Semantics vs Lexicon – Musings on the Evolution of Language

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1. Introduction

This paper presents speculations on a possible trajectory of the development of the human language from a neurological point of view. We are not concerned about the varieties of languages currently used in the world or about the human migrations that might be responsible for the modification of words in creating the variation of sounds. Our focus is with the processing of information in human brains and mapping of thoughts into expressible syllables. From the experiments in neuroscience and through empirical observations, we have reason to conclude that the human understanding is concept-based, and not word based. The ability to develop memory concepts from the sensory information seems to be a signature of the human species.

fMRI studies indicate that concept-based neurological information in the brain is stored in a distributed manner. The breaking of a concept into components is done internally like the formation of the concept itself. Labeling of the concepts by names seems to be an artificial process where the local language use dominates against the cognitive signature in the brain. We explore the word use in primitive languages to check how the concepts find an expression before they are used as words in communication. In expressing the concept, the uttered sound itself is expected to carry the total expression of the concept possibly colored by emotion.

Concepts form the understanding of the environment where the brain may perceive a distinction. Broadly such maps of the environment at different times and circumstances label themselves as "nouns" in the language. "Nouns" can form classes of nouns leading to varying amount of area coverage in the brain. We speculate that the transformation or action performed on one class of nouns to another is the role of a "verb". The verb is used purely for

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communication and is not a part of the concepts or their recall.

2. Organization of Human Memory in Articulation

In a companion paper to the Conference (1: Misra, Nagar, Kosaras, Singh, 2015) we have tried to demonstrate that the basic state of organization of human memory is based on emotional impact. Emotional impact creates specific "memory imprints" having a distributive arrangement inside the brain. These inferences are obtained from animal experiments. We need to extend these studies examine the emotional impact on humans.

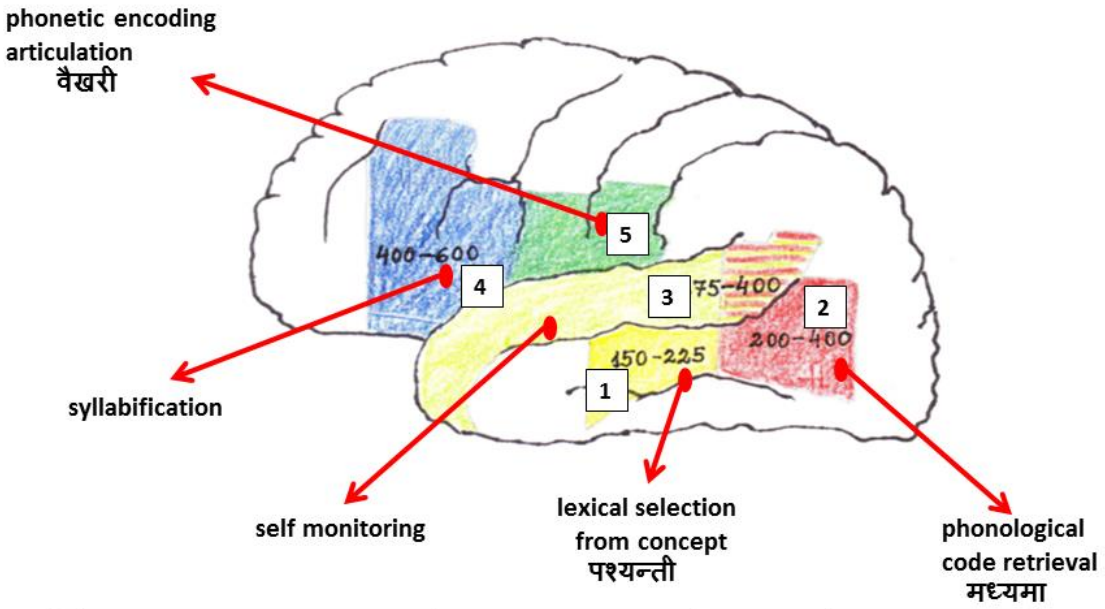
Animals are affected by two different non-invasive stimuli in creating emotion: sight and sound, or a combination of both. In human beings we have an extra dimension in words, which can be read and heard, but need an inner parsing in order to associate with an emotion. While such parsing is intuitively understood, the neural processes and the time delays are only being analyzed in the last fifteen years through controlled experiments in the laboratory (2: Indefrey, Levelt, 2004). Though the experiments used words from English lexicon, it would not be a stretch to assume that the structural processes transcend the languages. The time delays have a range and they could be a function of the language used.

The experiments of Indefrey and Levelt were done from the point of view of speech articulation. The initial trigger is through a word being thought of in the brain. At this point, the authors assert that the brain parses the word in order to visualize the image associated with the word. In the neuroscience literature, the process is labeled as "conceptual preparation". The process discriminates in the memory space and solidifies the image or the images that could be associated with the word. They estimate duration of 200 milliseconds for the process. This process is analogous to the पश्यन्ती "paśyantī" stage of the analysis by Bhartṛhari (3: Vakyapadiya).

