

LANGUAGE EVOLUTION AND THE COMPLEXITY CRITERION

Target Article on Language-Complexity

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Abstract

Though it is increasingly accepted in the behavioral sciences, the evolutionary approach is still meeting resistance in linguistics. Linguists generally cling to the idea that alternative linguistic features are simply gratuitous variants of one another, while the advocates of innate grammars, who make room for evolution as a biological process, exclude the evolution of languages. The rationale given is that today's languages are all complex systems. This argument is based on the failure to distinguish between complexities of form and function. The proper analysis reveals instead that linguistic features have consistently decreased their material complexity, while increasing their functionality. A systematic historical survey will show instead that languages have evolved and linguistic features have developed along a Darwinian line.

Keywords

complexity, Indo-European, language evolution, lateralization, neoteny, word order.

I. INTRODUCING AN EVOLUTIONARY PARADIGM IN LINGUISTICS

1. Evolutionists do not have an easy task. In the nineteenth century the evolution of species was able to prevail only after a long and arduous battle: in the last decades the evolution of behavior has been gaining greater acceptance (cf. Restak 1994:73), but the evolution of languages is peremptorily rejected. This paper breaks with that general attitude and argues that languages have pursued a developmental course. This will be done in four steps: The initial one will be a quick presentation of the existing situation, with, on the one hand, the structuralists and nonaligned linguists generally subscribing to a form of cultural relativism, and, on the other, the innatists combining the same cultural relativism with a genetic mutation that is said to have endowed our species with an inborn grammar. The second step will be an attempt to show that the history of linguistic features can be assessed in evolutionary terms and whether the linguistic development could be related to biology. The third will be a systematic study of the evolution of the major linguistic features of the Indo-European (hence forth I-E) languages. The fourth will address the issue of what may seem to be counterevidence. It will be shown that these examples actually fit in with a broader and more accurate view of evolution.

II. LINGUISTICS AND CULTURAL RELATIVISM

2. Cultural relativism is popular in linguistics. Both the phenomenologically and behavioristically inspired structuralists and most of the nonaligned linguists leave from the assumption that languages are systems of conventional signs tacitly adopted by their respective speaking communities, or sets of habits acquired during childhood. Humans are admittedly endowed with a potential for speech, but having postulated that linguistic elements, based on conventions or habits, are fortuitous, these linguists come to the deduction that, if there are variations, variants have no evolutionary significance (cf. Nichols 1992:277).

III. LINGUISTICS AND GENETICALLY-CODED GRAMMARS

3. For those who belong to the generative grammar movement, humans are not simply endowed with a potential for speech, but rather with an innate grammatical model, which in interaction with environmental linguistic stimuli, enables children to learn the language that is spoken around them. This innate grammatical model, labeled 'Universal Grammar' in Chomsky's terminology and 'Bioprogram' in Bickerton's (cf. Bichakjian 1989, for a comparative study of the two models), is said to be coded at the genetic level. That is when evolution is brought in, but the scenarios vary, between those of Chomsky, Bickerton, and Pinker and Bloom.

4. Chomsky insists on the specificity of linguistic skills, but remains vague on the phylogenetic development of the corresponding module. The learning of grammar is considered to be indeed one of the highly specific skills, but 'these skills may well have arisen as a concomitant of structural properties of the brain that developed for other reasons. ... The brain that evolved might well have all sorts of special properties that are not individually selected' (Chomsky in Piattelli - Palmarini 1980; cf. also Chomsky 1995:167). For Bickerton, 'it seems ... very likely that the development that gave us language took place in a single individual at a not very remote period and that the progeny of this individual spread throughout the then-inhabited world and superseded previous hominid populations in all parts of it' (1990:174). In the pages that follow, it becomes clear that the individual that Bickerton is referring to is Allan Wilson's African Eve (cf. Cann, Stoneking & Wilson 1987). Unlike Bickerton, Pinker and Bloom, who belong to the M.I.T. School, advocate a gradualist approach, and propose a classical evolutionary scenario for the development of the biological correlates of Chomsky's Universal Grammar. 'For universal grammar to have evolved by Darwinian natural selection it is not enough that it be useful in some general sense. ... There must have been a series of steps leading from no language at all to language as we now find it, each step small enough to have been produced by a random mutation or recombination, and each intermediate grammar useful to its possessor.'(1990:721; cf. also Pinker 1995:365 et sq.).

5. These scenarios will not be discussed here (for assessments, see inter alia Donald 1991:60; Locke 1993:357; Dennett 1996:370-400; and Deacon 1997:339). The reason why they have been mentioned is to show the precise role that evolution is made to play in current linguistic thinking. For holders of innatist views, evolution is biological, and starts playing a role when the first element of universal grammar becomes coded in the human genome, and that role is brought to a definite end when the coding is completed. The last mutation would coincide with the appearance of 'Homo sapiens', set ca. 200,000 BP (Pinker 1995:353), and, since then, all forms of evolution would be at a standstill. Having thus made evolution into a purely biological process and limited its role to the period immediately preceding the appearance of morphologically modern humans, the advocates of innate grammars find themselves subscribing to the cultural relativism professed by structuralists and nonaligned linguists.

IV. THE INDISCRIMINATE USE OF COMPLEXITY

6. In support of this relativistic view it is adduced that all natural languages are complex, whether they belong to technologically advanced nations or hunter-gatherer communities. 'There is no disparity at all in the degree of

development of languages -- all, so far as anyone can determine, are equally complex' (Bickerton 1992:13; see also Pinker and Bloom 1990: 707; and Pinker 1995:27-28). But, as Merritt Ruhlen has rightly pointed out, 'all extant human languages are today considered of equal "complexity" by virtually all linguists, despite the fact that there is no recognized way of measuring complexity in language' (1994:148). The vacuity of the 'complexity' notion was also pointed out by Richard Lewontin in his commentary of Pinker and Bloom's paper. 'We would all agree that a human being is more complex than a soap bubble ... but we cannot all agree that a dog is more complex than a fish, although fishlike forms preceded doglike forms by 500 million years and were their ancestors. ... What in fact do we mean with complexity?' (Lewontin 1990:740). Actually, the complexity argument is an important one, but provided one differentiates between functional complexity, which is an asset, and material complexity, which can be a burden. The distinction will be made clear in 3.1, and it will be shown that one can easily determine that there IS disparity in the degree of development of linguistic features.

