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Why don't Languages Adapt to their Environment?

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Abstract

The issue of whether languages adapt to their environment depends on our understanding of both *adaptation* and *environment*. If *adaptation* is defined as the result of the differential transmission of phenotypic traits by means of natural selection, then it is evident that both natural species and languages are adapted, since, according to Darwin's own insight, the evolutionary mechanisms for species and languages are "curiously the same". However, if the concept of adaptation entails that the environment is the essential source of the structure of evolving objects, then neither natural species nor languages can be said to be adapted to their environment in this sense.
In the case of languages, I will argue that much of their structure is insensitive to historical change and, therefore, incapable of adaptation to the external environment. The immediate environment of languages is in fact internal to the mind/brain and is thus less variable than the social and physical environment in which people live. On the other hand, the dimensions of languages that are variable have such an indirect relation with the physical and social environment that the notion of adaptation to extra-linguistic reality can only be applied weakly, and is unable to explain the main patterns of linguistic structural diversity.

Keywords:
language change, language evolution, adaptation, language typology, evolutionary theory, language diversity, faculty of language, I-language

1. Introduction: Reasons for skepticism

My aim here is to consider proposals that seek to explain the structure of languages in terms of adaptation to their physical and cultural environment, and to do so with a degree of skepticism. This is not, of course, to deny the inherent interest or value of such work (see a current synthesis in Ladd *et al*., 2015). My skepticism arises from two principal claims: (i) the influence of the physical and cultural environment in which languages are developed has a limited scope for explaining the properties of specific languages (including their main patterns of typological variation), and (ii) such studies do not lead to a satisfying account of what human language is, from a cognitive and biological perspective, but rather, they take us back to a traditional (and incomplete) view of language as a cultural construct analogous to ideologies or social institutions.

2. Languages evolve (change) like species, but this does not imply that their structure derives from the environment

Following August Schleicher, the first major linguist to address the analogy between languages and species suggested by Darwin, I will assume that "not a word of Darwin's need be changed here if we wish to apply this reasoning to languages" (Schleicher 1863: 64). The reason is that in both cases the evolving objects, languages and species, are *historically modified natural objects*. This identification allows us to say that the process of linguistic change and that of natural evolution are formally alike, although substantially different (see Mendívil-Giró 2014 for a discussion).
Although various proposals for establishing the specific terms of the comparison have been suggested (e.g. Croft 2000), in my opinion the most appropriate one is that formulated by Schleicher himself, in his review of the German edition of the *Origin of Species*:

"The species of a genus are what we call the languages of a family, the races of a species are with us the dialects of a language; the sub-dialects or patois correspond with the varieties of the species, and that which is characteristic of a person's mode of speaking corresponds with the individual" (Schleicher, 1863: 32).

What Schleicher calls "that which is characteristic of a person's mode of speaking" is the closest concept to the Chomskyan notion of I-language that could be formulated at that time. Chomsky's (1985) distinction between I-language and E-language seeks to establish that the object of study of linguistics as part of cognitive science is not an external object, a shared code or a social institution, but a property of a speaker's mind/brain. For this reason, I argue that in the comparison between linguistic change and natural evolution the appropriate terms for comparison are as follows: the equivalent of the natural organism (the individual) is the I-language, while the equivalent of the species is a set of similar I-languages. Thus, a natural language such as Spanish is simply the set of I-languages of Spanish-speaking people (that is, of the people we identify as speakers of Spanish), just as the natural species of tigers is nothing other than the set of organisms that we identify as tigers. In both cases the criterion of delimitation, based on similarity, is diffuse and somewhat arbitrary: the criterion of fertile breeding in natural species, and the criterion of mutual intelligibility in languages (see Dixon 1997). And just as we would not say that tigers are manifestations or realizations of the species of tigers (which would have an independent existence), it is not appropriate to say that I-languages are manifestations or realizations of the Spanish language (which would have an independent existence in grammars, in dictionaries or in social communities). The Chomskyan cognitive shift has as a central tenet the assertion that languages are not exclusively external, social objects that humans learn, use and transmit from generation to generation, but are in fact different (historically modified) states of the same language faculty, a specific attribute of human cognition. Similarly, natural organisms are different (historically modified) states of the same biochemical phenomenon: life.

