

## **Evolution of Human Language: Limitations of Contemporary Approaches and Comparison of Minimalist Principle (Chomsky) and the Integration Hypothesis (Miyagawa)**

**Mohammad Nehal and Mohammad Afzal**

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### **Abstract**

The evolution of human language has puzzled linguists, biologists and psychologists, as its relevance is also professionally important for clinicians and neurologists. Much that has been learnt about speech and audition and their evolutionary homology with the ancestors, language remains unique and an internal asset exclusively of modern man, different from so-called communication. It is largely an abstract computational cognitive system which is unique with a universal grammar which is a tool for generating thought. In that sense, it is a human faculty of recent evolution some 100,000 years ago. The central characteristics of this faculty is the 'merge' principle which produces a set from the subsets, say, a and b, as (a, b). This set is further having feature of displacement which has a different outcome. This basic structure is then roped with atoms of concepts, so-called words, which then carry the complete meaning. This is called the strong minimalist principle (SMP) of Chomsky which has a great scope for solving the so-called language puzzle for the linguists. In yet another attempt to improve the merge origin of human language, Miyagawa, et al. (2013, 2014) have put forward a recent Integration Hypothesis which takes the human language to consist of two structures\_viz expression and lexical one each of which is unique to the bird and the monkey respectively and in man has come together in one place..The present article outlines both the views and suggests some insights from biological perspective (evo-devo approach) to reach the possibility of empirical validation of the evolutionary linguistics.

### **Key words:**

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## **Introduction**

A very comprehensive review has appeared in the “Frontiers in Psychology” by a group of authors who represent the pinnacle of thought in evolutionary linguistics. The article “the mystery of language evolution” by Hauser, et al (2014) presents a very gloomy picture of the efforts towards studying evolution of language. These are the authors whose individual citations exceed over lakhs, and all are experts in their own fields. They have argued that all approaches to evolution of language are limited by major pitfalls namely (i) comparative anatomy of non-humans has no relevant parallel with human communication (ii) paleontology and archeology have little fossil record base and behaviour details, (iii) genetics of language is still impoverished in connecting genes to linguistic processes and finally (iv) modeling and simulation attempts have no solid empirical base for strong foundation of language. They have also suggested some ways ahead for tackling these problems.

## **Comparative Animal Behaviour**

Most animal studies in natural communication are simplistic, acoustic and gestural being different from human faculty of articulation of speech. A proper phonology must be defined for visual and acoustic signals, familiar to phoneticians. Secondly, the communicative signals have been studied in the field work, which can be studied in captivity for recording details of stimuli and their connection with the environment (viz for chimpanzees, monkeys and dolphins).

As far as the training of artificial language is concerned, these are heavily biased and conditioned to include massive training in small samples. Alternatively neural recording of the free-moving animals, sampling of mismatch negativity and the nature of stimuli should be done in detail.

## **Paleontology and Archaeology**

Little is known about the function rather than the size of the skull or its structure. Current work with imaging technology reveals very much intricate circuitry. Hence detailed study of the

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hyoid bone (Arensburg et al. 1989), the jaw morphology and homological structures should be studied meticulously. Archeological excavations are of recent past; still more ancient data may give us evidence for symbolic activity, the record of less iconic forms and with ordered structures.

### **Molecular Biology**

In molecular biology, the problem is not of language per se; rather our ability to map genes to complex behaviour comes first. This needs genomes of extinct animals, if possible, and creating transgenics and the model organisms, with knockout experiments despite the ethical bottlenecks involved. Can we insert human genes to developing ape brains? Selection studies further require more records of mutations from *H. neanderthalensis* and *H. sapiens* and their effect on changes in the language faculty.

### **Modelling**

This requires minimal realistic models tested with respect to the plausibility of their assumptions. Obviously this includes core process of generative computation, together with syntactic, semantic and phonological representation.