V. DEFINING EVOLUTION IN LINGUISTICS

7. Since evolution is less than accepted in linguistics, it would perhaps be easier to recognize evolutionary changes if the process is clearly understood. In biology, evolution could be said to occur in part when mutations providing their bearers with selective advantages accumulate and possibly lead to the development of a new species. There are admittedly neutral mutations, and not all mutations lead to reproductive isolation, but by and large, if B is a mutant of A and B has supplanted A, there are reasons to think that B probably has advantages that A did not have. There is, admittedly, a certain circularity in the Darwinian scenario when a feature is concluded to be advantageous because it belongs to the surviving group, and the group is said to have survived because it had an advantageous feature. But there are also cases suggesting that an objective assessment of the qualities of a feature is not impossible

8. In linguistics, if evolution does indeed take place, the process will have to be similar. If feature A is regularly replaced with feature B, then B must be presumed to have a selective advantage that A does not have (the term 'feature' will be used here not in its narrow phonetic sense, but to represent any linguistic implement, from sounds to syntactic strategies). While the logic of the reasoning is obvious, the problem is to recognize what constitutes a selective advantage in linguistics. The problem does seem thorny, but an answer is not impossible. Indeed, it was already suggested in Leslie White's definition of cultural evolution. He argued that 'other factors remaining constant, *culture* evolves as the amount of energy harnessed ... is increased, or as the efficiency of the instrumental means of putting the energy to work is increased_' (1969:368-69; with original emphasis). The efficient use of energy is indeed deeply rooted in living organisms. 'Animals adopt a strategy that allows them to get the most food with as little energy as possible', and a recent study has revealed 'that people do the same in selecting the best strategy for making money' (Naylor , 1994:285). A society evolves, therefore, either by finding new sources of energy or by making an increasingly efficient use of the existing sources.

9. For speakers, it will be the second alternative, the one that consists of making an ever more efficient use of the natural implements available for speech. Language evolution will therefore be a process that replaces an existing feature with a new one that requires a smaller expenditure of energy while providing at least equal and preferably better functional capabilities. It is this characteristic two-prong quest - that of finding implements that perform better and cost less to operate - that underlies the purely biological and cultural evolutions of humans, and the evolution of languages.

VI. MEASURING LINGUISTIC ADVANTAGE

10. If the above definition of linguistic advantage is theoretically plausible, one may wonder how the savings in energy and the expanded functional capabilities can be measured in concrete situations. The first task is not impossible. If, when children learn their native languages, it is observed that a given feature is acquired before another, it is correct to assume that the algorithm of its biological interface is simpler, and that this simplicity implies a smaller expenditure of the neuromuscular resources. In other words, the earlier a feature is acquired

during the language-learning process, the more economical it is to use. One may point out that certain constructions can be produced only when the necessary level of mental competence has

been achieved. A sentence such as 'If had known that fact, I would have expressed myself differently' requires of course a mental development that occurs only after children have started going to school, but no special mental development is needed to produce the English sound 'th', as compared to that of 's' or 'f', and yet 'th' is mastered long after 's' and 'f'. That time gap could rightly serve to substantiate the conclusion that the neuromuscular underpinning of 's' or 'f' is simpler than that of 'th'. It should be clearly stated however that chronology provides a reasonable indicator of complexity, but not the perfect gauge, which remains wanting.

11. The early acquisition of linguistic features also has other advantages. It provides a better physiological performance of speech because of the increased strength of the cerebral wiring (cf. *mutatis mutandis* LeVay, Wiesel and Hubel 1980), and allows for a head start in the development of social skills and mental functions, which in turn will be biologically better anchored and probably more extensive (cf. Bichakjian 1992, for a detailed discussion). Another significant advantage is pointed out by Deacon, who stresses the importance of acquiring language as early in life as possible, because immature brains have a greater 'ability to shift from indexical to symbolic referential strategies' (1997:136). It should also be observed that the early acquisition of linguistic features is in line with the early birth of the human foetus, which leaves the uterine confine some twelve months sooner than general mammalian factors would predict and finds in the outside world the stimuli that prompt its social and cognitive developments (Locke 1993:264). It is obvious that the features that make it possible for children to achieve linguistic proficiency earlier in life provide a number of selective advantages, but in this paper the focus will be on greater neuromuscular simplicity.

12. Though obvious, the advantages of early-acquired linguistic features or the increased simplicity of their biological interface must be clearly understood. There is of course no advantage to reducing the production cost, if the quality of the product is commensurately lowered. Efficiency is achieved when the cost is reduced, while the quality improves or at least remains constant. Therefore, for an earlier-acquired feature to be advantageous it must have functional capabilities that are at least equal and preferably greater than those of its antecedent. But then, how can one recognize whether the functional capabilities of the new item are greater than those of the old one? A mathematical answer is not always easy, but the task is not impossible. If the operational area of an item is greater than that of another, one may safely conclude that its functional capabilities are greater. Here are a few concrete examples.

13. The I-E consonantal system had three labiovelars, which the derived languages have gradually eliminated at differential rates and in differential ways. In many cases, this has led indirectly to the development of palatal consonants (cf. e.g. the 'satem' and Romance languages). In French, for instance, 'sh' is not the reflex of an ancestral 'kw', but since the development of the fricative and the disappearance of 'kw' are related, one may compare the operational capabilities of the two consonants to see whether the modern 'sh' is more functional than the ancestral 'kw'. The comparison reveals striking differences. The labiovelar was in fact used essentially before unrounded vowels (say, 'i' and 'e'); instead, the palatal can be used before and after every vowel and practically combines with any consonant. These distributional data leave no doubt that the functional capabilities of 'sh' are far greater than those of 'kw'.

14. In the case of subordination, a similar observation can be made. Hierarchical relationships, now generally expressed with sentence embedding, were originally conveyed through the use of participial or other such phrases (Meillet 1964:374). Instead of the Lat. 'ei dormienti apparuit Fortuna', English speakers would say 'Fortune appeared to him while he was sleeping.' The two alternatives may seem equally adequate variants, but on closer look one realizes that the finite-verb variant can be made to convey an array of aspectual and modal distinctions, as in

while he was sleeping
while he slept

while he had to sleep
while he should have been sleeping
while he wanted to sleep
while he had been made to sleep
while he could not sleep

whereas the nonfinite forms of ancestral languages could express only a few of these modalities.

15. The comparison of palatals and labiovelars, on the one hand, and embedded sentences and participial clauses, on the other, suggest that it is possible to assess the functionality of a linguistic feature and to demonstrate that one feature can have greater functional capabilities than another. Thus, when a change has taken place, if the incoming item is acquired earlier and displays a broader functional potential than the outgoing one, there are grounds for concluding that the host language has moved towards greater efficiency by reducing the cost and increasing the yield. The task of the observer who wants to ascertain the occurrence of evolutionary changes in linguistics is not therefore to behold the material complexity of a linguistic feature, but to check the functional yield of the energy spent for its production. The labiovelar example is clear. Judging by its two points of articulation and by its late acquisition, the ancestral labiovelar is materially far more complex than the modern palatal, but seeing the limited functionality of 'kw', one quickly realizes that the material complexity of the labiovelar, far from being an asset, is indeed a burden, since it requires a high expenditure of energy for a low functional yield. Therefore, 'kw' does not represent a higher degree of development than 'sh' because it is more complex: on the contrary, it is the increased efficiency of 'sh' that indicates a higher degree of evolutionary advance, for it is naive to think that in the beginning everything was beautifully simple and harmoniously ordained and that with time societies complicated their languages. The linguistic implement developed like all other human artifacts, from the more rudimentary to the more sophisticated from the least efficient to the most effective. Material complexity is therefore a misleading indicator: instead, it is the material simplicity combined with the degree of functionality that provides a measure of language evolution.

