing factor is the *externally triggered variation*. This is typically the case in multidialectal or multilingual situations. The multilingual brain is happy to playfully contami-

nate the languages, and the learner is confronted with enhanced variation. Let us briefly recapitulate:

- Evolution proceeds by the process of variation, a *random* process, and selection, an environmentally-based *non-random* process. For grammar, the environment is the processing brain.
- Individual *intentions* do not play a role. Organisms do not fabricate what they 'need' through 'inner drives' or intentional 'use and disuse.'
- Mutations are *not directed* for the overall benefit of the individual.
- Evolution is *neither goal-directed* nor *random*. It is driven by the *non-random* but *non-directed* process of selection.

This is true of evolution on the level of the biological genotype as well as evolution on the level of a cognitive representation (viz. the cognitive representation of grammar as the 'genotype' of the language determined by this grammar). In each case, a reproductive system produces variation and this pool of variation is exposed to blind selection. Selection is an environmental property. In biology, it is the environment where the phenotype finds its resources. Analogously, in cognitive selection the environment is the environment that provides the resources for the phenotype. In biology, the resource is where the energy for the organism is derived from (food). The environment for cognitive evolution is the ensemble of brain resources for language acquisition, production and perception. The brain resources constitute the 'biotope' in which the grammar 'virus' resides after it has won the 'struggle for life' in the course of language acquisition.

Here is a concrete case for the sake of providing a more vivid impression, given the abstract points raised above. It is the split of the Germanic language into a VO and an OV group during the time of the development of the Germanic V2 property. This is a sketch of the crucial points. For a detailed discussion please consult Haider (2010a) and Haider (in press; ch.1 and 5).

In the old Germanic languages, the verb positioning is variable. It may be VP-final, VP-initial or VP-medial. Old Englisch (Fischer & van Kemenade & Koopman & van der Wurff (2000:51)) is representative here (Haider 2010a; in press, ch. 5).

(3) a. Se mæssepreost *sceal* [mannum [*bodian* þone soþan geleafan]]$_{VP}$
the priest *must* [people [*preach* the true faith]] (*Ælet* 2 (Wulfstan1) 175)

b. þæt hi [urum godum [*geoffrian magon* ðancwurðe onsægednysse]]
that they our god *offer may* thankful offering (ÆCHom I, 38.592.31)

c. Ac he sceal [þa sacfullan *gesibbian*]
but he *must* the contenders *reconsile* (*Ælet*2(Wulfstan1)188.256

d. Se *wolde* [*gelytlian* þone lyfigendan hælend]
he *wanted humiliate* the living saviour (*Ælet* 2 (Wulfstan1)55.98

When the *V2-pattern*[14] got grammaticalized, this introduced an additional, structurally distinct, verb position outside the VP, accessible only for the finite verb. As a result, the structures became highly ambiguous when the finite Verb in the V2 position is related to its base

[14] [XP [Vfin$_i$ [… -$_i$ ….]$_{VP}$]]

position. Given the alternative V positions within the VP, there are several alternatives for the virtual base position:

(4) V2 + *variable* V-positioning inside the VP (pre-change situation)

a. XP V_{fin} YP ZP	3	alternative base positions (see 5)
b. XP Aux_{fin} V YP	3 + 2	alternative base positions
c. XP Aux_{fin} YP V	3	alternative base positions
d. XP Aux_{fin} YP V ZP	3 + 2	alternative base positions

The three alternative base positions for (4a) are indicated in (5). What this amounts to is a high degree of indeterminacy for determining the filler-gap relation for the fronted finite verb.

(5) XP V_{fin} YP ZP

a. XP V_{fin} [YP ZP $-_{\mathbf{i}}$]

b. XP V_{fin} [YP $-_{\mathbf{i}}$ ZP]

c. XP V_{fin} [$-_{\mathbf{i}}$ YP ZP]

The present day situation is as follows. Every Germanic language with a single exception[15] has changed into a language type with a *fixed* head position for the verb in the VP. The Northern group is head-initial (VO); the continental Western group is head-final (OV). This is a unique split within a language family, and it goes parallel with the grammaticalization of V2.