Following the "conceptual preparation", there are processes in the brain to associate other modalities to the image in order to prepare for articulation. In neuroscience, this process is called "phonological code retrieval". It is the blob of sound that appears as a representation of the image if one attempts to express the image in audible sound. This blob would depend upon the context and possibly depends on the languages one likes to render. It would carry the intonation and stress corresponding to that language. This process may take upto 400 milliseconds to complete. This is analogous to मध्यमा "madhyamā" stage in the Indian linguistic analysis.

Finally we have the process of "syllabification and articulation". We connect this phase to the वैखरी "vaikharī" stage of Bhartṛhari. This phase organizes the phonemes, triggers the

oral muscles to produce speech and eventually creates the utterance. Figure 1 sketches the anatomical regions and the processes involved with the speech articulation as obtained from the experiment.



	Brain Area	Activity	Time-Scale	Indian Grammatical Term
1	Middle and inferior temporal gyri	lexical selection from concept	150-225 msec	पश्यन्ती
2	Middle temporal gyrus and parieto-occipital gyrus	phonological code retrieval	200-400 msec	मध्यमा
3	Superios temporal gyrus	self monitoring	275-400 msec	
4	Middle and inferior frontal gyri	syllabification	400-600 msec	
5	Pre-and postcentral gyri	phonetic encloding and articulation	600- msec	वैखरी

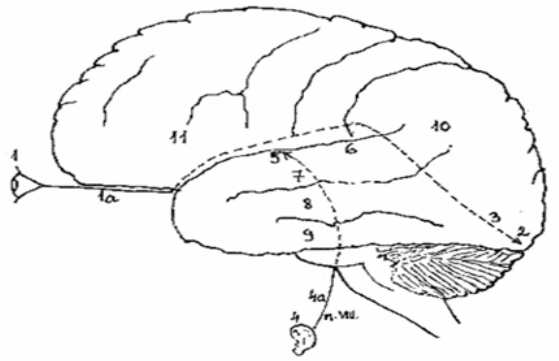
Figure 1

The experiment used word as the trigger for the process. But we have to go back in time when no words existed. In those times we have to assume that the stimulus for expression of sound rises out of emotion. Emotion can be created by external sight and sound or internal thoughts. The trigger due to the internal thoughts has been called परा "parā" in Indian literature. परा could be connected to the inception stage in the analysis given above.

3. Semantic Representation in the Brain

The reverse part of articulation is the process of how a word or a fragment of sound is understood by the brain. These experiments confirmed the reverse order of the above steps. The steps are: (a) detection of phonetic features (100 milliseconds) (b) segmentation to lexical

code (200 milliseconds) and (c) lemma retrieval (100 milliseconds). The process of lemma retrieval lets one get the word concepts. A final step is still needed to have the full



	Structure	Function I	Function II
1	Eye/retina	visual sensory organ	reception of color, shape, movement
1a	Visual neuronal pathway	conduct electrical messages	some processing occurs
2	Primary visual cortex	percepts information	retinotopic processing of information
3	Secondary visual cortex	combines modalities	associates modalities
4	ear/organ of Corti	auditory sensory organ	filters intensity and wavelength
4a	auditory neuronal pathway	conduct electrical messages	localizing the sound
5	Primary auditory cortex	percepts information	separation to tone
6	Wernicke's area	sensory auditory cortex	sensory perception of speech
7	Superior temporal gyrus	self-monitoring	examination through memory
8	Middle temporal gyrus	lexical encoding	lexical encoding and retrieval
9	Inferior temporal gyrus	lexical encoding	lexical encoding and retrieval
10	Parietal association cortex	combining multimodalities	association context and image
11	Middle and inferior frontal gyri	conscious processing	syllabification-concept grammar

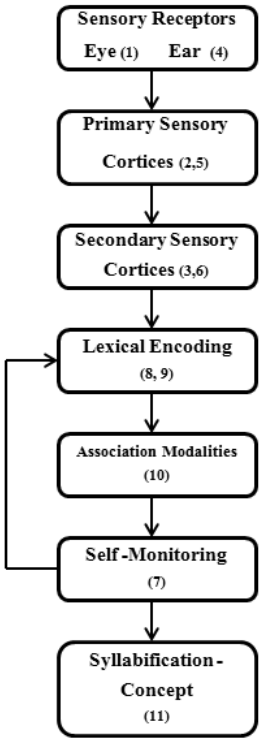


Figure 2

Comprehension of the sound as heard. We examine the experiments referred to in the following review (4: Buchweitz, Prat 2013).

The review dealt with multilingual syntactic parsing in the brain. The imaging studies showed that all parsing is done in specific areas of the brain. They were independent of the languages used. They were also independent of the mechanics of grammar. The studies further showed that the words with similar meanings lighted particular areas of the brain regardless of the language. For example, "cabana" in Portuguese and "hut" in English would point to the similar memory location in the brain. Experiments in sentences had similar result as long as sentences had similar meaning.

