

Chris Sinha

## Niche construction, too, unifies praxis and symbolization

**Abstract:** Arbib hypothesizes that evolutionary modern language significantly postdates human speciation. Why should this be so? I propose an account based on niche construction theory, in which Arbib's language-ready brain is primarily a consequence of epigenetically-driven adaptation to the biocultural niche of protolanguage and (subsequently) early language. The evolutionary adaptations grounding language evolution were initially to proto-linguistic socio-communicative and symbolic processes, later capturing and re-canalizing behavioural adaptations (such as serial and hierarchical constructive praxis) initially "targeted" to other developmental and cognitive domains. The intimate link between praxic action and symbolic action is present not only in the human brain, but also in the human biocultural complex. The confluence of praxis and symbolization has, in the time scale of sociogenesis, potentiated the invention of domain-constituting and cognition-altering symbolic cognitive artefacts that continue to transform human socio-cultural ecologies. I cite in support of this account, which differs only in some emphases from Arbib's account, my colleagues' and my research on cultural and linguistic conceptions of time in an indigenous Amazonian community.

**Keywords:** Niche construction, praxic action, epigenesis, culture, time

---

**Chris Sinha:** Lund University, School of Languages and Literature (Linguistics), P.O. Box 201, 221 00 Lund, Sweden. E-mail: [chris.sinha@ling.lu.se](mailto:chris.sinha@ling.lu.se)

The body is our general medium for having a world . . . Sometimes the meaning aimed at cannot be achieved by the body's natural means; it must then build itself an instrument, and it projects thereby around itself a cultural world (Merleau-Ponty 1962: 146).

I am grateful for the opportunity to comment on Michael Arbib's rich, multi-faceted book. I must admit to a feeling of challenge, too; not only because the breadth of vision evidenced by the book is matched by the scholarly depth of the synthesis presented, but also because amongst the many issues addressed by Arbib is that of the time depth of language, a topic laden with a heavy ballast of

theoretical disagreement, and precariously susceptible to radical revision in the light of our accumulating knowledge of human origins. It takes quite a bit of nerve to venture into this treacherous terrain, and I applaud Arbib for laying out his cards so clearly. I will try to match his clarity by saying upfront that I agree with two of his central propositions, that (a) the evolution of the “language-ready brain” preceded the development of language “proper” (what I will call *evolutionary modern language*, or **EML**); and (b) EML is a relatively late human acquisition or artefact.

Arbib’s dating of the emergence of EML (to 100 kya – 50 kya) places Arbib in the camp of “late emergence” theories, previous versions of which have not fared well in the light of recent evidence. In particular, the “human revolution” theory, that evolutionary modern language emerged as a result of a single genetic mutation about 35–40 kya (Mellars and Stringer 1989), is now considered to be inconsistent with the archaeological evidence of early hominid evolution, in Africa (Botha and Knight 2009) and elsewhere. If Arbib (and I) wish to maintain, nonetheless, that the emergence of EML significantly postdated modern human speciation, we have to advance a different theory. Arbib’s language-ready brain (**LRB**) hypothesis explicitly contradicts the hypothesis that late emergence was mutation-driven, because it suggests that had EML been present at, say, 200 kya, anatomically modern human infants of the Middle Stone Age would have been as capable of acquiring it as present day infants. So why, if EML really was not present, should it not have been? Here is a key passage (Arbib p. 162; see also précis Ch. 6) in which Arbib offers his explanatory account in a nutshell:

I will present eleven properties that make the use of language possible . . . my claim will be that the first seven were established by biological evolution that yielded the genome of the *Homo sapiens* brain and equipped early humans for the use of protolanguage, whereas the last four required no new brain mechanisms but emerged through the operation of cultural evolution on language-ready brains to yield human societies that did . . . have language. However, regardless of whether I can convince you later that protolanguage and language are on opposite sides of the divide between biology and culture, the key aim here is to encourage you to recognize that there is a divide and debate where it lies.