Comparable to natural evolution in biological organisms, then, is the process of linguistic change in human languages. The assumption that follows, hence, is that the process of language evolution (as a human faculty) is part of natural evolution, and not part of linguistic change. In other words, the process of linguistic change is one that affects (in historical time) the systems of knowledge we call I-languages, and has no

relation to the evolutionary processes that could give rise (in geological time) to the faculty of language. To avoid the "unfortunate ambiguity" (cf. Hurford 1992: 273) that expressions like *language evolution* have in English, I use the term *linguistic change* to refer to the process of historical change in languages, and I will reserve the term *evolution* for biological changes, including the evolutionary emergence of the language faculty. In this sense it is possible to affirm, following Berwick & Chomsky (2016: 92), that "languages change, but they do not evolve". For arguments against the assumption that the process of linguistic change is part of the process of language evolution, see Mendivil (2016, and submitted).

The parallelism between natural evolution and linguistic change in fact goes beyond the interesting similarities that Darwin (1871) observed, and persists in the relevant spheres of scholarship. Gould (2002) analyzes in detail the controversy between adaptationist, externalist, and functionalist evolutionary theorists (using Gould's 1996 characterization of neo-Darwinism) and, on the other hand, anti-neo-Darwinist theorists (such as Brian Goodwin, Stuart Kauffman and Gould himself). In linguistics too there is also a parallel controversy, revolving around functionalist and non-functionalist theorists of language change.

I think that Schleicher's approach represents the zenith of the comparison between language change and natural evolution, and that from that moment it declined. One reason for that decline is the change in the conception of language that would come along with the Neogrammarians and with European structuralism (especially the Prague School ideas). I refer mainly to the conception of language as a social institution in the service of communication and to the preference for teleological explanations of linguistic change (see Lass 1997 for a detailed critical review and a solid argument against functional/adaptive models of linguistic change).

It is relevant noting that the revival of teleological tendencies in the explanation of language change coincides in time and in orientation with the emergence in the twenties and thirties in the 20th century of the *Modern Synthesis* of evolutionary theory. The new synthesis implies an inclination to consider natural selection as the only motive power of natural evolution, which implies the idea that every change must be adaptive. In my view, this trend corresponds to functionalist approaches to linguistic change and to the more recent tendency to consider languages as complex adaptive systems (Kirby 1999).

Gould (1996) has described the fundamental difference between the neo-Darwinist model and its alternatives making use of the metaphor of the billiard ball against Galton's polyhedron. According to the neo-Darwinist point of view, an organism could be represented as a billiard ball in motion. Each time the cue hits the ball there is a variable movement. There is a free variation that goes in all directions. The cue hitting the ball would be natural selection, and the ball goes where selection drives it. This constitutes, in terms of Gould, an *externalist*, *functionalist* and *adaptationist* theory. By contrast, the anti-neo-Darwinist point of view presents the metaphor differently. The organism would be as a polyhedron resting on one of its facets. Once the cue hits it, the prospects for change are very constrained: it is a polyhedron, which has a certain internal structure that limits variation, so that certain options are more likely than others and some are impossible, however interesting that might be from an adaptive point of view.

Of course, this is not the place to review the long dispute over the meaning and implications of the term *adaptation* in evolutionary theory, nor to reiterate the debate on the channeling of previous history and the laws of nature "on which natural selection was privileged to work" (Kauffman 1993: 643). However, it is important to note that by adopting a cognitive point of view in the study of languages one cannot ignore the strict restrictions that the human brain and cognition impose on the structural design of languages, independently of those aspects susceptible to historical change (and, therefore, candidates for possible processes of adaptation to the environment).

