LANGUAGE ADAPTS TO ITS EVOLVING FUNCTIONS FROM ITS ORIGINS TO THE PRESENT

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Abstract

Language is as much a bio-cognitive as it is a socio-cultural phenomenon. It is both a bio-cognitive property of the human mind and a communicative technology with the primary function of communication, both brain-internal interconnections among neuronal networks, and interpersonal information exchanges.

The evolution of language is a process of adaptation to multiple environments, both internal to the individual's processing and learning mechanisms, and external, i.e. socio-cultural influences of populations. Thus it must adapt to both the human mind and its processing demands and the socio-cultural climate.

During the multiple millennia since its origination language co-evolved with its environment, both internal and external. It has adapted to fit the human body and mind for efficient learning and processing, and in the process has also altered the human organism to fit language-relevant functions. Language has also evolved in response to the external environment by diversification to fit the specific communicative circumstances of communities in a process of mutual adaptation as historical, cultural, economic and technological environments change.

Keywords: evolution**,** Modern Synthesis, functionalism, Language Faculty, adaptation

1. Introduction: evolution as adaptation to a function

Darwin's theory of evolution of species by natural selection is one of the major scientific achievements of all times. It defines diversification of life forms as alteration in heritable characteristics of successive generations. It is a three-step process and encompasses three interconnected phenomena in the living world : inheritance, variation and differential survival. Darwinian theory has offered the most plausible explanation for the complex design in life forms. In Darwin's theory the diversity of species is explained as resulting from series of small successive modifications in the ancestral species, by which they aim at becoming maximally fit to some element of the environment, i.e. the environment has a pivotal role and adaptation to some aspect of the environment is at the heart of the evolutionary process.

1.1. The evolution of Darwinism: Modern Synthesis(MS), Extended Evolutionary synthesis(EES), Universal Darwinism

Over the decades the Darwinian theory has inspired explosion of empirical research resulting in vast increase of very detailed and highly specific information about the evolutionary process, e.g. the discovery of the gene and the proliferation of Mendelian genetics triggered reevaluation and extension of the original Darwinian theory resulting in the MS as a new and improved understanding of evolution, based on a mathematical model for describing heredity in terms of an abstract model as a combination of discrete elements. MS describes heredity as " inheritance

by which stable non-decomposable characters, controlled entirely or overwhelmingly by a single genetic locus, are transmitted over many generations " (in www. medical-dictionary.thefreedictionary.com/ mendelian+ inheritance). It is influenced by classical physics and studies evolution in terms of recombination of stable immutable entities which act independently of context. Mendelian use of mathematical concepts is coupled with the influence of Turing's theory of computation where a finite and predetermined set of abstract symbols automatically combine according to a finite number of equally predetermined rules results in infinite number of combinations. In this sense evolution is defined as a computation process where a finite number of basic discrete units of DNA molecules , which form genes, combine and form the diversity of life forms and heredity is understood in terms of digitalization.

   Population genetics, a branch of evolutionary biology, complements the evolutionary theory by studying the genetic reservoir in small populations and its evolutionary role as a source of variation on which natural selection operates. It extends the conceptual arsenal of the evolutionary theory by focusing on genetic processes of genetic hitchhiking, genetic drift, founder principle, gene flow, which interact with environmental selection in the genetic makeup of the individual in human populations and other social animals (Mayr 2001 and elsewhere). To note, natural selection, genetic drift and gene flow are evolutionary mechanisms which interact as each contributes to evolution. In Darwin's theory variation is a matter of accidents in large populations, while variation produced by genetic isolation and genetic processes in finite populations are constrained by the specifics of the gene pool of each population. Genetic drift and similar intra-population processes could potentially neutralize or counter the effects of adaptation by fixation of deleterious genetic material(Andrews 2010). That said, organisms in all circumstances, individually and in populations, are subjected to environmental selective pressures for survivability. Further, more recent empirical findings, e.g. the pervasive pleiotropy (a single gene influences multiple, often unrelated phenotypic traits) in the formation of the phenotype, the fact of phenotypic diversity both inter and intra-species, despite the overwhelming stability of genetic inheritance, challenged the traditional postulation of gene supremacy in evolution. This coupled with a more detailed understanding of heredity, revealing that that genome is made of different types of genetic material, a good part of which has no role in the formation of the biological body and no exposure to selection, while other components of the cell are inherited and participate in the building of the phenotype on par with the genes. In addition, the finding that factors not only outside the genome, but outside the organism participate in coordination and contribute to inheritance, prompted a revision of the MS and conceptual enrichment of the evolutionary theory in EES, which introduced new concepts, e. g. extragenetic inheritance, epigenesis, niche construction, reciprocal causation, gene-culture coevolution to label the multiplicity of factors and processes, epigenesis, development, learning, the environment, which interact and cooperate in a multidimensional evolutionary process of the formation of the organism by multiple sources of inheritance(Jablonka, Lamb,2005 and elsewhere). In short, in a more profound and detailed understanding of evolution as a multidimensional process of constant interaction and feedback between biological forms and environment where biological forms are active participants in their evolution.

   An extension of Darwinian principles to socio-cultural change are articulated by D. Hull's generalized theory of evolutionary change which abstracts the evolutionary principles

from their original biological context and applies them to understand change of any entity in any field. At the foundation of Universal Darwinism are the basic principles of Darwinian evolution : **a.** replication by which biological organisms multiply, **b**. variation produced by copying errors during the replication (Darwin's descent with modification) **c.** competition among the variants fulfilling the same function , **d.** Selection leading to differential retention of some variants and the elimination of others based on superior survivability under current circumstances. In analogy to the gene-centric theory of biological evolution Hull understands the universal evolutionary process in terms of genotype and phenotype as two different entities with two different roles in it. The theory is applied for explaining changes in various spheres of culture, e.g. from technology, farming, fashion, to institutions , language .The terms ' replicators' (the containers of information which is copied , analogue to genotype) and 'interactors '(entities which interact with the environment and are subjected to selection, analogue to phenotype) are abstract enough to neutralize the idiosyncrasies of the evolving entities. A detailed analysis of Hull's theory can be found in Croft 2013, p. 11-). A gene-centric approach to cultural evolution is also proposed by Dawkins (1976) who introduces the concept of 'meme' as unit of cultural evolution analogue to the gene in biology.

1.2. Evolution of languages/Glossogenesis and Darwinian principles

Evolutionary principles of diversity, heredity and adaptive selection are evoked as explanation for periodical changes in language systems, the process of glossogenesis. Different authors interpret differently the metaphoric transplant of biological concepts into linguistics, e.g., gene-centred perspectives understand glossogenesis in terms of divergence from a " mother tongue", where language systems are considered dialects of the same language, or genetically related, if they share properties, arguably, inherited from a common linguistic ancestor. The gene-centred perspective is widely applied by historical linguistics.