(6) a. V2 + *fixed* V-position in the VP

b. XP V_{fin} YP ZP	1	(VO) or (OV)
c. XP Aux_{fin} V YP	1(+1)	(in VO)
d. XP Aux_{fin} YP V	1	(OV)

The gain of the change is obvious. It replaces a grammar with a high degree of indeterminacy by a grammar with an easy to determine filler-gap relation. The simpler grammar variant wins, and since there are two possible implementations (namely OV and VO, masked by V2), it must not come as a surprise that both found its way into the brain of language learners and users. There is no need for 'needs of a speech community'. It is selection on the level of cognitive representations.

5. No need for metaphors

A position much like Haspelmath's (1999) has been worked out in greater detail by Croft (2000) and (2009). He declared his approach as Darwinian. According to Croft, the basic unit in the evolution of language is the linguistic *utterance*. Only innovative linguistic expressions that are uttered recurrently are *(re)produced* successfully and will lead to a change. Change is not directly instigated by the speech community in as much as for a real change, any innovation has to spread through the population of language users before effecting the change. However, the speech community (= society) has an important role in his conception of linguistic evolution. It is the selector. *Social reasons* account for differential replication of 'linguemes' in language use (Croft 1999; sect. 1.2.: the box 'The theory of utterance selection):

[15] Yiddish has conserved a grammar that all other Germanic languages changed into one with rigid head-positioning. Arguably, this is due to the ad-strate effect of being embedded in Slavic speaking communities. Slavic languages are languages with flexible head-positioning. The all show the variation illustrated in (3).

> *"Human biological evolution actually takes place at a time scale far greater than the entire history of human language. What is important is that language change is a different evolutionary process: the evolution of utterances. Of course, these two processes are related. The replication of tokens of linguistic entities, which I have called linguemes […], is mediated by speakers: linguistic entities cannot reproduce by themselves."*

What he describes is exactly what Darwin had in mind with his example of *lexical* change: "*The survival or preservation of certain favored words in the struggle for existence is natural selection.*" Here, the token frequency correlates with the adoption of the novel word by other speakers. These changes are changes in the *declarative* system. 'They come on like gangbusters'. Grammar change is not change in the declarative system but in the procedural system. Language competence as grammar competence is not declarative. Nobody can tell what one's language know-how is but everyone can retrieve his active vocabulary.

For grammar change, the target is not the utterance. The target is grammar. An utterance is merely a facet of the phenotype of a grammar, that is, the set of utterances determined by a grammar. What Croft seems to misunderstand is the fact that for natural selection, the phenotype is the living organism as the representative of the *totality* of a genome. In cognitive evolution, the language (*E-language* in Chomskyan terminology) is the phenotype; the genotype is the grammar (*I-language*, in Chomskyan terminology).

A single utterance, either as token or as the set of tokens (= type) crucially is *not* the representative of the totality of grammar. The replication of an utterance is not the replication of grammar, of course. For an organism, however, its replication is the replication of its *entire* genome. This being evident, the usage frequency of an utterance in the speech community is not the causal factor, otherwise grammar change would start with the conventional utterances for greeting.

Moreover, Croft does not tell how a frequent novel utterance can have a causal effect on grammar. The 'theory of utterance selection' merely tells us that a given utterance is used frequently if it turns out to be useful for whatever usage. Crucially, it does not tell us how the frequency of a specific utterance can be the cause of grammar change.

Here is an example: few years ago, the ungrammatical utterance (7a) became popular because a prominent person had uttered it sincerely. In fact, a web search confirms that the ungrammatical utterance (7a) is still very popular. It is seven times more frequent than its grammatical variant (7b),[16] but nobody would assume that the frequency of this specific utterance could make it a catalyst of a grammar change that allows replacing dative by nominative in a German passive in general.