Specific experiments were done to test the memory pointers in interpreting words from Japanese and Korean (5: Buchweitz, Mason, Hasegawa, Just, 2009). A set of words with similar

meanings written in Japanese kanji, syllabic kana and in English were presented to a group of subjects. Imaging studies were conducted to monitor their brain in comprehending the word. The results showed that the syllabic and logographic representations had similar comprehension activation. They concluded "*What the brain activation indicates is that there is activation in cortical areas that may be associated with the recognition and processing of words and letter-to-sound mappings, and with the additional working memory load of keeping these mappings active."* At the conclusion they said: "*the data indicate that within the same language, sentence-level processing can elicit differential cognitive responses associated with word-level comprehension processes, and across languages, with more cognitively demanding phonological rehearsal processes."* Such results have been repeated in later experiments. Figure 2 gives a brain representation and the processes in word comprehension obtained from the literature.

Experiments to check the emotional impact through external stimuli have not been attempted on humans. But the experiments cited above suggest that provide the inference that comprehension is at the semantic level and not at the lexical level. The phonetic structure, the morphology and the syntax are only external wrappings. The essence of a word or a sentence is comprehended through a permanent cortical mapping. This semantic representation has been given the label स्फोट "sphoṭa" by the grammarian Bhartṛhari (6: vākyapadīya).

4. Development of Syllables, Baby Learning

A series of experiments using magnetic resonance on infants, Patricia Kuhl and her associates produced a revolutionary finding. They found that the infant's cognitive memory to language is as comprehensive as that of an adult. The infant has the full capacity of perceiving all stimuli presented to him/her and have an impression of the experience recorded in the memory. The stimuli may include sights, sound and speech. (7: Kuhl, 2010) The early infant (8 Mo) does not distinguish between native and non-native speech phonemes and is driven by the sound as a stimulus only (8: Kuhl, Ramírez, Bosseler, Lin, and Imada, 2014)

Studies on infant's vocal articulation have suggested a distinction between the expressive capacity and the motor control in uttering a sound. The brain and the musculature of the newborn are not fully developed to assist the sensory-neuro-muscular unit of the movements and sound creation. As the development of the dendritic tree of the neurons and the myelination progresses, it provides a better and faster transmission to the parallel developing muscles. At the beginning the baby can produce only generic sounds like "k", "g", "m", "p", "b" which are audibly discernible. Later with the more precise neuro-muscular

control they can express more complex sounds (9: Kuhl, 2010, Ibid.). All expressions by the infant until about eleven months of age are restricted to these sounds.

The articulation range and the phonetic diversity exponentially increase when the baby tries to learn the lip movements from the care-taker/mother. This is where the transition to the native language happens. The baby gradually develops a vocabulary and accent in the native language, though non-native language also can be taught with ease (10: Kuhl, Conboy, Coffey-Corina, Padden, Rivera-Gaxiola and Nelson, 2008). Experiments suggest that a baby can be a good bilingual speaker if two separate languages are heard by the baby. The baby has the capacity to cognize and to articulate in both (11: Buchweitz et al, 2013, ibid.)

The baby's ease of learning of grammar has been hypothesized to be connected to an innate attachment to grammar for human beings (12: Chomsky, 1977). As we will see below, the speech examples of hill tribes of South Asia do not show evidence of syntactic sentence construction. People in the interior communities can communicate through accents and prosody without depending on the use of verbs; the vowel endings are applied as indicators of stress and time. This could be similar to a baby's single word articulation.

Given the processing of external stimulus as presented in the previous section, we can now speculate that the baby creates an object-referenced memory structure which has secondary links to perceptual emotion. New inputs in such a structure would register as "relationships." Recall would be a process of reconstruction. Memory would be based on a few primitive objects located at certain specific areas of the brain that make the maximum impact in the infant's life (13: Rogerson, Cai, Frank, Sano, Shobe, Aranda, and Silva, 2014).

5. Nouns and Verbs

In a carefully constructed experiment in 1993 (14: Antonio and Tranel, 1993), the neuroscientists discovered the differential treatment of nouns and verbs in the brain. The results suggested that the nouns and verbs were stored in different parts of the brain. The nouns followed a class concept and the specific information was embedded in an overall neural complex. So the word sounds "cow", "horse", "elephant" were stored in a generic blob "animal" and recalled as animal" with specific features. The verbs had a more direct storage, and not hierarchical. Each verb was accessible with less effort than the phonetic coding for the nouns.

The results lead to two speculations: (i) lexically constructed object names have a lower priority in memory storage than the conceptual understanding (ii) verbs are parsed out from the sentences to be stored as a relational contextual system to the concept nouns. From our memory operations in recall, all our memory objects are "present" and the "time" or "location"

context do not come into consideration. We speculate that the grammar and tense use are not part of human information gathering, but a tool of communication.