VII. IS LANGUAGE EVOLUTION A BIOLOGICAL PROCESS?

16. Having argued that selective advantages can be assessed in linguistics, and that adequate criteria can be found for investigating the possible evolution of languages, one must now discuss the exact nature of the language evolution process. Obviously the development of the potential for language took place at the DNA level, but here language evolution will refer to the development of linguistic features from the oldest reconstructed or extrapolated prototypes to their extant alternatives. In a sense, but only in a sense (see below), the development of linguistic implements could be compared with technological advances, such as the one leading from the oldest assagai to today's ballistic missiles. But, the comparison is far from perfect, because there is a significant difference between the manufacture of weapons and the acquisition of language. Weapon making is a consciously targeted activity usually performed by experienced adults, whereas native language learning occurs naturally in every child through a biologically regulated process. Moreover, there are specific language areas in the human brain and each linguistic feature has a neurological underpinning, but no such specific equivalents exist for weaponry.

17. In the light of these differences and given the narrow correlation between language and biology, one is prompted to ask whether also the evolution of linguistic features is not supported by a biological process. This is not to suggest that changes in languages are directly linked to genetic mutations. The regression of labiovelars, the development of palatals, or the rise of sentence embedding, just to stay with the above examples, do NOT pair on the one-to-one basis with changes at the DNA level. Such a claim would be preposterous, and it is CATEGORICALLY rejected here. Yet, could it be that the evolution of linguistic features was in a general way fostered at the language level by an overall increase or improvement at the biological level of our general potential for language? In a recent article on the Williams syndrome, Lenhoff et al. report that 'some observers have proposed that the neocerebellum and the connected region of the frontal cortex evolved together to support the fluent processing of speech and may fall under the control of the same

genes'(1997:46). If this is so, could a slight modification in the expression of those genes contribute to a greater fluency of speech processing, and thence to the modification of linguistic features? In another article, experimental data were presented suggesting that there are 'sex differences in the functional organization of the brain for language' (Shaywitz et al., 1995; see also Gazzaniga 1992:102). If this is so, and perhaps not only between men and women but also among individuals, could it be surmised that language specialization of the left hemisphere is not a one-time event with an all-or-none result, but an open-ended gradual process which during its course could have influenced the organization of linguistic structures (cf. Deacon 1997:309)? Moreover, could it be that over the ca. 200,000 years of the existence of our species, and at an accelerating rate, the genetic coding of the biochemical events that control the language acquisition process has been modified in favor of an ever-earlier acquisition of linguistic features? These are all legitimate questions, yet science does not have the anatomical, and much less the genetic evidence, that could provide an answer. Therefore, the question of whether the evolution of linguistic features was in a general way fostered by an overall increase or improvement of our general potential for language, or whether the two processes cross-fertilized each other, will be left unanswered. The present task will be to show that linguistic features have evolved, and by that it is meant that they have become ever more functional to operate and ever more economical to use or process.

VIII. LANGUAGE EVOLUTION WELCOME IN BIOLOGY

18. While the topic remains anathema to mainstream linguists, language evolution is by no means unwelcome in the biological sciences. In a book that will mark a turning point in our understanding of the language phenomenon, Terry Deacon states unambiguously that 'languages do not change, they EVOLVE', and adds further on that 'the world=92s ... languages have all evolved to become learnable at the earliest age possible' (1997:109 and 137; with original emphasis). This is very encouraging. At a seminar in 1998, where we both made major presentations, I argued as a linguist that linguistic features display an evolutionary history, and that the course runs in the direction of ever-earlier acquired alternatives (see Bichakjian, 1992). Today, Deacon reaches similar conclusions on ;both these points, with arguments from neurology. The corroborating evidence coming from the neurological interface and from an authoritative neuroscientist is of overwhelming importance. Obviously, our vantage points differ, but our approaches concur, and he represents his position as well as the one that has been mine for years, when writes that 'the proper tool for analyzing language structure may not be to discover how best to model them as axiomatic rule systems but rather to study them the way we study organism structure: in evolutionary terms' and when he stipulates that 'language structures may simply reflect the selection pressures that have shaped their reproduction' (1997:110 and 111). Within this common approach, our actual endeavors advantageously complement each other. While Deacon argues in a general way that 'languages have evolved with respect to human brains' and in a detailed and systematic way that 'brains have been shaped to fit the demands of language as well' (1997:107 and 327), my efforts are aimed at showing with concrete linguistic evidence how from their earliest reconstructions to this day, languages have been guided by selection pressures into developing ever more adaptive features.

IX. AN EMPIRICAL STUDY OF LANGUAGE EVOLUTION

19. Conscious of the need to keep formal and functional complexity apart, and cognizant of the possible application of Darwinian principles to linguistic data, we may now proceed with the empirical study of language evolution. For such a task, linguists can choose between two approaches: one consists of giving examples from a long list of languages selected to represent all corners of the planet. The concern is right, but such examples remain scattered, and fail to present a coherent set of data that can reveal the major linguistic developments; the other stays within a given language family, where it scans the successive steps in the history of linguistic features and assesses the data in an evolutionary perspective. It is this second approach that will be used here, and the empirical data will be provided by the I-E languages, which have the distinct advantage of having the greatest geographic spread, the best documented history, and above all a protolanguage whose reconstruction has been scrutinized with the highest intensity. It is true, of course, that, however representative they may be, the I-E languages would only constitute a single case. The point is well taken, but it should also be

borne in mind that it was 'a scanty stock of animals' which provided Darwin the seminal facts that 'later posed the evolutionary puzzle -- and then supplied its key' (Browne, 1995:303).

X. DEVELOPMENTS IN THE PHONOLOGY OF INDO-EUROPEAN LANGUAGES

20. When the consonantal system of the ancestral language is compared to that of a modern language such as French (cf. table 1), it becomes apparent that the number of obstruents (say, 'true consonants', i.e., excluding 'm, n, l', and 'r') is almost the same (see Meillet 1964:94 for not including palatal stops in the protolanguage) - 13 in I-E, 12 in French - but, whereas the ancestral consonants, except for 's', were subject to important restrictions, the modern ones are fully functional.

p?	t?	k?	kw?	p	t	k
ph	th	kh	kwh	b	d	g
bh	dh	gh	gwh	f	s	sh
			s	v	z	zh

TABLE 1a. Indo-European

TABLE 1b. French

If the fricative and the sonorants are temporarily set aside, theoretically, the protolanguage should have been able to form 144 different CVC roots, which was the most common if not the only type of base lexical morpheme (cf. Beekes 1990:184). But, since 'p?' is not attested (Gamkrelidze 1987:55), since roots could not begin and end with a glottalic consonant or by the same voiceless aspirate, nor contain both voiced and voiceless aspirates (Szemerényi 1978:136-37), in fact, the total number of possible roots was only 68, which represents a functionality of 47%. Since the modern consonants can appear anywhere and combine with any other in a CVC root, their system is fully functional and even more than 100% since obstruents can also combine with one another before and after a vowel, which was impossible in the ancestral model.