While the article has numerous suggestions and provide an outline for future evolutionary linguistic research, the need for a central guiding principle in deciphering the evolution of human language can't be ruled out. This requires deep speculative thought as well as strong theoretical rigour for grasping the essence of the problem. Noam Chomsky (2002), as the doyen of modern linguistics he himself is, has shown the way ahead. His strong minimalist principle proposed few years ago is a major way out in solving this problem. These insights have gained much evidence from recent biological findings of paleontologists, geneticists and archeologists, not-with standing psychologists and neuroscientists.

A brief survey of these is presented here:

- (i) Externalized language is communication different from its inner core and the evolution of communication is different from evolution of language (Berwick et al 2013).

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- (ii) Neither speech nor visual communication of ‘Sign Language’ is like the evolution of language, nor haptic one in case of deaf and dumb (Chomsky 1986).
- (iii) Language evolution deals with computational cognitive mechanism that constitutes hierarchical syntactic structure (Berwick et al 2013).
- (iv) Comparative linguistics, similarly, can’t have any non-human language to be compared with. The nearest similar animal condition for syntax is birdsong (converging evolution). Chimpanzees lack this faculty altogether, while phonological syntax has some song rules in case of birds like the grammar in humans (Gobes and Bolhius 2000, Genter et al. 2006; Abe and Watanabe 2011; Berwick, et al. 2011; Beckers et al. 2012; Bolhuis and Mediators 2013). Avian vocal learning in bird species synchronizes their behaviour pattern somewhat similar to human prosodic processing (Shukla et al. 2011).

#### **(I) Strong Minimalist Thesis and Merge (Chomsky 1986; Chomsky 2000)**

Bolhius et al. (2014), in order to, search for a language phenotype suggested, “merge” to be convenient notion which requires two types of mappings – (a) the first one comes as internal conceptual interface or thought and (b) the second one includes sensory motor interface externalizing language as speech, sign or other modality. Neuroscientists have already found cortical bases of constituent structure of sentences in the brain (Pallier et al, 2011) while this type of pattern is entirely lacking in chimpanzees (Yang 2013). Before the appearance of merge, therefore, there was no combinatorial ability, viz., of either “box “or black large box” and “A cat in the black large box drank milk (word to phrase and sentence).” From evolutionary account, merge is uniformly present across all human population unlike the variability to digest lactose or showing skin pigmentation.

One line of anthropological evidence for evolution of spoken language is given as the relationship between basic cranial flexion, laryngeal descent and ability to produce sounds, hence searching evidence in large structure of hyoid bone. A fossil hyoid bone of Neanderthal man has been discovered from *Kebara* (De Anastasis, et al., 2013) which has been studied through reconstruction study of its biochemical internal structure and function allowing for capacity of

speech among Neanderthals. This also showed that speech is not sufficient for language evolution as the Neanderthal had no language.

Another evidence to link language with symbolic thought has come from archeology. Objects from the African middle Stone Age contained pierced shell beads from 100,000 years old sites and Blombo caves from South Africa with its geometric shapes 80,000 years ago. Although these appeared as early as 20,000 years ago for *H. neanderthalensis*, it is not direct evidence for language evolution either. The same conclusion also comes from genomics, the Fox P<sub>2</sub> protein being present in Neanderthals, but that is not a language gene, though it is coding the transcription factor important in helping language. Language seems to have arisen from a rapid change brought about by a rich cultural stimulus that led to a civilizational change. However the cost paid by the species was huge, as descent of larynx and gullet makes it impossible, to breathe and engulf something simultaneously that could even lead to choking.

The rapid change brought about by cultural stimulus is an affront to Darwinian gradualism. This is important as requirement for language was present before the advent of modern man; the distinction of producing sound was present as ‘bat or pat’ and also for faculty of audition to discriminate sound pitch (heaving) was present in the ancestors. The transition however, from pre modern human to modern human, was rapid one due to emergence of ‘merge’ which linked the so-called ‘concept’ and the expression power of man provided by language. Without ‘merge’ we can’t connect string of words with the concept or meaning in hierarchical series. This is same as mathematical calculation with large numbers can’t be done without the use of figures or the notations of algebra.