Like a baby operating in an object-dominated universe, we also have examples of primitive tribes operating with a limited set of phonemes and words. In a peculiar finding the researchers discovered that a primitive tribe Pirahã in Amazon had difficulty in appreciating a monkey's image on a computer screen. Unlike the common literary knowledge of language speakers, the experiment established that there was a difference between the natural object and its rendering. (15. Colapinto, 2007, 16: Everett, 2005). This distinction could be a biological human instinct that the concepts we store in the brain are the natural objects as we determine through our senses. Such observation was made by the grammarian Bhartṛhari as early as 700 AD, where he used the word प्रसिद्धि "familiarity" for the commonly known objects. देशकालेन्द्रियगतैर्भेदैर्यद् दृश्यतेऽन्यथा। यथा प्रसिद्धिर्लोकस्य तथा तदवसीयते॥ *"A thing which appears otherwise, due to differences in time, place or the sense organs, is, nevertheless finally understood in the form in which it is well known to the world."* (17: Bhartṛhari. Translation by K. R. Pillai) Grammatically the renderings are separate related objects and might be connected by suffixes to the original मृगपश्वादिभिर्यावान् मुख्यैरर्थः प्रसाध्यते। तावान्न मृन्मयेऽप्यस्ति तस्मात्ते विषयाः कनः॥ *"Actions of the type performed by the original animals are not performed by their models of clay. Therefore "kan" is added to such words."* (18: Bhartṛhari. Translation by K. R. Pillai).

We must make a distinction between comprehension and communication. Comprehension is a function of our personal information management, matured through our senses independent of a vocabulary. Communication needs a context to a second party, the second person's capacity and the language. Vocabulary comes into play through communication and is language-dependent. The identification of the object on the other hand is language-independent being cognized by the shape, size, sound and utility. The baby receives the labels for the cognized objects from the mother and the local environment. The baby lumps all similar objects into the same label confirming the class concept of memory.

When the concepts are "present" there is no need of a verb. The object exists or does not exist. Any variation of the object becomes a function of the class. The relationship between objects is expressed as prosodic variation which is the signature of the primitive language including the baby language (19: Kuhl, Conboy, Coffey-Corina, Padden, Rivera-Gaxiola and Nelson, 2008).

6. Sound and Word

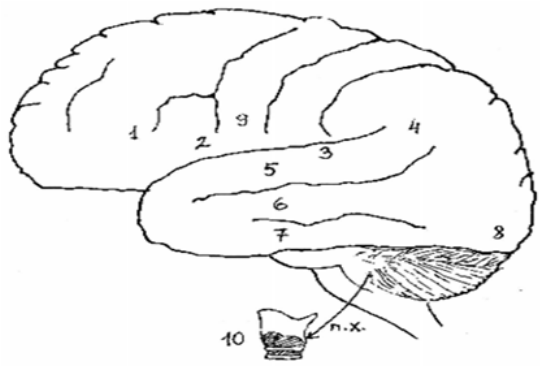
The grammarian Bhartṛhari had theorized two different variations of the perception of the sound unit containing the word: स्फोट "signature" and अर्थ "meaning". स्फोट is the conceptual essence of the sound unit as it registers in the brain. Its conceptual value is distinct and unique to the recipient. It is possible that the conceptual value in the sound unit as it registers in the human brain is universal in nature. This can lead to the metaphysical thought that the essence of sound is indeed the essence of the universe. Such concept has been called नादब्रह्म "nādabrahma" in the literature. The idea is that one can create the universe from the trace of a sound.

While the स्फोट relating to a concept is likely to be independent of the individual, its interpretation might not be. The interpretation अर्थ is a function of analyzing the sound into smaller components, determining the possible sequence of phonemes, checking if the sequence has any local cultural value or popular use, and interpreting a meaning. Thus the registered concept can assume various forms by its lexical decomposition with the appreciation of the stress and intonation on the syllables. These variations do "color" the sound by associating our interest when we convey our speech. The origin of the speech is in the स्फोट level, but the word uttered has a lexical sequence along with the stress and intonation. In Figure 3 we summarize the existing neurological information on the articulation of speech from the basic स्फोट.

Thus, Bhartṛhari continues to make the point that a word in its semantic concept is as indivisible as any of its perceived component parts. It is a global sound unit and is accepted as such. पदे न वर्णा विद्यन्ते वर्णेष्ववयवा इव। वाक्यात्पदानामत्यन्त प्रविवेको न कश्चन॥ *"Just as there are no parts in letters, there are no "letters" in the word. Nor there is any reality in abstracting a word from a sentence."* (20: Bhartṛhari, Translation by K. R. Pillai). We may impose grammar on words to restrict their application value in order to conform to their accepted usage. One needs grammar to understand pre-composed material which is syntactically composed by the author. In some sense, we learn to superpose the new learned meaning on the old स्फोट to create a new conceptual understanding. So, any new sound we hear gets analyzed by this transformed framework. This could be empirically true for all the different languages in the world.