21. What is also more functional is the use of phonetic features. In order to distinguish 13 obstruents with a functionality of 47%, the protolanguage used 4 sets of features for the various points of articulation (cavity features), another one for the manner of articulation (=B1 continuant), and 3 others for the glottal modalities (=B1 voiced, =B1= aspirate, =B1 glottalized), for a total of 8. Instead, for 12 fully functional obstruents, French uses 3 sets of features for the points of articulation (the switch from the velar area for stops to the palatal area for fricatives is covered by marking conventions, cf. Chomsky and Halle 1968:424), and 2 other features, one for the manner of articulation and the other for voicing (see table 2) making it a total of 5.

p?	t?	k?	kw ?		+ glottalized	
~~~~~						
ph	th	kh	kwh	-	voiced	
-----						
bh	dh	gh	gwh	+	voiced	
s					+	continuant
Total: 12 partially functional obstruents + 14 distinctive features + 4 sets of features for the points of articulation						
Total number of theoretically possible obstruents : 64 Actual number of obstruents: 13; Efficiency rating: 20,31%						

TABLE 2a. The distinctive features of Indo-European obstruents

p	t	k	-	voiced	
-----					
b	d	g	+	voiced	
f	s	sh	-	voiced	
-----					
v	z	zh	+	voiced	
Total: 12 fully functional obstruents 2 distinctive features + 3 sets of features for the points of articulation					
Total number of theoretically possible obstruents: 12 Actual number of obstruents:					

22. Theoretically, the distinctive features and sets of features marshaled by the protolanguage could produce a total of 64 obstruents, but in fact they defined only 13, which represent a very poor yield of 20.31%. The features and sets of features mustered by French can define a maximum of 12 obstruents, and that is exactly what they do. So, their efficiency rating is 100%. Critics may point out that the nature of the distinctive features used by the protolanguage was such that certain combinations were impossible. That is so, but that indeed is what made the ancestral system inefficient and disadvantageous. When the efficiency ratings of distinctive features is combined with the distribution restrictions in CVC roots, the overall yield falls down to a dismal 11%, whereas it is a full 100% in French.

23. Turning from the yield to the cost itself, one promptly observes that the modern obstruents not only have a greater functional potential, but also entail a lower cost. French toddlers can pronounce all their obstruents before the age of 2, but Mayan children still have problems producing their glottalized consonants past the age of 10 (see Bichakjian 1988, for a discussion of the psycholinguistic data and the bibliographical references). This more-than-8-year gap for the glottalized consonants, and less for the aspirates makes it abundantly clear that the biological interface of the modern obstruents is considerably less complex.

## **XI. THE EVOLUTION OF THE I-E VOWEL SYSTEM**

24. The most common reconstruction of the ancestral vowel system is the one with a unique functional vowel 'e', combined with three 'h'-like sounds, called laryngeals and represented with the symbols H1, H2, and H3. It is known from Arabic, where the corresponding pharyngeals exist, that, while H1 has no effect on the adjacent vowel, H2 gives it an 'a'-color and H3 an 'o'-color; so that when the I-E laryngeals later disappeared, two sets of changes took place: 'e' became 'a' and 'o' when the adjoining laryngeals were respectively H2 and H3, and moreover, all vowels were lengthened when the disappearing laryngeal was post-vocalic. It is therefore the loss of the ancestral laryngeals that led to the development of a system of ten vowels - the syllabic variants of 'j', and 'w' eventually combined with a following laryngeal, would provide the other four. These were fully functional vowels, free from distributional restrictions imposed by the previous pattern of alternations. Of course, a ten vowel system subdivided along a long/short dichotomy is not the ultimate panacea, but the development of ten distinctive syllabic peaks gave a huge boost to the word-building potential of the ancestral language.

25. This is not to say that before the loss of the laryngeals the functional capabilities of the existing system were almost nil. By placing the 'e' before or after the three laryngeals, the protolanguage could produce the equivalent of six vowels: 'H1e' (= 'e'), 'H2e', (= 'a'), 'H3e' (= 'o'), 'eH1' (= 'e:'), 'eH2' (= 'a:'), and 'eH3' (= 'o:'), but at what cost? Allan Keiler has pointed out that the I-E laryngeals "represent the most complex sounds in a universal phonological hierarchy" (1970:88), and this judgment is fully confirmed by the psycholinguistic data that reveal that the acquisition of the equivalents of H2 and H3 by native Arab children still causes problems past the age of 10.

26. The combined evidence from historical linguistics and language acquisition makes it abundantly clear, therefore, that the development of vowels, like the evolution of consonants in the I-E languages constitutes a definite case of optimization: the material complexity has steadily grown less, while the functional capabilities have continued to rise.

## **XII. MORPHOLOGICAL DEVELOPMENTS: ELIMINATION OF DUAL AND REGRESSION OF**

GENDER

27. After a long evolution, which will not be outlined here, the ancestral language had reached a state where it had three genders and three numbers. These distinctions and the complex morphological apparatus that conveyed them clearly show the danger of being misled by the material complexity of languages. It is easy to imagine that, when grammars were first devised, speakers felt the need to code into their incipient linguistic systems cognitive distinctions, such as moving vs motionless, animate vs inanimate, concrete vs abstract, etc., and give a grammatical status to the number two, since duality is so deeply anchored in our biological essence (cf. also Schmandt - Besserat on the origin of the plural 1992:188). But the slightest familiarity with English is sufficient to realize that gender for inanimate referents and a dual serve absolutely no linguistic function. Hence, their steady disappearance.

### **XIII. FROM VOWEL ALTERNATION TO SUFFIXATION TO FREE PARTICLES**

28. In the protolanguage, marking was done essentially with vowel alternation or suffixation. At first blush, vowel alternation strikes the observer as an elegant and economical solution: CV1C for the grammatical distinction GD1, CV2C for GD2, and CV3C for GD3. But in actual use this model is highly restrictive, because it makes it impossible for each vowel to appear in a grammatical context other than the one it is assigned to. If in English, the vowel alternation used in 'write, wrote, written' were the rule, verbs such as 'store' and 'fit' would not be possible. Vowel alternation therefore raises serious productivity problems, and that is the reason why this process, which admittedly could provide an efficient and attractive solution in a small lexicon, was marginalized as languages expanded their word stock. It is also not the solution for a broader set of distinctions. Suffixation has a far greater potential, but it often runs the risk of becoming a wasteful process in inflectional languages where several synonymous suffixes tend to arise.

29. The waste is easy to observe in Latin, where the ablative singular, for one, was marked by no less than six different suffixes, and each morphological variant had an array of meanings ranging from the expression of origin to that of instrument, including the representation of time, place, cause, quality, and comparative reference. This model, which, because of its allomorphic and polysemic characters, constituted a double violation of the one word: one meaning principle (or Humboldt Universal), was conspicuously inefficient, since the yield had to be divided by the number of morphological variants. It is true of course, that the plurifunctional character of the case reduced the allomorphic waste, but the most efficient approach is not to find compensations for the waste, but eliminate it altogether. That is precisely what the modern languages have done by replacing the ancestral inflectional systems and their loads of syncretic cases and allomorphic markers with a selection of prepositions that comply far better with the Humboldt Universal. Moreover, since on the whole children acquire prepositions long before the complete set of the corresponding case markers, by shifting from inflection to prepositions, languages not only have gone on to a better organized system, but also to one that is less costly to operate.

