SEARCHING FOR THE ORIGIN OF (PROTO)LANGUAGE: TRACING THE ORIGINS OF THE LEXICON

Svetlana T. Davidova

Abstract

Resent interest in understanding the evolution of language has delivered remarkable debt and detail of knowledge , empirical and theoretical. Significant advances are made in understanding the processes by which modern language has evolved from earlier and simpler communication systems, i.e protolanguage, or pre-language, defined by the predominant use of content words in their bare forms and labeled as grammarless.
That said, very little is known of the evolution from the communicative grunts of primates to the the first lexicon as a prerequisite for lexical protolanguage. It is fair to say that this period of the evolution of language has attracted much less interest, given the lack of factual support which in the past has driven scholars to resort to conjectures and speculations as a substitute.
The goal of the present article is to minimize this gap by making the best use of known findings and offering alternative analyses of these. Consistent with the windows approach in evolutionary linguistics the article argues that knowledge of the past, lost forever, can be inferred from the present.In addition, traces from the remote past can be found in phenomena observable today, from which valuable insights into language origins and the nature of the first linguistic signs are extrapolated.
The article identifies the formation of the lexical word as a turning point , marking the beginning of language. Modern technology , e.g. AI involving artificial agents can be of help by imitating as close as possible the communicative interactions which lead to the beginning of language.
The origin of language is here understood in terms of an invention accomplished with pre-existing bio-cognitive properties without a language faculty.
And although bits and pieces of available knowledge considered individually have limited contributions to the issue at hand, taken collectively they add clarity in the search for language origins, reaffirming the advantages of multidisciplinary cooperation of theoretical paradigms and methodology.

Keywords: language origins, protolanguage, self-organization, signs, iconicity, language faculty, semasiographic systems

1. Introduction

The origins of language mark a distinct stage in evolution of life forms prompted by the desire or need to consciously and voluntarily share thoughts and experiences.
Because scholars differ on their definitions of language, so do their visions on language beginnings.

1. 1.What is language which has originated

Language is a heterogeneous phenomenon which makes it very difficult to define and study. In the words of N. Elllis " ...language can be viewed as " a genetic inheritance, a mathematical system, a social fact, the expression of individual identity, the expression of cultural identity,

the outcome of dialogic interaction, a social semiotic, the intuitions of native speakers, the sum of attested data, a collection of memorized chunks, a rule-governed discrete combinatory system, or electrical activation in a distributed network...We do not have to chose. Language can be all of these things at once. " (N. Ellis, 1998, p. 642).

This is reflected in the theoretical plurality pervasive in the field of linguistics as the editors of the latest edition of the Oxford Book of Linguistic Analysis (2015), B.Heine and H.Narrog have underscored in the Introduction the diversity of theoretical perspectives and acknowledged that the filed of linguistics is better represented by a list of the 32 most prominent paradigms given that little common ground can be found among them in conceptualization of language. That said, the field is dominated by two theoretical perspectives.

The generative paradigm, highly influential in current linguistic thought , defines language as a bio-cognitive property of the human organism, a highly complex algorithm capable of processing cognitive structures of great intricacy, i.e universal grammar(Chomsky, N. 1972, 1980, 1986, 1995, and elsewhere) The beginning of language in this context is understood in terms of a genetic accident resulting in the imposition of the grammar algorithm onto pre-existing cognitive capacity for protolanguage, making possible encoding, learning and processing human thought in a highly structured way (Bickerton D.1984, 1990 and elsewhere).

Alternatively, in usage-based context language is defined as a system of symbols organized for the propose of sharing human experiences (Bybee,J., Beckner, C. 2009, and elsewhere)

Regardless, modern language is understood as complex grammatical machinery deployed for the efficient externalization of the rich and complex human semiosis.

For the purposes of this paper I define it as a communication system of hierarchically organized largely symbolic signs, used as the main avenue of communication by populations of individuals with distinct genetic, anatomical, cognitive, behavioural properties attributed to Homo sapiens species.

Protolanguage is identified as an earlier intermediate stage in the evolution from animal vocalizations to modern language. It is defined in terms of meaning-based short utterances composed mostly by lexical words with concrete meanings and often uncertain grammatical categorization, organized by the principles of information around the opposition old vs. new. (Bickerton, 1984, 1990 and elsewhere).

That said, some fully functioning languages of human populations today demonstrate striking resemblance to the hypothetical protolanguage, e.g. Piraha, Riau Indonesian, some languages spoken by isolated human populations still preserving a hunter-gatherer lifestyle (Cysouw, Comrie 2013; Everett, D. 2005 and elsewhere; Gil, D. 2009). And various linguistics (Jackendoff, Wittenberg 2014) have argued that there is no qualitative difference between protolanguage and languages attested today as protolanguage-like modern languages fulfil all the major functions of language, i.e to codify and communicate infinite human thoughts by finite linguistic means, albeit with minim use of abstract grammatical arsenal. Thus, the difference between protolanguage and language is a matter of degree.

And all language speakers are biologically and cognitively normal humans regardless of the wide variation in the complexity of the language systems they use.

In this sense the beginning of language is the formation of the first words making possible the

initiation of language, a system marked by duality of patterning and discreteness.
The present article argues that language has begin with the reorganization of the multimodal animal communication and the formation of a novel subsystem with the first spoken words used as a minor component of multimodal utterances.
Needless to say it is difficult if not impossible to find factual evidence for language origins forcing scholars to resort to speculations. The present article attempts to alleviate this difficulty by showing that traces of the remote past can be detected in phenomena observable today. By offering alternative interpretation of known facts one can minimize this gap.

1.2 .Language begins with the invention of the word: the notion of " minimum complexity"

As per Pinker and Bloom's seminal article (1990) language has begun as a cultural invention, i.e. as a communicative novelty, prompting subsequent bio-cognitive adaptation of the human body by the evolution of a language faculty.
In this sense the Complexity theory, initially designed to understand the spontaneous emergence of novel entities with unique internal organization in physical matter (Prigogine, Sengers, 1993; S. Kauffman 1995) and subsequently adapted for understanding complex design in a broad range of contexts , including social contexts (Heylighen 2009, 2013) can provide some guidelines into understanding the beginnings of language as a communicative innovation. It states that complexity increases from an initial point of minimum complexity, which marks the point of irreversibility (Prigogine and Stengers,1993, p.301) So, complexity does not arise from simplicity, but from some minimum of internal organization and with middle-sized formations (Prigogine, Stengers , ibid.)
In language a primitive form of word, or protoword, identified as minimum internal organization of meaning and form, larger than a phoneme or a syllable and smaller than a sentence, fits these requirements.

So, in search of understanding of language origins universal principles of organization underlying complex design in nature and in society can be reinterpreted in understanding the origin of language, although providing only very broad theoretical foundations under the assumption that universal principles and processes influence language as part of broader nature.

To note, although in current linguistic thought word is not well defined, it is usually identified as a codified bundle of semantic, grammatical(syntax and morphology) and phonological primitives i.e. the simplest units of organization, pointing at membership in a multilevel architecture of language.

Theoretical paradigms vary significantly in evaluating the role of the word in the language system, e.g. traditional generativism proposed by Chomsky attributes a marginal role for words in UG, while alternative generative paradigms, e.g. the parallel architecture (Jackendoff, 2002 and elsewhere) places the word at the centre of language as interface of the three levels of structure, making it the cornerstone of the language system.

Significantly, there is linguistic communication with minimum grammar but there is no

language without words. Words are the first to emerge in the developing brains of youngsters and the first to mark the beginning of a new language. Given that, one would anticipate that the beginning of language is marked by the invention of a lexicon of words as bare stems, encoding the very essentials of semiosis.

2. Language as a system of signs

Communication is based on signs and understanding the origin of language requires some basic understanding of signs in nature and culture.
The theory of signs by C.S. Pierce (see Stanford Encyclopedia of Philosophy) distinguishes three categories of signs: icons, indices and symbols. In icons the relationship between the meaning and the form is physical resemblance. Portraits are icons. Indices are patterns of correlation and co-occurrence of two sensory experiences, one of which points at the other, or indicates the presence of the other and becomes the form and the other the meaning of an index. The lit window indicates that someone is in the house, or the smell of skunk indicates the near presence of the animal. Both icons and indices are motivated signs in that the connection between the two sides, meaning and form, is motivated, either by physical resemblance or by correlation, spatial and/or temporal. Symbols are different in that the connection between meaning and its representation is established by a social convention. The flag of a country is a symbol of a nation, a dollar bill is a symbol of certain value. Indices are ubiquitous in nature, they are at the foundation of communication starting at the lowest organic levels, e.g. between the molecules of a body. Indexical communication is limited by the present as it cannot be detached from the here and now. Iconic signs are found both in nature and in culture. In the immune system the antibodies block the " invader"' by creating a mirror image of it and blocking its access to the rest of the organism. In culture photographs are the clearest example of iconic signs. Language makes use of all three types of signs, i.e. it is a polisemiotic system.

2.1. Common ground, the foundation of signs

Humans, as many other social species, are creatures of habit, they conceptualize reality in repeated patterns, thus, they memorize patterns not only of natural occurrences but of behaviour of animals and conspecifics. In a closed group of interacting individuals the members are united by common daily experiences as interactions with one another and with the material reality. Eventually common experiences become routinized and common patterns of behaviour emerge and become recognizable as part of group identity, i.e. group members are expected to behave in certain predictable ways. In cognitively advanced species shared behavioural routines furnish common conceptualization of reality, which in humans becomes the foundation for the formation of signs, based on agreement on common meanings as behavioural common ground, which becomes the foundation of culture.
Common ground is the knowledge and understanding of the surrounding world an individual shares with the members of the group, including knowledge of oneself, which is gained through interactions of the individual with the environment, including one's own body. In

communicatively advanced species the fact that it is shared means that it does not need to be explicitly communicated as it is implied. The understanding of the self as a helpful group member is a pre-requisite for the formation of norms of behaviour and social conventions, such as language. It presupposes shared knowledge and the pre-existence of a form of culture, i.e patterns of behaviours and practices not directly shaped by survival necessities and based on shared meanings, likely to be assembled on a small scale, in a small group of people who interact daily, live in close proximity, very likely, family members. The formation of common ground relies on theory of mind, or the cognitive ability to understand that all individuals (conspecifics) have minds and have representation of others' minds, i.e. I know that you know.
Crucially, the formation of common ground and the ability to participate in joint behaviours is based on the innate propensity for socialization, inherited from ancestral species, but elevated significantly in humans. It is plausible to suspect that the formation of common ground by establishment of common cultural practices (by a process of self-organization) is one of the prerequisites and a stepping stone in the origination of language, as it lead to the formation of common meanings, an essential component of any sign systems and the linguistic sign.
Human minds, and , presumably other non-human language using species, evolved advanced capacities for socialization, beyond the ape reciprocal altruism as a result of selection pressure to participate in group activities as survival necessity, initially in a small group of genetically related individuals. Later the advanced capacities for socialization were extended beyond the family circle with the formation of larger and more complex social organizations, e.g. tribes, kingdoms etc. , thus implicating evolutionary processes in cognition as well as in social organization.
Croft (2017) distinguishes various types of common ground knowledge:
a. natural common ground, based of the recognition of other humans as conspecifics with common human anatomy, physiology, cognitive capacities
b. perceptual common ground , based on the cognitive capacity for joint attention and categorization
c. communal common ground, based on joint practices among community members.
d. actional common ground : the use of conventions, such as language, for coordination of joint activities.
In sum, the uniquely human propensity for cooperation made possible the formation of common ground, which is a prerequisite for any type of communication. Behavioural common ground becomes a prerequisite for the formation of the first lexicon.