Gould characterized the controversy in evolutionary theory as follows:

"In what ways does the skewed and partial occupancy of the attainable morphospace of adaptive design record the operation of internal constraints (both negative limitations and positive channels), and not only the simple failure of unlimited number of unconstrained lineages to reach all possible position in the allotted time?" (Gould 2002: 1053).

And both options have an equivalent view in linguistic theory. The internist and formalist approach (characteristic of generative linguistics) conceives languages as systems of knowledge restricted in their range of variation by the structure of the human faculty of language (that is, as Galton's polyhedrons). This view correlates with a uniformitarian conception of language diversity and with a restrictive conception of linguistic change. The externalist and functionalist approach (represented by cognitive-functional linguistics) conceives languages as external cultural objects that owe their structure to the adaptation to speakers' cognitive and communicative requirements (that is, as billiard balls). This view correlates with an unconstrained conception of linguistic change and with an emphasis on the diversity of languages (see Mendívil-Giró 2012 for a review of that controversy).

It seems to me that what we know about how, and how much, languages can change in time and in relation to the environment places us in the first scenario: that is, one in which the human faculty of language strictly channels the aspects and components of languages that can vary in time and space.

3. But what changes when languages change?

According to Hauser *et al*.'s (2002) influential model, the human language faculty could be conceived of as a complex system minimally integrated by three components: a conceptual-intentional (CI) system (related to meaning and interpretation), a sensory-motor (SM) system (related to the perception and production of linguistic signals), and a computational system (Narrow Syntax, responsible for the creation of the syntactic structure that underlies linguistic expressions, and ultimately for the compositionality and productivity of human language).

Following later developments of this model (Chomsky 2007, Berwick & Chomsky 2011, 2016), I will assume that the computational system has an asymmetrical relationship with the two "external" components (CI and SM), such that the computational system would be optimized for its interaction with the CI system, while the relationship with the SM system would be ancillary or secondary. See Figure 1.

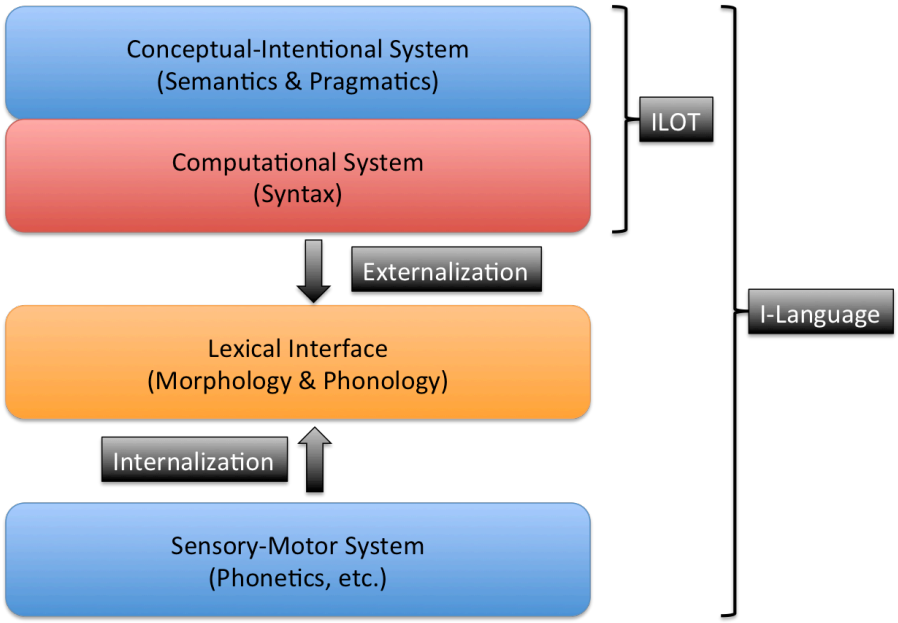

Figure 1. The structure of an I-language. For each component the traditional area of research is indicated. The main components of language are asymmetrically related. The conceptual-intentional (CI) system has a direct connection with the computational system and they form a internal language of thought (ILOT). This ILOT is connected with the sensory-motor (SM) system for language externalization. This connection is established through a lexical interface. The lexical interface changes historically during the process of transmission from generation to generation.