The transition from the first principle conceptual understanding to guided understanding through the language lexicon apparently begins at eleven months of age when the baby accepts

mother's language (21: Kuhl etal Ibid 2008). In such a development, the expressive capacity of the baby is replaced by the need for communication. We can conclude that the endowed faculty of understanding is replaced by a cultural mode of survival through artificial labels to



	Structure	Function I	Function II
1	Prefrontal and middle frontal gyri	conscious processes	unpacking concept memory
2	Broca's area	articulation commands	syllabification
3	Wernicke's area	sensory auditory cortex	sensory perception of speech
4	Parietal association cortex	combining multimodalities	identification context and image
5	Superior temporal gyrus	self-monitoring	examination through memory
6	Middle temporal gyrus	lexical encoding	lexical encoding and retrieval
7	Inferior temporal gyrus	lexical encoding	lexical encoding and retrieval
8	Visual cortex	processing visual information	process color, shape, movement
9	Motor cortex	organizing motor responses	sending commands to muscles
10	Laryngeal muscles	muscle movements	articulation-vocalization

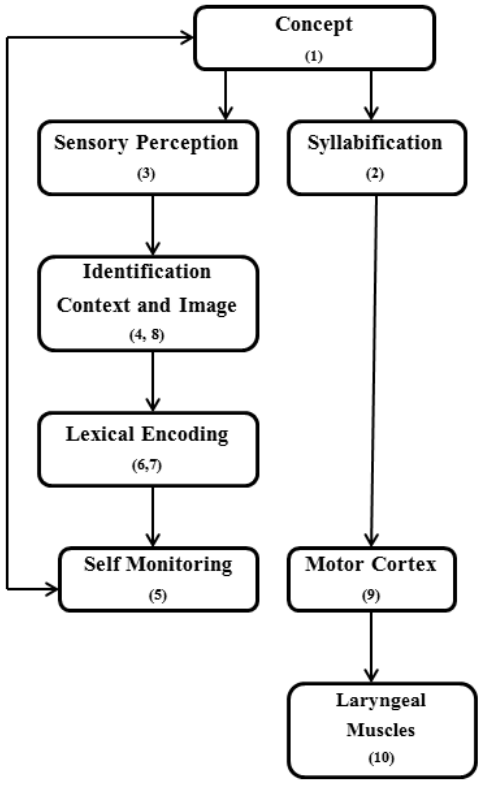


Figure 3

sound units. We should point out that this is where the Pirahã tribe distinguishes itself by differentiating the natural object from the rendered object.

7. Cognitive Grammar

As we have cited before, human beings are endowed with a capacity to accept the sensory information and create a storage record of the information. Such storage could be selective and could be unique to the individual through his/her genetic makeup and cultural environment. This storage and memory develops early in life and goes on building relationship links with an internal self-monitor (22: Rogerson et al, 2014) Such memory is based on pure

information as sensed by the individual and is not associated with any words or vocabulary. We will call it “cognitive memory.”

It is the cognitive memory that goes into the process of “understanding.” It is behind the manifestation of the स्फोट process. It is the identification and relationship of the person to a stimulus. Such process is complete only when the original signature is etched in the cognitive memory. As we observe, such etching is a function of one’s “intentionality,” borrowing a term from neuroscience. Intentionality is individual’s own assertion than being externally imposed. “Cognitive memory” is selective in its storage and possibly starts forming very early in the childhood.

We can further speculate that the “cognitive memory” has a packing function that new material gets linked to the old material and is stored together. The packing can be dense and the capacity can be large. This packing is however concept-based as we observe in the recall process. There is reason to suspect that the cognitive memory is more like a compressed knot that reveals information as we try to force “recall”. Such activity can lead to “imagination”, but no imagination gets stored. A connected imagination becomes an idea and becomes functional through words.

The Indian philosophical concept of बिंदु “bindu” (“point”) has similar concept in both philosophical and cosmological sense(23: Atharvaveda). The information can be packed to a point and can be visualized through intentional recall. Though the packing process is not a design imposed by the individual, the recall is. It is easy to experience that the “recall” has a lot more details that we might be aware of. They are linked and are contextual. This process of selective packing has an individual order to it and we will call it “cognitive grammar”. It is based on our inner ability to “remember” and is most likely a built-in defensive tool for the human species.

“Cognitive Grammar” is different than the “Universal Grammar” advocated by Noam Chomsky in his theory of language (24: Chomsky, 1965). Universal grammar bases itself on the observation of sentence structure and the capacity of recursive use of clauses in the sentence. It is a process of communication and not a process of understanding. “Cognitive Grammar” could be a part of the “conceptual-intentional” segment as presented in the review paper by Hauser, Chomsky, and Tecumshe Fitch (25: Hauser, Chomsky, Fitch, 2002). Though they present it in the speech context, we believe that the packing has a built in design which creates a defense mechanism for the individual.