   Others espouse E. Mayr's population perspective and define languages in therm of population of idiolects. To remind, an idiolect is the individual's I-language. In this context two language varieties are considered the same language if people's I-languages are similar enough to allow successful communication. In this context communicative isolation leads to loss of intelligibility which marks the difference between language varieties and different languages. In short, a language is defined in terms of the communicative interactions in a community of speakers, which drive the dynamics of glossogenesis. In Croft (2000) glossogenesis follows the general principles of evolution, i.e. there is variation at various levels of language use is pervasive: **1**. there is diversity of idiolects, **2.** among sociolects, as sociolinguistic diversity, motivated by various social factors: age, gender, class, **3.** variation within idiolects : in phonetics, lexicon and grammar as the same person is found to use different linguistic devices at different occasions in expressing the same idea. There is competition, e.g. two or more vocabulary items are used as alternatives to encode the same concept (synonyms), or various syntactic structures are alternatively used to describe the same event. And there is selective inheritance, where some linguistic forms are persistently preferred over less effective alternatives, i.e. the evolving entities are individual linguistic forms. Resistance to change is detected not only in written texts , but also in the oral traditions of illiterate societies where knowledge is past on in myths and legends over centuries (Croft 2000).

Others interpret the population view differently, i.e. a language is analogized with a species and defined as a sociolect in terms of a population of highly similar idiolects. In this context a sociolect is in perpetual mode of adaptation to fit the bio-cognitive constraints of the human individual and socio-cultural specifics of populations as components of environmental niche, or " language ecology" (Mufwene, 2014 and elsewhere).

2. Defining the environment in human evolution: brute nature and invented social reality

The human mind experiences the physical reality by sensation and by abstract concepts and this difference in experiences is registered by the mind in terms of a clear dividing line between physical objects, which exist in material form and as such have spacial and temporal dimensions, and abstract ideas devoid of material representation. That said, advanced civilization makes the dividing line between these two not always a clear-cut. Searle (1995) differentiates between reality which exists independently of human consciousness (particles, atoms), and reality which exists only by social agreement in the minds of human beings (contracts, money, laws, institutions,) in their material representation. The later is not less factual, or material, than mountains, valleys or trees, e.g. banks, i.e. financial institutions are represented by buildings, pieces of paper are material representations of the concept of money and national flags are pieces of cloth representing national identities. In this sense a distinction is made between " brute facts", i.e. ontologically objective entities, which exist independent of minds, and " institutional" facts, i.e. ideas and their material representations are recognized only by convention. This means that our experience with reality depends on the human mind, moreover, it is an expression of collective intentionality according to subjective goals, values, etc. Importantly, language adapts to both material reality, i.e. "brute facts" and to the invented reality constructed by human civilization.

3. Language, a bio-cognitive program or communicative technology

The generative/biolinguistic perspective has consistently argued for an innate body of knowledge of language i.e. a Language faculty or Universal grammar, defined as a universal set of grammatical categories and rules for computation, underlying all human languages, existing and potential, predetermined by the human genome and specific to linguistic structure. It is hypothesized as a computation mechanism, located in Broca's area. And although generative hypotheses on the details of the nature and scope of linguistic computations have changed over time, the foundational argument for a human unique innate knowledge of language is maintained. The LF is argued to have initially appeared as abstract patterns of hierarchical organization appropriate for computing conceptual hierarchies in service of silent reflection, i.e. Language of Thought (LoT). In this context, if one is looking for evolutionary explanation for the language bio-program, the generative/biolinguistic perspective points at digitalization of human thought , i.e. silent reflection as adaptive function. The so hypothesized bio-cognitive ability is said to be unprecedented evolutionary achievement marking human cognitive exceptionality.

Alternatively scholars who subscribe to the usage-based perspective who deny the existence of innate grammar-producing algorithms, nevertheless point out that the use of language

requires some specific conditions in the human organism created by participation and coordination of a multitude of general cognitive capacities used in various activities not specific to linguistic behaviour. Among these capacity for symbolic representation, socialization (the need of the company of con-specifics), capacity to form categories(things and actions are universal categories), capacity to learn/ extended memory, capacity for mind reading or theory of mind, capacity for self-monitoring or meta-cognition, a mimetic capacity as coordination of control over the flexibility of motor movements, or motor movements free from genetic predetermination, conscious and purposeful rehearsal and refinement of motor skills, voluntary recall of memories, capacity for kinematic imagination, thus, spatial and temporal displacement of representations of action patterns (Donald 1993, 1999, Deacon 1997, Tonasello 2003, 2010, Dunbar 1998, among many others). In addition, a capacity for speech, i.e. capacity for articulation and perception of discrete sounds and sound combinations, implicated in the formation of a lexicon, i.e. a list of vocal signs for representation and communication of meanings in structured combinations (Liebermann 2007 and elsewhere) Thus, a mosaic of cognitive and physiological traits distributed through the brain are coordinated in an emergent language faculty in service of communicative interactions among social creatures in service of sharing information. And sharing pertinent and detailed information about the environment in timely manner is a highly adaptive evolutionary development.

3. 1.The Language Faculty in the human body: speculations vs. biological realities

As per the biolinguistic perspective and Mandivil-Giro(2018)" Differences between languages ...are the result of change, but linguistic changes only occur in the most superficial dimension of languages..."(ibid.p. 5), i.e. those receiving the influence of external environments, e.g. communicative environments of culture and history, accommodated by the limited flexibility of parametric variability provided by the language faculty. In this sense the observable variation in language systems is attributed to variability in parametric choices, given that there is lack of correlation between innate linguistic structure, imposed by Universal Grammar(UG) and socio-cultural factors, e.g. number of speakers in a population and their age, affecting language learnability, historical developments leading to language contact, philosophical and religious beliefs, social and economic sophistication. Thus, the innate properties of language remain stable and universal and permanent, unaffected by external adaptive influences, i.e. not evolvable, given its isolation from brain-external contact. Moreover, the minimalist program postulates Merge as the computational mechanism for recursively combining pairs of abstract grammatical categories into an integrated unity with internal organization as the hallmark of the Narrow Language Faculty (FLN) (Hauser,Chomsky, Fitch 2002 and elsewhere).
    That said, it is not difficult to notice that Merge is a general attribute of nature, living and not, as examples of combining two entities to form a unity with internal organization abound, from chemical compounds, ex. H_2O, to pair bonding in animals and humans. What makes Merge usable in language processing is the availability of a lexicon organized in semantic and grammatical categories. Without access to a lexicon Merge is not usable in language processing. And if it is assumed by the biolinguitisc approach that the Narrow Language

Faculty also contains detailed specifications of grammatical categories and their admissible merging options, i.e. a very detailed highly specific bioprogram, this in itself puts into question the minimalistic aspirations of its authors and, crucially, its phylogenetic explanation.

In addition, in the generative formalism the NFL is understood from a modularity perspective (Fodor, 1983 and elsewhere) as a spatially and functionally isolated from the rest of cognition, citing selective cognitive impairments in individuals demonstrating inability to form and understand grammatically correct sentences. The argument for modular cognition, including human cognition is based on the assumption that cognitive modularity has evolutionary advantages as it allows the different modules to be " tinkered" separately, without causing perturbations in the brain as a whole.

A counter argument is supported by empirical demonstration that the human brain persistently shows no evidence of concentration of functions specific to language in any single brain area, instead there is usually many-to-many distribution of brain locations and functions. In addition studies of damaged brains show that all brain areas are neurologically interconnected and compensate and balance each other's functions when necessary (Tomasello 2008; Liebermann, 2000 and elsewhere). As a result brain damage to language-related areas of the brain do not result in compete loss of linguistic abilities , they are maintained albeit to lesser extent.

