

What is Wrong, and What is Right, about Current Theories of Language, in the Light of Evolution?

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ABSTRACT

Two extreme and contrasting positions held currently by various researchers in language evolution are compared. Each position comprises five ideas which contradict the corresponding ideas in the other position. In Extreme Position A, there was a single biological mutation, creating a new unique cognitive domain, Language, immediately enabling unlimited command of complex structures via Merge, used primarily for advanced private thought, and only derivatively for public communication (internalism), not promoted by natural selection. By contrast, in Extreme Position B, there were many cumulative biological mutations, allowing expanded interaction of pre-existing cognitive domains – no new domain was created, gradually enabling command of successively more complex structures, used primarily for public communication, and derivatively for advanced private thought (externalism), promoted by natural selection. These extreme positions are not hypothetical ‘straw men’, insofar as prominent researchers exist who adopt each of them. At the end of this paper I will present a ‘scorecard’ summarizing which parts of the two extreme positions are justified by available evidence.

Keywords: nativism, domain specificity, modularity, genes, communication, thought gradualism, continuity.

Introduction

I will compare two extreme and contrasting positions held currently by various researchers in language evolution. Each position comprises five ideas which contradict the corresponding ideas in the other position.

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In Extreme Position A, there was

1. a single biological mutation,
2. creating a new unique cognitive domain, Language,
3. immediately enabling unlimited command of complex structures via Merge,
4. used primarily for advanced private thought, and only derivatively for public communication (internalism),
5. not promoted by natural selection.

By contrast, in Extreme Position B, there were

1. many cumulative biological mutations,
2. allowing expanded interaction of pre-existing cognitive domains – no new domain was created,
3. gradually enabling command of successively more complex structures,
4. used primarily for public communication, and derivatively for advanced private thought (externalism),
5. promoted by natural selection.

These extreme positions are not hypothetical ‘straw men’, insofar as prominent researchers exist who adopt each of them. At the end of this paper I will present a ‘scorecard’ summarizing which parts of the two extreme positions are justified by available evidence. The paper thus covers a number of issues that have been at the centre of theorizing in linguistics for many decades, issues such as nativism, domain specificity, modularity, and function. Underpinning the argument is the premise that any theory of what language is like must take into account the question of how it could possibly have evolved to be that way.

1. Natural Selection

It is convenient here to start with the fifth issue, that of natural selection. Natural selection here is about biological selection of the DNA that ultimately encodes the human capacity for complex language, often called ‘UG’. UG is theorized to determine what languages human infants could possibly acquire, given suitable input experience. It is also often assumed that UG is the main

determinant of what languages are like. For several decades, it was claimed that UG is a richly structured set of principles. It was the job of linguistics to discover these principles.

An old argument, no longer valid, involves arbitrary abstract properties of grammars, which I will illustrate with the example of Subjacency.

The Subjacency principle, allegedly innate, is what prevents children learning English, for example, ever experimenting with strings like the following:

* *Who do you like the man that saw?*

with a meaning like the emphatically incredulous, and acceptable, echo question

You like the man that saw WHO?

The Subjacency principle was one of a handful of similarly abstract principles postulated to govern the organization of grammars in languages. David Lightfoot argued amusingly, and correctly, that such principles, though taken at the time to be innate, cannot be the result of natural selection.

The Subjacency Condition has many virtues, but I am not sure that it could have increased the chances of having fruitful sex. (Lightfoot, 1991)

The programme of searching for such abstract principles of grammar gave way toward the end of the 20th century to a biologically more plausible view, dubbed 'Minimalism' (Chomsky, 1993, 1995). Under Minimalism, there are no such arbitrary properties. So the set of properties of language not plausibly attributed to natural selection, i.e. apparently arbitrary properties, disappears. In Minimalism, what remains is the recursive Merge operation, whose application (whether to concepts or to linguistic forms) is universally available to (non-pathological) humans, and occurs in all languages. An ability to merge concepts in ones head to form more complex conceptual representations is obviously adaptive in private thought. An ability to merge meaning-form pairs, Signs, to express more complex meanings in public communication is also adaptive -- more on this later.

The 'no natural selection' hypothesis would

- either predict that humans who are incapable of Merge (whether privately or publicly) are not pathological cases, not evolutionarily disadvantaged. This is false.
- or claim that the Merge capacity (whether private or public) went to fixation in humans by a population-level statistical accident. This is very unlikely.

So the human capacity to merge (either private concepts or public Signs) is promoted by natural selection. This settles issue 5 in our list.

2. Immediate Infinite Capacity

The context is set by the following statement:

there is no possibility of an “intermediate” language between a non-combinatorial syntax and full natural language syntax -- one either has Merge in all its generative glory, or one has effectively no combinatorial syntax at all. (Berwick, 1997, p. 248)¹

Temporarily, for the sake of argument, assume that such a cognitive capacity, Merge, could result from a single biological mutation, immediately enabling unlimited command of complex structures via Merge. This is impossible, as working memory limitations must have been present from the start. The putative unlimited command can only be theoretical, not real or practical. Of course, no human has literally unlimited command of an infinite range of expressions. Such a set, to be infinite, would necessarily contain an infinite number of strings too long for a brain to process. Rather than there being an infinite set of expressions that a person can manage, there is in fact an infinite set that no one can, or ever could, manage.