2.2. Words are unique signs.

Most words are symbols. But the arbitrary association of an idea, i.e. a concept and its material representation , which is the definition of a symbol, is not all that words are.
Culture is based on symbols, from traffic signs to mathematical formulas, to films. But the cultural symbols are different from linguistic symbols. Cultural symbol systems fall into two categories, one is codes, i.e. systems composed of discrete symbols with unambiguous and stable meanings each with a well defined and unique place in the system . They are

interpretable only within that system. Traffic signs and mathematical formulas fall into this category. Codes do not need grounding in time and space as they are context -independent, that is, they receive the same unambiguous interpretation in all contexts they appear.
Others, e.g. films and music, although may have discrete form, (music, for example) have holistic meanings whose interpretation depends on the context. The meaning of a painting and a music score is " in the eye of the beholder". They belong to the so called inferential communication where the same symbol receives different interpretations by different interpreters and contexts, e.g. the same music score is often used in a film and in a commercial advertising and is interpreted differently in these very different contexts.
Words are different as they are unique in that they are both symbols and indices. A word is a stable meaning - form association recognized as a unit by all speakers of the respective sociolect. Such association is at the same time flexible as it points to a different referent in each communicative act, i.e. words have sense and reference. Thus, the meanings of words are general and specific at the same time. A word is a hybrid, a combination of two traits .
Hurford (2007) identifies the beginning of language as the initiation of the dual role of the linguistic sign as combination of denotation (intension, stable representation of a class of objects , a code,) and reference (extension, representation of a particular object in a particular situation). The inferential use of the linguistic code in individual communicative circumstances is the central characteristic of the word. This hybrid nature of the word is unique in communication. The uniqueness of human language as both a code and inferential system begins with the word.

3. Speculations on the nature of the original meanings of linguistic signs

3.1. Synthetic vs. analytic models

Various scholars have speculated on the original meanings of the first linguistic signs. The synthetic account postulates pre-existing protowords encoding atomic meanings, assembled in meaning-based utterances with propositional content, hence lexical protolanguage, defined as lexicon without grammar(D. Bickerton, M. Tallerman, 2005, and others). Thus, it assumes compositionality in meaning and form (vocalizations and manual signs) as a precondition.
The alternative analytic account (Wray, 2002, p.113-) defines protolanguage as a holistic system, a precursor to lexical protolanguage, consisting of formulaic expressions where a stream of speech sounds, or a vocal phrase, is mapped onto to a holistic meaning containing a proposition. Thus, a holophrastic protolanguage would have phonology.
Formulaic expressions have the function to manipulate physically and emotionally the behaviour of group members and are also instrumental to social bonding. Linguistic forms in holistic protolanguage resemble the words in polysynthetic languages seen from the perspective of a learner who has not yet analyzed them into component parts and perceives them as an indivisible whole.
Wray's hypothesis has an advantage in demonstrating the continuity from the natural communication of primates in their function of manipulating the minds of conspecifics by dyadic communicative acts.

"…the holistic cries and gestures of our pre-human ancestors were transformed , over a long period of time, into a phonetically expressed set of holistic message strings with a manipulative function such as greeting, warning, commanding, threatening, requesting…" (A. Wray, 2002, p.115).
Holistic elements persist in modern languages, as they have proven successful in their functions as fast, efficient and unambiguous expressions of the community's emotional life as formulas of social bonding. (A. Wray, 2002, p.117-).
Wray's model of holistic protolanguage is criticized by M. Tallerman(2005) who reminds that the reason phonemes exist is to differentiate word meanings, suggesting a protolanguage is conditioned on a lexicon of word-sized units. For a detailed discussion of the various theories of protolanguage see T. Fitch (2010).
The two systems are argued to have marked two successive stages in the evolution from animal vocalizations to language, i.e. a holistic stage being a precursor to a lexical stage, where the older holistic messages continued to be used for socializing, while the compositional system filled the need for exchange of referential information as proto-words were most likely labels for concrete objects and actions, relevant to the experiences of community members in interactions with nature and each other and worthy of talking about. Holistic messages as well as non-linguistic body signals, i.e. body posture, facial expressions, etc. retain their function of communicating emotional states.
Remnants of these early stages persist today, e.g. a mixture of holistic and compositional elements is found in the linguistic communication of trained apes, early child language, basic variety (a pidgin-like system, spontaneously formed by adult second-language speakers), identified by W. Klein, C.Perdue (1997), the communication of people with damaged brains, suggesting ancient roots.
"… the interaction of these two systems (generative and holistic) in the absence of hierarchical grammar, is a convincing match for existing grammarless systems, such as those of Kanzi, very young children, aphasic people, and foreign tourists." (Wray, 2002, p.116)
And although visions of protolanguage are by necessity speculative, these are reasons to consider these speculations plausible.

3.1.1. Protolanguage, a continuum of atomic and holophrasitc expressions

The holistic vs. synthetic alternative models of protolanguage are questioned. M. Dowman (2007, 2008) demonstrates by computer modelling that a variety of linguistic meanings on a continuum from atomic to holophrastic could have been potentially in use. Significantly, he argues that most of the linguistic forms had meanings more complex than atomic, but less complex than holophrase , i.e. semi-holophrastic. Thus, words in protolanguages could encode a mixture of various types of meanings, i.e. suggesting a semiotic diversity of the first language-like systems.
Needless to say that protolanguages were able to express only a limited range of meanings given the memory and articulatory-acoustic limitations of their users.
Importantly, lexical items of extant languages also represent meanings along the same continuum. The lexicon of English words with atomic meanings, e.g. *book, table,* along with

words encoding two or more atomic concepts, e.g. *beef* , a combination of the atomic concepts COW+MEET, *pie* incorporates a number of atomic concepts. See also M.Arbib (2008) for similar views.
A different understanding of compositionality as word+deictic gesture combination, each representing a different semantic element in a message, observed in young children and language-trained apes, is presented by P. Greenfield et all .(2008) suggesting implications for protolanguage, i.e. that messages, defined as holistic are in fact compositional.
Thus, a variety of protolanguage types are likely to have existed suggesting a variety of possible paths towards language as we know it today.
Because in computer modelling agents are highly simplified representations of human communicators, their findings would have only limited contributions by projecting only general tendencies. That said, the communicating agents in Dowman's model are designed to reflect the bio-cognitive properties of language-trained apes, assuming similarities between apes and the Homo species as language creators. These preliminary assumptions add credibility to Dowman's findings.

3.2. Holistic vocalizations, a precursor to speech: musical protolanguage

Various authors, as early as Darwin and later Jespersen, have expressed the idea of song-like holistic vocalizations as a precursor to speech and language , further developed in a theory which argues for primacy of music and singing as a distinct stage in language evolution and a step up from animal emotional vocalizations. In this initial stage of transformation from animal communication to language the meaning of a proposition is represented by melodious vocalization as a holistic sign (see T. Fitch 2010, 2013 for a review). A subsequent stage is marked by a process of analysis resulting in the formation of combinable units of form and meaning, a precursor to language as a combinatorial system.
Of course the term " musical protolanguage " does not refer to the standard understanding of music, it means that the meanings of the messages were unanalyzed, holistic, thus there was no direct correspondence between parts of the signal and parts of the meaning. Thus, there was no duality of patterning. Most recently S. Mithen (2005) has developed his version of " musical protolanguage" hypothesis with his Hmmm (holistic, manipulative, multimodal, musical) theory. It is also suggested that the natural propensity for music emerged initially from the mother-infant bonding, suggesting that " motherese" has its evolutionary roots in musical protolanguage.
Although this is another speculation, it has merits in suggesting common beginnings of language and human culture given that language, music and dance are uniquely human universal behaviours.

3.3.. Speculations on the original modality

The original modality of the first lexicon is a matter of debate as some identify the vocal channel (Liebermann, 2007 and elsewhere), while M. Corballis (2002 and elsewhere) argues for gesture before speech. Alternatively multimodal language beginnings are proposed as a

bridge between animal communication and language.

3.3.1.The emergence of language from prelinguistic multimodal communication

Multimodal communication is defined as a composite integrated signal containing simultaneous emission of signals from multiple modalities, e.g. vocalizations, gesturing, body posture, facial expression. Recent studies of primate communication have the potential to shed light on the initial stages of language evolution as a vocal component of a multimodal communicative complex which includes non-linguistic vocalizations, intentional and instinctive , manual gesticulations , facial expressions, etc.. Chimps in captivity communicate with signals emitted simultaneously from a variety of modalities. They recognize and produce visual, tactile, vocal signs in their communication with caregivers.

"… primate communication is inherently multimodal, at both behavioural and neuronal level, indicating that unimodal research tells only part of the complex story. " (Slocombe, Waller, Liebal 2011).

Often one modality provides multi-sensory stimulus, e.g. a gesture provides visual, tactile, auditory, etc. information, thus a signal is usually composite, a combination of various components, which act in concert to deliver the complete message. In this sense studying each component in isolation ignores the role of the rest.

" When a slap is paired with a playface it leads to play. Isolating the slap from the playface will not, therefore, help us understand the signal better." (Waller et all. 2013 p. 540).

In short, " communicative complexity may be less about how each single modality is used, and more about signal integration. " (Waller et. All. 2013, p.540).

It is argued that pantomime, a uniquely human application of multimodality using the whole body for externalization of signs is an intermediate stage in the transition to language (M. Donald 1991 and elsewhere)

4. Traces of ancient linguistic forms in todays languages

Under the window approach in evolutionary linguistics traces of earlier linguistic signs, both in form and in meaning, can be found in languages of today.

4.1.Prosody, a link between animal communication and language

Prosody, i.e. stress, and intonation, is a component of language which remains holistic as part of a predominantly discrete system. It bares some resemblance with animal vocalizations which are also holistic. On this basis some argue that the capacity for speech has evolved from the prehuman capacity for holistic vocalizations (P. Liebermann, 2007 and elsewhere) relying on findings that lower animals are innately predisposed to convey emotions by

vocalizations . In higher animals there is a level of control over the vocal organs. The transition from uncontrolled expression of emotions to use of intonation for holistic expression of propositions is the easiest and most natural way to initiate the use of already existing capacities in a slightly different way at a stage when the highly refined control of the articulatory organs needed for modern type precise pronunciation has not yet evolved. Further, there is a one-word phase in early child language development, when one word accompanied by intonation is used to communicate propositional meaning, suggesting that this could be another intermediate stage in a long and protracted process.
Intonation plays a major role in protolanguage -like systems and to a lesser extent in spontaneous dialogues by speakers of modern languages to communicate questions, grammatically shaped as statements, in imperatives shaped as statements, etc., intonation and stress is used routinely to resolve ambiguity, effectively reducing or eliminating the need for complex syntax.