(7) a.* Hier werden *sie*$_{\text{Nom}}$ geholfen
here are you helped
b. Hier wird *ihnen*$_{\text{Dat}}$ geholfen
here are you helped

Crofts ‚theory of utterance selection' may account for lexical changes, but not for changes in the *procedural* system of language (viz. grammar change). The token frequency of an utter-

[16] 2.910.000 for (7a) versus 394.000 pages for (7b). [google-search on April 17th, 2012].

ance could only explain the fossilization of an utterance[17] as an idiom or the adoption of a novel lexeme. It is neither the type frequency nor the token frequency of an utterance that matters. What matters is the availability of an *alternative structuring* of an utterance. This is not a question of token frequency. It is a question of the size of a type set.

What we need is facts. Lupyan & Dale (2010) provide a particular set of facts in terms of correlations between typological traits (based on WALS) and social data (overall number of language users, geographical spread).[18] They suggest a functionalist interpretation for their finding. This interpretation is arguably inappropriate, however. In fact, these data immediately support the cognitive evolution hypothesis sketched above. Here are the facts they highlight: For languages used by large numbers of speakers – in their terminology languages of an '*exoteric*[19] *niche'* quality (in contrast to an 'esoteric niche') – the following probability weighted properties apply. Languages that qualify as 'exoteric'

1. are more likely to be classified by typologists as *isolating* languages,
2. contain *fewer case markings*, and have case systems with *higher degree of case syncretism* (further reducing the number of morphological distinctions),
3. have *fewer grammatical categories* marked on the verb and are less likely to have idiosyncratic verbal morphology,
4. are more likely to *not possess noun/verb agreement*,
5. are more likely to make possibility and *evidentiality* distinctions *using lexical (e.g., verbal) constructions* rather than inflectional affixes,
6. are more likely to *encode negation using analytical strategies* (negative word) than using inflections (affixes),
7. are *less likely* to *encode the future tense morphologically* or possess remoteness distinctions in the past tense,
8. are less likely to have *definite and indefinite articles*. If both are present, they are more likely to be expressed by separate words than affixes,
9. are less likely to communicate distance distinctions in demonstratives,
10. are more likely to *express pronominal subjects lexically* than morphologically.

Their interpretation of these data is the *linguistic niche* hypothesis: "*We tentatively propose that the level of morphological specification is a product of languages adapting to the learning constraints and the unique communicative needs of the speaker population. Complex morphological paradigms appear to present particular learning challenges for adult learners even when their native languages make use of similar paradigms. As a language spreads over a larger area (e.g., as a result of colonization) and is being learned by a greater number of*

[17] ‚*Vater unser*' (father our) is ungrammatical in German, but it is the first verse of the prayer every Christian prays. It is the direct translation of '*pater noster*'. Its extremely high frequency in German has not had any effect on the grammar of German, though.

[18] "*Across a wide range of linguistic features, a systematic relationship between demographic and typological variables was found, providing overwhelming evidence against the null hypothesis that language structure is unrelated to socio-demographic factors*."

[19] The *exoteric linguistic niche* is the situation of languages with large numbers of speakers. Speakers of languages in the exoteric niche compared to speakers of esoteric languages are more likely to (1) be nonnative speakers or have learned the language from nonnative speakers,and (2) use the language to speak to outsiders - individuals from different ethnic and/or linguistic backgrounds

adult learners, complex morphological paradigms have a greater probability, over historical time, to become simplified.

Their functionalist viewpoint introduces once more "*the unique communicative needs of the speaker population"* as an explanation for "*languages adapting to the learning constraints.*" I shall accept their correlation data but reject their explanation. Their case is a good illustration of functionalist construals of findings that are better explained by cognitive evolution.

The explanation they suggest amounts to a scenario of language change as the result of imperfect adult language learning in second language learning situations. A language is imposed on non-natives and they simplify this language into a kind of creolized variety. Let us be specific. Lupyan & Dale regard the history of English and its linguistic dominance in the former colonies of the British Empire as representative. What they overlook is the massive counterevidence for their scenario. Their hypothesis needs to be tested against solid data.