Rather than debating where, in the spectrum of complexity from protolanguage to EML, the “nature-culture divide” can best be placed, I prefer to challenge the distinction itself. The idea that human culture, uniquely in the living world, built new capacities by “terminal addition”, on a platform provided by prior biological evolution, is an old one, and in my view one that is fatally undermined by two relatively recent strands of research. The first is the study of animal cultures, a term that would have been viewed as oxymoronic by past generations of anthropologists, wedded as they were to human uniqueness. Culture, however, can be

defined in an evolutionary biological perspective as the existence of intra-species group differences in behavioural patterns and repertoires, which are not directly determined by ecological circumstances (such as the availability of particular resources employed in the differing behavioural repertoires), and which are learned and transmitted across generations. On this minimalist definition, there is ample evidence of cultural differences in foraging strategies, tool use, and social behaviours in chimpanzees (Whiten et al. 1999; de Waal 2001).

This brings us to the second recent development, consisting in new approaches to gene-culture co-evolution, in particular niche construction theory (Odling-Smee et al. 2003). Arbib draws attention to niche construction, but he does not, in my view, sufficiently integrate it into the LRB hypothesis. While I agree that “only the human brain is *language ready*” (p. ix), I would also maintain that Dor and Jablonska (in press) have it right, too, when they argue that “we evolved *for* language”: that is, (proto-)language itself was a decisive constituent of the artefactual niche that made possible the evolution of the LRB and the elaboration of EML from protolanguage and early language. In other words, I will argue that the LRB hypothesis should be processually coupled with the hypothesis that the LRB evolved (primarily, though not exclusively) as an adaptation to the self-constructed niche of language. Although my emphasis on the primacy of the communicative niche differs from Arbib’s emphasis on the primacy of the niche of praxis and action analysis, this difference is indeed one of emphasis rather than principle, since both depend on adaptation to cultural learning. Even so, my proposed modification departs significantly from the “terminal addition” model favoured by Arbib, which he repeats in the following passage:

Our distant ancestors (eg *Homo habilis* through to early *Homo sapiens*) first had a (possibly quite limited) protolanguage based primarily on manual gesture (protosign) . . . protosign did not attain the status of a full language prior to the emergence of early forms of protospeech (p. 178) . . . the expanding spiral of protosign and protospeech must have reached a critical level prior to the emergence of *Homo sapiens*, a level that provided and built upon the level of natural selection that yielded a modern vocal apparatus and brain mechanisms to control it (p. 245) . . . there was a spectrum of protolanguages across the time and space of the “dawn of humanity” from the truly primitive to those that had achieved a complexity little different in their properties from the simplest of “real” languages (Arbib p. 253).

In referring to a “prior” level resulting from natural selection, Arbib implies that the LRB was a product of strictly prelinguistic or nonlinguistic adaptations, and he also does not make it clear what he means by “real” language, or what would be the simplest form of real language, except to say that increased complexity should be understood as a product of lexical partitioning, grammaticalization and constructional flexibility. I suggest that employing the notion of “early

language” (Heine and Kuteva 2007) can help to make more explicit the steps involved in the “expanding spiral”, while qualifying the “late emergence” scenario by distinguishing EML from *both* protolanguage *and* early language. There follows my revision of Arbib’s expanding spiral and its timeline.

*Multimodal protolanguage* (speech+gesture+mime), I hypothesize, has a time depth of at least 2 million to 1.5 million years. It was almost certainly possessed by *Homo erectus*, given the dispersal range of that species. Protolanguage, Arbib suggests, was holophrastic, a suggestion that I find plausible, but which is in contradiction with his idea (see quotation above) that there existed plural “protolanguages”. The point is that holophrastic and/or situationally structured multimodal utterances are not governed by combinatorial conventions, whereas *early languages* were. Conventional early languages, involving lexically-based core constructions and grammatically differentiated semantic participant roles, can be hypothesized to have emerged as the first original biocultural semiotic artefact of the “language ready brain” at 200 kya to 150 kya. *Evolutionary modern languages* (grammaticalized, morphosyntactically more complex, and with elaborated functional differentiation) probably date (as proposed by Arbib) from 100 kya – 50 kya. Their emergence and elaboration can be hypothesized to be associated with social and kinship differentiation (clan/moiety structure), and with the emergence of mythic and collective narratives, expressed, as well as in language, in other (probably pre-existing) semiotic media, including rock art, song and dance.