In addition, in the newly emerged Al Sayid Sign language prosody plays essential part in conveying syntactic structure., e.g. " not only do prosodic signals serve to separate clauses into intonational phrases, they can also link them to one another to form complex propositions...complexity may be encoded in the prosody...prosody plays crucial role in marking constituents and dependencies from the very beginning" (Aronoff, et all. 2008).

The persistent use of intonation in linguistic communication today is a window into earlier stages in the evolution of language as a remnant of its beginnings.

4 .2. Traces of multimodality in linguistic communication of today

Traces of multimodality are observed today as humans routinely combine language with non-linguistic sound-making and other non-verbal cues, e.g. facial expressions, body posture etc., to complement the linguistic message, thus, preserving some aspects of the original multimodality. In this context language evolution can be conceived of as a process of internal transformation of non-human multimodal communication by which language has emerged as the major component in this multimodal complex, partially displacing the role of the rest of components and attributing them only a supportive role.
In addition, ontogeny is argued to represent a condensed version of phylogeny and provides a potential to infer information, permanently lost and non recoverable, pertinent to the evolution of language, from observation of early language development. In this sense the multimodal nature of the first communicative engagements at early age could shed light at initial stages in language evolution, e.g. in the first weeks and months after birth the infant displays affinity for socializing and participating in communicative behaviour by visible body actions, e.g. smile in response to a smile, imitate facial expressions, demonstrate turn-taking in non-verbal sound making and playful interactions , facial expression, gesticulations, body posture, direct attention by sound making, looking, pointing. The youngster's first experimentation with language begins with babbling , followed by one-word utterances where children 's communicative interactions are predominantly by body movements with language having a

limited and supporting role, which broadens with the next stages of language development with two-word utterances and beyond. As development progresses, although the child's linguistic abilities become more sophisticated, his/her linguistic output continues to be complemented by non-linguistic body signals. During the development of syntactic competence, as children often omit arguments or elements of constructions, potentially compromising the overall understanding of the message, the lack of full linguistic competence is mediated by body actions, e.g. pointing, gesturing, etc. Linguistic behaviour is constantly synchronized with communicative use of other modalities as a component of a multimodal unified system (Morgenstern A.,2014). And although the use of body gesticulations as compensation for linguistic immaturity gradually decreases as the child's linguistic skills develop in full , to paraphrase Morgensterm A.(2014), body signals continue to illustrate, specify, reinforce, modify the linguistic message (ibid. p. 18).

In sum, multimodal non-linguistic signals precede the origin of language and continue to be active participants in linguistic communication today, although reliance on them diminishes with experience with language, suggesting that it is reasonable to envision language beginnings from multimodal communication, gradually becoming a major component of a multimodal communicative ecology.

4 .3 .Language “ fossils”

Scholars argue that some linguistic forms in use today have ancient roots in pre-linguistic communication and can be of value in reconstructing the first linguistic forms.
There is a small and heterogeneous group of linguistic forms in languages attested today which deviate significantly from the standard definition of a linguistic form. Jackendoff (2002) terms them 'language fossils' and argues that they are relics , bits and pieces from earlier stages of pre-linguistic vocal communication and as such might provide clues for earlier stages of language evolution. These include :
a. Holistic utterances with phonology, but no syntax, mostly exclamations of the sort ' Damn' 'ha-ha-ha ', or 'Wow' , which display more similarities to instinctive vocalizations (reactions to pain , etc.), than to linguistic entities as they are not consciously communicative. They exist as individual utterances, not integrated into the language system.
b. Holistic utterances used intentionally for communicative purposes, although limited to specific situations and better defined as communicative noises, e.g. Shtt'. Their meaning is interpretable from the context , most of them have no distinct syllable structure nor grammatical features.
c. Holistic utterances of the sort 'Hello', 'Good bye', ' Yes',' No ' , etc. with phonological structure and holistic meanings , tied to specific communicative situations.
If these forms are indeed remnants of ancient pre-linguistic forms , the fact that they continue to exist incorporated in the modern linguistic system would suggest that they have retained their original functions and that these functions are relevant for humans today as they were at the dawn of humanity.

For the proponents of gestural origins of language, elements of pantomime, still persistent in

contemporary human behaviour, are argued to be behavioural fossils which help reconstruct the initial stages of language(Żywiczyński P, Wacewicz S, Lister C. 2021)

4 .4. Form-meaning association biases, a window into language origins

The idea of arbitrary nature of language both in the lexicon and grammar dominates theoretical perspectives, and non-arbitrary/motivated meaning-form associations were considered insignificant exceptions. That said, recent studies have found that sound-meaning association preferences are a universal phenomenon which persists through space and time. These can provide additional clues in search for the origin of linguistic forms.

4 .4.1. Sound-meaning association biases, a general property of language

Sound-meaning association biases of various types,e.g. iconicity, sound symbolism, synnesthasia, previously thought to have a marginal role and are recently found to have a bigger than anticipated impact in the formation of the lexicon.
Iconicity is a broad term which stands for actual or perceived closed similarity between the form and meaning of a sign. Various types of iconicity are distinguished (Johansson, Holmer, Carling, 2020). Iconicity in vocalizations, based on a natural connection between meaning and sound, is most clearly demonstrated in onomatopoeia, where the linguistic form is an imitation of the sound an object makes e.g.“ splash, chirp, swoop”, etc.
Earlier studies by J. Hyman (1993) and more recent findings (Permis, Thompson, Vigliocco, 2010; Perniss, Vigliocco, 2014) find iconicity to be pervasive and universal, i.e. far from insignificant little quirk. More broad-based analysis of a number of languages (mostly non-Indo-European, in both modalities), e.g. languages of sub-Saharan Africa, aboriginal languages of Australia, indigenous languages of South America, languages of south-east Asia, Japanese, Korean, etc. confirm that iconicity is one of defining properties of language, on par with arbitrariness, suggesting that it must be reflected in theories of language.
“...any viable theory of language must include iconicity in addition to arbitrariness as a guiding principle...” (Pernis, Thompson, Vigiocco, 2010 p. 14).
Iconic mappings are found both in lexicon and grammar. In the lexicon onomatopoeia, the spoken form of a word is an imitation of the natural sound of the class of object it denotes. Monaghan et all. (2014) term this transparent connection “ absolute iconicity, e.g. “ meow” as the sign for the sound a cat makes, distinct from relative iconicity, i.e. partial similarity with the natural sound the class of named objects make , e.g. there is a tendency to associate the sounds of small animals with high vowels, e.g. birds chirp, and the sound of large animals with low vowels, e.g. a lion roars.
The role of vocal iconicity and sound symbolism was viewed as marginal until recently as these were thought to be restricted to lexical words with holistic meanings and forms in a system defined by compositionality (Hurford 2012). That said, a recent study by Johansson, N., Holmer, A., Carling, G., (2020) analyzing 344 near universal concepts in 245 language families demonstrates that lexical forms exhibiting meaning-form association biases, i.e. iconicity and sound symbolism, involve associations between semantic and phonetic primitives

, although their combinations in both form and meaning vary with language diversity.
In grammar there is iconicity of sequence, where the sequence of verb forms (and the sentences formed around them) mirrors the sequence of events they denote. That is, spatial proximity of linguistic forms reflect the proximity of meanings these forms denote. This means that words as signs reflect the human experience with the world. Iconicity is found in all grammatical categories: nouns, verbs, adjectives, adverbs. It is a universal property of all languages at all historical stages.
Importantly, arbitrariness and iconicity are not binary notions and in sign languages many linguistic forms display both to various degrees. That is, "...the degree of iconicity or arbitrariness ascribed to individual signs is best understood as a continuum" (in Perniss, Thompson, Vigliocco, 2010 p. 5).
Iconic effects are shown to influence language learning in children and adults in both modalities by injecting transparency in the association of form and meaning.
On the other hand, if we take motivated signs to mean semantic transparency , then most of the newly invented lexical items are motivated signs. A closer look would reveals that most of the new lexical inventory are assembled of reused and recombined phonological and/ or semantic material as a demonstration of transparency in the meaning-form pairings, while genuinely novel words are rare. In this sense one could say that in all languages for the overwhelming majority of the words in the lexicon the relationship of meaning and form is motivated.
This preference for transparency is explicable with constraints imposed on language by the human brain as acquisition / learning of any language includes the memorization of a vocabulary of thousands of words presents a challenge for the memory.
Iconicity informs about the internal organization of the brain and the way it processes language. Processing of iconicity in language involves the formation of neuronal connections across multiple, especially proximate cortical areas and multiple modalities.
It challenges the view of language as an abstract system unrelated to experience and shows that language is intertwined with both sensory experience and with other aspects of cognition. In addition, it challenges the view that different aspects of language, phonology, syntax, semantics, are processed independently and demonstrates that linguistic theories do not reflect the way language is processed by the human brain.
Sound symbolism is a type of sound-meaning association where a natural relation is perceived between a sound and the meaning it represents . It is not as rare as previously thought. Hurford (2012, p.128-) shows that in many unrelated languages the sound symbolism is part of the language system. Others confirm hie findings, e.g. in English /gl/ in word initial position signals visual perception of a phenomenon, e.g.*glare, glance, glimmer* (Blasi et all. 2016) This correlation of meaning and form is used in the creation of new words. Most recently Blasi et all. (2016) report on sound-meaning biases in the basic vocabularies of about two thirds of attested languages, spatially diverse in with different histories, suggesting that this is a tendency enduring through space and time and across cultures.
One would assume that conventionalization of sound symbolism has played a role in the very early stages of language evolution via facilitating word learning by making it predictable as similarly sounding words are likely to have similar meanings. Further, as per Hurford (2012) in a number of languages attested today the conventionalized sound symbolism is extended to

grammar, e.g. there is a correlation between the phonetic form and the grammatical category. In Dutch, French, Japanese, English, phonological cues help distinguish content from function words and nouns from verbs, thereby facilitating language learning. Moreover, a large number of nouns of high frequency of use have back vowels, and high frequency verbs have front vowels. See also Cuskley and Kirby (2013) for similar findings. This furnishes Hurford's argument that iconic correspondences of meaning and form facilitate not only the learning of lexicon, but also of grammar, effectively eliminating the need to postulate an innate Universal Grammar.

Synesthesia is anomalous psychological blending of perceptions where perception in one of senses provokes perceptual stimulation in another, e.g. smell triggers colour, words trigger shape, etc. Synaestasia is pervasive which hints at the possibility that it may be rooted in human cognition. Elements of synesthesia in language point at the influence of cross-modal perception on linguistic meanings, e.g. sound properties of continuants is associated with visual perception of angularity. Similar associations are noticed between vowels and perception of taste, e.g. sweetness is associated with low long vowels (Cuskley and Kirby 2013). Ramachandran and Hubbard (2001) argue for neural basis of synesthasia as simultaneous activation of various sensory and motor maps in the brain, properties of human cognition thought to precede the emergence of language as one of its pre-adaptations, subsequently co-opted for use in service of language-relate functions.