The isolationist model of the language faculty and the brain's mechanisms for language processing are idealizations, consistently contradicted by experimental studies in human neurobiology and cognition, which demonstrate interdependence of physiology, cognition and communication in the internal interconnectivity and functional integration of the human brain and its processing activities (Friedericci 2018 among various others). But perhaps most significantly for the purposes of this paper it justifies the argument that the brain, as any biological entity, is subjected to evolutionary principles and evolves as a unity in adaptation to functionality. In this context the language faculty as a language processing mechanism of neuronal assemblages, distributed throughout the brain and integrated with the rest of its functions, i.e. language processing is integrated with memory, sensation, emotion, motor functions, etc., suggesting that mechanisms for language processing and their implementation by human physiology evolve in coordination.(Liebermann 2016 among various other authors). From evolutionary perspective in biolinguistic context the appearance of Merge as a computational ability and its cognitive isolation and computational restriction to silent reflection, subsequently extended to communication, is identified as the corner stone in the evolution of human unique intelligence and the source of the human unusual power of cognitive creativity as emblematic of the species. Alternatively, the unprecedented cognitive power of sapient species is explicable with " cognitive fluidity", or " capacity to draw analogies...to adapt ideas to new contexts, and to map across different knowledge systems "(Gabora, Russon, 2011, p.336), allowing for interconnection and integration of conceptual and knowledge systems. Such novel cognitive ability is explicable by cognitive evolution from extensive modularity to integration of previously isolated cognitive modules, which made possible the use of analogy and metaphor, instrumental to modern human reasoning. In this context, it is argued that a " genetic changes involved in the fine-tuning to the bio-chemical mechanisms underlying the capacity to shift between these modes of thought" (Gabora, Russon, 2011, p.337) and in this way " tailor one's mode of thought to the demands of the current situation" (ibid. p.337)is proposed as explanation for the Paleolithic cultural

advancement. Integration of knowledge results in better understanding of regularities in nature and makes possible higher order abstractions and executive decisions. An expansion of the prefrontal cortex, the location of executive functions, in addition to expansion of memory capacity in the overall enlargement of the brain is argued to be the biological manifestation of such cognitive transformation. Thus, the unprecedented cognitive abilities of humans is attributed to a bio-cognitive transformation from cognitive specialization to cognitive fluidity and knowledge integration, effectively contradicting the biolinguistic argument for cognitive isolation of linguistic computations. In this sense Jackendoff's argument(Jackendoff 2002, Culliciver, Jackendoff 2005 and elsewhere) for a language faculty as parallel architecture of integrated meaning and form, structure and use, incorporated with the rest of the brain, offers an alternative, consistent with our current knowledge of the functioning of the brain. That said, the original argument for innate UG is maintained and even expanded, makes it equally implausible from evolutionary perspective. At the same time Pinker Bloom's argument (1990) for evolutionary explanation of a language faculty in adaptation to a pre-existing language system is consistent with evolutionary principles.

4. Language or languages, what evolves?

4.1.The uniformity argument and its challenges

The uniformitarian hypothesis has been the foundational assumption of evolutionary linguistics by both the generative/biolinguistic and usage-based perspectives. The generative formalism stipulates that linguistic structure, although superficially changing, in fact remains stable and uniform trough space and time, based on the generative argument for uniformity of the innate language capacity. The generative perspective assumes an innate capacity for syntax, and its uniformity in all members of the species, thus, even the possibility of variation, in the case of this biological entity is excluded as an option, although variation is the norm in all biological entities. The idea that the shapes of modern languages come from a language organ, identical in all members of the species, implies that all languages, real and potential, are replicas of the same original, thus, they have identical structure and, thus are of equal complexity. Similarly, Mendivil-Giro (2018) argues that the generative component is the only universal, and genetically fixed, i.e. stable and unalterable by experience, component of the language faculty, while the observable variation is understood as peripheral and cosmetic. In biolinguistic context the semantic, morphological and phonological processing mechanisms producing the lexicon are a mere appendage to the FLN, i.e. the computational mechanism , deriving the mapping of conceptual and grammatical hierarchies is at the centre of language processing. And these peripheral bio-cognitive mechanisms are subjected to glossogetic processes, explicable with influence of environmental factors, internal to the brain, e.g. developmental processes of learning the local sociolect, as well as external, e.g. social and cultural changes reflected in historical changes in the lexicons of languages. They are understood as superficial manifestations of changes in the externalization component taking place during the formation of the individual's I-language/idiolect and as such, as irrelevant to the computational mechanism (Hauser et all.2002 and elsewhere). In this context the diversity and adaptability of languages derives from the sensory-motor component of the language faculty, which transforms the hierarchical nature of linguistic computations into sequentially

arranged linguistic forms, i.e. the lexicon, while the semantic and computational components remain stable and universal. In this sense if languages are said to adapt to communicative environments, adaptation is restricted to externalization through changes in the lexicon, e.g. by reanalysis, not to the computational, i.e. Universal Grammar and semantic core i.e. Language of Thought(LOT).

" grammatical structure is largely immune to external factors (ex.of language use in communication in historical, cultural circumstances, emphasis added)(Medivil-Giro, 2018, p.9).

The usage-based /functionalist approach interprets the uniformitarian hypothesis from its own rational, i.e. if one compares the subsystems of languages differ in complexity, e.g. some languages have more complex phonology than others, or more complex syntax. To note, a complex system is one composed of multiple components which interact in coordination and form a unified whole. In linguistics more regularity in a language systems makes it less complex and the abundance of irregular patterns adds complexity. In usage-based context the uniformity principle is justified by the stipulation that higher complexity, or higher irregularity in one component is balanced out by lesser complexity, i.e. abundance of regular patterns, in another, so that an overall equal or very similar level of complexity language system as a whole is maintained. Moreover, uniform complexity is maintained despite language change as, while one component of the language system may increase in complexity, another must become simpler, so that the language system as a whole maintains equilibrium. This means that despite the observable language diversity both in space and in time, the overall complexity of languages throughout their history remains constant. That is, all extant and theoretically possible languages at all stages of their history are essentially of equal complexity and there are no simple languages.

   From usage-based/functionalist perspective the assumption of uniformity of languages is based on the assumption of uniformity of functions, i.e. languages are of equal complexity because they have the same role, to serve the communicative needs of speakers. And as all people have the same communicative needs, they require the same linguistic complexity. Heine and Kuteva subscribe to uniformitarianism in the study of glossogenesis. They argue (Heine, Kuteva, 2007) that the process of grammaticalization, or the emergence of grammar from the lexicon, attested in a large number of languages and demonstrated in written texts, can be extended to project far back into the earliest stages of language evolution. By this logic grammaticalization patterns can be thought of as general patterns of glossogenesis which have shaped language since its beginnings. That is, the process of grammaticalization attested in resent history of languages is a window into language origins.