This particular packing that we are talking about could be more wide-spread than just being confined to humans. The number of "centers of activity" could be restricted by the habitat and need. We speculate that humans are endowed with infinite capacity to capture varieties of experiences and store them in memory by default to be recalled in need. This capacity of recall and vocalization of a particular track or connecting multiple tracks is the beginning of the computation subsystem "Faculty of Language Narrow" as expressed in the review paper mentioned above.

8. Vocalization, Creation of Word

As observed by the authors in the above review, humans carry the capacity of broad range of phonetic expressions, which could be (i) natural, or, (ii) reproduced through imitation. Many memory impressions of interest do carry their phonetic information with them and we can reproduce them if we direct our intention to them. The important part is that activation of one area can lead to the activation of other areas depending on our intentionality which is the foundation of imagination and creativity.

As we observe in the Pirahã language, it is restricted to the basic phonemes that have evolved locally and are not externally influenced. We also learn that the Pirahã people refuse to learn new phonemes being taught in their own environment. We can only speculate that uprooting them from their environment and by flooding them with non-native sounds might create new centers of cognition and possibly help them learn new language. It would not be easy. This has been the basis of bilingualism as we discussed before (26: Buchweitz et al, 2013, ibid.). In the particular Pirahã case, the learning of a new language was found to be a most difficult task (27: Everett).

The question comes how does the store of concept based memory information convert to create words for communication? We note that the numbers, colors, non-parental relationship are not basic concepts and are filtered out from the memory storage. It is quite possible that the first articulation could be a "prosodic rendering" of recalling a memory event (28: Colapinto, 2007, Ibid.). Such articulation would be confined to the reproducible phonemes that the human being is capable of rendering.

We speculate that the first adult human vocalization could be a prosodic articulation of mood associated with the memory. The mood can only be a function of recalling an interaction with an object; hence our thinking is that the first vocalization related to an object was either lovingly rendered or uttered in remorse. Either way, the uttered sound would help represent the object. We are completely in dark about how the recall function would translate into vocalization. We would close by saying that it is peculiar human capacity distinguishing the humans from other species.

Once the articulation is understood or taught by the mothers to children, new prosodies can develop and possible sentences can be built. Hence we agree with the Chomskyian theory that the first part of articulation is intentionality reflected in the mood associated with the event in the memory. This intentionality brings in the tone and intonation. While the phonemes could be few, a variety of expression can be built by varying the tone. This capacity of reproduction of sound is uniquely human.

9. Prosody and Vowels

Prosody is the usual way of communication in the known tribal languages in the world including those in India. A prosodic phrase may contain a consonant embellished with allophonic vowels with intonation. With variation of tone and time duration of the vowel rendering, the concept of time and space can be conveyed. Eventually the vowel rendering expresses the activity of the object rendered by the consonant phoneme.

In the word structure, a vowel may initiate a word and various consonants would follow to cause different semantic concepts. The following is an example from Santali (29: Majhi, 2012) in India. We give the Santali sounds transliterated in English and their meanings expressed in English. "*o*" – burning stick, "*ot*" – earth, "*otā*" – (verb) press down, "*ote*" – (verb) listen , "*oṅ*" – breath, "*ok*" – burn, "*oj*" – work, "*oh*" pain, "*or*" – drag, "*on*" – grain, "*og*" – mother. The language also is phoneme-limited though we do not have documentation on its grammar. We have no explanation on the use of consonants in the above string of words. We think that such single syllable words are the trace of the early rendering of thoughts into words.

Another way, vowels come in play is to make verbs out of the of consonant phoneme words. We can check in Oriya, an Indo-European language. "प" "pa" can be a symbolic presentation of "water," obtained from primitive lip movement. "पि" "pi" is a verb denoting "to drink", "पिए" "pie" meaning "drinks normally", "पिउछि" "piuchi" meaning "is drinking", "पिइछि" "piichi"meaning "has drunk", "पिउथाए" "piuthāe" meaning "habitually drinks", "पिइथाए" "piithāe" meaning "habitually drunk", "पिआहुए" "piāhue" meaning "drinking happens", "पिइहुए" "piihue" meaning "facilitates in drinking". We would not go into the detailed analysis, but to observe that there is a distinct difference in attaching "आ" "ā" , "इ" "i", "उ" "u" and "ए" "e" to the verb. "उ" seems to connect to the event happening currently, while

"इ" seems to connect to a state just finished. "आ" denotes the action of the verb and "ए" adds empiricism and regularity.

We have not examined how general sub-vowel insertions are in the other languages. But we are amused to notice that old Oriya has the following substitutions of vowels to connote meanings. "क" "ka" stands for "who", "का" "kā" stands for "where", "कि" "ki" stands for "what", "के" "ke" stands for "who (plural)". "कु" "ku" does not fit in this series and used as a particle (30: Mahapatra, 2009). Tabulation of other old language structures might give some clues to the neurological foundation for vocal representation from the semantics.