Thus, form-meaning biases of various kinds are a universal tendency in both basic vocabulary and grammar. In each case form-meaning biases helps avoid ambiguity and illustrates how language is used to communicate one's experience with the world by providing the link between the gradient nature of our perceptual experiences with the world and the linguistic forms, signalling that linguistic forms are grounded in human experience.

Both these needs, for disambiguation and the externalization of bodily experience through linguistic communication, are present at the time of language origination, suggesting the likelihood that this has been a prominent feature in the earliest stages of language genesis. Importantly, given that we know from historical linguistics that vocabulary forms, mainly lexical words, but also some grammatical forms, encoding the very essentials of human semiosis tend to resist change (Nettle, 1999), these can offer additional clues in tracing the origins of language.

4 .4.2. Form-meaning transparency and the earliest language forms

Traditionally inquiries into language evolution begin with the assumption that arbitrary association of form and meaning has been a defining property of language since its inception. Arguments for synthetic, holistic or musical protolanguage assume a symbolic nature of linguistic signs (Tallerman, 2007, Wray, 2002, Mithen, 2005).

More recently scholars have hypothesizing a natural connection, iconic and/or indexical, between the meaning and form of the first words, facilitating communication at a time when the formation of words as systematic pairings of meaning and form were in early stages (R. Berling, 2005). Bickerton hypothesizes that to assure adequate reception of the message by

placing limits on the possible interpretations in situation of displaced reference the first words would have had to be iconic signals, e.g. imitations of natural sounds (Bickerton, 2009). Similar arguments are made by Clark, B. 2011).

Vocabulary formed by non-arbitrary form-meaning associations denote basic concepts, e.g. body parts, primary colours, mental and body functions, kinship terms, properties of the environment (wet/dry, long/short, close/distant), etc. indispensable for functioning in pre-civilization environments where the first language users were living. For details refer to Johansson, N., Holmer, A., Carling, G., (2020)

Iconicity and other types of form-meaning biases alleviate challenges in comprehension by providing transparency in the connection of form and meaning, which, one would presume, would be highly effective in memorization of basic vocabulary at the inception of language as a new form of communication as a novel use old bio-cognitive properties.

Iconic associations are prominent in small lexicons, especially at initial stages of formation of idiolects and sociolects. Early stages of language acquisition demonstrate high degrees of iconicity, although it diminishes dramatically with increase of age and vocabulary size (Massaro, D., Perlman,M. 2017). Early stages of ASL and the Al-SAYIID sign language (Aronoff et all. 2008) demonstrate high degree of iconicity, later reduced and partially replaced by arbitrary signs, themselves elaborations of the original iconic signs. If one takes these to be windows into language origins, this would suggest a non-arbitrary stage in the formation of the lexicon.

Iconicity was likely a prominent feature in the initial stages in the evolution of language systems, spoken, signed, written (Perniss, Vigliocco, 2014). This could suggest that communication systems begin by reflecting a strong natural connection between signs and referents. In this sense Cuskley and Kirby (2013) argue for a perception-based proto-lexicon in a sensory based protolanguage emergence.

Iconicity is attributed a key role as a bridge between the indexicality of animal communication which relies on the spatial and temporal proximity of a sign and a referent, and the displaced reference as a unique property of modern language . The replacement of indexes with icons replaces reference to an object, i.e. " functional reference", with reference to a concepts or " conceptual reference" where the concept is represented by an image (Perniss, Vigliocco, 2014).

The iconic representation of reality has deficiencies as icons are necessarily limited and fixed in number and refer only to existing entities. In a changing environment they represent outdated information, which puts learners in disadvantage as learning old information is useless for survival in new conditions.

As the functions of linguistic communication increased a demand for vocabulary enlargement brings the need for adaptation by introducing arbitrariness. This is because "... arbitrariness ...allows for a maximum discrimination between entries in the lexicon. " (Pemiss, Thompson, Vigniocco, 2010, p.17). In addition, the frequency of use and the need for speedy communication must have increased. Faster and , as a result, sloppier pronunciation lead to truncation of the iconic signs, making the initial natural connection unrecognizable.

Consequently, the natural connection between signifier and signified is lost resulting in the substitution of icons by symbols, a demonstration of evolutionary process in communication. At the same time a purely arbitrary system would be difficult to learn. Thus, both arbitrary and motivated signs have advantages and constraints, suggesting that language originated with a mixture of both types of signs, each making a contribution to adequate learning and communication.
Symbols have replaced to a significant degree the role of iconicity in language and this transformation was motivated by key advantages of symbols, i.e displaced reference and discreteness in meaning and form, resulting in duality of patterning . That said, despite its inherent limitations in encoding linguistic meanings, iconicity has retained a role in languages of today as it contributes to ease of learning and fast and accurate understanding of the message.

Arbitrariness is more widespread in spoken languages while iconicity retains significance in sign languages. And arbitrariness illustrates the role of convention and cultural diversity, while iconicity points at continuous connection to reality of nature and the universality of human perception.
In sum, form-meaning transparency of the oldest linguistic forms would be well suited for the limited functions of the first language systems in pre-civilization environments and given the bio-cognitive limitations of the first language users. It also marks a crucial departure from indexicality of animal communication and a bridge to displaced reference and symbolization.

5. Language as invention

Because direct evidence for the formation of a lexicon is unavailable scholars resort to indirect sources of information as a substitute. Some scholars evoke principles of the Chaos theory and understand the formation of language as a communicative novelty by processes of self-organization and emergence. Crucially, the process of language emergence in vastly different contexts seems to display common patterns which makes the search of the beginnings of language not so impossible task.
In this context P. Corning (2002, 2003) attempts to explain the formation of language from coordinated synergistic activities at multiple levels:
1. synergy among organs and systems in the individual organism:
a. synergy among the articulatory organs for the purpose of speech production
b. synergy among cognitive capacities, e.g. capacity for reference (to represent a class of objects through signs (as special case symbolic thought, symbolic representation), capacity to form categories (things and actions are universal categories), capacity for mind-reading, or theory of mind, capacity for self-monitoring, or metacognition, (Studard-Kennedy, Knight, Hurford, 1998), consciousness (awareness that one's person and mind differ from others), intentionality (stimulus-free initiation), capacity to learn i.e. extended memory, imagination, planning or displacement, i.e. capacity to refer to distant referents, distant from here and now, capacity for socialization i.e, need for the company of conspecifics
2. cognitive and behavioural synergies among the members of a group:

a. synergy in behaviours resulting in common cultural practices,
b. synergy in conceptualization resulting in the so called " common ground', i.e. standardized views of reality reflected in myths, folklore, etc. which makes possible the formation of a vocabulary.
Experiments involving artificial intelligence by L.Steels (1995) and others where robots mimic the behaviour of human individuals to some degree, demonstrate a similar pattern of emergence of shared vocabulary. Similar simulations are performed by Dale Barr (2004). Similarly, Heylighen's modelling of the emergence of conventions through self-organization in interacting agents as coordinated efforts of individuals aligned on a unifying goal, replicates the formation of social conventions in human communities (Heylighen, 2013). This happens as all interacting individuals contribute to the final result, thus, no one entity or individual imposes its control in determining the internal organization.

By the same token the formation of speech patterns is understood with principles of self-organization and emergence.

On the assumption that language has originated as a new behaviour by reusing available capacities, one would expect the first attempts to articulate speech to have been made with pre-existing capacities evolved for essential functions of biological survival.
The frame-content theory of speech evolution (Davis, MacNeiladge 2004; MacNeiladge , 1998) argues that lip smacking motions in primates were co-opted for the formation of the syllable and its most basic structure as CV. In addition, a plausible argument is made by Ralph-Axel Muller (1996) that the syllable is an instance of a " general motor alphabet", a unit of body motion, which has assumed a new role in speech production. The emergence of the syllable as a linguistic unit is traced back to the " rhythmic jaw oscillation" and the rhythmic nature of the movements of the body-extremities. 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.). Vowels are argued to originate form neonate "comfort noises" (Muller, ibid.).
Thus, the phoneme and the syllable as linguistic units have originated from general tendencies and principles of biology and physiology, used in pre-linguistic life forms for purely biological functions, which have received a new function of producing speech . Needless to say that early speech must have been slow, clumsy and inarticulate, i.e. inefficient in both production and perception.
The emergence of speech is also replicated by experiments with AI where a general principle of particulation , known as " particulate principle of self-diversifying systems" (Studderd-Kennedy, M. 1998) is evoked as part of the general process of self-organization in nature. Here holistic entities are broken down into discrete primitives, further combinable into hierarchical units , e.g. chemical compounds, the genetic code etc. The formation of reusable units is shown as crystallized points along a sound continuum, formed under the pressures for ease of articulation and auditory distinctiveness. (Oudeyer, P., 2006; de Boer 1998). The process develops as follows :

a. Particulation, the formation of discrete units as clusters along a continuum.

"... from the continuous space of possible gestures , speech carves out basic building blocks which it reuses systematically. The phonemic and gestural continuum becomes discretized. " (Oudeyer, P. 2006, p.24)
b. Formation of phonetic gestures, units of action.
c. Formation of stable combinations of parallel coordinated gestures, phonemes, which are reused according to patterns of vocalizations.
d .Formation of reusable phonotactic patterns, i.e. syllables, displaying universal tendencies in syllable structure.
The robots interact and as a result converge on a limited number among the many possible combinations of gestures or phonemes and phonotactic patterns. The fact that different languages have similar but not identical choices of phonemes and syllables shows that they are the result of self-organization processes and not innate phonological universals.
The experiments in artificial intelligence describe a hypothetical state of affairs which only vaguely approximates the functions of the human organism, which puts into question the relevance of the findings to the issue at hand. That said, the results are in unison with the linguistic reality, as , although phonemic inventories of languages vary greatly from 11 to 144, (Evans, Levinson 2009, p. 433) these are constrained by the perceptual and articulatory limitations of the human vocal tract.
Two constraints which bootstrap and shape the phonological systems, both of biological nature, are pointed at:
1.Articulatory-acoustic interdependence. The sound patterns are formed through dynamic interactions between the organs of perception and sound production. Patterns which are the most frequently heard are the patterns most frequently pronounced, creating patterns of joined neuronal activity.
2. Energy cost. Achieving more with less effort is one of the main principles of in any activity. In speech the power of this constraint is exemplified in syllable structure as CV is universally preferred to VCV, CCVVC etc. as it requites less muscular energy from the articulatory organs, even though the less preferred options contain the same phonemes (Oudeyer P. 2005)
In this sense, one would agree with Liebermann (2007 and elsewhere) that the quantal vowels /i,a,u/ which require extra articulatory flexibility and would be beyond the articulatory abilities of language speakers at this early stage and excluded from the phonemic arsenal at the very beginning of language.
In a similar manner the usage-based /emergentist paradigm defines language as a patterns of communicative behaviours formed by cultural conventions.
J. Koster (2009) defines language as a communicative technology formed as the unintended result of repeated, intentional communicative interactions of all participants, thus, the community is the collective author in the invention of language. The implication is that biological organs are flexible and can be recruited for new functions on demand.