Protolanguage was thus, consistently with Arbib’s LRB hypothesis, part of the biocultural complex of nested niches of evolutionary adaptation (including also the niche of praxic action and the niche of infancy) in which early languages evolved; but so too were early languages part of the biocultural complex in which evolutionary modern languages evolved, and it would be unwise to rule out the possibility that some genetic adaptations for language learning occurred after the speciation of *Homo sapiens*, during the long period that early languages were spoken.

A key role, I suggest, was played in this process by the evolution of epigenesis. Epigenesis and epigenetics are terms referring to inheritance processes and mechanisms, at different levels ranging from the molecular to the organismic, that are controlled or modulated by factors other than those inscribed in the genome (Jablonka and Lamb 2005; Sinha 1988). Epigenetic developmental processes in ontogenetic behavioral development are those in which the developmental trajectory and final form of the developing behaviour are a consequence as much of the environmental information as of the genetically encoded information. A genetically specified initial behavioural repertoire is subsequently elaborated through experience of a relevant environment, yielding an envelope of

potential trajectories and outcomes. In an epigenetic perspective, any adaptive developmental predisposition for learning language is unlikely either to involve direct coding of, or to be dedicated exclusively to, linguistic structure (Mueller 1996). Rather, we may hypothesize (in a modification of Arbib's account, but consistently with the evidence he adduces) that epigenetically governed adaptations initially evolved in response to proto-linguistic socio-communicative and symbolic processes, later capturing and re-canalizing behavioural adaptations (such as serial and hierarchical constructive praxis) initially "targeted" to other developmental and cognitive domains.

In the niche construction perspective, the class of organisms with the language capacity (normally developing humans) can be theorized as a phenogenotypic replicator (Odling-Smee et al. 2003), systemically associated with a wider biocultural complex of symbolic and praxic-constructive cognitive capacities, also of a phenogenotypic nature; and individual language acquisition and use is situated in the contexts of actuation of these inter-related capacities. This is the fundamental evolutionary matrix for Arbib's Mirror System Hypothesis. What makes humans unique is not an innate language acquisition device plus a variety of other species-specific innate cognitive modules, but a generalized semiotic or praxic-symbolic capacity, epigenetically developed from a suite of cognitive capacities largely shared with other species, but attaining higher levels of organization in humans. This capacity is not inscribed in the human genome, but distributed across the genes, practices and cultural systems co-constituting (with the epigenetically developed human organism) the human phenogotype.

This account, importantly for and consistently with Arbib's approach, provides a non-reductionist unification of the evolutionary dynamics of human material culture and symbolic culture. As Boivin (2008: 190) has pointed out "Tools, technologies, and other aspects of the material world of humans and their predecessors have largely been seen as the outcome of evolutionary developments, and little attempt has been made to investigate their potential role as selection forces during the course of human evolution." The same can be said of the biocultural niche of language, which is not separate from the other material and symbolic components or niche-structures that make up the human biocultural complex. It is crucial to appreciate, in this context, that the human biocultural complex, like other animal artefactual niches, is not merely *part of* what is reproduced, but is also fundamental to the *process* of its reproduction and transmission, since it constitutes a self-made environment for adaptive selection.

Language is the primary and most distinctive constituent of what the Russian semiotician Yuri Lotman called the "semiosphere" (e.g. Lotman 1990): the universe of signs, or the semiotic dimension of the human biocultural complex. The self-constructed hominin biocultural complex both favoured the emergence

and elaboration of language, as proposed by Odling-Smee and Laland (2009: 120); and was fundamentally transformed by the biocultural niche of language (Sinha 2009). This semiotic discontinuity has been amplified by the consolidation, through language, of human culture as a fundamentally symbolic order. Signs are both transformative cognitive tools, and constitutive of specifically human cultural ecologies. The human semiotic capacity triggered transformative effects across all or most cognitive domains, thereby potentiating human symbolic cultures, which constitute the biocultural complexes in which human cultural innovation and transmission occur. Language as a biocultural niche, or semiosphere, is processually and developmentally interdependent with the “technosphere” of material artefactual supports for praxis and for learning through social interaction (Sinha 2005). The human semiotic capacity, in collaborative synergy with constructive praxis and intersubjective, social learning, has been the fundamental driving force in the prehistoric and historical time scale of sociogenesis of the evolution of human culture and extended human embodiment.