It is then implied that the computational system is coupled with the CI system to form an *internal language of thought* (ILOT), one that would be essentially homogeneous within the species, and the evolutionary design of which would not be for communication but for thought. Chomsky has suggested that from an evolutionary point of view, language was initially a language of thought independent of communication and of the systems of externalization: "the earliest stage of language would have been just that: a language of thought, used internally" (Chomsky 2007: 13).

The connection of the ILOT with the SM system is what would allow the "externalization" of language for interaction and communication with others. Since the connection of the ILOT with the externalization systems is posterior or secondary, it would be precisely within this process that the principal source of the structural diversity among human languages would emerge:

"Parameterization and diversity, then, would be mostly –possibly entirely– restricted to externalization. That is pretty much what we seem to find: a computational system efficiently generating expressions interpretable at the semantic/pragmatic interface, with diversity resulting from complex and highly varied modes of externalization, which, furthermore, are readily susceptible to historical change (Berwick & Chomsky 2011: 37-38)".

The connection of the ILOT with the SM system is what allows the externalization of language and, incidentally, what causes the existence of different I-languages. The essential hypothesis is that the same ILOT underlies all languages, so that differences between them are not caused by differences in the conceptual-intentional, the computational, or even the sensory-motor systems (which would be biologically

conditioned), but follow from differences in how the ILOT is connected to the SM system. Let us suppose, to simplify, that the interface between the ILOT and the sensorimotor system is a kind of "lexicon", that is, a repertoire of morpho-phonological formants that allow the externalization of the hierarchical syntactic-semantic representations (produced by the computational system in its interaction with the CI system) in the form of chains of morphemes and phonemes (or, if applicable, visual signs). The role of the lexical interface, then, is to transform abstract hierarchical structures into sequential structures legible at the sensorimotor system. A possible way to understand the format of this lexical interface would be in terms of the type of lexical entries postulated in so-called nanosyntax (Starke 2009).

Such a model predicts that the diversity in I-languages is the result of variations in externalization, that is, variations in the configuration of the *lexical interface* represented in Figure 1. As shown in the diagram, the development of language in an individual implies the learning (the internalization) of the lexical material necessary for communication, and it is exactly during this process that reanalyses can occur. A reanalysis is a mismatch in the grammar of two speakers between an internal representation and the linguistic expression produced by the sensory-motor system. It can be seen as the equivalent of genetic mutations in organisms.

Let us consider a simple example: in present-day English the future is expressed as a phrase (*I will love*) whereas in Spanish it is expressed as a single word (*Amaré*). According to the model presented, the underlying syntactic structures of the two expressions are very similar (and therefore they mean the same), while the morphological (and phonological) structures are very different. However, what is now a bound morpheme in the Spanish future (*-é*) was an auxiliary verb in earlier stages of this language (derived from the vulgar Latin phrase *amare habeo* 'I have to love', an alternative to the classic Latin synthetic form *amabo* 'I will love'). The transition from a phrase (main verb + auxiliary) to a word (root + affix) at some point in the evolution of Romance necessarily implied a process of reanalysis (a mutation). Hence, and again to simplify, we could say that for speaker S_1 expression E has the underlying structure Verb+Aux, whereas for speaker S_2 the *same* expression E has the underlying structure Root+Affix, that is, speaker S_2 *reanalyses* expression E, conferring on it a different underlying structure (Root+Affix) than that of speaker S_1 (Verb+Aux). In a sense, then, the I-language of speaker S_2 has a mutation, because the relationship between the elements of expression E and its underlying structure is different from that in the I-language of speaker S_1.