   Many challenge the argument for equal complexity and lately various scholars have presented convincing evidence to the contrary. The expectation for internal compensation in complexity is not supported by studies in historical phonology, which failed to find compensation in complexity of phonological systems and instead demonstrate that "...languages vary quite considerably in their phonological complexity...Similar variability and absence of compensatory patterning was also found... in comparing phonological and morphosyntactic elaboration." (Maddieson, 2005. p. 267). In addition, Piraha (Everett, 2005) fails to display the characteristics which are thought to be the very hallmarks of the human language, e.g. it lacks NP and S embedding, it has the simplest pronoun system, lacks linguistic

means for talking about the past and the future, e.g. no counterfactual expressions, e.g. *if...then,* verbs *wish, imagine, etc.* and no verbs for mental processes, e.g. *think, believe, hope*, which in European languages invite clause subordination (I think, imagine , that ...). This, on the one hand, suggests that Piraha and other languages with similar properties(Hallpike 2018), despite violating the uniformity principle, are fully functional languages, equally capable of encoding infinite human thoughts in finite linguistic forms. From a different angle, the fact that Piraha speakers are in no way cognitively deficient and like all humans entertain complex thoughts, although using linguistic vehicles very different from speakers of European languages, suggesting, among other things, the cognitive dissociation of language and thought. For detailed discussion on this topic see Joseph, Newmeyer(2012), Hallpike(2018). In short, the more our knowledge of language diversity improves, the less credible the uniformitarian principle becomes.

4.2. On languages and functionality

From functionalist perspective language changes as a consequence of change in function. The function of language is usually defined as communication of meaning. That said, various aspects of grammar in languages have no informative value. An example of grammatical forms with no informative value is the category of grammatical gender assigned to nouns for inanimate objects e.g. in many European languages the noun for SUN is classified as masculine gender and the noun for MOON is feminine gender is worthless as a source of information about the real world. McWorther (2001) points out that Kikongo, a language spoken in Africa, has various grammatical markers for past tenses encoding various meanings of pastness which are superfluous, i.e., make the linguistic coding of pastness unnecessarily overly detailed without adding any meaningful semantic value. In this context a language systems is viewed as a collection of individual linguistic forms which function and evolve independently. And if within the usage-based approach one espouses a population perspective, the conventionalization of some counter-adaptive linguistic forms is to be expected. Newmeyer (2001) calls this approach Atomistic functionalism. Givon (1979), Haiman (1983) are some of the functionalists subscribing to atomistic functionalism. As an alternative holistic functionalism sees this relation as indirect , given that many linguistic forms are not only lacking any discernible function, but, in many cases their presence is detrimental to the efficient transmission of information, e.g. double marking of negation in many languages. A possible explanation points at system-internal factors, e.g. assuring the stability of the system by extending and broadening the scope of a rule to bringing generalization. As per Newmeyer (2001, 4.2.)" No rule or constraint has a functional motivation in and of itself, but rather only within the total system in which it occurs. " i.e. the language system as a whole changes and adapts. In addition, extending generalization reduces complexity and can be interpreted as adaptation to learnability.

   From a different by related viewpoint linguistic conventions and their reliability established and perpetuated in a community is ultimately a functional motivation of stability and reliability of social norms and their perpetuation and preservation as signals of group identity. As pointed out by Newmeyer(ibid.) some linguistic forms are propagated and standardized in a community not because of its functional utility in communication of information , but for sociolinguistic reasons, e.g. it is used by individuals with higher social standing which lower

classes tend to imitate.

That said, some linguistic forms are consistently more closely associated with a specific function. For example, in all languages the informative function is usually carried by lexical words, while group identity function is carried by grammar. We know that the same information can be encoded both by excessively complex grammars with abundant irregular forms and complex morphology , e.g., the grammars of Latin, Russian, German, etc. as well as with fewer irregularities , e.g. in Turkish, suggesting that the function of grammar is less about what information is encoded, but how it is presented.

From the perspective of language origins it is logical to suppose that the function of effective information sharing would be the primary function at the initial stages of language, given its relevance to physical survival and grammatical complexity as a marker of tribal identity can be adaptive in later stages of social organization.

Contrary to these expectations Redhead, Dunbar's experimental study (2013) which tested the innate memory predispositions of language users, finds that stories with "social contents are remembered better than factual, ecologically related content ", suggesting that **a**. interest in social content is a natural reaction of the human mind and thus, the social function of language is firmly engraved in the human mind, and consequently, **b**. socialization is the original function of language.

4. 3. Speculations on the phylogenesis of the Language Faculty(LF) as adaptation to an original function of silent reflection

The generative/biolinguistic perspective is traditionally anti-adaptationist based on Chomsky's statement that the Language Faculty is not a regular biological entity and as such it could not have evolved by standard evolutionary processes,which furnishes the argument for self-organization event as the answer to the unusual characteristics of the bio-computations for grammar. The argument is consistent with Gould and Lewontin (1979) anti- adaptationist stipulation that some aspects of the organism may have appeared as a side effect of selection for some other, unknown and possibly unknowable, traits , i.e. the organism possesses traits which are not selected for, or spandrels in analogy to spandrels in buildings. As it happens a spandrel in buildings and in biological bodies is initially functionless.

The hypothesis has not been taken seriously by most evolutionary biologists as the likelihood that a cognitive entity with such specific characteristics could have appeared by chance is highly unlikely. In subsequent publications Gould and Vrba, (1982) have introduced adaptationist angle by enriching the anti-adaptationist argument with the concept of exaptation, a special case of adaptation , hypothesizing that under certain circumstances a biological spandrel could eventually acquire a function by undergoing a process of exaptation, i.e. slight adjustments as adaptation for a function. Another option is for a biological entity to acquire an additional function, different from the original one as nature looks for shortcuts by recycling what is already available in its attempt to respond to rapid environmental challenges. The exaptationist argument is entertained by various scholars proposing alternative possibilities, e.g. phrase structure in syntax is believed to be a cognitive exaptation of the thematic role structure in protolanguage (agent, theme, goal,etc.)(Bickerton, Calvin 2000), exaptation from the so called social calculus (conceptualization of interpersonal relations)(Dunbar (1998, 2009), exaptation from phonology, e.g. phrase structure , the distinction between Noun Phrase

and Verb Phrase is believed to be an exaptation of syllable structure(Carstairs-McCarthy, 1999), others speculate that include the original function of the language organ may have been spacial orientation, i.e.the capacity for tracking is argued to have been put to use in forming linguistic structure.

Most attention, including in latest publications has received the argument hypothesizing the origin of LF as LoT for the function of providing internal organization of human reasoning with further evolutionary advancement of its close association with the computational component, a milestone in human speciation, while regarding its use in communication as a subsequent adaptation by coordinating its cognitive machinery with human physiology, resulting in its use in communication. In this sense, as most recently articulated by Reboul (2015) the LoT, defining the cognitive uniqueness of its bearers, is said to have created the demand for communicative sophistication resulting in the evolution of spoken language.

That said, the direct causality between cognitive sophistication and the need for its communicative materialization is not clear, i.e. it is not clear why the internal communication among neurons in a spatially and computationally isolated cognitive module(Fodor, 1975, Fodor Pylyshin 2015) creates the demand for its use for sharing this communicative sophistication with other minds. So, it is simply stated without justification that " cognitively sophisticated species needs appropriately sophisticated system of communication" (Reboul 2015, p.10), without explanation of why such need would arise. It is not unreasonable to imagine a species of highly intelligent loners using cognitive power for successful survival. To note, since for the generative/biolinguistic paradigm language is defined in terms of computation, it is pertinent to remind that the first computers were invented as thinking machines, i.e. individual problem solvers. Moreover, although the human conceptual system is repeatedly stated to be unique in its hierarchically organized syntax, in contrast to primate minds, such stipulations are unwarranted as we don't have access to the minds of today's primates and can only speculate about the internal organization of their thoughts. In this sense comparing (on the basis of such speculation) the conceptual systems of primates, i.e. species only remotely related to us, with the conceptual systems of humans in today's industrialized societies, formed by exposure to literacy and education as standard bearers for human cognitive superiority, is missing the point. More informative is the comparison with Neanderthals, based on indirect evidence, suggesting complex thoughts, comparable to humans', and even language. In this sense, the conceptual systems of humans living in small hunter-gatherer communities today, with lifestyle largely unaffected by modern civilization, is a much better source of information about our innate cognitive abilities.