This raises the familiar distinction between competence and performance. Competence determines the regular behaviour of individuals. Competence is also thought of as knowledge of unbounded possibilities; practical bounds are held not to apply to a theory of competence. This reflects an early idealistic and naive love affair by linguists with infinite sets.

¹ See Hurford (2011, p. 585-587) for a fuller critique of the formal problems with this bald assertion.

Though conceived and applied almost exclusively in the context of human behaviour, the notion of competence can also usefully be applied to complex birdsong. Complex birdsong is very regular behaviour, based, like language, on an innate template and environmental exemplars. The regularity in birdsong includes clear numerical upper and lower bounds on the number of repetitions of phrases and the overall duration, in phrases, of songs. For example, a chaffinch song includes a repeated phrase of several notes, but the number of repetitions is limited to a range of between 4 and 11. A competence/performance distinction is appropriate for complex birdsong, but the boundary should be shifted to include numerical features of competence, what I have called ‘competence-plus’ (Hurford, 2011).

Performance is associated with two kinds of factor: (1) accidental and temporary factors, e.g. distraction, drunkenness, sudden death, and (2) permanent limiting factors, e.g. processing capacity, storage capacity, short-term memory in conditions of alertness. The latter belong in an integrated component of an individual’s acquired language, competence-plus, which has built-in, rubbery, numerical constraints.

UG, the innate capacity for language, is what, given suitable experience, scaffolds the growth of adult competence in a language. Just as an augmented concept of competence, namely competence-plus, is necessary to account for adult behaviour, so an augmented concept of UG, which I call ‘UG+’, is necessary to account for language acquisition.

Formal UG would not have evolved independently of memory and processing power. What would be the use of innate information about the form of language without a capacity for processing it? What would be the use of power to process language without the prospect of acquiring something to process? Memory and processing power are inherently numerically bounded. I propose a numerically bounded initial state of the language faculty, UG+, a package of formal and numerical information. Complex behavioural dispositions have co-evolved along with a complex cognitive computational capacity to manage them. A modern child is born with UG+ and, on enough exposure to a language, acquires competence-plus in that language.

Practice can, to some extent, extend numerical memory and processing limits. Even with quite restricted working memory, it is plausible that early hominin mutants, in a non-communicative version of events, had an adaptive advantage. Realistically, there must have been some working memory limitations on intuitive judgments and internal thought processes. And of

course there still are. Unlimited, infinite, command of any capacity, cognitive or otherwise, cannot exist in nature. There are always performance limitations.

So we can envisage a mutant with a new, but performance-limited, capacity to combine (i.e. Merge) conceptual units, in an environment where this is adaptive. She would prosper, and the mutation would spread, giving rise to a strain of *Homo* with superior private reasoning power, better tools, better hunting techniques, better shelter, better long-term planning, etc.

3. Private Thought versus Public Communication

I now discuss issue 4 of the two extreme positions being compared. How likely is it that increased cognitive computational power was for purely private individual thought, not communicated to other members of the group? Could early *Homo* have been a strain of clever social isolates, each person good at planning his future moves and privately solving environmental challenges as an individual?

The social isolate scenario would have favoured individual selection, but not social group selection. Was social group selection, in addition to individual selection, a factor in the rise of humans? Social group selection is not a directly biological process, but a social process, in which groups compete with each other. Members of culturally more successful groups have greater chances of biological reproduction. Were early hominins more like modern orangutans than like modern chimpanzees and bonobos? Our closest primate relatives live in social groups, form alliances and cooperate to a limited degree. There is inter-group competition in many primate species, usually motivated by food resources. Inter-group competition is positively correlated with group size, hence (indirectly) with neocortex size and levels of tactical deception.

Humans have the largest group size of any primate, the largest neocortex, and the greatest capacity for tactical deception. The humans who spread around the globe probably lived in highly cooperative groups, in competition with other groups. Such in-group cooperation, and inter-group competition, would have fostered public exchange of successively more complex information within groups.

Further, group-specific codes (akin to different languages) are compatible with inter-group competition.

This introduces externalization of (going public with) the previously private conceptual units. And, so far, we have not considered whether the capacity to merge items operated solely on concepts for private thought, or arose as an operation on public symbols. That is, a question of timing arises. There are two simple possibilities, and a more complex one, which I will introduce a bit later. First, the simplest possibilities.

1. Public externalization preceded the capacity to Merge. Even the simplest conceptual units were externalized from an early stage. This is the familiar Bickertonian Protolanguage scenario. In this view, Merge, from the start, involved public signals, i.e. was an operation on meaning/form pairs.
2. The Merge capacity preceded public externalization. The capacity to Merge conceptual units for advanced thought preceded externalization and advanced communication.