In addition, observations of emergence of communicative conventions in real time by J Aitchison (2000) show that the process started out from a chaotic situation where a concept was labeled differently by each speaker. At the stage communication is impossible, there is only an attempt to communicate which with time results in communicators converging on

single sound/meaning pair, established as a norm and is passed to the next generation.

From the emergentist perspective within the usage-based paradigm (Ellis, N.1998 , Ellis, N., Larsen-Freeman D. et all. 2009 and elsewhere) language is conceived of as being created in three time scales by adapting to the processing limitations of pre-linguistic bio-cognitive hardware of the human organism i.e. on-line processing during daily communicative interactions, learning by children and cultural transmission over generations as it adapts to pre-linguistic bio-cognitive hardware of the human organism(Christiansen, Chater, 2016, to name just the most recent of multiple publications).
Emergentist perspectives of language development understand word learning in infancy as process of emergence of novel neuronal pathways in the young brain with no pre-established innately preconfigured neuronal assemblages (B. MacWinney 2005). Here word learning is a cognitive process of coordinated self-organization among three " local maps" of neurons during which patterns of associations are formed and reinforced, i.e. auditory map, a concept map and articulatory map . This means that the conceptual space and the sound space are configured through experience without a language faculty.
" Language areas' develop epigenetically. They are the end products of complex chains of interactions with internal and external environments (R.A. Muller, 1996, 6.3)
Koster (2009) points out that word meanings are stored as " information clusters" produced by self-organization both at the level of the idiolect and the sociolect and vary from person to person depending on people's experiences, thus, they are not universal.

Importantly, " information clusters" are said to contain vague information about some part of the environment as underspecified potential meanings, later to become specified in the context. They are stored in memory in association with memorable elements in the environment, which points at potential referents. Thus, linguistic entities must point at potential applicability in communication.
To note, in order for communication to be possible, there must be a considerable overlap in the stored information of the speakers because they share the same natural environment, have very similar physiology and function in the same culture and thus, have very similar experiences. A similar convergence in combination of information storage and potential for referential use is likely to have happened in the minds of speakers at the beginning of language.

Nevertheless, although it is reasonable to suggest that word formation in young language learners bare similarities with word formation in the inventors of the first words, references to language acquisition could be useful to a degree as the resemblance with natural language origination is limited , given that language acquisition is actually learning an already existing language.
Observation of the initial stages in the formation of ASL and the Al-SAYIID sign language (Aronoff et all. 2008) demonstrates how a shared lexicon can emerge spontaneously from scratch.
Jill Morford (2002, p.338) looks for answers for language origins in the abnormal ontogenetic experience of individuals deprived from normal access to spoken language, e.g. homesigners (deaf children of hearing parents who have not been exposed to sign systems in early childhood and invent their own gestures to communicate, i.e. homesigns). In this case

a simple communication system is created de novo in real time without any input where emergence of conventions of form-meaning pairings, thus, formation of a few word-like symbols are negotiated between a pair of communicators.

That said, observation of the formation of vocabulary from scratch today could be useful to a degree as the resemblance with natural language origination given that today new linguistic conventions are formed in a society with already established social and cultural values, essential for formation of common meanings.

The argument is weakened by the fact that the human organism clearly has some specific predispositions for learning and use of language (Bloom 2000; Liebermann, 2007 to name a few) whether one terms it a language faculty or not. That said, the argument is much better suited for explaining the formation of earliest stages of language from scratch as initial environmental pre-condition, prompting the evolution of a language faculty as adaptation. Thus, some theoretical perspectives outlining processes of language emergence today are better suited for understanding the initial stages in language origins.

In sum, language origins are reasonably explained with the creativity of the bodies and minds of homo and human species. Language begun as an invention , a communicative novelty without a language capacity as a new behaviour made possible with available bio-cognitive machinery, repurposed for use in language from other non-linguistic functions.

5 .1 . Semasiographic systems, a potential window into the invention of language

The lack of evidence for language origins can be further partially compensated by studying the processes of formation in cultural sign systems, other than language, e.g. art, writing, musical notation, maps, mathematical symbols, etc. which are also uniquely human behaviours. The common denominator which unites them in a group is that they are conventions for encoding meaning via signs. These systems are certainly different from language in that they are semantically restricted, i.e.they encode very specific meanings. That said, their relevance here comes form a number of similarities shared with language. This suggests that the history of sign systems other than language can be viewed as another window into the genesis of language.

In Croft (2017) the knowledge of how sign systems other than language are formed is examined and parallels with the history of language formation are suggested. In each case the cooperation is voluntary and is based on common ground, or shared knowledge, and although each participant has their own agenda, all manage to coordinate their individual actions by which a system of social conventions as arbitrary rules of behaviour emerges.

Semasiographic systems display the following properties:
a. they encode information for the purpose of sharing it , thus, they are communication systems, b.they are systematic, the same meaning is consistently encoded in the same sign, c. they are combinatorial systems, d. start as simple and increase in complexity over time, d. they are applied biology, (Koster, 2007) thus, they use the available biological and cognitive resources of the human organism each in a different but equally creative ways.

The formation of semasiographic systems displays a clear evolutionary path:
a. begin with a narrow semiotic envelope, i.e.limited number of meanings in limited contexts, e.g. numbers were initially used to count tangible, concrete objects, e.g. life stock, etc. and only later their use was extended to other countable entities. The same trajectory is found in writing: it was initially used to record only certain types of information which made them unusable in broader contexts.
b. reference to present before reference to past and future: initially the signs in writing systems, were used to refer to factual experience of the present, and only later came to refer to past and future, as in memories and plans.
c. from icons to symbols: signs in these systems evolved over time from more iconic to increasingly more abstract(symbolic) .
d. initial multimodality: a mixture of signs were combined in writing and in music annotation.
e. initial reliance on contextual interpretation : at first the meanings in sign systems were only vague representations of concepts with significant reliance on contextual interpretation.

The formation of the semasiographic systems is a very long process, e.g. it has taken thousands of years from the first representations of visual art , 50,000 ya (years ago)to the invention of writing, some 6,000 ya.
That said, none of the above discussed systems display duality of patterning, which is a unique characteristic of language. This difference is attributed to the fact that discussed systems are restricted in their functions and types of information they encode, unlike language with its ability to encode a significant part of human semiosis and a very broad communicative function.
Despite notable differences there are similarities in the general pattern in the process of formation of sign systems and language from the very beginning to their further elaboration. These are as follows:

a. both evolve incrementally
b. from simpler versions
c. originate as depending on context for disambiguation and evolve context-independence
d. originate with very restricted semiotic envelope and incrementally broaden it
e. originate as motivated (icons and indexes) and evolve into arbitrary signs
f. from multimodality to single modality
Thus, despite notable differences strong parallels between language and other culturally formed sign systems affords the opportunity to extrapolate common historical processes of evolution in communication as another credible source contributing to our understanding of the genesis of language.

6. Language origins: making a new product with old machinery

Given that the first linguistic forms were produced without a language faculty, i.e. with pre-linguistic bodies, brains and minds, one would need to trace the bio-cognitive and physiological ingredients which made that possible.

6 .1. The continuity vs. discontinuity argument

The fact that at present humans are the only language users has prompted the argument for human exceptionality in the living world. Depending on one's definition of language, scholars differ in their views on the question of continuity, cognitive and communicative, vs. discontinuity of humans as language users from the rest of life forms.
The defenders of the discontinuity position are scholars who identify language origins with the onset of grammar as attested in languages of today and attribute this to the innate computational properties of the language faculty (Lenneberg,1967; Chomsky, 1972, 1980, 1986, 1988, 1995, 2000 and elsewhere), explicable with transformations in the human genome, most notably with the human version of the FOXP2 gene and its role in the Broca's area as location of the UG processor.
Some archeologists argue for behavioural discontinuity as a demonstration for cognitive discontinuity between subhuman species and homo sapiens (W. Noble, I. Davidson, 1996). But if one argues that language begins with the formation of a small lexicon of content words crudely assembled into short utterances, attributed to some known to us homo species, as I have in earlier segments, one must seriously consider the continuity argument.
Biologists usually reject the notion of human exceptionalism and are interested in the question what components of the ape organism could have been precursors to language (Fitch, 2009, Liebermann, 2007 and elsewhere, among many others). Genetic continuity is revealed by studies of FOXP2 gene as " …the Neanderthals carried a FOXP2 protein that was identical to that of present-day humans in the only two positions that differ between human and chimpanzee. …this establishes that these changes were present in the common ancestor of modern humans and Neanderthals…. Whatever the two amino acid substitutions might have for human language ability, it was present not only in modern humans , but in late Neanderthals."(Krause, et al. 2007).
And genetic similarity suggests behavioural similarities and justifies the argument for linguistic continuity.
Importantly, arguments for exceptionality of us as species are obviously anthropologically biased as the very concept of speciation implies some unique traits defining each species. Thus, "Uniqueness is not unique" as per Matt Ridley in The agile gene.
In what follows I will briefly remind of findings which demonstrate continuity of humans with the rest of life forms and especially with primate and pre-human ancestors.

6 .1.1.Continuity in brain architecture and functions

We share most of our genes, the basic body plan and functions, including essential brain functions, with the rest of life forms.
The neocortex is a layer of neurons which envelops the inner layers of brain tissue (Fitch 2009). Mammalian species have evolved a thick neocortex where the cels are not pre-specified for a function and can easily be grown in volume, making them highly flexible and adaptable for various functions, from specific sensory functions to abstract thought, under the influence of internal and/or external factors. Thus, the neocortex is one explanation for the

adaptability of mammalian species. It is thicker in volume in apes and homo species, suggesting that quantitative change in neurons can result in qualitative difference in cognitive functions. The overgrown cortex in humans provides one possible explanation for the extreme adaptability of the human species, while at the same time providing an example of physiological and cognitive continuity between us and the rest of the living world.
Moreover, continuity is found in brain functions despite differences in brain size as brain organization and functions in small-brained and in big-brained species are highly similar. There is "...little evidence that basic learning abilities differ significantly across species of vastly different brain size"(T.Deacon, 1997, p.163).
In addition, many non-human species have rich mental lives. Animals, including primates, have two types of memory, semantic, i.e static knowledge, innate or learned, of the way the world is, and procedural, i.e. ability to recall stored episodes of individual experiences by combining concepts from the semantic memory. Humans have inherited both types, but they typically are said to be directly linked to the use of language, the contents of declarative memory being expressed linguistically in declarative sentences and the contents of the procedural memory by imperative sentences.
Nevertheless, studies summarized in Hurford (2007) show that both stable concepts and their use in humans are independent of language, implying continuity.

6 .1.2. Continuity in cognition

Comparative studies consistently show strong continuity between animal and human cognitive abilities (Fitch, 2009). Various animal species, monkeys, birds, dogs, dolphins, etc. , thus, not just primates, display the following abilities :
a. form categories by generalizing from experience
b. remember past events and use these memories in plans for the future
c. use learned information in creative ways in solving novel problems
d. basic arithmetic abilities for representing small number of objects
e. form cognitive representations from multiple sensory sources
f. tool use, thus, hierarchical organization of mental representations and planning
g. social intelligence : in interaction with conspecifics understand dominance hierarchies, kin relations
h. follow gaze, precursor to a theory of mind and pragmatic inference
i. as a result of training many species are capable of learning numerous words and use them referentially in understanding a signal (dogs, parrots)
I will sum up with a quote by Fitch (2009 p. 148) " animals have surprisingly rich mental lives and surprisingly limited abilities to express them in signals."