Equally puzzling is the statement that " thoughts and sentences share the same structural organization"(Reboul, ibid. p.10), and "That thoughts and sentences match so nicely is part of why you can say what you think and vice versa"(Fodor, Pylyshin 2015, p.89), given that difficulties in verbalizing one's thoughts is everyone's everyday experience. These statements are challenged by multiple findings demonstrating dissociation of language and thought , e.g. "Language is sketchy, thought is rich" (Gleitman L., Papafragou A. (2013). Spatial and functional dissociation of processing of language and thought is demonstrated by Fedorenko,Varley (2016).

4.4. Language diversification as adaptation

It is obvious that there are signature characteristics of language, or language universals, e.g. encoding human semiosis in a lexicon and articulating in multilevel hierarchical organization human thought via combinations of discrete sounds, i.e. speech, which makes it distinct from animal communication. And as languages are subjected to universal processes of change, e.g. grammaticalization, and iterated learning, in addition to the universal bio-cognitive constraints of the human body and mind, one would expect that all languages would converge over time on a common universal architecture. And yet, there are about 7,000 extant languages, thus, language diversity is another universal property of language, without parallel in animal communication. As per Lupyan, Dale(2016) this is explicable in part with the fact that languages are used in different environments which affects the language systems in all aspects, i.e. phonetics/phonology, vocabulary, grammar. In this sense the logical explanation for the persistent language diversity is that languages adapt to their respective environments of language use which reflect geographical, social, cultural diversity of populations. Significantly, although diversification of languages as adaptation to environments is most often attributed to cultural evolution, a participation of body-internal factors, e.g. genetic contribution in the perception and production of lexical tone is argued, implicating a number of gene groupings affecting brain development which confer precision in vocal agility and refined perception of pitch(Dediu, Ladd, 2007).

5. Language adapts to multiple environments

To reiterate, from the still prominent bio-linguistic perspective the language algorithm is deemed fixated in the genome since the beginning of humanity and, thus, immune from influences , external to the language processor both within the human organism and beyond. Such factors are at best understood as influencing language periphery, e.g. the communicative use of the innate UG mainly by influencing morphology and phonology. Thus, the environment is irrelevant to the functioning of the language processor.

   The usage-based/functionalist perspective, in fundamental disagreements with the innatist approach, attribute a major role to human cognition and its flexibility in accounting for language variation and change, while recognizing the influence of social factors(Tomasello 2005 and elsewhere). A more complex and multidimensional approach is articulated by Mufwene (2014) who adopts the niche construction perspective and argues that languages function and evolve within the constraints of the individual's human body, brain and mind, as a language processor and its interaction with other minds. In addition, languages are formed and altered within a highly complex and multifaceted ecology of socio-economic, cultural and historic contexts.

5.1. Adaptation to physical reality: climate and biota influence human bodies and their linguistic abilities

5.1.1. Language adaptation to a bio-environmental niche : whistled languages, adaptation to demands for remote messaging in dense vegetation

It is well known that local environmental conditions affect the human body, e.g. differences to

sun exposure explains differences in skin pigmentation in different parts of the globe and populations living in high altitudes have adapted to the reduced access to oxygen. And because the human body as a whole is a language processor, it is natural to expect that some bio-physiological adaptations to climate and local ecology would influence language processing and human communicative strategies. Meyer (2021) finds that local landscapes, e.g. topography and vegetation, influence sound dispersion. For example dense vegetation in mountainous regions absorbs sounds. This reduces the effectiveness of linguistic communication especially in small communities populating remote locations, for whom communication is usually at large distances. Shouting of linguistic messages has proven ineffective as it rapidly exhausts the vocal cords. This combination of geography and biota, experienced by diverse communities and various locations, e.g. Mexico, African regions, Papua New Guinea have triggered adaptive strategies by developing whistling practices. In whistled languages speech is replaced, or translated, into whistled melodies with no consonant/vowel differentiation and, thus, no syllables, where the acoustic signal is formed by the airstream passing freely though the oral cavity, shaped only by the lips. And although the whistled messages are simplifications of spoken utterances, the intended meanings are effectively transmitted. In addition, the physiological energy demand is reduced by focusing on the energy from the lungs and controlling the vibration of the vocal folds and the speech fundamental frequency. But perhaps most significantly, whistled speech can be effectively transmitted at distances 10 times longer than by shouting, thanks to exploiting a narrow frequency range of 1-3kHz, which makes this bio-acoustic strategy highly effective in communication at a distance, often crucial in open spaces at remote locations as it successfully compensates for the distortions of the vocal signal imposed by the natural obstacles. The whistled signal retains its effectiveness also in atmospheric disturbances, e.g. wind, fog, rain. Whistled speech displays universal properties observed in a wide range of unrelated languages.

5.1.2. Dry climate and the phonology of tonal languages

Climatic variation is a well known factor in species' diversity, including diversity in communicative strategies as species in local habitats adapt their communicative signals for maximum effect. Climatic fluctuations are argued to be a significant factor in human evolution and the evolution of human linguistic abilities as a signature trait of human speciation. And climate continues to be an adaptive force in human linguistic abilities to the present. Recent attention to the role of climate and climate change on the human bodies and activities has uncovered that adaptation of human body to local climatic conditions produces adaptive variation in populations' communicative strategies and preferences. Everett C. et all. (2016) have found that temperature and air humidity levels affect human respiration and influence the anatomy of the nasal cavity, e.g. adaptation to colder and drier climates triggers anatomical adaptations aimed to humidify the inhaled air. Moreover, dry air is a challenge for respiration and reduces the flexibility of the vocal folds, reducing their effectiveness in sound production, which prompts populations to avoid complex tonality and in some cases alter the place of articulation of some consonants. An example is the preference for alveolar to velar voiced plosives in search for ease of pronunciation, which alters the configuration of the phonological system and reverberates throughout the language system as a whole by affecting the phonological contrast marking the semantic distinction of linguistic forms. In addition, climate

is argued to influence also semiosis and its encoding in linguistic semantics by naming aspects of the natural environment with survival significance, e.g extended vocabulary of temperature distinctions, local flora and fauna, weather patterns etc. In sum, climate and its periodical changes affect biological bodies and their abilities to communicate. And because human bodies and minds are also language processors, climate influences indirectly language which must adapt to biological changes to maintain efficiency of processing and learnability and ultimately its survival.