The listener (or the child acquiring a language) does not have immediate access to the syntactic structure or to the semantic representation underlying a given expression, but only to the sound wave that externalizes it. The task of the listeners (or learners) is to use their I-language (including their own lexical interface) to discover this structure by analysing the sound wave received. In the ideal case, the structure that they get is identical to what the speaker had in mind. When this is not the case, we can say that reanalysis has occurred. So reanalysis is basically a decoding (or acquisition) error, and when this error (this "mutation") is stabilised in the listener's I-language and is extended to other speakers we say that there has been a linguistic change. The model predicts that changes happen in the lexical interface that materializes syntactic structures, not in the computational system itself.

On the other hand, in linguistic change, as in the case with natural evolution, one has to clearly differentiate the reasons why an innovation arises and the reasons why this innovation extends over a population over time. There are many factors that might lead, for example, to the introduction or elimination of a particular acoustic feature in a phonetic segment (from climatic conditions to the presence of speakers of other languages), but a linguistic change will only occur if that mutation extends to other individuals (I-languages), and this itself will only happen if the speakers imitate the speech of the innovators, and the innovations pass these on to subsequent generations. As Labov (1967) has shown, the crucial factor in the selection of innovative variants, whether phonetic, morphological, lexical or syntactic, is not functional efficiency or cost of execution, but social prestige. Some authors (e.g. Croft 2000) argue that innovations are functional/adaptive, that is, they have a teleological motivation. But as Lass notes, "unless a motivation is arbitrary, its implementation ought not to subject to contingent factors like age, sex, prestige, etc." (1997: 364).

Differences between languages (such as differences between natural species) are the result of change, but linguistic changes only occur in the most superficial dimension of languages, those that are exposed to learning from the environment and are susceptible to historical reanalysis. In the same way, biological evolution significantly alters the form and structure of organisms, but does not modify the biochemistry on which they are built, this remaining unchanged since the emergence of the first forms of life.

4. The diversity of languages does not correlate with the cultural diversity of their speakers

Even assuming that externalization patterns are the only thing that changes historically in languages, it could still be argued that there is a great deal of room for variation and that, therefore, the structural diversity of languages could reflect processes of adaptation to the environment. Indeed, we know that notable variation in the structure of languages does exist, although the model proposed in Figure 1 would rule out the kind of unrestricted variation which some authors continue to advocate (see Evans and Levinson 2009 and Mendívil-Giró 2012 for a critique).

The parameters of linguistic structural variation that have always caught the attention of typologists are those of a morphosyntactic nature (that is, related to how the morphology of languages reflects the syntactic structure). There are languages with case marking morphemes, and languages without them; there are languages in which verbs are conjugated and agree with several arguments, and languages in which they do not; there are languages in which heads precede complements, and languages in which this happens in reverse; and there are languages in which interrogative words move to the front of sentences, and languages in which they do not (see Dryer & Haspelmath, eds. 2013 for a general survey). Between each of the mentioned options there is a complex range of intermediate steps.

For example, among the languages that morphologically mark grammatical relations between verbs and arguments (either with cases or with agreement), some follow the nominative-accusative pattern (formally grouping the subject and differentiating the direct object) and others the ergative-absolutive pattern (formally grouping the subject of the intransitive verb and the object, and differentiating the subject of the transitive verb). Yet there are also languages that are accusative in certain tenses/aspects and

ergative in others (see Dixon 1994). All such variation is compatible with the model set out in Figure 1, and a number of research programs are currently addressing the issues of structural typology based on differences in the externalization component (e.g. Richards 2016).