## **(II) Integration Hypothesis of Miyagawa**

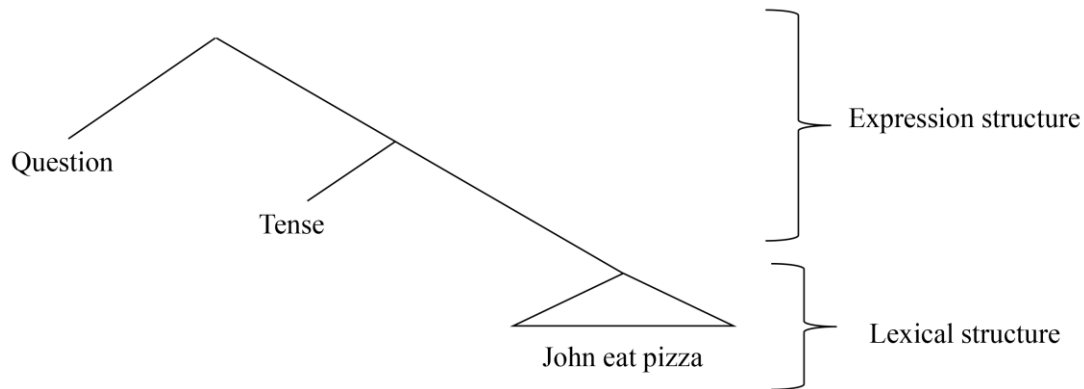
According to a paper published in ‘Frontiers in Psychology’, Miyagawa et al (2013) have presented the Darwinian approach to evolution of language through two distinct types of animal communications viz. (i)The lexical type as in monkey alarm calls (for python or leopard denoting a danger) and (ii)The expressive type of bird song as seen in Bengalese finch. These two types of communication are finite, which in case of human species, get connected together

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by a grammatical intervention and make it infinite. Thus human language has, so to say, two layers of structures as can be seen here in the sentence. “Did John eat pizza?” as follows:



**Figure 1.** Integration hypothesis: (after Miyagawa et al. 2014).

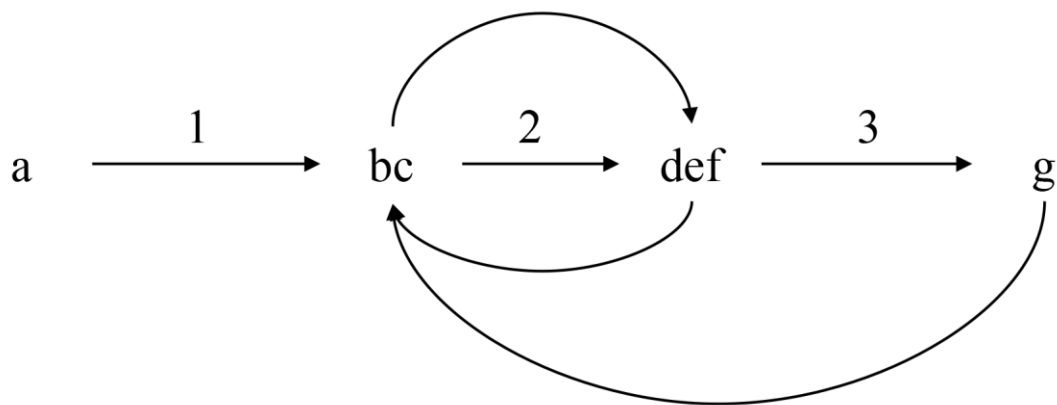
“John eat pizza” is the lexical structure while ‘did’ denotes both tense as well as question and hence it is the expression structure. The outline of E-L system is simple:

To put it here,

**Lexical structure (L)** – Bee dances (Riley et al 2005), primate calls (Seyfarth et al 1980).

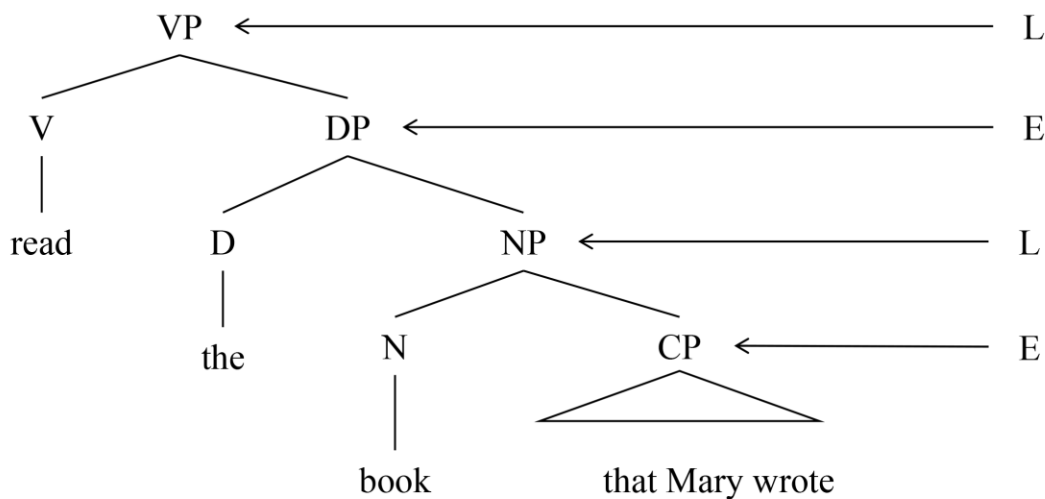
**Expression structure (E)** – Bird song (Berwick et al 2011).

They present that the Bengalese finch song lacks words but carries structure as can be shown in a pattern thus –



**Figure 2.** Bengalese finch song lack words but have hierarchical structure (after Miyagawa et al. 2014).

According to Berwick, et al. (2011) bird song can be described as a k-reversible finite state automaton which can be learned by them very easily. Further it is to be noted that the lexical functional grammar (Bresnan 2001) views words and phrases as having equivalent functions, though there are, in fact, separate argument structure and expression structure in each (Bresnan 2001). It has been further shown that the distributed morphology (Halle and Marantz 1993) denies a division between word formation and phrase formation. It is DM that integrates the two viz. lexical items (book, cat, eat) lack the specification of category, when a category inducing head is merged (u, n, a, etc.), the structure takes on familiar category of N, V, A, and so on (Marantz 1997). Therefore, integration hypothesis takes from DM elements to link EL and can be further recursive as E-L-E-L as given here:



**Figure 3** Sentence “read the book that Mary wrote” (after Miyagawa et al. 2014).

Thus the above hierarchy is possible in this sentence, where the symbols denote viz D-determiner, CP complementary phrase, V-verb, N-Noun, Phrase.

Similarly, Miyagawa et al. (2013) have given examples of finite state to give rise to non-finite state by prefix additions (Boeckx 2006, Narita et al. 2014).

- a. [anti-missile]
- b. [anti-[anti-misle] missile] missile

This leads to centre embedding to non-finite structure. They show that anti-missile is a modifier and modifies the noun with this property [anti-missile]-missle, [anti-missle]-defence. They also give examples of full and partial reduplication, and finite state automaton and reduplication and reduplication, and suffix reduplication. (For details, see their paper, Miyagawa et al. 2014).