5.2. Language adapts to the human mind and body

5.2.1. Language adapts to the brain as a processor

From a usage-based/ functionalist perspective language is defined as a collection of constructions (as defined in Construction grammar), which determine " the language genotype"(Christiansen Chater 2008 and elsewhere). And for students of language change espousing a Modern Synthesis perspective an individual construction, as analogue to a gene, will be copied by other brains and disseminated depending on its " fitness" to the learning and processing demands of the brain, which act as selective pressures. In this context the linguistic rules and categories are determined to be functionally motivated, countering the biolinguistic argument for innate UG, immune to external influences from their implementation. For example, the binding constraints on reflexive pronouns, advocated by the generative approach as a poster child for the arbitrary nature of grammatical rules, are viewed under the functionalist approach as motivated by a general tendency in brain functions to resolve ambiguities as early as possible. For example in the English sentence *" Molly hurt herself"* the reflexive pronoun *"herself"* is co-referent of Molly which indicates that the referent of *" herself"* is the same as *Molly.* The repeated placement of the head of a phrase, either to the left or the right of the complement is consistent with the tendency to identify and remember elements occurring as ordered sequences. Attention to sequential patterns is a general tendency in human cognition, demonstrated in other types of cognitive activities. Another such constraint concerns memory limitations which places limits to the length of a sentence and restricts phrasal and clausal embedding. In short, language must adapt to the human brain and its processing routines.
    Moreover, conceptual complexity is universal property of the human mind and one of the most distinctive traits of the human species. And language is identified as the main vehicle for encoding and advertising private thoughts to conspecifics. In this sense the conceptual repository shared by language becomes property of the community. The conceptual repertoire of a community is also indicative of cultural complexity and sophistication and ultimately, of the complexity of human civilizations. In this sense language must adapt to capturing the wealth of the conceptual inventory in forms most suitable for its fast and accurate sharing. In Schoenemann (1999, 2005) this adaptation is accomplished by the formation of complex grammar i.e. language structure emerges to reflect the memory limitations of the human brain. In addition, it is argued that the structured nature of language reflects the structured nature of extralinguistic reality which is reflected in the structured cognitive representation of it by the human mind.

" ….Given that the world is hierarchically organized (or at the very least that we have evolved to conceptualize the world hierarchically) should we not expect the syntax of our languages to reflect this?"(Schoeneman 1999, p.330,)

Thus, the hierarchical structure of sentences is a direct reflection of the way conceptual structure is organized and phrase structures are groupings based on meaning relations. In this sense, what is represented in the human mind are semantic structures, derivative from the universal cognitive capacity of humans to conceptualize reality in complex ways and the emergence of hierarchical organization is understood as adaptation in coping with semantic complexity. And increase of semantic complexity in the form of increase in the number of words in the lexicon, which overloads the memory, leads naturally to the emergence of hierarchical structure in grammar as a solution to the overload which conceptual complexity creates for language processing.

5.2.2. Adaptation to language learning

The function of informing by socialization requires periodical adaptation to the ever changing social dynamics in populations. And to maintain effective this function language must be learnable, which means that it must adapt to fit the learning constraints of youngsters.
This is captured by the Iterated Learning framework, which points at the crucial role of ontogeny in the formation of compositional language, understood as a continuous process of regularization and structure formation as adaptation of the language system to become easily learnable(Smith, Kirby, Brighton, 2003 and elsewhere). The hypothesis is empirically demonstrated with language games where from initially amorphous flow of speech, segmentation and emergence of lexical categories e.g. NP (Noun Phrase), VP (Verb Phrase) , etc. and grammatical categories, e.g. tense, aspect, etc. occurs from interaction of artificial agents, designed to closely resemble human minds and behaviours. The emergence of compositionality is understood here as a solution to bottlenecks, formed when a large volume of traffic attempts to go through a narrow passage causing blockage or delay in the flow, which results in reorganization in the flow. In the context of language learning a bottleneck is defined as the inability of the mind of the agent to absorb the wealth of samples of natural language to which it is exposed during the language acquisition period. Similarly, observations of children during early language development show that language learning starts with holistic utterances which gradually become parsed into smaller combinable units. (Tomasello in Givon 2002, p. 310-). Thus, emergence of compositionality and regularization in the language system is adaptation to the learning constraints of the young developing brains. In addition, languages must adapt to the learning constraints of adult 2nd language learners.

5.2.3. Language adapts to the human anatomy and physiology

Moreover, language also must fit the constraints of the human anatomy and physiology and its articulatory capacities. Davis and MacNeiladge (2004) and MacNeiladge (1998) who has authored the frame-content hypothesis of speech evolution which argues that lip smacking gestures in primates were co-opted for the formation of the syllable and its most basic structure

as CV. In addition, there is a claim by Ralph-Axel Muller (1996) that the syllable is an instance of a " general motor alphabet", a unit of body motion of opening and closing the mouth of which language takes advantage and incorporates in the formation of syllable structure as CV. Muller also suggests that this "general motor alphabet " (not specific for any group of muscles and comparable across species) , when applied to the human vocal tract, yields the set of phonemes found in human languages." (Muller, ibid.). Moreover, vowels are hypothesized to have originated from neonate "comfort noises" that trace the syllable back to "rhythmic jaw oscillation analogous to rhythmic movements in the extremities." (Muller ibid.).
In a similar vein Oller, Griebel (2021) attribute a crucial role to the vocal dexterity and functional flexibility of the human vocal organs, unparalleled among the Homo branch, allowing the use of vocal signs and emergent early in infant development. In short, speech is shaped to fit human anatomy and physiology.

   Moreover, the formation of sign languages is adaptation of language to the human condition of deafness by using the manual-visual modality as alternative material representation of language. Sign languages display all the distinctive attributes of human language, e.g. compositionality, systematicity, recursivity. That said, sign languages have some unique structural characteristics, imposed by the manual modality, i.e. the grammar of sign languages is different from spoken grammars, demonstrating, among other things, the influence of modality on the language system. For example, it is widely agreed that sign languages display a much broader use of iconicity in lexicon by signalling the visual resemblance of sign and referent, while the pervasive use of symbols is facilitated by the discreteness of speech in spoken languages(Lillo-Martin, Gajewski 2014 for examples). Iconic relations are also demonstrated in grammar, e.g. in American Sign Language(ASL) pronominal anaphora is represented manually by a pointing gesture to signal the association of antecedent and pronoun. In addition, the argument structure of a verb is represented by enacting the spatial-temporal association among the participants of a scene, i.e. the visual modality makes effective use of tridimensional space in encoding abstract relations. In addition, in sign languages verb inflection for agreement, tense, aspect and these grammatical functions are marked by navigating the space around the body and the position of the hands within it. For example, verbs form plural by repeated hand from side to side, habitual aspect is marked by repeatedly enacting the verb meaning(Fischer , van der Hulst 2012, Kimmelman 2022). In sign languages classifiers, i.e. linguistic forms attached to nouns to signal differences in referents, which influence their associations with other linguistic forms, e.g. countable nouns are combined with numerals, are represented iconically by hand shapes to signal the spatial attributes of an object and their associations are represented by gesturing in space. In short, the manual-visual channel allows sign languages to use iconicity effectively in encoding semantic and grammatical information. Linguistic functions, semantic and grammatical, are articulated with hand movements in coordination with hand and body and face movements. Non-manual movements e.g. head and brow movements represent yes/no questions, topicalization, etc. in some sign languages(Lillo-Martin, Gajewski 2014) as alternative to prosody and intonation in representing some grammatical forms in spoken language. In short, language is shaped by building upon and incorporating the fundamentals of human biology and physiology, adapted for the specific needs of linguistic communication.