What is relevant to us here is that, as Pinker (2007) has pointed out, "the non-universal, learned, variable aspects of language don't fit into any meaningful purposive narrative about the surrounding culture". The causes of the changes that produce such variation are inherent to linguistic structure itself, and to the mechanism of change (reanalysis). To quote Pinker once more, these changes "aren't part of any symbolic or teleological plan of the culture". Adapting Pinker's words to our example above, we can say that there are ergative languages and accusative languages, but there are no ergative cultures and accusative cultures.

The assumption that there is a correlation between culture or worldview and the grammatical structure of languages is as old as reflections on language typology. In the past it was assumed that the degree of "cultural evolution" determined the degree of "linguistic evolution". Thus, if we turn again to the case of ergativity, it was claimed that ergativity correlated with a lack of rationality: "What for us is a true cause is for primitive man merely an event involving mystical forces" or "savage man apparently feels that most events are not due to his own volition" (quoted by Seely 1977, apud Dixon 1994: 214). Dixon argues that by using the same data we could conclude that only speakers of ergative languages have a true notion of agency, since only these speakers formally identify the agentive argument; he concludes that, "in fact, there is no one-to-one correspondence between grammatical marking and mental view of the world" (Dixon 1994: 214).

On the other hand, some current authors (e.g. Boroditsky 2009) make the assumption that differences in the structure of languages determine the worldview. However, neither interpretation seems to have empirical support (which eliminates the problem of inducing a circular argument). The reason for this is simple: the fact that one language, for example Mohawk, has more morphological complexity than another, for example English, has no relation to the complexity of the culture in which those languages are spoken, or to the sophistication of its literary tradition, but simply depends on a chain of previous historical facts (this further "encapsulated" in the lexical interface of Figure 1). The bound morphemes that characterize the complex morphology of many languages are the result of the historical reanalysis of ancient free words. Yet the almost invariable, morphologically simple words that characterize other languages are often the result of the loss of morphological complexity, also resulting from historical reanalysis. In both cases reanalyses, like genetic mutations, are blind and random processes, and Darwin's conclusions can be applied to them: "There seems to be no more design in the variability of organic beings, and in the action of natural selection, than in the course the wind blows" (Darwin 1893: 63).

Although structural types of languages do not correlate with the types of societies and cultures that populate our planet, it is still possible to see how certain formal aspects of languages can be explained as processes of adaptation to the environment within the process of linguistic change. However, prior to this we need to determine what is understood by environment and what aspects of a language are sensitive to it.

5. What is the environment to which the variable parts of languages would adapt?

The diagram in Figure 1 represents any I-language (that is, the equivalent of a natural organism). What parts of the phenotype of this "linguistic organism" are likely to have been shaped by adaptation to the external environment? And more pressingly: what is the external medium to which these parts could have adapted?

It is not a simple question. The structure of Figure 1 may be interpreted as a sandwich, so that only the outer layers would be susceptible to contact with the environment. Thus, we could consider that the CI and SM systems are "more external" than the computational system. The CI part of any language may be in contact with the rest of the conceptual system of people, so that it would then be expected that certain aspects of the physical, social and cultural environment in which people develop and live can have an influence on the range of available concepts and notions. This would explain a relatively trivial aspect of the adaptation of languages to the environment, that of the substantive lexicon: In a culture with highly developed technology there will be words and phrases to denote scientific instruments, techniques and concepts not found in languages spoken by hunter-gatherer communities, which, on the other hand, would have areas of the lexicon relating to wildly occurring food, animals and methods of survival unrecognized in the languages of modern urban communities. As we know, changes in culture, technology and lifestyle often lead to changes in the lexical inventory that we require in everyday life. When a society moves from a rural to an industrialized life, the most widely used lexical inventory also changes.

But the differences in the type of conceptual elements that have specific lexical expression are not related to the morphosyntactic structure of languages. Indeed, languages spoken by supposedly simpler societies, hunter-gatherer societies, often have greater morphosyntactic complexity (greater "maturity" in the sense used by Dahl 2004) than many modern European languages such as English or Romance languages.