English had arrived at its present day grammar before it got accepted as the official language of India or of the United States. More dramatic grammatical changes happened to English on its way from OE to ME than from ME to modern English. But then, English was definitely a language in an 'esoteric niche' spoken on an Island. The very same changes towards the 'exoteric' syndrome happened to languages in the North of Europe (continental Scandinavian), in an even more 'esoteric niche' area. On the other hand, Brazilian Portuguese has changed minimally compared to the expansion from the esoteric niche of Portugal into the exoteric niche of Brazil. Similarly, Spanish is still Spanish although it crossed an ocean an spread across a whole continent, while the linguistic descendants of Latin changed significantly in spite of immediate neighbourhood (cf. Italian, Piemontese, Provencal, French, Spanish, Portuguese). Afrikaans, the language of the Dutch settlers at the South end of Africa, on the other hand, has changed into the direction of an exoteric niche language, although the Dutch people at the Cape were an 'esoteric niche' community.

Their functionalist account would neither capture the necessary nor the sufficient conditions of grammar change. It is a fact that for a language to acquire properties of the esoteric niche it is not necessary to have a large number of speakers spreading over large territories. Positive evidence comes from continental Scandinavian languages and Afrikaans. They acquired most of the 10 properties despite their esoteric niche existences.

On the other hand, the niche hypothesis would predict a causal relation between the acquisition of 'exoteric niche' properties, once a language has acquired a sufficiently large amount of speakers. In terms of the numbers of speakers and the area covered, German is predicted to be the most exoteric language among the Germanic languages. In fact, the opposite is true. German is highly 'esoteric' in comparison to its Germanic kin, in terms of the properties listed above since 60% of the properties (viz. 1,2,3,4,8,9) do not apply to German.

The evidence of Latin cuts both ways. The follower varieties of Latin in the former Roman colonies are all 'exoteric', but the prediction is false for Latin itself in its history of a language of a small community that has turned into the language of the largest empire of the classical period. Over more than three centuries during the time of the expansion, classical Latin did not change significantly.

In sum, the language niche hypothesis is a conjecture without sufficient empirical support, and it is highly unlikely that the niche conjecture would survive detailed empirical testing. But

this is exactly what one would expect from the point of view of an evolutionary account. The outcome of a process of evolution is random, but the niche hypothesis pretends to be part of a deterministic theory. Grammar change may happen in any language, independent of its 'size', but the chance that a change survives depends is different.

Lupyan & Dale (2010) jump to a functionalist conclusion too hastily and fail to adduce solid evidence for their conjecture. Their conjecture amounts to the claim of a *causal* relationship between the expansion of a language and its morpho-syntactic make-up. If true, a language is predicted to acquire the 'exoteric niche' properties when expanding, but keeping the 'esoteric niche' properties, as long as the language is the language of an 'esoteric' speech community. The facts are less clear cut. Languages may get 'exoteric' also in 'esoteric' niches (continental Scandinavian), and they may keep their 'esoteric' properties even if they expand (German).

Their correlation data are much more easily accountable in a cognitive evolution scenario: *First*, languages that are used by large populations and spread over large territories are more likely to develop varieties than languages of small populations. This is what we see if we look at the distribution of dialectal varieties.[20] Second, the new varieties are not (or less often) in contact with the 'old' variety in languages that spread over large territories. This is essential for a new variety to come into being, stay alive, and gain momentum. Consequently, changes have a much higher likelihood to 'survive' in a large speech community.