6 .1.3. Discontinuity in communication

The natural communication of non-human species is very different from modern language, which has prompted the argument, popular among linguists of generative persuasion, that language has evolved de novo, with no communicative precursors.

Scholars focus on the following differences (Fitch, 2009 p. 181-):
a. animal signals are innate, i.e. unintentional and each species, including humans, has a specific set of signals, although some species are capable of some voluntary control. e.g. some species of monkeys are capable of deceptive alarm calls,
b. animal vocal signs are arbitrary,
c. most vocalizations have simple structure, although some bird songs display similarities to syllable structure ,
d. meanings are holistic, tied to specific set of emotions and referential information, e.g. warning calls for predators or food sources,
On the other hand, animals are capable of making pragmatic inferences , thus, the cognitive capacity for pragmatic interpretation is not specific to language and to humans and predates the evolution of language .
Moreover, an act of communication involves at least two parties, a sender and a receiver, and communicative acts are dyadic, i.e. between a sender and a receiver, and triadic, i.e. between a sender, receiver and a referent. Animal communicative acts are 1. social acts, which implies some form of social organization, a sense of membership in a group, 2. dyadic, i.e., non-referential, e,g, they do not represent propositions and do not have truth values. Dyadic communication is rampant in many animal species, not just in apes. Primate communication is largely illocutionary, i.e. performative (Hurford, J. 2007).
Thus, animal signals are limited in range in the information they encode and predominantly innately fixed. They are not different from human innate signals, e.g. laughter, smile, cries, facial expressions, etc. which usually accompany and complement the use of language.

Despite obvious significant discontinuity in meaning, form and function, elements of non-human communication persist in human communication and are argued to have been stepping stones in the evolution of language. Dyadic communication predates triadic communication ontogenetically and, arguably also phylogenetically (Hurford, J. 2007) Illocutionary speech acts are central to language even today, as language is used largely for " doing things"(A. Wray, 2003, p. 126) and any referential statement can have an interpretation as a demand or request , suggesting that the original manipulative function of earlier forms of language is persistent although expressed in highly sophisticated grammatical instruments in languages attested today.

6 . 2. Continuity in vocalizations, potential precursors for speech

6 .2.1.Vocalizations in birds and mammals

Many species express their physiological and cognitive states by vocal signals. Comparative analysis has identified the general mechanisms of vocal production. All "...vocalizations are produced by a source, which converts air into sound, modified by a filter, which filters or " sculpts " this signal with a set of formant frequencies. " (Fitch, 2009, p.306). The articulatory organs, e.g. tongue, larynx, jaws, lips, velum, pharynx, are participant in vocal production in all sound-producing animals. They are dynamic biological structures able to constantly alter their configurations. Most animal calls are species-specific, innately predetermined, i.e.

uncontrollable and immutable, and so are human non-linguistic vocalizations expressing uncontrollable emotional reactions, suggesting continuity.
On the other hand, the fact that pre-human vocalizations are involuntary and under the control of the limbic system, while human speech organs are intensional and under the control of the pre- frontal cortex, points at discontinuity. This transition from involuntary to intended signals is believed to be one of the uniquely human adaptations for language.
That said, studies of non-human species , summarized by Hurford (2012) show that the voluntary control of vocalizations is not a uniquely human trait as " the neocortical area homologous to the human speech area takes part in the generation and control of monkey vocalizations ..." (Hurford, ibid. p. 106). So what is unique in humans is " fine control of articulation" (Hurford, ibid. p.107). Significantly, great apes have voluntary control also over their facial movements.(Hurford, 2012, p.107).
The dropping of the larynx , previously thought to be a uniquely human adaptation for speech, is common to many mammal species, including dogs, primates and hominid species, e.g. in red deer and other species, evolved for body size exaggeration and useful in self-defence (Fitch (2009, p. 321). In humans lowering of the larynx happens in males during puberty and is part of natural growth, with no relevance to speech, suggesting that the evolutionary trajectory of the vocal organs is about 200 million year old.
Importantly, discreteness and combinatoriality in the perception and production of the sound signal, essential for the formation of phonemes and phonological systems, thought to be unique feature of language, is found in the songs of some birds as hierarchically organized combinations of discrete sounds, i.e. demonstrating phonological syntax (A.Hilliard, S.White, 2009), thus, displaying some similarities to speech. That said, bird songs display combinatoriality, but not compositionality as the sound combinations they produce have holistic meanings i.e. individual notes are not analogue to morphemes or words. In short, birdsongs lack double articulation, or duality of patterning, an essential property of human language. In addition, vocal learning is found in birds, some marine animals and even bats and elephants (A.Hilliard, S.White, 2009; J. Petri, C. Schraff, 2011, p. 2125).
Vocal learning suggests a critical period , found in song birds. (A.Hilliard, S.White, 2009). Macaques (T. Fitch et all. 2016) and bats have demonstrated a complex system of vocalizations and echo-detection. Bats learn new vocalizations throughout their lives, their vocalizations have dialects as markers of group identity, a pre-requisite for sign-based communication and their communicative interactions resemble human dialogues in turn-taking, a pre-requisite to participation in a dialogue (S. Vernes, 2017).
Nevertheless, despite obvious similarities, human physiology is specifically adapted for facilitating speech: the human speech organs are very agile, capable of rapidly altering their position due to efficient motor control, which results in rapid change in formant frequencies. And although other animals are also able to alter rapidly the positions of their vocal organs, and Neanderthals show some capacity for speech, (Liebermann Ph. 2007 and elsewhere), the human vocal tract has a unique L shape in part because the tongue root in humans is permanently positioned low in the pharynx, allowing the unique ability to produce the so called " quantal vowels" /i, a, u/. And only in humans these abilities are exploited to the fullest for communication purposes.

Similarity in vocalizations suggests similarity in perception. Sound perception and production are asymmetrical in all non-human species. Production is much more constrained and species-specific. On the other hand, the basic biological machinery of the auditory system is shared not only in all mammals, but even more generally in vertebrates (Fitch 2009). Categorical perception of speech sounds, e.g. categorization of stops, initially thought to be uniquely human, is within the abilities of many animal species, e.g. the perceptual abilities for discriminating consonants is identical in humans and chinchillas (Fitch, (ibid, p. 326).
This makes sense as a general tendency in evolution, given that the accurate perception and identification of a wide range of sounds plays important role in survival and also supports an argument that sound production, including speech production, has co-evolved with sound perception.
In sum, "...speech perception is based on perceptual processing mechanisms largely shared with other animals."(T. Fitch, 2009,. p. 327). And uniqueness grows from similarity.

6 .3. The extinct ancestors

All species of great apes, including hominids and humans, evolved in Africa .The details as to the classification and labeling of the species within the Homo branch are a matter of debates. The information presented as follows reflects the broad consensus based on the studies of Richard Leakey (1994), a recognized classic in the field.
From 7mya to 2 mya following the divergence from the great apes, the hominid evolution is marked by various stages:
a. Australopithecus, a bipedal ape, evolved about 4-2 mya. A representative of these species in the paleontological record is the skeleton known as Lucy, a bipedal, small-brained ape with brain size of about 400cc (cubic centimetres). Bipedalism as change in locomotion is explained as adaptation to change in climate and resulting formation of the savanna or grass land in east Africa.
Bipedal locomotion is not unique to these species, it is demonstrated in bird species and dinosaurs, although unusual in mammals. It brought a cascade of physiological and cognitive alterations in the Australopithecus species, most significantly increase of brain volume, facilitating a range of new behaviours e.g. faster running after pray, freed hands for carrying food, tool use etc. Australopithecus used tools at the level of today's chimpanzee.
b. A branch of Australopithecus evolved into the genus Homo, species with larger bodies and brains. Large brains as ratio to body size is the defining characteristic of the Homo species. The earliest representative known as Homo Habilis lived in Africa about 1,9 mya (million years ago). Large brains coincide with the appearance of tools known as the Oldowan culture.
c. The evolution of Homo Erectus from a species sister to Habilis, divergent from a common ancestor, represents a key stage in the evolution of the Homo branch. The Erectus species were the first to leave Africa about 2 mya and disperse in Asia and beyond. The name Ergaster usually refers to the African version of these species and Erectus refers to the Asian version, represented in the paleontological record by the skeleton of the " Turcana boy" with larger body, brain size of 750- 1200 cubic centimetres (cc) , very close to that of a human , i.e.1000-2000 cc as per Fitch (2009). Homo Erectus is credited with producing major innovations, e.g.

developing more complex tools, known as the Acheulian culture, which remained in use for about 1 million years, the controlled use of fire about 400,000 years ago (ya), suggesting a significant degree of cooperation.
d. Homo Heidelbergensis is described as post-Erectus hominid and identified by traits intermediate between Erectus and Sapiens and determined to be the common ancestor of Neanderthals and Sapiens, also known as Homo Rodesiensis. Heidelbergensis is the branch of Erectus which emigrated out of Africa and evolved into Neanderthals and the branch which remained in Africa evolved into Sapiens .
e. Neanderthals, which share a common ancestor with Sapiens, display very significant bio-cognitive and behavioural similarities with us, e.g. large brain, comparable to human size, large body with strong built, well adapted to could climate, used fire, hunted large game, demonstrated care for elders and of burials, developed the so called Mousterian culture, and some scholars attribute to them simple art and symbolism. Neanderthals lived in Asia and Europe for about 500,000 years.
Neanderthals and other non-human homo species are argued to have used a form of linguistic communication and we do not know which of these were the inventors of the first lexicon.

