Title

The emergence of grammar in a language-ready brain Comment on “Towards a Computational Comparative Neuroprimatology: Framing the language-ready brain” by Michael A. Arbib

Author

Hawkins, John A

Publication Date

2016-03-01

DOI

10.1016/j.plrev.2016.01.006

Peer reviewed

Elsevier Editorial System(tm) for Physics of Life Reviews

Manuscript Draft

Manuscript Number:

Title: The emergence of grammar in a language-ready brain Comment on "Towards a computational comparative neuroprimatology: framing the language-ready brain" by Michael A. Arbib

Article Type: Comment

Keywords:

Corresponding Author: Prof. John Hawkins,

Corresponding Author's Institution: University of California Davis

First Author: John Hawkins

Order of Authors: John Hawkins

The emergence of grammar in a language-ready brain
Comment on "Towards a computational comparative neuroprimatology: framing the language-ready brain" by Michael A. Arbib

John A. Hawkins
Department of Linguistics, University of California Davis,
One Shields Avenue, Davis, California 95616, USA

Arbib makes the interesting proposal [3, §1.6] that the first *Homo sapiens* could have been "language-ready", without possessing the kind of rich lexicon, grammar and compositional semantics that we see in the world's languages today. This early language readiness would have consisted of a set of "protolanguage" abilities, which he enumerates (1-7 in §1.6), supported by brain mechanisms unique to humans. The transition to full "language" (properties 8-11 in §1.6 and §3) would have required no changes in the genome, he argues, but could have resulted from cultural evolution plus some measure of Baldwinian evolution favoring offspring with greater linguistic skill. The full picture is set out in [1].

Do the language sciences provide any relevant evidence for or against this view of language evolution? Arbib critiques one prominent proposal in [2] associated with Chomsky's "Universal Grammar" (see [6,7]) and exemplified in [25], whereby the first *Homo sapiens* would have had "language" in its essentially modern form, complete with all the hypothesized innate linguistic properties that have been claimed [6,7] to form the bedrock of languages today and to make their learning possible by successive generations.

Chomsky's Universal Grammar has been considerably scaled back over the years [4,8,9,13], with "recursion" almost the only proposed universal left. This greatly reduces its relevance for defining the language abilities of the first humans. The arguments from language learning for supposedly innate properties of grammars have also been undermined by numerous studies [5,11,16,19,27]. These have shown that the absence of negative evidence given to children (i.e. information about what sentences are ungrammatical as opposed to grammatical) is no argument for a rich innate Universal Grammar guiding learning, since children regularly solve parallel learning problems involving properties quite idiosyncratic to individual languages that cannot possibly be innate. This whole approach to understanding the language faculty of the first *Homo sapiens* has now become quite unhelpful, therefore, and it was in any case too speculative and insufficiently grounded empirically to begin with.

Arbib's proposal for language-readiness, derived from neuroscience, comparative primatology and computer science, offers an alternative that linguists and psycholinguists need to consider seriously. We now have considerable evidence about, and databases on, the world's grammars [12]. We know a lot about grammatical change, and about how grammatical function words and rules emerge out of lexical items at earlier historical stages, not just in the familiar Indo-European languages but across the globe [21]. We also have a lot of empirical support for the role of psycholinguistic mechanisms of production and comprehension, i.e. language processing, in shaping the data both of language performance and of grammars [16,19]. Examining these phenomena in the light of Arbib's proposals for brain evolution can lead to a fruitful, and mutually beneficial, research program.

Notice first Comrie's point in [10] that many grammatical properties that we find in the world's languages today could not have been present in the language of the first *Homo*

sapiens because they are known to have evolved from less complex earlier stages. We see different complexity levels in typological samples [12] of the numbers of vowels and consonants across languages, in the internal structure of words, in the syntactic structures permitted [15,17,18]. Comrie [10, p.210] writes that "certain complexities of all or many presently attested languages, such as morphophonemic alternations, phonemic tone, phonemic vowel nasalization, and affixal and fusional morphology were not present in early human language, but have arisen on the basis of historical processes of types that can be observed as we examine the attested historical development of languages".

Second, there is now a rich database of "grammaticalization" phenomena across languages linking grammatical words and affixes to the lexical items from which they evolved [20,22,24]. E.g. future *will* in English (*I will go to work now*) derives from a lexical verb meaning 'to want' (which is still visible in the cognate verb *wollen* in German), the Finnish postposition *kanssa* meaning 'with' has been reduced to a "comitative case suffix" *-ka* attached to nouns in languages closely related to Finnish, and so on. The obvious relevance of this for work on language evolution and for inferences about the earliest human language is discussed in [21].

Third, Arbib refers (in §3.4) to my own work [15] as being relevant for the evolution of grammars and grammatical rules in response to considerations of language processing and efficiency. These efficiencies can be seen empirically in languages that give speakers choices between alternatives, such as *look the number up* and *look up the number* in English [26]. When grammars do conventionalize a fixed rule of ordering, the same efficiencies can be seen in the formal properties of the rules as are seen in speakers' preferences in performance, leading to a "Performance-Grammar Correspondence Hypothesis". Matching sets of data from performance and grammars [14-19] show that even subtle aspects of syntax, of the kind earlier attributed to an innate Universal Grammar [6,7], can emerge from earlier pre-grammatical stages. This evolution from performance preferences to grammars has been modelled in a computer simulation by Kirby [23], leading to the predicted typological distribution of grammars defined in [14] which closely matches their frequencies across the globe.