30. In the foregoing discussion, the emphasis was laid on the shift from case markers to prepositions, but that was just one example; in fact, the arguments that were used also apply to the rest of the inflectional affixes and their corresponding free particles. The development of prepositions is indeed part of a broader movement which gave rise to the forming of articles (the specific marker of determination and often the advantageous vector of number and case), personal pronouns, and auxiliaries of time, voice and mood (cf. Engl. 'he HAS seen, he WILL see, he IS seen, he "WANNA" see' and the Lat. 'vidit, videbit, videtur, viset'). All these free particles present the double advantage of combining a reduced material complexity and an organizational system that better conforms with the Humboldt Universal.

31. By and large the I-E languages have gone from vowel alternation, to suffixation, and thence to free preposed particles when the latter shift coincided with a reconfiguration of word order from head-last to head-first (cf. e.g. Lat. 'cano / ( ce ) cini', 'cantavi', Fr. 'j'ai chant'). Together, these three steps represent an evolution towards greater functional potential and lesser material complexity. When the shift to head-first syntax was not

in the offing, some languages proceeded along a different evolutionary path. Instead of developing free pre-posed particles they achieved greater efficiency through agglutination, a process whereby autonomous affixes are serially added after the root of the word. Given their autonomous nature and the analytic character of the chain they form, the affixes of the agglutinative languages should not therefore be lumped with the suffixes of the inflectional languages: they should be seen rather as the head-last counterparts of the free pre-posed particles of the head-first languages.

## **XIV. RISE OF TEMPORAL DISTINCTIONS AND TRAVELS OF THE MIND THROUGH TIME**

32. The I-E verbal paradigm, where only the active imperfective indicative had a past tense, and pertinent typological indications warrant the inference that in one of its earlier stages the protolanguage could convey the chronological details of an action only in terms of aspectual distinctions (Beekes 1990:300 and Szemerényi 1987:424). The 'subject' (this notion will be discussed in 4.2.4) was the author either of (1) an on-going action (imperfective), or (2) a completed one (perfective), or (3) the patient of the state resulting from the corresponding action (stative). When the aspectual distinctions were the only ones, moving in time was linguistically impossible. The verbal system always presented the action in the present. The subject was always the 'present' author of an action either in progress or brought to an end, or the patient of a present state, but the action was never set in another time slot, not in the past, and much less in the future. It could be said that with the development of temporal distinctions, i.e., a past tense instead of a perfective aspect, and later a future tense instead of a desiderative mood, languages shifted from photography to motion pictures.

33. The development that took place in language is indeed an extension of the evolution of our species' mental faculties. In a book remarkable for its lively prose and solid judgment, John McCrone points out that humans are not 'shackled to the present' (1991, p.110). 'Human minds ... have broken free. We can think about the past, make plans for the future, and fantasize about imaginary events' (1991, p.89). 'The hominids needed language to take the quantum leap forward and break free of the straitjacket of the present' (1991, p.141). Actually, this 'quantum leap' is the long accumulation of the results of the interaction between our mental potential and the linguistic implement: 'the two ... were locked together in an advantageous spiral of development' (McCrone, letter to B Bichakjian, dated April 19, 1993).

34. The development of the past tense, and later the future, belongs to this advantageous spiral, because, if access to language had made it possible for humans to catalogue their experiences, it is the emergence of temporal distinctions that finally liberated linguistic expression from 'the straitjacket of the present'. The new verbal system was no longer compelled to force the account of events into an *hic et nunc* presentation; it had just acquired the means to scan the past and travel through time. A century ago, it was the visual presentation of sequences of events that made a quantum leap, thanks to the invention of the Lumiere Brothers. Materially, the development of temporal distinctions differs from the invention of cinematography, but the nature of the quantum leap is the same, and its significance just as great (see also Dennett 1996:380 for a parallel between photography and language and their comparable advantages).

35. When it comes to complexity, the balance is not easy to draw. The development of tenses constitutes a definite expansion of the existing grammar, but this growth was compensated by the corresponding reduction of aspectual distinctions, which were generally confined to the past tense, and by the waning role of modal variations. Moreover, wherever aspect was replaced with tense, material complexity diminished since the psycholinguistic data suggest that aspectual distinctions are more difficult to handle than temporal ones. But even if the overall balance were to show an increase of material complexity, the development of temporal distinctions would nevertheless constitute an enormous advantage, given their vital functional importance.

## **XV. THE DEVELOPMENT OF THE SUBJECT FUNCTION AND OF THE PASSIVE VOICE,**

### **OR LOOKING AT THE ACTION FROM A NEW VANTAGE POINT**

36. If the development of temporal distinctions provided the means for linguistic expression to escape the straitjacket of the present and be free to move in time, the verbal system underwent another set of changes which made it possible for speakers to recount an action not only in the perspective of the agent, but also in the reverse one. These changes led to the development of the passive voice. It is a matter of factual knowledge that I-E did not have an active/passive opposition, but an active/middle dichotomy inherited from an earlier developmental phase of its syntax (cf. Benveniste 1966:168; and Meillet 1964:245). This opposition, which can be seen in such pairs as Engl. 'lay/lie', was at least morphologically present in Latin, where e.g., the active 'dico', 'I say', contrasted with the deponent, i.e., middle, 'loquor', 'I speak'.

37. What is striking in this opposition is that in both cases the action was viewed and reported from the agent's perspective, and the only difference was whether there was an independent patient, or whether the agent was also the seat of the action. The distinction may seem far-fetched, if not frankly contrived, but there is a logic to it, one that is in line with the organization of the underlying syntax. The active/middle dichotomy is a characteristic feature of active and ergative languages, where the notion of 'subject' does not exist, and where verbs combine with either a patient and an agent, or only a patient if there is no actual doer. Since at the syntactic level, the main distinction is between the actual agent and patient, and not between subject and the object(s), it is only logical that the verbal morphology would have one form for actions where the agent reaches out to a patient and another for actions where the agent is also the patient (cf. such pairs as 'lay/lie', 'set/sit').

38. It is hardly surprising that, when they started improvising a grammar, humans, who belonged to a species which throughout its phylogenetic development had beheld actions in terms of agent and patient, should have build their first sentences around those two functions. But, if one can readily see the logic of initial grammars being based on an agent/patient dichotomy, one also realizes that such a syntactic model offers very little flexibility for linguistic expression (cf. also Nichols 1992:158). It is understandable therefore that the overwhelming majority of languages hastened to develop the purely linguistic functions of 'subject' and 'object', which have freed grammars from the straitjacket of the physical reality and given them the flexibility our minds are capable of. Whereas in active and ergative systems only a subcategory of nouns could qualify for the function of agent - the Latin neuter gives us an idea of all those that were excluded - in the nominative languages the subject function is open to all nouns. The newly-acquired freedom not only increased the functionality of nouns, but also enabled speakers to capture events from different vantage points, and express them from the angle that suited the presentation best.

39. Once it had become possible for speakers to present events from a perspective other than the agent's, i.e., when the notions of 'subject' and 'object' had developed and produced nominative syntax, languages were in a position to develop a new grammatical strategy, which coupled with a regular morphological device would enable speakers to cast in the subject role not only the agent, but also the patient. This development was that of the passive voice, which English has pushed a step further than other modern languages with the possibility of casting even the beneficiary in the subject function, as in sentences such as 'The waiter was given a tip.'