5.3. Languages adapt to socio-cultural environments

5.3.1. Adaptation to social structure

Studies of history of human societies have revealed correlation between the type of social organization and the organization of language systems. Croft (2003) suggests that throughout human history social organization has influenced language. 4 types of social organizations are identified as follows:

a. Band: A band is a closed community of about 25 genetically related members, i.e. an extended family, with nomadic lifestyle (no fixed territory) which is why in case of conflict bands do not fight, but disperse. A band's social hierarchy is based on age (leaders are elders) . It is economically and politically an egalitarian society, i.e. no division of labour, no permanent leadership, and no class differences. Economy is based on hunting and gathering. Band communities have limited knowledge of the environment and thus, little new information to communicate. Givon's hypothetical " society of intimates" bares resemblance to Croft's concept of band, the the socio-economic conditions of which are said to have fostered the initial stages of language formation, e.g. small vocabulary, limited grammar which functions in a monolingual society. Band dispersion results in language divergence and formation of new languages as a result of isolation.

b. tribe. A tribe has larger population size, in the hundreds and even thousands, comparable to the size of a today's village, with a relatively sedentary lifestyle as they occupy a fixed territory. The population is divided into clans based on family ties. Tribes are egalitarian societies: no division of labour and no class divisions although there is internal competition for leadership. The economy is based on domestication of animals and plants. Competition of territory often results in conflicts with neighbours. Knowledge of the environment is broadened, reflected in some increase in vocabulary size and some grammatical complexity by introducing new grammatical categories, although their use is optional .Communication is exclusively by direct face-to-face dialogue, where the linguistic message is coordinated and complemented with extralinguistic body signs, e.g. head shake, body posture, gesticulations, etc.

c. chiefdom. Chiefdoms represent a major change in social organization. The population numbers reach multiple thousands with emergent social stratification. Permanent leadership and a ruling elite emerges based on biological inheritance and as a result class division of rulers and ruled is formed where a ruling elite emerges based on biological inheritance vs. the rest of population producing goods. Emergence of trades, builders, fishermen, dressmakers, etc. introduces division of labour. The population occupies and defends a permanent territory, divided in villages with the chief's village having a special role as a centre of power, thus there is stratification of territory. Sophisticated social structure brings rich social relations, reflected in language as increase in vocabulary, social stratification and division of labour results in the formation of registers and registerial diversity, increased number of speakers leads to increased regularization in the language system. This implies increased role of grammar and fully modern languages and, in some cases, the formation of writing systems. Language is enriched with perlocutionary acts as its sphere of use is extended in literature, poetry, theatre.

d. states. States have large populations of hundreds of thousands occupying vast territories. The social organization is based on territorial integrity and class membership with multiple sources of power. Class and territorial division brings sociolinguistic variation. This triggers the establishment of standard dialect on which government documents are written. States have the

ability to conquer new territories and populations, thus creating multiethnic and multilingual societies. The development of trade brings long-distance travel and development of trade pidgins, migration brings multilinguism and the formation of lingua francas.

Importantly, a persistent correlation suggesting causal connection has been demonstrated between social organization and linguistic structure(Hirford 2012) e.g. languages spoken by small isolated communities tend to develop complex morphologies and simple syntax, while shared assumptions about the details of a communicative situation in direct communication explains simplified deictic systems. The lexicons and grammars of small communities are also less transparent, e.g. they contain more irregular forms relying on the fact that social norms, one type of which are linguistic norms, are easily enforceable in a small closed group. In contrast, languages spoken in large communities, open to migration, develop simpler morphology and complex syntax, transparency of word formation. Regularization and simplification is the answer to the learnability demands of newcomers who are adult second-language speakers. And although every pattern has exceptions, e.g. Russian, which is spoken by a large population of multiple ethnicities, dominated by the Russian and later by the Soviet empire, has shown little simplification over centuries in its highly complex case system, replete with irregular patterns, the general tendency for language simplification in populations with large numbers of adult second language learners remains valid.

From a slightly different perspective, the formation of multiple Englishes is adaptation to abolishment of colonialism and formation of new nations in search of establishing national identity.

Importantly, a correlation between community size (small vs. large) and social organization , which determines the nature and frequency of social interactions (dense vs. loose), is argued by Trudgill(2009). Predictably, lack of language contact in circumstances of territorial isolation coincides with increased grammatical redundancy and irregularity, i.e. increase in complexity. In contrast, extensive and prolonged language contact in large communities open to migration coincides with simpler morphology, complex syntax, transparency of word formation as languages must adapt to the needs of newcomers who are second-language speakers. At the same time sporadic language contact in circumstances created in some occasions by trade , in others by colonization, where speakers of mutually unintelligible languages are forced to communicate, an extremely simplified form of language, a pidgin, is formed as a mixture of two or more pre-existing complex languages by stripping these of the majority of their grammatical irregularities to the bare minimum . Pidgins cover only the most essential of the overall communicative needs of the speakers, who, in addition to the pidgin also communicate in their native languages. In short, in different historical circumstances different types of language contact produces different language systems.

To sum up, language structure is influenced by the communities who use it. The social organization in them determines the nature of interpersonal relations and interactions. And because in human groups members are language speakers, their economic , political, social relations are reflected in the organization of language. In addition, evolution of social structure is found to parallel the evolution of language.

5.3.2. Adaptation of language to cultural idiosyncrasies

Most scholars consider culture irrelevant to the organization of linguistic systems as

representation of the universal properties of human cognition. That said, the use of taboos and honorifics and their grammatical representation, are a clear example of the influence of cultural idiosyncrasies on the language systems. Many languages have honorific forms, e.g. English has aristocratic and royal titles His Royal Highness(HRS), Your Majesty, titles of academic excellence e.g. Professor, Doctor, to name just a few, Romance and Slavic languages have specific forms for addressing a person of respect in 2nd person singular as part of the language system. Some languages also have humilifics, linguistic forms conveying humility, humbleness (Brown 2020). A well know example of influence of culture on language is a case study by D. Everett of Piraha, a language spoken by a small tribe in Brazil, has demonstrated the influence of culture on linguistic structure. For example Piraha speakers avoid talking about knowledge of experience beyond immediate past.

" Grammar and other ways of living are restricted to immediate experience, (where experience is immediate in Piraha if it has been seen or recounted by a person alive at the tale of telling)" (Everett, 2005. p. 622).

Piraha culture have no myths or folktales about their history which is reflected in the lack of past tense or any other grammatical devices for marking past events . Moreover, Piraha language lacks numerals and grammatical number or other ways of encoding quantification which correlates with the lack of concepts for precision and counting. Quantity is indicated by gesturing the distance between the hand and the ground. Piraha is also the only language known to science without colour terms. It has the smallest inventory of pronouns and the simplest kinship system. Interestingly, Piraha lexicon has no words for individual fingers and refers to fingers as " hand sticks". Pirahas often point not with the fingers but with the jaw, lip, or motion of the head. There is no word for ' last'. In short, language systems are sensitive to the cultural values of the communities.