Language is not only grounded in human praxic interactions with material culture, but is also the symbolic ground of a special subclass of artefacts, that I designate symbolic cognitive artefacts. This subclass can be defined as comprising those artefacts that support symbolic and conceptual processes in abstract conceptual domains, such as time and number. Examples of symbolic artefacts are notational systems (including writing and numeric notations), dials, calendars and compasses. Symbolic and/or cognitive artefacts (Hutchins 2005; Norman 1993) have been plausibly proposed as key components of human cognitive evolution, in virtue of their status as external representations of cultural and symbolic practices (Donald 1991), and embodiments of the “ratchet effect” (Tomasello 1999) in cultural evolution. I would like to advance the argument further, by suggesting that symbolic cognitive artefacts are not mere repositories of prior changes in practices and cognitive structures, but have the status of *agents of change* in cultural-cognitive evolution. Cultural and cognitive schemas organizing at least some conceptual domains may be considered, I shall argue, as dependent upon, and not merely expressed by, the employment of symbolic artefacts in cultural and cognitive practices. This perspective has further implications for hypotheses regarding inter-domain conceptual mapping relations and their cognitive basis (Arbib Ch. X).

Cultural concepts and schemas of time are a prime example of the role played in cognition by symbolic cognitive artefacts. The cultural dissemination of “calendar time” (which was important in the computation of saints’ days), and later “clock time”, had profound effects upon medieval and early modern European societies, enabling the accurate determination and registration of both religious



**Fig. 1:** A medieval clock in Lund Cathedral, Sweden.

festivals and working time (Postill 2002; Whitrow 1988; see Figure 1). What is perhaps less appreciated is the extent to which the invention and cultural evolution of the calendar and the clock have transformed human cognition, not least by constituting a novel cognitive domain of abstract “Time as Such” (Sinha et al. 2011). By this, I mean a notion of time that situates or encompasses the events that occur “in time”, and their time of occurrence, analogously to the way that space situates or encompasses objects and their locations.

Numerically based calendric systems can be regarded as organizing Time-based time intervals. Time-based time intervals (such as “Clock Time” and “Calendar Time”) are those whose boundaries are constituted by the segmentation and measurement of “Time as Such”. Examples of Time-based time intervals are hours and weeks. Time-based time intervals can be distinguished from Event-based time intervals. Event-based time intervals are those whose boundaries are constituted by the event itself. In this sense, there is no cognitive differentiation between the time interval and the duration of the event or activity which defines it, and from which in general the lexicalization of the time interval derives. The

reference event is often natural (such as ‘spring’, e.g. “let’s take a holiday in the spring”), but sometimes conventional (such as ‘coffee break’, e.g. “let’s discuss this during coffee break”).

Many languages employ spatial expressions to conceptualize events in time, their relationships to other events, and the experience of subjects in relation to events. “The summer passed quickly”, “your exams are coming up” and “her vacation is approaching” are examples of linguistic constructions in which events “move” along a time line with respect to the phenomenological “now” of the experiencer (the speaker, the addressee or a third party, respectively). A different construction type conceptualizes the experiencer as moving along the time line with respect to static or fixed events, as in: “I left the things of childhood behind”, “you are coming up to your exams”, “he is past his prime”. Constructions of the first type have been called “Moving Time”, and of the second “Moving Ego” (Clark 1973).