40. It is important to stress the difference between the active/middle and active/passive dichotomies. In the ancient diatheses, the action was always presented from the perspective of the performer. In the modern grammatical voices, this restriction has been eliminated and speakers can choose the agent's vantage point, as well as the patient's, or even, if the corresponding development has taken place, that of the beneficiary. This is the huge increase in productivity that was brought in by the shift to nominative syntax, which eliminated the restrictions that were inherent to the agent/patient model, and subsequently by the development of the passive voice which doubled and in some cases even tripled the yield of the subject function.

## XVI. SYNTACTIC DEVELOPMENTS

41. The discussion of the development of a nominative sentence structure and that of the passive voice, which it made possible, have brought us into the field of syntax, which had made a huge leap forward by switching from agent and patient to subject and object, and from active and middle to active and passive. The two other major developments are the reversal of word order and the technique of embedding a sentence into another one.

## XVII. THE SERIAL ORGANIZATION OF SPEECH AND THOUGHT

42. The evolution of word order includes two separate changes. One is the reordering of the constituents in each syntactic unit, the other is the shift from free to fixed order. The reordering of the elements can be observed when Latin and English structures are compared with one another. On the whole, Latin placed the 'head' (the item that grammatically governed the other) AFTER the item it governed (called 'modifier'), whereas English and most modern I-E languages have moved it BEFORE. See the examples below, where the heads have been italicized:

- 1 a. [*victoriam*] REPORTAVIT ]  
b. (he) [WON [(a) victory]]
- 2 a. [*pulchra*] EST]  
b. (she) [IS [beautiful]]
- 3 a. [*aere*] PERENNIUS ]  
b. [MORE LASTING [than bronze]]
- 4 a. [*sax*]O ]  
b. [WITH [(a) rock]]
- 5 a. [*legere*]HABEO ]  
b. (I) [SHALL [read]]

The above examples were given, not to prove that the opposite order was never used by the Romans, but to illustrate the dominant order in Latin which was indeed head-last (cf. Bauer 1995) and thence, by extrapolation, that of the protolanguage and indeed of all protolanguages, because their word order was also head-last (cf. Givon 1979:275-6). Likewise, the head-first order of Modern English is not the universal order of all modern languages, but there is a universal propensity for languages to move in that general direction, each one at its own rhythm (cf. Bichakjian 1991, for the occurrence of this shift in non-I-E languages, and Bichakjian 1993, for a discussion of the reverse changes, which conflicting factors can exceptionally produce).

43. The shift from the head-last to the head-first order constitutes an important step in the expression of thought and thence in thinking itself. The ancient order is based on a global perception and requires a processing that is also global. The sequence 'victoriam reportavit "or" aere perennius' can only be interpreted when the entire utterance has been heard, i.e., when the phrase-final head has been uttered. Instead, in the head-first languages, the analysis begins immediately and goes on as the modifiers unfold. The ancient model requires therefore a global interpretation, whereas the modern one lends itself to a progressive analysis.

44. The key to the understanding of the origin of this difference and the nature of the shift seems to lie in the specialization of the two cerebral hemispheres. 'The right hemisphere synthesises over space. The left ... analyses over time. The right hemisphere notes visual similarities to the exclusion of conceptual similarities. The left ... does the opposite. The right hemisphere perceives form, the left ... detail. The right hemisphere codes sensory input in terms of images, the left ... in terms of linguistic descriptions' (Levy 1974:167). Though expressed with greater nuances, a similar specialization is also advocated by Posner and Rauschle, who report concurringly that 'most perceptual studies have suggested that the left hemisphere is more identified with the detailed analysis of parts of objects and the right hemisphere with the analysis of the more global aspects of objects' (1994:94; see also 162). For Gazzaniga, the important thing to observe is the interpretive role of the left

hemisphere, but he too acknowledges that the right hemisphere performs essentially global tasks, while the left hemisphere is more analytical in its approach. 'The right brain can be critical without being knowledgeable. It can judge the grammaticality of an utterance, but it cannot use syntactic information to place constraints on understanding word strings' (1992:130). Deacon argues against too rigid a conception of lateralization in favor of a more dynamic distribution of functions, but also point out that the right hemisphere is critical for 'large-scale ... processing' (1997:312). It is clear that the emphases vary from one neuroscientist to the next and that specialization does not present a black-and-white picture, yet it is also clear that gestalt perception is more characteristic of the right hemisphere, while the left brain is more capable of analytical processing.

45. This organization of the cerebral functions enables us to see and understand both the initial steps in the development of language and the subsequent evolution of linguistic implements. Before language, events were perceived globally with the means of the right hemisphere, and, as grammars were first improvised, the linguistic coding of the subject matter and ipso facto the decoding of the linguistic message were also carried out globally. This use of ancestral means and methods is not surprising, since evolution always starts with the existing elements and processes. But that was only the initial phase, and later grammars gradually conceived and developed exclusively linguistic implements, capable of expressing with the analytic potential of the left hemisphere the synthetic perception of the right hemisphere. The modern grammars are indeed capable of converting global sensory perceptions into analytical linguistic expressions. This is essentially the function of the left hemisphere.

46. This explanation of the shift from the head-last to the head-first model does not imply in any way that the linguistic changes and cerebral lateralization took place at the same time. Lateralization has been there presumably since the origin of our species, but each language had to develop the means to tap the resources of the left hemisphere and get ever more profit out of them. This interpretation seems to concurs with that of Deacon, who writes: 'the structure of languages has evolved to take advantage of intrinsic subtle biases in developing brains' (1997:309). The growing role of the left hemisphere also explains why grammars started with the perceptual notions of agent and patient before switching to the linguistic concepts of subject and object, and, in syntactic structures, why the initial models were head- last and global before being replaced by their head-first and analytical counterparts.

47. The advantage of the modern order is hardly apparent if we compare brief segments such as 'victoriam reportavit' and 'he won a victory', or the Engl . 'a red ball' and the Fr. 'un ballon rouge'. But the important advantage of a technique, however, is not to do the simple things drastically better, but to achieve what was out of reach or to produce easily what required considerable effort. The advantage of an internal combustion engine over the sprocket wheel of a bicycle is negligible when it is matter of going to the corner store for a quart of milk, but it becomes noticeable when pounds of groceries are to be hauled from a distant supermarket. Likewise, if a comparison is made between the following sentences, where the first one uses head-last structures and the second their head-first equivalents, it quickly becomes apparent that sentence 1, though formally correct, is in fact difficult to decode and ambiguous, whereas sentence 2 does not present any problem, neither for the speaker nor the listener.

1. (The dog chased) the cheese eating mouse catching cat.
2. (The dog chased) the cat that caught the mouse that was eating the cheese.

Similar restrictions occur in German, where the head-last order is a must in subordinate clauses (3), but becomes impossible when the modifier is an embedded sentence (4).

3. Ich glaube, dass Heinz das Buch gelesen hat  
lit. 'I believe that John the book read has'
4. *Ich weiss, dass du, dass Heinz das Buch gelesen hat, glaubst  