Second, variations are filtered by the selector. The selecting brain rewards changes that make a grammar more easily learnable and the structures determined by the grammar more readily processable. The ten properties of the esoteric niche reflect properties of adaptive dynamics of grammar changes in terms of a more economic inventory and processing system. Sapir's drift is irreversible. There is no attested diachronic change of a grammar that would go into the opposite direction. The drift is a drift towards *eliminating* morpho-syntactic 'complications' from the grammar systems and not towards *introducing* complications. It is a constant drift from a high degree of *directly morphologically coded* information to a higher *degree of compositionally* coded information. Morphological coding is a *declarative memory technique*, compositional coding is procedural memory. So, the drift is a shift from reducing *declarative memory load* by *enhancing procedural implementations* of the same grammatical relations.[21]

Given this state of affairs, larger speech communities that spread over large territories are producing more varieties ('mutations'). The more grammat mutations occur, the higher is the likelihood that these mutations produce winning varieties in terms of cognitive evolution of grammars. This is all you need for understanding the correlations assembled by Lupyan &

[20] Hungarian and Italian are illurtrastive: Hungarian has hardly any dialectal differentiation, whereas Italian is notorius for its abundance of dialects. Hungary is a geographically homogeneous area, while the peninsula is geographically partioned by mountain ridges and the dominant North-South extension.

[21] Compare the ‚esoteric' technique for coding passive and tenses (future tense) in Latin with the ‚exoteric' technique of German, for instance:
ama-b-o-r (I shall be loved), ama-b-eris (you will be loved) ama-b-it-ur, etc. (stem+future affix+tense&mood+ passive affix) vs. German: *geliebt*$_{\text{Participle}}$ *werden*$_{\text{Aux-Infinitive}}$ wird$_{\text{Aux}}$.
In Latin, you have to turn each and every verb into its individual (passive) future tense form if you want to express future. In German, on the other hand, you simply combine single forms: You take (the participial form of the verb and) the infinitival form of an auxiliary and combine them with a single auxiliary. The economic gain in terms of generating forms is evident. If you are in doubt, check the many paradigm pages in a Latin grammar book. Obviously, there is no language that has given up the composition technique and returned to direct morphological coding. Diachronically, this is a one-way road.

Dale, and it does not justify invoking *"the unique communicative needs of the speaker population".*

6. Summary

Language is both a cultural and a biological neuro-cognitive phenomenon. Whether language change is a cultural or a 'natural' phenomenon is an empirical question therefore. This paper argues for accepting 'cognitive evolution' as an instance of classical evolution, applying to different domains though. Darwinian evolution operates on the level of genetic structures, while cognitive evolution operates on the level of the structures of cognitive representations of self-replicating cognitive systems.

As seen already by Darwin (1871) the development of languages and the development of species *follow the same general laws*, but they are implemented in different domains. The laws are the laws of evolution that hold for *replicating* systems, whose *variants* (mutations) are exposed to *selection*. The effect is *adaptation* (to the selection parameters) and diversification, with luxurious side effects.

Linguistics is the domain of *cognitive* evolution. The replicating system is the grammar of a language. It is an ontologically *real* object that resides in human brains as a cognitive virus and makes the brain a servant for the purpose of replication (by producing language structures that serve as the basis for the acquisition of this grammar by other brains).

Cognitive evolution is nothing else but evolution working on cognitive entities. Hence, the outcome is totally parallel to evolution in biology in terms of adaptation. The paper argues for abandoning the customary *metaphorical* allusions to evolution and for taking the groundbreaking Darwinian insight seriously, on the appropriate level of theoretical generalization. Crucially, this does not mean that evolution of grammars is to be subsumed under the domain of biological evolution. This would obviously be misguided.

It means that a hitherto overlooked domain of application of the theory of evolution is the domain of *self-replicating cognitive systems*. The prominent case is grammar as the ensemble of processing systems for language production and reception, and, importantly, for language acquisition. Once cognitive evolution is recognized, the adaptive properties of grammars find a scientific explanation and the frequently felt desire for invoking (functionalistic) teleological explanations can be satisfied in an unexpected but logically valid way. It is the way that has been disclosed and paved by Darwin in the domain of biology.

The evolution of biological species is an exemplary case of evolution, but it is not an exclusive domain. Evolution applies to *any replicative* system that replicates in a domain of *restricted resources*. Once grammars are seen as natural, replicative systems that come in variants whose replication depends on limited resources, Darwinian evolution is predicted to apply, with adaptation and diversification as the inevitable outcome.

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