   At the same time correlations between linguistic properties and the historical and cultural environments does not imply causation and its relevance as a significant factor in shaping languages is received with skepticism(Ladd, Roberts, Dedui, 2015, Mendivil-Giro, 2018).And when such factors are acknowledged individual factors are considered in isolation, e.g. the number of speakers, presence/absence of language contact, etc. Nevertheless changes in general, and in languages in particular, are usually multifactorial as a constellation of factors of various strength, e.g. type of governance, availability of writing system and population levels of literacy, etc. conspire and influence change to different degrees in different historical and cultural circumstances. For example, language contact can influence different languages differently, depending on the particular historical and cultural circumstances of communities in contact e.g. the Norman invasion of Britain has influenced English language differently from the influence of English language on the formation of pidgins during colonization, and ignoring such differences will inevitably deliver dubious conclusions. Instead, a combination of multiple factors, specific to a language or a group of languages in a historical and cultural environment would avoid swiping generalizations while ignoring details. In this sense better understanding of history and social dynamics of individual communities would be more illuminating than statistics and mathematics, proposed by Ladd et all. (2015)

5.3.4. Adaptation of languages to writing

Out of the 7,000 extant languages today the vast majority are used by small communities by speech and sign. As per www.worldswritingsystems.org only 293 of these have writing systems. The invention of writing as a communicative technology is a significant cultural development, which has triggered a significant transformation in the language system to the written medium given the crucial change in its use as a communicative tool, suggesting that writing constitutes a cultural niche in which language systems function. The invention of writing made possible the compact and efficient encoding of highly detailed information which contributed to a crucial social and cultural transformation by making possible unprecedented access to information and accumulation of knowledge and experience over generations, making possible the development of science, technology, literature, i.e. the foundations of complex civilizations. For example, loosely structured short sentences, composed mostly of lexical words and organized by principles of semantic compatibility and interpreted with liberal reliance on extralinguistic context in face-to-face dialogues. These are the hallmarks of language systems made explicit in conversations among people with close social ties who share lifestyle, world view, cultural practices in a " society of intimates" in pre-literate societies, organized in bands and tribes . The emergence of writing facilitated a transformation into a language system, marked by meticulously structured by phrasal and sentential embedding and highly abstract grammatical categories and interpreted with minimum reliance on extralinguistic contexts, usually used in monologues addressed to people with diverse ethnic and social backgrounds, separated by place and time in a " society of strangers" (Givon 1979, 2002). In sum, the innate potential for language is used differently by different communities dependent on the number of speakers and the nature and extent of their interactions and communicative goals.

   Importantly, language assumes different functions at different points of history. At initial stages of origin isolated small communities organized in bands are most likely to use loosely structured proto(languages) primarily for fast and efficient information sharing, essential for their survival in pre-civilization environments. And although it is natural to suppose that socialization would be the primary use of language in these circumstances, social interaction among closely related people is usually by direct body contact, e.g. hugs, hand-shakes and other non-verbal signs , e.g. smiles, gesticulations etc. and communal display of belonging is demonstrated by cultural traditions of chanting, singing, dance. In larger groups, where socialization by direct contact is a challenge, while information remains the first and fundamental, language assumes an additional function of socialization, e.g. by verbalizing emotions, attitudes, cultural values, etc., thus assuming the role of extralinguistic signals. The formation of tribal social organization and especially of large well-organized societies, looking for identity and self-determination, the functions of language are amplified by additional function as a symbol of communal identity, e.g. in post colonization era the former colonies of the British empire developed multiple Englishes and former Spanish colonies developed multiple Spanishes by adding unique linguistic details in both vocabulary and grammar. In short, as language has assumed ever increasing role in communal life, its functions have increased during human history.

5.3.5. Adaptation of written language to information technology and communication in real time : social media and language

Written texts and spoken conversations have very different functions in human communication, reflected by significant differences in internal organization. Semantically written texts are organized as codes, i.e. a linguistic form has a single meaning identifiable by a single form to facilitate communication at a spatial and temporal distance divorced from immediate pragmatic context. The grammar of written discourse is highly detailed, elaborate, following strict conventions of grammaticality with the use of highly abstract grammatical categories and multiple embedding of phrases and sentences. In contrast meanings of spoken language forms are vague and open to interpretation within a communicative and extralinguistic contexts with the contribution of extralinguistic information, e.g. body signalling, facial expressions, pointing, and spoken utterances within the time limitations of a dialogue reduce the use of constructions to those with clear contribution to meaning while intonation assumes grammatical functions, e.g. in questions and imperatives. Moreover, texts and direct conversations are processed differently. For example individual words are perceived and processed in written texts as discrete combinable units, separated by punctuation marks and spatial boundaries, while and in spoken dialogues in they are perceived and processed as indivisible stream of sounds, separated by a pause.

   The invention and proliferation of the internet made possible long distance dialogue in real time. Its use in social interaction has emerged as another cultural niche and triggered adaptation of the conventions of written language to the demands of long distance dialogue in real time. And the use of writing as a substitute to direct in-person dialogues has triggered adaptation in language to the novel conditions of use imposed by the latest advances in information technology. Language has responded by altering some conventions of writing to fit the new demand for immediacy and speed of streaming dialogues and introducing new conventions as compensation for the deficiencies of written language resources in expressing pragmatic and emotional details of direct communication. For example acronyms , e.g. LOL(laugh out loud), ASAP(as soon as possible), aka(as known as), BFF(best friend forever) and emojis, i.e. digital pictograms are introduced for a wide range of messages, e.g. human emotions, objects, activities etc. usually embedded within a linguistic message as substitutes of linguistic forms, intended to increase communicative effectiveness. These ingenious solutions to the communicative and processing demands imposed by the new medium are consistent with the Zipf's law(Zipf 19949) of communicative efficiency by applying the least effort for maximum outcome. In sum, written language conventions designed for encoding and proliferating rational thought at a distance are creatively adapted for a new function of a vehicle for spontaneous long distance communicative interactions as effective replacement for direct face-to-face dialogues. See Lupyan, Dale (2016) for discussion.

5.3.6. Whistled languages are adaptations to a socio-cultural niche of rural communities

Natural environments influence the cultural choices of communities, e.g. clothing, cuisine, calendars are designed around patterns of seasonal changes in nature, i.e. cultures are influenced by natural events and processes. The whistled languages discussed above are one such example as they are formed in particular socio-cultural circumstances, e.g. in pastoral lifestyle by shepherds and tea harvesters who spend long periods in isolation from their families in which case whistled languages help maintain communal relations and transmit

weather information, ask for help etc. Thus, whistled languages are also adaptations to a particular socio-cultural niche, a lifestyle born and maintained in specific natural and historical circumstances.

Summary and conclusions

Language is as much a bio-cognitive as it is a socio-cultural phenomenon. It is both a bio-cognitive property of the human mind and a communicative technology with the primary function of communication, both brain-internal interconnections among neuronal networks, and interpersonal information exchanges.

   The evolution of language is a process of adaptation to multiple environments, both internal to the individual's processing and learning mechanisms, and external, i.e. socio-cultural influences of populations. Thus it must adapt to both the human mind and its processing demands and the socio-cultural climate.

   During the multiple millennia since its origination language co-evolved with its environment, both internal and external . It has adapted to fit the human body and mind for efficient learning and processing, and in the process has also altered the human organism to fit language-relevant functions. Language has also evolved in response to the external environment by diversification to fit the specific communicative circumstances of communities in a process of mutual adaptation as historical, cultural, economic and technological environments change.

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