lit. 'I know that you that John the book read has believe'

In those cases, German abandons the canonical head-last order and uses instead the more manageable head-first alternative (5).

5. Ich weiss, dass du glaubst, dass Heinz das Buch gelesen hat  
lit. 'I know that you believe that John the book read has'

(cf. Bach et al. 1986; and Kempen 1996 for corroborating psycholinguistic evidence).

48. The modern word order has therefore a double advantage: in the first place, it allows for the coding and decoding of linguistic messages with a minimum of mental effort, since it taxes the working memory of speakers and listeners as little as possible; and, in the second place, because the processing of linguistic messages is facilitated, it makes it possible to conceive and express increasingly more complex thoughts.

49. Languages move therefore in the direction of head-first structures, and as they do they are led to cast off their suffixes in favor of pre-posed particles, and, when case markers have been eliminated, word order becomes fixed. Since case markers are generally lost after the shift from SOV to SVO has taken place, the resulting fixed order is SVO. In the preceding discussion, it was argued that the head-first arrangement, which includes the SVO order, had considerable advantages; the question that now arises is whether a fixed word order is by itself also advantageous. The answer is twofold. If a given model is advantageous, any provision that reinforces its exclusive use can only be advantageous. But this formal argument does not stand alone. Psycholinguists have consistently observed 'that even in a language that does not require word order for communication clarity, children tend to impose order in their speech' (Slobin and Bever 1982:234). This observation was made of children learning their native Serbo-Croatian, an I-E language with an SVO sentence pattern, but a similar conclusion has been drawn in the case of a non-Indo-European SOV language such as Hungarian. 'The fact that naive people apply an ordered based strategy when facing difficulties of interpretation suggests that in the "psychological model" of sentences order plays a role even in a formally nonconfigurational language' (Pleš 1989:174). It seems therefore that there is, independently of the benefits of the head-first pattern, a distinct advantage to having a configurational representation of grammatical functions. When word order becomes fixed, the functional yield does not change, but the material complexity of inflectional markers is eliminated and the eventual decoding problems are excluded.

## **XVIII. THE RISE OF SUBORDINATE CLAUSES: A SHIFT TO A HEAD-FIRST**

### **STRATEGY**

50. In the ancestral languages, where everything had to be said, and indeed could only have been said, in one simple sentence, the main verb was in a finite form, and subordinate action was expressed with verbals, as in the following Latin sentence,

Credebas dormienti haec tibi confectores deos? (Ter. Ad. 693),  
lit. Did you believe to you sleeping these things performers gods?  
i.e. Did you believe the Gods would take care of things for you  
while you were sleeping?

The Latin syntax used here, which is characteristic of the protolanguage (cf. Meillet 1964: 374, for Sanskrit examples) and of many contemporary languages with similar hypotactic strategies, offers another example of a head-last structure requiring a global interpretation. Instead, the English translation, which displays the modern alternative, is an analytical construction which does not overload one's working memory, since it can be coded and decoded as the utterance progresses. The ancestral phrases built around verbals belong therefore to the head-last model and reflect the determining influence of the synthetic perceptual mode of the right hemisphere. But, as speakers learned to put the resources of the left hemisphere to greater linguistic use, the strategies

became analytical, and the technique of embedding a sentence into another, which belongs to the head-first model, came to replace participial and other such phrases.

51. The replacement is not total, since, like the English compounds and pre-nominal adjectives, the head-last structures that do not make excessive demands on one's working memory, remain acceptable. But, on the whole, the advantages of sentence-embedding subordination are enormous: not only does the mental processing take place without overloading the speaker's and listener's working memory, but the potential for transmitting information is considerably increased since finite verbs can carry a whole array of grammatical values and take a greater number of objects (cf. supra 3.1). In addition to providing these advantages, the use of subordinate clauses also dispenses with the need to learn a range of verbals and their inflectional paradigms. Since these items are mastered late by children, it is easy to see how profitable it is for a language to eliminate or at least reduce to a minimum the inventory of such forms.

## **XIX. THE COMPLEX AND DIVERSE NATURE OF EVOLUTION**

52. The object of this paper has been to present and defend the hypothesis that linguistic features have pursued an evolutionary course and that the corresponding changes are adaptive. As the above discussion of the evolution of the I-E languages has shown, the evidence is overwhelming, but evolution is not a simple process. There are trade-offs, conflicting selection pressures, and above all a bushy pattern that must be properly understood.

## **XX. TRADE-OFFS**

53. While optimization is indeed what characterizes the development of linguistic features, it should be noted that trade-offs have taken place along the line. It was pointed out that the complex consonants of the ancestral sound system were replaced with simple and streamlined alternatives. The economy of energy and the potential for greater functionality is obvious, but it is also true that the complex items were probably easier to perceive, and thus had a communicative advantage. That advantage was apparently outweighed by those that were achieved through their material simplification. Such deals are common in biological evolution, where humans, for instance, have traded off part of a larger olfactory faculty for a greater mental or perhaps linguistic potential. In the overall framework of our specialization, a more powerful mind proved to be more advantageous than a more potent sense of smell.

## **XXI. CONFLICTING PRESSURES**

54. In addition to such intra-linguistic trade-offs, languages are constantly confronted with the need to reach a compromise between efficient systemic requirements and psychological considerations. Perhaps, one of the most deep-rooted beliefs in the human psyche is that 'it should be difficult; it should hurt; victory should be snatched from the jaws of death'. This psychological propensity is no doubt the key to our evolution, but the initially correct observation that worthy achievements may require painful efforts can be turned around and made into the misconstrued precept that hardship itself is a worthy accomplishment. This distorted outlook plays a major role in the evolution of languages. Not only have linguists seen language evolution as a decaying process (cf. Schleicher 1852:14-30), but also pundits and plain speakers have themselves tried to block evolution by pouring scorn on the replacement of canonical items by more efficient, but in their eyes, more 'lax' alternatives. Such an attitude explains the dutiful preservation of useless linguistic features such as grammatical gender, the subjunctive mood where it is meaningless, etymological spelling, and many other thorny idiosyncracies that have been created or made to survive in languages. A sense of aesthetics and the force of habit, which is a form of economy that works in the opposite direction - it may be more economical to keep using an older less efficient implement or strategy one knows than learn to handle their newer more efficient

alternative - may also interfere with the optimization process, but humans have a well developed psyche, which tempers the pursuit of efficiency and steers toward trade-offs between psychological and linguistic needs.

55. Conflicting pressures can also arise in bilingual situations. In the first millennium of our era, Armenian was becoming a head-first language (Nichanian 1989:56; and Bichakjian, forthcoming), but the loss of national independence and the ensuing bilingualism meant that its speakers had to use two structural patterns: the increasingly head-first order of their own language, and the reverse set-up of the occupiers' grammar. Since they obviously could not change the dominant language, they reorganized their own syntax so that they would use only one word order, which meant that the shift to head-first structures was reversed. Critics may seize this and similar events to contest the directionality of language evolution and deny the existence of adaptive changes, but such a criticism is based on a superficial observation. In normal, i.e., monolingual circumstances, head-first is the more advantageous word order (see above), but it is better to have a head-last order than having to juggle with two different ones. So, in certain circumstances, the reverse of an adaptive process can also be adaptive.