It has been suggested that this prevalence of using terms and constructions whose primary, more basic meanings relate to spatial location and motion, to express concepts of time and temporal relations, attests to a human cognitive universal. Fauconnier and Turner (2008: 55), for example, claim that “Time as Space is a deep metaphor for all human beings. It is common across cultures, psychologically real, productive and profoundly entrenched in thought and language.” This claim of universality has to be questioned in the light of the research my colleagues and I carried out on notions of time, and the language of time, in the culture and language of an indigenous Amazonian community, the Amondawa (Sinha et al. 2011).

Our findings can be summarized as follows. First, we found that the Amondawa language has a rich variety of lexical and grammatical resources for conceptualizing and expressing spatial relations and spatial motion (Sampaio et al. 2009). Although there are some features of the Amondawa language that led us to propose modifications of previous linguistic typologies of spatial motion, the language presented no characteristics that were radically different from those described for other languages and language families. It certainly could not be maintained that the language of space in Amondawa, and the resources afforded by it for conceptualizing and expressing spatial relations and spatial movement, is in any respect impoverished in comparison with, say, English or French.

Our findings regarding the language of time in Amondawa, however, presented a startlingly different picture. Our data suggest that this language presents a counter-example to the often-assumed universality of space-to-time metaphoric mapping. Amondawa speakers who are bilingual in Portuguese, while able to understand space-time metaphoric constructions in Portuguese, insist that such constructions do not exist in Amondawa, even though the equivalent spatial mo-



tion constructions exist. We established in our research that the non-existence in Amondawa of space-time metaphoric constructions is not a consequence of their being ungrammatical; nor is it a consequence of a generalized lack of metaphor in the language. Rather, it seems that space-time metaphorical mapping has simply not emerged, or been “invented”, in this language. Why might this be the case?

Other findings, relating to time interval concepts in Amondawa, may hold the clue as to why space-time metaphors are absent in the language. The first thing to note is that Amondawa is one of many Amazonian languages that are known to have very restricted number systems. Small number system languages generally lack numerals above four or five; Amondawa is typical of such languages, in having only four numbers, with larger numbers being indicated by lexical and intensifying variations on words meaning “many”. Clearly, a calendar of the kind that we are familiar with, involving weekly, monthly and annual day counts, simply cannot be constructed in a small number language such as Amondawa. Unsurprisingly, therefore, Amondawa lacks a calendric system in which days of the week or months of the year are enumerated. In the absence of the symbolic cognitive artefact of a numerically organized calendric system, the conceptualization of “Time as Such”, and of a timeline independent of Event-based time intervals, neither makes sense, nor is implicitly awaiting invention and explication.

I interpret our findings about the language of time in Amondawa to imply that Arbib’s “expanding spiral” is one in which cultural evolution *sensu strictu* (that is, cultural evolution relatively autonomous from biological evolution) stands in a relationship of *continuity*, rather than discontinuous terminal addition, with the biocultural evolutionary process that produced the language ready brain and evolutionary modern languages. Language, on this account, is an artefact/niche that potentiates the invention of a wide range of new, domain-constituting and cognition-altering symbolic cognitive artefacts, a process that continues and indeed accelerates as we reach the present day. Cultural evolution is not unilinear “progress” along a universal timeline; rather it is a process of the exploration of culturally specific implicate order (Bohm 1980), habitus (Bourdieu 1977), or symbolic cognitive ecology. The epigenetically evolved, language ready brain, on this interpretation (which, I think, is Arbib’s as much as mine), is also the calendar ready brain, the space-time metaphor ready brain, the literacy ready brain and the spreadsheet ready brain. The brain did not get all these artefacts at once and universally, any more than it got evolutionary modern languages all at once. But the idea that the brain “got” language is itself too one-sided; it would be just as true to say that language “got”, or captured, the brain, setting in motion an expanding spiral of human unity-in-diversity.