6 .3.1.Behavioural and physiological continuity of great apes and humans

Great apes are a branch of hominids to which a number of subspecies belong: chimpanzee, gorilla, bonobo, orangutan, sapiens, and others, and which share a number of bio-cognitive and behavioural traits. Ape brains show left hemisphere bias in perception and production of conspecifics' calls , in attention to visually represented meaningful symbols, ability also detected in various species of mammals, birds and amphibians (Hurford, J.,2012, p. 119-). Thus, for one, the ape brain is ready and able to learn word-like signs , and two, these abilities are concentrated in the left hemisphere, as are in humans.
Chimpanzees display characteristics comparable to humans : large body, large brain, long life, unusually low reproductive rate, i.e one child at a time, long childhood, thus, long period of child dependence on parental care, rich social life as they live in large social groups, with primitive division of labour, e.g. male individuals hunt. They also hunt for meat, kill conspecifics, self-medicate using plants, use caves for shelter, practice tool making and use, pair binding and parental care for infants (Fitch, 2009, p. 238-).This means that the last common ancestor of humans and chimps also had these characteristics.
Great apes have shown superior cognitive abilities compared to non-ape species: extensive learning from conspecifics, or social learning, of animal traditions through imitation, e.g. Japanese macaques learned potato-washing, are capable of self-recognition in a mirror, have the concept of discreteness , i.e. perceive discrete objects and events and thus, have the concept of same and different, understand abstract relationships, understand complex events as ordered actions and know when to participate in them, have some concept of group membership and can organize a war, can learn a limited vocabulary(M. Donald, 1991).
These cognitive capacities in non-human animals are very similar, and probably identical, to human's , demonstrating clear continuity of cognitive functions in human evolution.
Moreover, apes demonstrate capacity(albeit limited) to control and alter their innate emotional

vocalizations and manual gesticulations by learning (Hurford 2012, p. 119-; Byrne R.W. et all. 2017).Significantly, great apes and even monkeys anticipate calls to have a communicative function, suggesting a primitive form of Grician principles of signal interpretation, demonstrate awareness of social structure as they tailor their calls to reflect the social rankings of the receivers. Apes also produce call combinations with cumulative meanings different from the meanings of the individual calls in isolation and demonstrate ability to interpret calls in context-dependent way. Importantly, recursive conceptual structure has been demonstrated in primates. Primate communication , similar to human conversations, is multimodal, consisting of vocalizations, gesticulations, facial expressions, body posture (K. Zuberbuhler, 2015). Bonobos have demonstrated iconic gesturing (Genty, Zuberbuhler, 2015). Even some monkey species can combine individual calls to create new complex meanings, suggesting some form of capacity for syntax (Hilliard, White, 2009).
Importantly, primates' thoughts are said to be proposition -like, suggesting that they intuitively understand that a thought is composed of parts, which stand in a relation to one another. And although primate propositions are simpler, e.g. with limited number of arguments, compared to humans', given limitations in episodic memory capacities, they clearly suggest cognitive continuity.
That said, ape thoughts remain private, while humans have invented a way to make their thoughts public by linguistic and other communicative technologies, a major point of discontinuity.

6 .3.2.The linguistic abilities of trained apes

Apes raised in human families along human children and exposed to the same environment children are raised display remarkable capacities for learning, remembering and creatively using a large number of symbols, e.g. some have learned over a hundred symbols. Similar experiments with similar results have been conducted with an African Grey Parrot by I. Pepperberg (2017 and elsewhere).Thus, the ability to understand and use signs and learn large vocabularies is not specific to humans, not even to apes.
Chimps do not just memorize signs, but form categories and have symbolic representations of these, thus, they use symbols and simple combinations of them in a meaningful way, in some cases spontaneously. Moreover, Kanzi, the bonobo trained in sign language "…have demonstrated a well-developed ability to comprehend all types…of sentences, including conditionals " (Fetzer, 2005, p.65). Language-trained apes display the same initial stages of language learning as human children (S. Savage -Rumbough 1986 and elsewhere). Thus, primates in captivity develop and use, although not at the level of humans, almost all human capacities and display only quantitative differences with humans in handling the major aspects of what we call human uniqueness .
On a different note, conceptualization in any species is based on perception , i.e. concepts are embodied in all species and human concepts are reflections of human perceptual experiences with reality. And because human bodies are very similar to pre-human's, given the well known genetic, physiological and behavioural similarities, one must assume also cognitive similarity and from this, similarity in conceptualization of reality, especially given the long lasting

interaction among sapiens, Neanderthals, Denisovans, and probably other similar species. And as language is a way of making the concepts in the individual mind public, one would anticipate that communication systems of Neanderthals, Denisovans etc. and others, whether called languages or not, had similar meanings.

6 .3.3.Primate social organization

Primates are social species who live in groups with complex social organization with its internal hierarchical structure. They learn from conspecifics, a sign of social intelligence (Cheney, Seyfarth, 2012, 2017; Hurford , J. 2007, p. 191-) and a pre-requisite for complex communication. That said, their social structure is dictatorship- like. In despotic societies the social standing of individuals is fixated by the dictator's attitudes and does not allow for social mobility. This , on the other hand, does not encourage the development of negotiating skills in individuals, which, in turn, does not encourage the development of communicative complexity.
An egalitarian society, on the other hand, encourages the development of communicative skills and communicative complexity, as individuals do have prospects for improving their status by negotiating improvements in social standing.
Thus, primates have complex social lives determined by their place in the hierarchy of the social group, which they learn as in different social groups an individual of the same species can have a different social status. And although their behaviours as group members is obviously very different from human's, we share with chimpanzees and bonobos 99% of the genome, and many biological, cognitive and behavioural similarities, including propensities for social skills. On the other hand, the emergence of language-like system requires the creative use of social skills in a social structure stimulating continuous improvement, which could in part explain why primate communication retains its limitations, while human communities have invented language.

6 .4. The “ mirror neurons” , a precursor to protosign

The mirror neurons, first identified by G. Rizzolatti and M. Arbib (1998) are a type of neurons which control motor movements and become excited both when the individual performs an action and it witnesses the action performed. They are found in brains of numerous species, from monkeys to humans, ergo, they can be traced to the last common ancestor of us and monkeys.
The presence of mirror neurons is hypothesized to signal a capacity to interpret gestures as signs, thus, attach meaning to body movements, a pre-requisite for the formation of protosign, an ability to form iconic signs, learn by imitation and ground symbols in physiology. It is suggested that the mirror neurons paved the way to a transition from gestural to vocal communication and speech and even the foundations of syntactic structure in motor routines or “ action grammar” (Arbib, 2004). Arbib recently has argued for a gradual transition from a multimodal communication, dominated by gestural signs and marginal use of vocalizations, into dominant use of vocalizations and formation of speech, given the facility of speech to

encode symbols. Physiologically the shift is explained with the extension of conscious control of manual gestures in the monkey' s area F5 to the adjacent area responsible for orofacial movements and sound making, resulting in replacement of gestural communication with some form of proto-speech which propels the development of spoken protolanguage (M. Arbib. 2007, p. 21-47). For extended discussion and criticism see T. Fitch (2009 p. 462-). Although the mirror system hypothesis is not without critics, it adds clarity in our understanding of the initial stages of language genesis by suggesting cognitive, physiological and neurological continuity.
In short, a long process of evolution produced bio-cognitive and social conditions which made possible the origin of language and the invention of the first linguistic forms.
To sum up, the argument for evolution of a language faculty by Pinker and Bloom (1990) relies on the assumption of a pre-existing form of language formed with prelinguistic cognition, anatomy and physiology, prompting adaptation of the human body and mind. Thus, at the first stages language started as an invention produced by pre-linguistic bio-cognitive machinery, demonstrating genetic, anatomical, cognitive, developmental, behavioural, continuity, from which communicative discontinuity was initiated.

Summary and conclusions

The search for the origins of language is challenging and rife with conjectures and speculations as credible evidence of processes and events pertaining to our remote past is hardly available. It is likely the result of multiple converging factors demanding multidisciplinary cooperation of theoretical paradigms and methodology.

Nevertheless, available knowledge can be reinterpreted to fill this gap. The article identifies the emergence of the lexical word as the crucial point in the divergence from animal communication to language as a result of a communicative innovation. It argues that some traces of the original linguistic forms are preserved in languages of today. Consistent with the window approach it demonstrates that innovative analysis of observable processes of formation of vocabulary in sociolects and idiolects today as well as the formation of semasiographic systems follow common patterns from which information of the beginnings of language can be extrapolated. With the help of modern technology one can extrapolate information about the nature and function of the first linguistic signs. And although individually each of above referenced findings have limited contributions to the issue at hand, collectively they clarify that language started with the invention of the first words within the multimodal communication in groups of highly social individuals with pre-linguistic bodies and minds, looking to improve their collective survival chances by being creative. From this initial but crucial point evolutionary changes in linguistic signs lead to the transformation of lexical words from motivated signs to symbols. And long before that multiple evolutionary changes in bodies, brains, minds of a number of species produced capacities potentially usable in the invention of the first lexicon. A combination of universal processes of self-organization and evolution in bio-cognitive and social contexts contributed to the formation of the first linguistic signs in the bodies, minds and communities of the inventors of the first words.

The question of a single mother tongue vs. variation from the start remains. In this sense AI

could probably help by expanding on the experiments mentioned above and design experiments where populations of interacting agents, divided by diversity of cultural values but at the same time united by perceptual universality, converge on a language-like communication system. If such experiments are possible the result would be exciting and informative. The article also aims to encourage a change of focus in future theoretical models and empirical inquiries of language origins and evolution to the origin of the word and linguistic representation of meaning more generally.

References

Aitchison, J. (2000)The seeds of speech: language origin and evolution, Cambridge University Press

Arbib, M. (2004) From monkey-like action recognition to human language: an evolutionary framework for neurolinguistics, in Behavioural and Brain sciences , 28: 105-167

Arbib M.(2007) The mirror system hypothesis, how did protolanguage evolve, in Tallerman,M. ed. Language origins, Perspectives on Evolution,Oxford University Press, p. 21-47,).

Arbib, M. (2008) Holophrasis and the protolanguage spectrum, Interaction studies, 9:1, p.154-168. John Benjamins, doi:10.1075/is. 9.1.11arb

Aronoff, M., Meir, I., Padden, C., Sandler, W.(2008) The roots of linguistic communication in a new language, Interaction studies, 9:1,p, 133-153, doi: 10.1075/is.9.1.10aro

Barr, D. (2004) Establishing conventional communication systems. Is common innate knowledge necessary? , in Cognitive Science, 28, p.937-962

Berling, R. (2005)The talking ape, how language evolved, Oxford University Press

Bickerton, D. (1984) The Language Bioprogram Hypothesis, in Behaviour and Brain Sciences, vol.7, p. 173 -221

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

Bickerton, D. (2009) Adam's tongue: how humans made language and how language made humans, Hill and Wang, Publishing, New York

Blasi, D.,Wichmann, S., Hammarstrom, H., Stadler, P.,Christiansen, M. (2016)Sound-meaning association biases evident across thousands of languages, PNAS, vol.113, no. 39,p. 10818-10823

Bloom, P. (2000) How children learn the meanings of words, MIT Press

Bybee, J., Beckner, C. ,(2009), Usage-based theory, in Heine, B. Narrog, H. Eds. Oxford Handbook of Linguistic Analysis, p. 827-855

Byrne, R., Cartmill, E., Genty, E., Graham, E., Hobaiter, C., Tanner, J., (2017) Great ape gestures: intentional communication with a rich set of innate signals, Animal cognition, 20: 755-769, doi:10.1007/s10071-017-1096-4

Chomsky, N. (1972) Language and Mind, Cambridge University Press

Chomsky, N. (1980) Rules and Representations, Columbia University Press

Chomsky, N. (1986) Knowledge of Language, Its nature, origin and use, Greenwood Publishing

Chomsky, N. (1988) Language and the Problem of Knowledge, MITPress

Chomsky, N. (1995) The Minimalist Program, MITPress

Chomsky, N. (2000) New Horizons in the Study of Language and Mind, Cambridge University Press

Christiansen, M., Chater, N. (2016) Creating language: integrating evolution, acquisition and processing, MITPress

Clark, B, (2011) Scavenging, the stag hunt and the evolution of language, J.of Linguistics, 47, p.447-480