## XXII. THE BUSHY PATTERN OF EVOLUTION

56. Another serious misunderstanding arises when one fails to take into consideration the bushy pattern of evolution and adduces that changes cannot be adaptive because what is supplanted in one language survives in another. As we look at the situation in biology, we see a whole array of extant species which illustrate and, with domain-confined modifications, represent the successive evolutionary steps leading from unicellular organisms to humans. But would any biologist ever claim that because there are fishes and reptilians today, the mammalian features have no selective value? Or that a placental reproductive system does not have selective advantages because marsupials live perfectly happily in Australia?

57. Head-last and head-first languages are a case in point. Though this is not a black-and-white situation, there are roughly as many languages that are predominantly head-last as there are languages that are head-first, but the survival of the ancestral type, which was head-last, and their equal number, does not constitute evidence against the advantageous character of head-first structures. There are fishes today, and in greater number than mammals or even all other vertebrates put together, and yet mammalian features developed because they had selective advantages, and such is the case of head-first features. Just as the survival of ancestral species does not belie the selective advantages of their descendants and thereby the evolutionary process itself, so the existence of ancestral linguistic features in extant languages fails to constitute a valid argument against the adaptive character of language change and against language evolution.

58. If fishes have not moved on the evolutionary scale leading to amphibians, reptilians, etc., it would be mistaken to assume that they have stood still since the appearance of amphibians 400 million years ago. They too, in some groups more than others, have undergone evolutionary changes that within their general body plan have made them better adapted and indeed quite successful in their environments (Gould 1996:64). The situation is again similar in linguistics, where the shift from head-last to head-first structures constitutes a major evolutionary step, but, while remaining within the general confines of the ancestral pattern, extant head-last languages have undergone adaptive changes. This can be seen especially in the array of hypotactic constructions that head-last languages have developed to convey hierarchically organized thoughts, while remaining within the SOV pattern. Latin and Armenian, for instance, developed, next to their standard use of participial constructions, personally organized demonstratives and pressed them into service in the cases where SVO languages would use head-first relatives, provided however that modality did not have to be expressed. Cf. the example below, where 'ista omnia' (lit. 'all those things referring to you') stands for an entire relative clause:

Ego ista sum omnia dimensus ( Cic ., Cat. 59).  
I am the one who drew the plans of all the things you are  
admiring.

Later, as Latin evolved into a head-first language, the personal demonstratives gave way to a proximal vs. distal dichotomy, while Armenian, which kept, and, under bilingual conditions, reinforced its head-last character, continues to use the personal system ( Bichakjian, forthcoming; for alternative subordinating strategies showing their uses and their restrictions in non-Indo-European head-last languages, see Kornfilt, 1997:45-77 and Hakulinen, 1961:358-61). Another major adaptive feature of the head-last languages is agglutination, since it facilitates the processing of grammatical markers, while producing structures that remain within the canonical pattern.

59. Therefore, just as fishes have undergone adaptive changes since the emergence of amphibians, so have languages that have not become head-first developed features that present selective advantages. That is the framework in which Collinder's oft-mentioned, but seldom properly assessed objections should be placed. Responding to Jespersen, who had stressed the tendency of I-E and other languages to become analytical, Collinder had argued that such a trend is not universal, and that Hungarian had conversely created case markers out of nouns (1936:58-59 and 1956:120). The actual process can be understood by looking at the history of the Fr. 'chez'. The Latin noun 'casa' meaning 'house' became a preposition in French as 'casa Petri' 'in the house of Peter' developed into the Fr. 'chez Pierre', 'at Peter's.' Through a comparable process, once full-fledged lexical items developed into case markers in Hungarian. One may want to stress that in one case a noun became a preposition and in the other a case marker, but the contradiction is only apparent, and, on closer look, the existing consistency becomes manifest. Such differential behavior is also that of an animal feeder who would nurse a kitten with milk and feed hard-boiled egg crumbs to a chick, where under the superficial disparity lies the common objective of providing a protein-rich diet biologically adapted to the recipient's metabolism. When the Latin noun became a preposition, the host language was, at least in such cases, head-first ('casa Petri' and not 'Petri casa'), so it is only normal that the emerging item would be a preposition and not a case marker, and conversely since Hungarian was a head-last language, it is also normal that the newcomer was integrated in the dominant pattern and developed into a case marker. In both cases the changes are adaptive within the existing systems, and that was the spirit of Jespersen's claim (1964:364).

60. The situation in linguistics compares indeed with the state of affairs in biology. As Gould points out, there is an obvious evolutionary sequence from the least to the most complex organisms (1996:171), but all of today's living organisms form a 'full house' where a higher rank in the developmental sequence does not automatically translate into a higher degree of success. Bacteria are 'the dominant forms of life on earth'; 'insects ... dominate among multicellular animals'; and 'teleosts (modern bony fishes) are the most successful of all vertebrate groups' (1996:175, 145, and 64). Likewise, SOV is the ancestral form of SVO, but it is nearly as frequent, particles are modern, but inflectional markers are quite common; vowels grew new qualitative distinctions, but vowel length has not disappeared. There is also a 'full house' of linguistic features, but as in biology, they have their evolutionary history, a history where selection pressures have steered them toward increased functionality and smaller material complexity.

## **XXIII. A HOPEFUL CONTRIBUTION TO LIFTING THE TABOO ON LANGUAGE**

### **EVOLUTION**

61. This paper was about complexity in linguistics. It was stressed that a distinction should be made between complexity of form and complexity of function, and it was argued that at least in the most widespread and most intensively investigated language family, the major linguistic features have evolved by decreasing the complexity of their form and increasing the complexity of their function. On the basis of these observations, it was suggested that languages have evolved along a Darwinian line. Obviously, I-E is only one of several language families, and absolute certainty that the evolutionary process discussed above is universal will come when the two-prong complexity parameter is applied to the other language families. It should also be admitted that the perfect yardstick for gauging complexity is not given. The chronology of acquisition is a reasonable

indicator, not an absolute measure of the complexity of neuromuscular algorithms, and there is no universal formula for computing the functional yield of a linguistic feature. These problems exist, but not just in linguistics. How does one measure the selective advantages of warmbloodedness or placental reproduction? Yet, we know that they have selective advantages, and we also know that however fish-like their appearance may be, dolphins do not belie Darwin's theory of evolution and confirm Lyell's uniformitarian scenario. This type of knowledge and discriminating judgment was used above to assess the linguistic data and argue that they suggest the existence of an evolutionary process in linguistics. This paper does not pretend to be an open- and-shut case, but an important objective will be reached if it contributes to lifting the prevailing taboo on language evolution.

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