These research strands from linguistics and psycholinguistics appear very compatible with Arbib's language-readiness proposal, and they provide mechanisms for the transition to grammars as we know them today from earlier stages, even from the pre-grammatical stage of a proto-language as he envisions it. The devil lies in the details, but a research program integrating these empirical and theoretical strands from the language sciences with his interdisciplinary neuroscience proposal is now urgently needed. Notice that I have chosen to focus my remarks on these three strands, rather than on pidgins and creole languages and on child language acquisition. These latter can provide some relevant data for language evolution but they also introduce confounds into the discussion of a language-ready mature human brain, namely transfers from a pidgin-speaker's native language, and an immature brain and cultural experience, respectively.

References

[1] Arbib MA. How the brain got language: the mirror system hypothesis. New York, Oxford: Oxford University Press; 2012.

[2] Arbib MA. How new languages emerge (Review of D. Lightfoot, 2006. How new languages emerge. Cambridge University Press). Linguist List 18-432 Thu Feb 08 2007.

[3] Arbib MA. Towards a computational comparative neuroprimatology: framing the language-ready brain. Physics of Life Reviews 2015; this issue.
[4] Berwick RC, Chomsky N. The biolinguistic program: the current state of its evolution and development. In: di Scullio AM, Boeckx C, editors. The biolinguistic enterprise: new perspectives on the evolution and nature of the human language faculty. Oxford: Oxford University Press; 2011, p. 19-41.
[5] Bowerman M. The "no negative evidence" problem: how do children avoid constructing an overly general grammar? In: Hawkins JA, editor. Explaining language universals. Oxford: Blackwell; 1988, p. 73-101.
[6] Chomsky N. Aspects of the theory of syntax. Cambridge, MA: MIT Press; 1965.
[7] Chomsky N. Language and mind. New York: Harcourt, Brace & World; 1968.
[8] Chomsky N. Minimalist inquiries: the framework. In: Martin R, Michaels D, Uriagereka J, editors. Step by step: Essays on minimalist syntax in honor of Howard Lasnik. Cambridge Mass: MIT Press; 2000, p. 89-56.
[9] Chomsky N. Three factors in language design. Linguistic Inquiry 2005; 36:1-22.
[10] Comrie B. Before complexity. In: Hawkins JA, Gell-Mann M, editors. The evolution of human languages. Redwood City, Calif.: Addison-Wesley; 1992, p. 193-211.
[11] Culicover PW. Syntactic nuts: hard cases, syntactic theory and language acquisition. Oxford: Oxford University Press; 1999.
[12] Haspelmath M, Dryer MS, Gil D, Comrie B. The world atlas of language structures. Oxford: Oxford University Press; 2005.
[13] Hauser M, Chomsky N, Fitch WT. The faculty of language: what is it, who has it, and how did it evolve? Science 2002; 298:1569-79.
[14] Hawkins JA. A performance theory of order and constituency. Cambridge: Cambridge University Press; 1994.
[15] Hawkins JA. Processing complexity and filler-gap dependencies. Language 1999; 75:244-85.
[16] Hawkins JA. Efficiency and complexity in grammars. Oxford: Oxford University Press; 2004.
[17] Hawkins JA. Language universals and the performance-grammar correspondence hypothesis. In: Christiansen MH, Collins C, Edelman S, editors. Language universals. Oxford: Oxford University Press; 2009, p. 54-78.
[18] Hawkins JA. Processing efficiency and typological patterns. In: Song JJ, editor. The Oxford handbook of linguistic typology. Oxford: Oxford University Press; 2011; p.206-26.
[19] Hawkins JA. Cross-linguistic variation and efficiency. Oxford: Oxford University Press; 2014.
[20] Heine B, Kuteva T. World lexicon of grammaticalization. Cambridge: Cambridge University Press; 2002.
[21] Heine B, Kuteva T. Grammaticalization theory as a tool for reconstructing language evolution. In: Tallerman M, Gibson K, editors. The Oxford handbook of language evolution. Oxford: Oxford University Press; 2011, p. 512-27.
[22] Hopper PJ, Traugott EC. Grammaticalization. Cambridge: Cambridge University Press.
[23] Kirby S. Function, selection and innateness. Oxford: Oxford University Press; 1999.
[24] Lehmann C. Thoughts on grammaticalization. Munich: Lincom Europa; 1995.
[25] Lightfoot DW. How new languages emerge. Cambridge: Cambridge University Press; 2006.
[26] Lohse B, Hawkins JA, Wasow T. Domain minimization in English verb-particle constructions. Language 2004; 80:238-61.

[27] Stefanowitsch A. Negative entrenchment: a usage-based approach to negative evidence. Cognitive Linguistics 2008; 19(3):513-31.