On the other side of the sandwich, we have a sensorimotor system, which in oral languages corresponds to the vocal-auditory system. It is conceivable that certain aspects of the physical environment may bias the kind of sounds most used in some languages (see Everett et al. 2016), but again there would be very limited effects on the morphosyntactic structure of languages.

So, which environmental factors could have molded the historical drift of the morphosyntactic systems of languages? My general proposal is that there are no such factors, since the structural typology is relatively isolated from the semantic and material dimension of languages and does not seem to fit them. But if we were to look for them, the place to start is within the brain.

According to the model I have described here, the object of study, from a cognitive perspective, is not that of languages understood as social institutions, but the I-languages that reside in the minds/brains of individuals. In this context it is imperative that we recall that the only environment with which "mental organs" are in direct contact is the brain itself. If there is an "external" medium to which I-languages can adapt, it must be internal to the mind/brain.

It may be argued that many of the most notable changes that have been documented in the history of languages have contact with other languages as a crucial factor. And, indeed, it is indisputable that language contact has much more effect on linguistic phenotypes than the social or physical environment in which people live. But languages do not come into direct contact within the physical environment or in society, but only in the brains of speakers. Language A can only have influence on language B if the speaker of B has some kind of knowledge of language A. In our terms we could say that the development of a new lexical interface can affect the previous lexical interface, which can alter the linguistic emissions that the new generation of speakers will use to develop their own lexical interface.

Natural evolution is only possible thanks to the reproduction of organisms, and linguistic change is only possible thanks to the transmission of languages from generation to generation. Much of the structure of a I-language is transmitted from parents to children along with the rest of their biological endowment, but obviously the variable parts of language are learned (internalized) from environmental linguistic stimuli. As I have already noted, this is the phase in which mutations in the lexical interface can occur. These mutations, depending on their range of transmission, can give rise to linguistic changes and, ultimately, to what we see as a different language. The task of the child who learns a language is to reproduce in her mind/brain the lexical interface of her interlocutors, a typically insecure ('abductive', cf. Andersen 1973) procedure that is at the basis of linguistic change.

As Dahl (2004) has shown, the usual dynamics of linguistic change produce an increase in morphosyntactic complexity (*maturity*) up to a certain limit, and thereafter such complexity tends to be maintained. The degree of maturity of a language is measured in terms of the quantity of structures involving a previous derivational history, that is, non-universal processes that can only be explained by long previous evolutionary chains, such as inflectional and derivative morphology, incorporation, the existence of phonological tone, case marking or ergativity. However, we might note that according to the model presented in Figure 1 this natural increase in linguistic complexity actually amounts to an increase in the complexity of the lexical interface, not the whole language itself. In this sense, no languages are more complex than others, but there are languages with more complex lexical interfaces than others. This is an important difference. The notable grammatical differences between, on one extreme, Georgian and, on the other, Tok Pisin, do not imply differences in the deep layers of structure (basically the conceptual-intentional system and the computational system), but rather differences in the historical evolution of their externalization components. The proof of this is that the two languages serve their users in carrying out the same cognitive and communicative functions.

The initial intuition here is simple: the more prior history, the greater morphosyntactic complexity, and vice versa. In fact, McWhorter (2011) argues that the natural state of a language, that is, when no drastic disturbances in its transmission from generation to generation have occurred, is "highly complex, to an extent that seems extreme to speakers of languages like English" (2011: 1). It seems clear that the brain of human children is able to internalize lexical interfaces as complex as those of Native American languages or Caucasus languages, typical examples of "mature" systems in Dahl's sense. Neither the brains of other organisms nor the brains of the majority of human adults are as efficient in the internalization of arbitrary systems of gender and noun