## References

- Bohm, D. 1980. *Wholeness and the implicate order*. London: Routledge.
- Boivin, N. 2008. *Material cultures, material minds: The role of things in human thought, society and evolution*. Cambridge: Cambridge University Press.
- Botha, R. & C. Knight. 2009. *The cradle of language*. Oxford: Oxford University Press.
- Bourdieu, P. 1977. *Outline of a theory of practice*. Cambridge: Cambridge University Press.
- Clark, H. H. 1973. Space, time, semantics and the child. In T. E. Moore (ed.), *Cognitive development and the acquisition of language*, 27–63. New York: Academic Press.
- de Waal, F. 2001. *The ape and the sushi master*. London: Allen Lane.
- Donald, M. 1991. *Origins of the modern mind: Three stages in the evolution of culture and cognition*. Cambridge, MA.: Harvard University Press.
- Dor, D. & E. Jablonka. In press. Why we need to move from gene-culture co-evolution to culturally-driven co-evolution. In D. Dor, C. Knight & J. Lewis (eds.), *The social origins of language*. Oxford: Oxford University Press.
- Fauconnier, G. & M. Turner. 2008. Rethinking metaphor. In R. Gibbs (ed.), *The Cambridge handbook of metaphor and thought*, 53–66. Cambridge: Cambridge University Press.
- Heine, B. & T. Kuteva. 2007. *The genesis of grammar: A reconstruction*. Oxford: Oxford University Press.
- Hutchins, E. 2005. Material anchors for conceptual blends. *Journal of Pragmatics* 37. 1555–1577.
- Jablonka, E. & M. Lamb. 2005. *Evolution in four dimensions: Genetic, epigenetic, behavioral, and symbolic variation in the history of life*. Cambridge, MA: MIT Press.
- Lotman, Y. 1990. *Universe of the mind: A semiotic theory of culture*. New York: I.B. Tauris & Co. Ltd.
- Mellars, P. & C. Stringer. 1989. *The human revolution: Behavioral and biological perspectives on the origins of modern humans*. Edinburgh: Edinburgh University Press.
- Merleau-Ponty, M. 1962. *Phenomenology of perception*. London: Routledge.
- Mueller, R.-A. 1996. Innateness, autonomy, universality? Neurobiological approaches to language. *Behavioral and Brain Sciences* 19. 611–675.
- Norman, D. 1993. *Things that make us smart*. Reading, MA.: Addison Wesley.
- Odling-Smee, J. & K. N. Laland. 2009. Cultural niche-construction: Evolution's cradle of language. In R. Botha & C. Knight (eds.), *The prehistory of language*, 99–121. Oxford: Oxford University Press.
- Odling-Smee, F.J., K. N. Laland & M. W. Feldman. 2003. *Niche construction: The neglected process in evolution*. Oxford: Princeton University Press.
- Postill, J. 2002. Clock and calendar time: A missing anthropological problem. *Time and Society* 11(2/3). 251–270.
- Sampaio, W., C. Sinha & V. da Silva Sinha. 2009. Mixing and mapping: Motion, path and manner in Amondawa. In J. Guo, E. Lieven, N. Budwig, S. Ervin-Tripp, K. Nakamura, Ş. Özçalışkan (eds.), *Crosslinguistic approaches to the study of language. Research in the tradition of Dan Isaac Slobin*, 427–439. London: Psychology Press.
- Sinha, C. 1988. *Language and representation: A socio-naturalistic approach to human development*. Hemel Hempstead: Harvester-Wheatsheaf.
- Sinha, C. 2005. Blending out of the background: Play, props and staging in the material world. *Journal of Pragmatics* 37. 1537–1554.

- Sinha, C. 2009. Language as a biocultural niche and social institution. In V. Evans & S. Pourcel (eds.), *New directions in cognitive linguistics*, 289–310. Amsterdam: John Benjamins.
- Sinha, C., V. da Silva Sinha, J. Zinken & W. Sampaio. 2011. When time is not space: The social and linguistic construction of time intervals and temporal event relations in an Amazonian culture. *Language and Cognition* 31. 137–169.
- Tomasello, M. 1999. *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.
- Whiten, A., J. Goodall, W. C. McGrew, T. Nishida, V. Reynolds, Y. Sugiyama, C. E. G. Tutin, R. W. Wrangham & C. Boesch. 1999. Cultures and chimpanzees. *Nature* 399. 682–685.
- Whitrow, G. J. 1988. *Time in history: Views of time from prehistory to the present day*. Oxford: Oxford University Press.