Corballis, M. (2002), From hand to mouth, the origins of language, Princeton University Press

Corning, P.(2002), Re-emergence of "emergence": a venerable concept in search of a theory, in Complexity 7:6, p. 18-30, DOI: 10.1002/cplx.10043

Corning, P. (2003) , Nature's magic: synergy in evolution and the fate of humankind, Cambridge University Press

Croft, W.(2017) Evolutionary complexity of social cognition, semasiographic systems and language, in Mufwene, S., Coupe, C., Pellegrino, F. eds. Complexity in language, developmental and evolutionary perspectives, Cambridge University Press, chap. 5

Cuskley, C., Kirby,S. (2013)Synestesia, crossmodality and language evolution, in Simner, J., Hubbard, E., eds.Oxford handbook of synesthesia, chap. 43, p. 869-903

Cysouw and B. Comrie (2013) Some observations on the typological features of hunter-gatherer languages , in Bickel et all. Eds., Language typology and historical contingency, in honour of Johanna Nickols, John Benjamins p. 383-394, doi.org/10.1057/tsl.104.17cys

Davis,B., MacNeiladge, P.(2004) The frame-content theory of speech evolution: from lip smacks to syllables, Primatologie, vol 6, p. 305-328

Deacon, T. (1997) The symbolic species, Norton

de Boer, B.,(1998) Emergence of sound systems through self-organization,

www.ai.rug.nl/~bart/naic98.pdf

Donald, M. (1991) Origins of the modern mind: three stages in the evolution of culture and cognition, Harvard University Press

Dowman, M. (2007) Protolanguages that are semi-holophrastic, European Conference on Artificial Life: Advances in artificial life, p.435-444

Dowman, M. (2008), The nature of words in human protolanguages: It's not a holophrastic-atomic meanings dichotomy, Artificial life, 14(4), p.445-465, MIT Press doi.org/10.1162/arti.2008.14.4.14403

Ellis, N. , (1998), Emergentism, connectionism and language learning, Language Learning, , 1998, 48:4, p. 631-664

Ellis, N. , Larsen-Freeman, D. et all. 2009, Language as a Complex Adaptive System, Position Paper, in Language learning , Language learning research club University of Michigan 59 Suppl. 1 December p. 1-26,

Evans, B., Levinson, V.,(2009) The myth of language universals, Behavioural and brain sciences, 32, p. 429-492

Everett, D. (2005) Cultural constraints on grammar and cognition in Piraha: another look at the design features of human language, Current anthropology, 46(4), 621-634

Fetzer, J. (2005) The evolution of intelligence: are humans the only animals with minds, Open court, Chicago

Fitch, T. (2010) The evolution of language, Cambridge University Press

Fitch, T. (2013), Musical protolanguage: Darwin's theory of evolution revisited, in Bolhuis,J., Everaert, M., eds. Birdsong, speech and language: exploring the evolution of mind and brain, MIT Press

Fitch T.et all. (2016) Monkey vocal tracts are speech-ready, Science Advances,vol.2, n.12, 2016, DOI: 10.1126/sciadv.1600723

Genty, E., Zuberbuhler, K. (2015) Iconic gesturing in bonobos, Communicative and integrative biology, 8:1, e992742, doi:10.4161/19420889.2014.992742

Gil, D. (2009) How much grammar does it take to sail a boat? In G. Sampson, P. Trudgill, eds. Language complexity as an evolving variable, Oxford Univ. Press

Greenfield, P.,Lyn, H., Savage-Rumbaugh, S.(2008) protolanguage in ontogeny and phylogeny, Interaction studies 9:1, p. 34-50, doi: 10.1075/is.9.1.04gre

Heilighen, F. (2009), Complexity and self-organization, in Bates ans Maack, eds. Encyclopedia of library and information sciences, p.1-17, Taylor and Francis

Heilighen, F. (2013) Self-organization in communicating groups, the emergence of coordination, shared references and collective intelligence , DOI: 10.1007/978-3-642-32817-6_10

Heine, B. Kuteva, T. (2007) The genesis of grammar, A reconstruction, Oxford University Press

Heine B., Narrog H. Eds.(2009), The Oxford Handbook of Linguistic analysis

Hilliard A.,White S.(2009) Possible precursors of syntactic components in other species, in Bickerton D., Szathmary E. eds. Biological Foundations and Origin of Syntax, MIT Press, p.161-185

Hurford J. (2007) The origins of meaning, Oxford University Press

Hurford, J. (2012) The origins of grammar, Oxford University Press

Hyman, J. (1983) Iconic and economic motivation, Language,vol 59, No.4, p. 781-819

Jackendoff, R.(2002) Foundations of Language, Oxford University Press

Jackendoff, R.,Wittenberg, E.,(2014) What can you say without syntax, a hierarchy of grammatical complexity, in Newmeyer, F.,Preston,L. eds. Measuring Linguistic Complexity, Oxford University Press , chap.4

Johansson, N., Holmer, A., Carling, G., (2020) The typology of sound symbolism: defining macro-concepts via their semantic and phonetic features, Linguistic typology, 24(2), p.253-310

Klein, W., Perdue, C.,1997, The Basic Variety or Couldn't natural languages be much more simpler?, in Second Language Research, vol.13, p. 301- 347

Koster, J. (2009) Ceaseless, unpredictable creativity, Language as technology , in Biolinguistics, vol.3 No.1, p. 061-092
www.let.rug.nl/koster/paper/language%20as%20technology.pdf

Krause et all. (2007) The derived FOXP2 variant of modern humans was shared with Neanderthals, Current Biology, p.1908-1912
DOI: 10.1016/ j.cub.2007.10.008

Leaky, R. (1994) The origin of humankind, Basic books

Lenneberg, E.(1967)The Biological Foundations of Language, Wiley and Sons

Lieberman, Ph.(2007) The Evolution of Human Speech, its Anatomical and Neural Bases, Current Anthropology , vol 48, No.1. Feb. , p. 39-66

MacNeiladge, P. (1998) The Frame-Content Theory of Evolution of Speech Production, BBS, 21, p. 499-546
MacWinney, B.(20050 Language emergence, five timeframes and three illustrations, in Burmeister, Piske, Rohde, eds. An Integrated View of Language Development, Papers in honour of Henning Rhode, p.17-42, Trier: Wissenshaftliche Verlag

Massaro, D., Perlman,M. (2017), Quantifying iconicity's contribution during language acquisition, implications for vocabulary learning, Frontiers in communication, vol.2 art.4 doi: 10.3389/fcomm.2017.0004

Mitten, S. (2005) The singing Neanderthals: the origins of music, language, mind and body, Harvard University Press

Monaghan, P. et all.(2014) How arbitrary is language, Philosophical transactions, The Royal Society Publ. Doi:10.1098/rstb.2013.0299

Morford , J. (2002) Why does exposure to language matter? in Givon,T., Malle. B. eds, The evolution of language out of pre-language, John Benjamins Publishing ,p. 329-343

Morgenstern ,A., (2014) Children's multimodal language development, in Facke,C. ed. Manual of language acquisition, De Gruyter, p. 124-142

Mueller R. A.(1996) Innateness, autonomy, universality? Neurobiological approaches to language, BBS , ,Vol. 19 ,issue 4, p. 611-675

Nettle, D. (1999) Is the rate of linguistic change constant? , Lingua, (8), 1999,p. 119-136

Noble, W. Davidson ,I., (1996) Human Evolution, Language and Mind, a psychological and archeological inquiry, Cambridge University Press

Oudeyer, P.Y. (2005) Self-organization of combinatoriality and phonotactics in vocalization systems, Connection Science , vol 17,no. 3-4, 2005,Taylor and Francis p.325-341

Oudeyer, P.Y. (2006) Self-organization in the evolution of speech , Oxford University Press

Pepperberg, I. (2017) Alex the parrot, in Vonk, J., Shackelford, T., Encyclopedia of animal cognition and behaviour, Springer

Perniss, P., Thompson,R., Vigliocco, G.(2010) Iconicity as a general property of language , evidence from spoken and signed languages in Frontiers of psychology, 1:227,

Perniss, P.,Vigliocco, G.(2014)The bridge of iconicity: from world of experience to experience with language, Philosophical transactions of Royal society B, Royal society publ. doi:10.1098/rstb.2013.0300

Petri, J., Schraff, C.,(2011) Evo-devo, deep homology and FOXP2, implications for the evolution of speech and language, Philosophical Transactions of Royal Society B, p. 1-17; doi: 10.1098/rstb.2011.0001

Pinker, S. , P. Bloom (1990) Natural language and natural selection. BBS 13(4), p. 707-784

Prigogine, I., Stengers, E.(1993) Order out of chaos, man's new dialogue with nature, Bantam books

Ramachandran, V., Hubbard, E.(2001) Synaestasia, a window into perception, thought and language, Journal of consciousness studies, 8,No.12, p. 3-34

Riddley, M. (2004) The agile gene: How nature turns on nurture, Harper Perennial

Rizzolatti, G. Arbib, M. (1998) Language within our grasp, Trends in neuroscience, 21(5)p.188-194

Savage-Rumbough, S. (1986) Ape Language : from conditioned response to symbol, Columbia University Press

Seyfarth, R., Cheney,D. (2012) Primate social cognition as a precursor to language, in Tallerman, Gibson eds. Oxford Handbook of Language Evolution, Oxford Univ. Press, DOI: 10193/oxfordhb/97801119.13.0004

Seyfarth, R., Cheney, D.,(2017) Precursors to language, social cognition and pragmatic inference in primates, in Psychon Bull rev, 24(1), p. 79-84
DOI: 10.3758/s13423-016-1059-9

Slocombe, K., Waller, B., Liebal , K. (2011) The language void: the need for multimodality in primate communication research, Animal behaviour, 81 (2011) 919-924

Steels, L. (1995) A self-organizing spatial vocabulary, Artificial life, 2(3), p.319-332, MIT

Press

Steels, L. 1997, The synthetic modelling of language origins, Evolution of communication, 1(1), p. 1-34, John Benjamins

Studderd-Kennedy, M. (1998) The particulate origins of language generativity: from syllable to gesture , in Studderd-Kennedy, Knight, C., Hurford, J. eds. Approaches to the evolution of language, p.

Tallerman, M. (2005) Language origins, perspectives on evolution, Oxford University Press

Vernes, S. (2017) What bats have to say about speech and language, Psychonomic bulletin and review,vol. 24, issue 1, p. 111-117

Waller, B., Burrows, A., Liebal, K., Slocombe, K., (2013) How can a multimodal approach to primate communication help us understand the origins of communication, Evolutionary psychology, 11(3) 538-549

Wray ,A.(2003)The transition to language, Oxford University Press

Zuberbuhler, K. (2015) Linguistic capacities of non-human animals, Wire's Cognitive Science, vol.6.issue 3, Wiley Online, p.313-321

Żywiczyński P, Wacewicz S, Lister C. (2021) Pantomimic fossils in modern human communication. Phil. Trans. R. Soc. B 376: 20200204

<>*Svetlana T. Davidova* is a linguist, unaffiliated researcher, based in Toronto, Canada
address for correspondence: svetlana.t.davidova@gmail.com