In normal humans, complex thought and complex language go together, but in pathology, they can be dissociated. There is an overall correlation between verbal and non-verbal IQ. In human children, even learning simple public labels modifies thought. Bilinguals perform better on certain nonlinguistic cognitive tasks. When we think in words, we use the words of particular public languages, as an aid to thought.

These facts point to a more complex timing possibility, namely that there was co-evolutionary spiral of successively more complex external language and successively more complex private thought, both always bounded by working memory capacity. In this spiral, complexification of public language is the evolutionary driver. The spiral builds on the asymmetry between production and comprehension. Access to more complex thoughts comes through comprehension of sporadically produced complex public expressions.

Socio-historico-cultural processes, such as grammaticalization, led to successively more complex languages. In tandem, such capacities as short-term working memory, long term storage of thousands of Signs, and fast vocal/auditory production and interpretation evolved.

The conclusion is that complexity in private thought and in public communication co-evolved. This is a nuanced solution to issue 4, the relative

timing of going public with language and the capacity for combinatorial language.

4. Was there a Single Mutation?

This is the least controversial issue. The language faculty is not monolithic. Even within the areas traditionally regarded as the core of linguistic structure, namely phonology, morphology and syntax, different organizing principles apply. For example, phonotactic rules determining combinations of phonemes have no obvious counterpart in syntax. Further, competence in these core areas could not be achieved without support from so-called peripheral systems (including storage, working memory, vocal or manual skills, pragmatic skills, etc.). Capacity in all these had to evolve in partnership. True, pleiotropy (one gene, many traits) is possible, but the traits governed by a pleiotropic gene are seldom so functionally coordinated.

Known language-related genes, e.g. FOXP2, do not do the whole job of creating a complete faculty for language. There are very few phenotypic traits that can be attributed to a single gene. And there is no prospect of ever discovering a single gene that accounts for the whole human capacity for language.

In conclusion, the least controversial answer of all these issues – a single mutation underlying language is not plausible.

5. Was a New Domain, Language, Unique to Humans, Created?

The evolved capacity for language has built on pre-existing hierarchical organization of behaviour, semantic memory for facts (storage), and fast routinization of useful procedures, to mention only several pre-existing factors. Seeds of these pre-existing features can be found in rudimentary form in non-human animal behaviour. But in language, each of these is now special to language in some way, and not found in other cognitive or behavioural capacities.

The working memory used in language processing is different from mere digit span usually identified with (non-linguistic) working memory. The numerical constraints inherent in UC+, hence in competence-plus, are

sensitive to different types of grammatical structure, e.g. right-branching vs. centre-embedding. Below is a classic example of right-branching

*This is the farmer sowing his corn
 that kept the cock
 that crowed in the morn
 that waked the priest all shaven and shorn
 that married the man all tattered and torn
 that kissed the maiden all forlorn
 that milked the cow with the crumpled horn
 that tossed the dog
 that worried the cat
 that killed the rat
 that ate the malt
 that lay in the house
 that Jack built!*

Despite the length of this sentence, it poses no parsing problem. It is long enough to need memorizing, but it makes natural sense and its meaning can be understood without undue effort. No nonlinguistic task, in human or non-human life, is comparable in such effortless coping with complexity.

By contrast, as is well known, centre-embedding structures, even quite short ones, are hard to parse, actually impossible beyond a very low limit, as illustrated below.

*This is the malt the rat ate.
 This is the malt the rat the cat killed ate.
 This is the malt the rat the cat the dog worried killed ate.
 This is the malt the rat the cat the dog the cow tossed worried killed ate.*

The difference between right branching and centre-embedding is a matter of specifically linguistic structure, analogues of which cannot be found outside language.

An adult native speaker of a modern language has memorized literally tens of thousands of constructions. Many of these are single words, while others are more complex constructions. A common noun is a relatively simple construction, often requiring only the information that it is a common noun,

plus the accompanying semantic specification of its meaning and the phonological specification of its pronunciation. Pragmatic information, such as degree of formality (register), or taboo status, may also be stored. A transitive verb is a more complex construction, with specifications of the type of object it can take, whether it can be passivized, and so on. Function words, such as auxiliaries and determiners, are also conveniently viewed as constructions. The Merge operation combines constructions into sentences, yielding the spectacular expressive power of human languages. The vast expressive power of languages derives just as much from the massive store of items as from the combinatory power of the Merge operation. If we had only two or three items in our memory store, even a very free capacity to combine them would be extremely impoverished by comparison with a real language. The human capacity to rapidly acquire and fluently use such massive stores of linguistic items is special, and has no clear analogue outside the language domain.

The conclusion is that complex language has evolved to be a unique cognitive domain.

6. Summary and Scorecard

Neither of the extreme positions set out at the beginning of this paper is totally correct. The table below gives the ‘score’, as this paper has argued it, for the relative strengths and weaknesses of the two extreme positions.

	Position A	Position B
Natural selection	0	1
Immediate infinite potential	0	1
Private v public	½	½
Single mutation	0	1
New unique domain	1	0

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