classifiers, agreement patterns, or quirky cases (not to mention phonological systems). Consequently, McWorther hypothesizes that whenever we find languages with low degrees of morphosyntactic complexity it is because such languages have been interrupted in their normal accumulation of complexity; that is, languages with relatively low degrees of complexity "owe this state to second-language acquisition in the past" (McWhorter 2011: 2). In this category we could include languages like English, Romance languages, Persian, Mandarin Chinese and Indonesian. Compared to other, related languages (such as Sanskrit, Latin, Greek or Baltic) these languages (which McWhorter calls *Non-Hybrid Conventionalized Second-Language Varieties*) are characterized by a loss of complexity that reveal evidence of widespread second-language learning in the past. According to this model, creoles are extreme cases of the same phenomenon: "where complexity has been lost to a radical degree, we can assume that the language was born in a situation in which adult acquisition was universal" (McWhorter 2011: 2). These cases of suboptimal transmission would therefore be clear examples in which the brains of adult learners have operated as an environmental factor to which languages have adapted.

Another interesting approach is developed in Bickel et al. (2015), in this case regarding the development and persistence of ergative systems in relation to universal processing preferences. Using experimental evidence, Bickel et al. (2015) propose that there is a universal principle that favors the processing of an initial unmarked NP (in nominative or absolutive case) as an agent (as in *John sold a car*). When the rest of the sentence shows that this unmarked NP is not an agentive subject (as it would be in an ergative language, which marks the subjects of the transitive verbs, or in a construction like *John I sold a car*, familiar in languages like German), they observed an event-related potential (N-400) signaling a reanalysis of the role of the first NP (for example, as a patient argument). Bickel et al. hypothesize that this principle is "species-wide and independent of the structural affordances of specific languages" (2015: 2) and that, as such, "the principle favors the development and maintenance of case-marking systems that equate base-form cases with agents rather than with patients" (2015: 2), that is, nominative-accusative systems over ergative-absolutive ones. Using a large database of linguistic changes in various language families (617 languages in total) they note that of the two possible historical changes, ergative > accusative or accusative > ergative, languages show a clear bias toward the former:

"Languages tend to avoid ergatives when they evolve over time: if a language has ergative case marking, it is more likely to lose than to keep it, and if a language lacks ergative case marking, it is unlikely to develop it. To be sure, ergative cases can arise and be maintained for a while, but the probabilities of this are always lower than the probabilities of avoiding ergatives" (Bickel et al. 2015: 18).

If Bickel *et al*.'s conclusions are correct, we would again have a clear example of how a language-external (but mind-internal) factor can condition the adaptation of languages in their processes of change (see Hawkins 2004 for a detailed model). However, this also leads us to an important conclusion, one at the heart of our present discussion: even though a general principle of processing exerts a measurable pressure on linguistic systems, the inertia of the language's previous history is capable of overcoming it, showing that morphosyntactic structure is stubbornly resistant to external adaptive pressures, even though they are internal to the mind/brain.

It is important to note that ergative systems are mature systems in Dahl's sense, which would also explain, at least in part, both the unequal statistical distribution of the two types of languages, and the historical bias documented by Bickel *et al*. The relevant fact for us here is that a language like Basque, which is fully ergative, shows no symptoms of maladjustment and remains fully functional for its users. More relevant still, there are processes of historical development of ergativity (otherwise, ergative languages would never have existed) which show that grammatical structure is largely immune to the influence of external (i.e. non-grammatical) factors.

Conclusions

If we adopt McWhorter's theory, we could say that adult brains have influenced the historical development of some human languages to a decisive extent. On the somewhat confusing lines of the externalist view of languages, it could be said that some languages have adapted to (non-flexible) mature brains, simplifying their historical accretions and rendering themselves easier to be learned. But this should not obscure the fact that language, just like breathing, memory or vision, is a human attribute essentially homogeneous in time and space, from the onset of *Homo sapiens* until today.

Many and diverse external and internal factors have left their mark on languages, especially in their systems of externalization, but I do not believe that this in itself allows us to claim that the structure of languages is essentially a matter of adaptation to the environment.

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