10. Sentence structure and Cultural imprint

From the neuroscience analysis of memory, we can assert that memory operates on relative

Table 1

Sentence (English)	**Punjabi**	**Hindi**	**Oriya**	**Hungarian (sequence of words interchangeable)**
The sun rises in the east (1)	Suraj charde paase chardda hai	Surya puurvame.n nikaltaa hai	Surya puurvadigare ue.n	A Nap keleten kel
The sun is rising in the east (2)	Suraj chard riha hai	Surya puurvame.n nikal rahaa hai	Surya puurvadigare uu.nchhi	A Nap keleten most kel
The sun has risen in the east (3)	Suraj chardiya hai	Surya puurvame.n nikalaa hai	Surya puurvadigare ui.nchhi	A Nap felkelt keleten
The sunrise happens in the east (4)	Same as (1)	Suryodaya puurvame.n hotaa hai	Suryodaya puurvadigare hue	A napkelte keleten van
The sunrise is happening in the east (5)	Same as (2)	Suryodaya puurvame.n ho rahaa hai	Suryodaya puurvadigare heuchhi	A napkelte most van keleten
The sunrise has happened in the east (6)	Suraj chard giya hai	Suryodaya puurvame.n huaa hai	Suryodaya puurvadigare hoichhi	A napkelte megvolt keleten
The sun rose in the east (7)	Suraj chardiya si	Surya puurvame.n nikalaa	Surya puurvadigare ui.nlaa	A Nap keleten kelt
The sunrise happened in the east (8)	Same as (7)	Suryodaya puurvame.n huaa thaa	Suryodaya puurvadigare helaa	A napkelte keleten volt

links and context. This would indicate that object relationships would be more contextual and relative than independent existence. We have a concept stack rather than a lexicon stack. Words are created from the concepts on demand at the time of verbal expression. In order to examine the concept we take eight simple sentences and examine in four different languages representing the authors of this paper. The sentences and their renderings in Punjabi, Hindi, Oriya and Hungarian are given in Table 1.

Detailed analysis of the semantic mapping in different languages would be done in a separate paper. Currently we wish to observe that sun's relationship to the east is a sematic feature that the languages bring out. In Punjabi "east" is built on to "rise" and is not explicitly used. Aside from the empirical statement in (1) "east" can be omitted in all phenomenological sentences without losing meaning. In Punjabi, the "sunrise" does not seem as a separate concept, but is equivalent to "sun" associated with the verb "rise". All example cases suggest "sun" to be a single conceptual block with built-in attributes and links.

11. Sound as Signature

The linguistic analysis of the world's languages has been done on the basis of cognates extrapolated by empirical theories of accent in migration and acclimatization. The cognates that are used in creating families of languages would not be the primitives associated with a semantic origin but would be the remnants of the first communication. We wish to claim that the syllabic structure of the utterance is different than the cognitive structure in the brain. We do develop brain anatomical areas where the syllabic structure is interpreted and comprehended by the brain.

We have reason to believe that the brain operates on sound cues and signatures. Hearing is our most important attribute giving us the complete understanding than what is visual. The cosmological principle of sound is also a consideration. Śrīmadbhāgavatam observed अर्थाश्रयत्वं शब्दस्य द्रष्टुर्लिङ्गत्वमेव च। तन्मात्रत्वं च नभसो लक्षणं कवयो विदुः॥ (31: Śrīmadbhāgavatam) Broadly translated: "Sound is the property of space and carries the signature indicating the object". It's the object's shape and properties that are stored in sound. We would speculate that the brain has the capacity to decode the sound signals to alert action. We have labeled this capacity as "cognitive grammar".

The elements of sound decomposition to facilitate grammar are more difficult to decipher and are embedded in the inherent neurological structure in the brain. Such facility would be a signature of the human species which involves sensory perception, analysis, decomposition and comprehension. The time delays in the analysis are more in the lexical detection than in semantic comprehension. We do not know the minimum structured sound

unit that can be computationally processed in the brain. Cultural issues and familiarity possibly do play a crucial role.

Merrit Ruehlen in his book "The origin of Language" tries to demonstrate that "*all the languages currently spoken on the earth are the descendants of a single ancestral language*." (32: Ruhlen, 1994). The question is what is the trace of the cognates that we can use to reconstruct? We have to examine if it is the semantic meaning of "ma" that prevails in the human species or if it is the lexical presentation of "ma" in logos or in syllables. In our view the latter are artificial and more of a convenience than evolutionary.