According to them there is no combination of L-L (through though there are compound words). Some E-element does occur between two l-s viz. as in German language Blumi-n-wiese (flower meadow). Here the linking element(N) has no function and this has a L-E-L structure (Aronott and Fuhrhop 2002). In case of English language the words, craftsman, marksman and spokesman etc (s) performs this function (Marchand 1969) shows that there are further two elements which can be included in E, thus,

**(a) Movement:** What did you eat? Here ‘what’ is the object of eat which moves it from L to E (Chomsky 2001).

**(b) Agreement:** It is another process that crosses elements from E to L (Miyagawa et al. 2013).

Movement and agreement connect L to E, and we reach from finite state grammar processes to non-finite one.

### **Speculation for Integration of E and L**

While the monkey and man have a mammalian lineage, the bird song is an example of parallel evolution to man. There must be a separate origin of the two, viz., some birds also have vocal learning independently evolved, viz., ruby throated humming bird (possess vocal learning) and the Anna’s humming bird does not possess it.

Many examples of finite state grammars are present in non-human viz. Syrian golden hamsters (*Mesocricetus auretus*) routinely collect and store food away, and can be carried by

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actions obeying finite state grammar (Jones and Pinel 1990), another example is the facial grooming and taste elicited ingestive/ aversive actions of rats (Berridge, et al. 1987).

Although the E system of birds is actually devoid of functional meaning, however, the interpretation is possible only when bird song is taken holistically. Thus the ingenuity of E system (i) creates sustained pattern and (b) it holistically expresses an internal state of the singer.

Apart from the bird song, the so-called E system was suggested in case of non-human primates also by Charles Darwin himself (1871) among gibbons (Hylobatidae, Marshall and Marshall 1976, Hainoff 1984), Gibbons can sing long complex songs that last for ten to thirty minutes. Though the gibbon song may show probabilistic transitions among different notes, these are not patterns like in the case of birds. There are different notes (14 distinct) in the song of silvery gibbon (*Hyalobates maloch*) There is, however, no internal syntactic hierarchy in this and can't be analogous to grammatical structure of the bird songs.

There is yet a third requirement for complex hierarchical song to be there – the lip-smacking activity is required for precise timed coordination of the articulation apparatus. This feature is present in *gelada*, the non-human primate (Ghazanfar, et al. 2012). Recently it has been noted that *geladas* not only lip-smack rhythmically but can also vocalize, while lip-smacking (Bergman, 2013).

As we compare the two approaches to explain the language evolution, we find that they both have tried to fill the gap between animal communication and human language. The Chomskyan 'merge' is indeed the first step to suggest the route to the origin of meaning and syntax. However, it is not able to answer the question that Miyagawa put, viz., a) how did 'merge' appear? b) why is human language characterized by finite grammar? and c) why do we find process of movement and agreement in human language?

Miyagawa has enriched the Darwinian world of gradualism taking from two pre-adapted systems among animals to the present one in humans. Yet it needs to be further explored in

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Darwinian tradition before coming towards the more evolved grammar model of language evolution in modern times.

Further from the above account, it appears that there is a great scope for studying the evolution of language from biolinguistic approach (Afzal et al., 2007; Nehal and Afzal 2012, 2013; Boeckx and Burraco 2014), the main link of grammatical evolution is the central crux of the language development among humans. There are many questions that still remain unanswered. In working out a rather detailed biological root of language and grammar, recent endeavours of some evo-devo biologists (Burraco and Boeckx 2014) are quite promising and more data from behaviour and ecology will further help in easing out many disturbing issues in tracing the origin and evolution of language and grammar.

Although biologists are still divided on the Neo-Darwinian approach (gradualism) or saltational evolution of language (Santors et al. 2015), it is a very simple way indeed to approach the evolution of human language from the biological changes brought out in modern man, which is a very appealing hypothesis, hence the strong minimalist thesis has been put forward by Noam Chomsky. The rest is to workout the details of this basic principle in evolution of grammar and find its parallelism in animal kingdom with so-called song production in birds. (Everest and Huybrechts 2013). Here language is essentially like a thought generating engine which made the civilization as well as cultural life possible for modern man within a very short span of time, when talking in terms of an evolutionary time frame.

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