12. Evolution of Language

A syllable is only a manifestation of an internal thought. We only know the anatomical regions that participate in converting a thought to a word, but we do not know how the

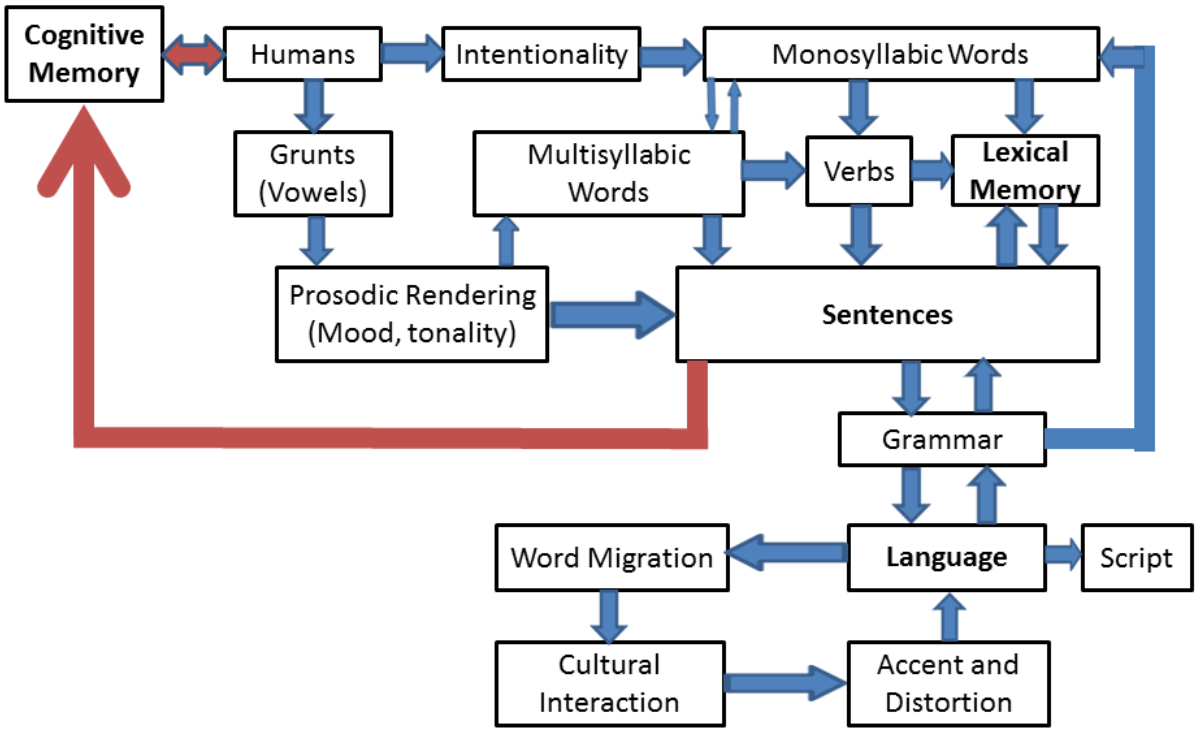


Figure 4

mapping may operate. We rely on our memory for phonological reconstruction where sound signatures are stored representing our internal understanding. We accept that the internal understanding is an innate capacity while expression is a function of cultural influence and the physical capability of our muscles. Given our analysis, we present in Figure 4 our views about the possible steps in the evolution of the human language. We do show the importance of the "cognitive memory" in the sketch. The development of "cognitive memory" is not considered in the sketch.

The origin of human speech possibly happened at multiple locations with different syllable/word creation at different locations. These proto-syllable/proto-words form the basis of the cognates in different languages. Possibly there is an evolutionary path for each area depending on the habitat and evolution of culture in the area. The early language could be vowel dominated and expressed in prosodic patterns. The neurology of prosody is another area that needs to be examined and understood.

13. Epilogue

The need to communicate from what one comprehends about objects and the world gives rise to processes in the brain to turn concepts that are stored in brain into words. This need is biological and social. The ability to turn objects and sounds into words is biological. In the evolutionary process it seems to have become hard wired in humans. Given a particular social and historical context, a particular language comes into being or has come into being in interaction with nature and humans. In neuroscience as we have seen it to be referred to as "social brain"(33: Kuhl, 2010, Ibid.) at work. Due to socialization certain lexical rules are learnt in a particular context, which become grammar of a language, determining how the nouns and the verbs are related. That is why it has been said that learning language is like learning a game and rules of the game is called grammar (34: Wittgenstein, 1999). But lexical relationships cannot reflect the semantic comprehension or landscape of one's understanding as cognitive economy at work operates on the basis of a minimalist program (35: Chomsky, 1995). It is for this reason some thinkers have called language as "frozen consciousness" (36: Marx, 1844) or that we do not speak language, but language speaks through us (37: Heidegger, 1996).

Given the different conditions and interaction, different scripts arose to help write the spoken word. This rendering can and does develop a sophisticated system of signs, symbols and signifiers to convey meaning in order to communicate. Vocabulary, grammar and script, over the millennia have become essential for the language. While convenient, none of them is necessary for brain to process what it receives from the world. It is only a clothing for the thought, but not the thought itself. We quote from *ṛg veda* (1.164.45) चत्वारि वाक्परिमिता पदानि तानि विदुर्ब्राह्मणा ये मनीषिणः। गुहा त्रीणि निहिता नेङ्गयन्ति तुरीयै वाचो मनुष्याः

वदन्ति॥ “ "Speech hath been measured out in four divisions, the Brahmanas (wise men) who have understanding know them; three kept in close concealment cause no motion; of speech, men speak only the fourth division."(38: Griffith)

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