

Leap of faith: A review of *Language and Species*

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Believing, as I do . . . , that the possession of articulate speech is the grand distinctive character of man . . . , I find it very easy to comprehend that some . . . inconspicuous structural difference may have been the primary cause of the immeasurable and practically infinite divergence of the Human form from the Simian stirps.

— T. H. Huxley

Here is a book after Huxley's heart, arguing that language is indeed the distinctive character of *Homo sapiens*, the foundation of the species' self-reflexive consciousness and, in the end, of its control over the terrestrial environment. The book is the first of its kind, a closely reasoned attempt to fit linguistic theory into the framework of evolutionary biology. Actually, Bickerton has little to say about "articulate speech," and the linguistic theory he is trying to square with biology is the current version of generative grammar. However, since no other description of language has anything like the scope and detail of generative grammar, Bickerton's decision to follow Chomsky, "arguably the Newton of our field" (p. 5), was perhaps a necessary step toward confronting the full complexity of language. The book is remarkable for its determined, if ultimately unsuccessful, endeavor to do justice to both evolutionary and linguistic theory, a task from which (as Bickerton remarks) professional linguists, despite lip service to biology, have resolutely flinched.

Of course, Bickerton himself is a professional linguist, a student of pidgins and creoles, and this fact has determined the highly original cast of his argument. Nonetheless, he has read widely in many fields, including anthropology, evolutionary biology, philosophy, psychology, and neuro-

psychology, and this fact gives the argument its depth and scope. Although there are many passages of somewhat technical discussion, and although the book demands constant attention if you want to catch every trick, Bickerton addresses a general audience in a brisk conversational style.

The gist of his argument is this. Anyone who accepts the theory of evolution must also accept that language, however complex, is an adaptation that evolved out of some prior system. Yet the gap between language and the most sophisticated systems of nonhuman animal communication is so vast that there seems to be no conceivable way of getting from there to here. This is the Paradox of Continuity.

The source of the paradox lies in a qualitative difference between the modes of human and nonhuman communication. So far as we know, all nonhuman systems address a limited set of topics essential for survival and reproduction (food, predators, sex). Humans, by contrast, can talk (at least in principle) about anything they choose. The difference is due not simply to differences in cognitive capacity (which, to a large degree, may be a consequence rather than a cause of language), but rather to formal differences in the mechanisms of communication. Animal calls and signs are structurally and functionally holistic: each unitary call refers to a whole situation. A spoken utterance, on the other hand, typically breaks the situation to which it refers into parts (agent, action, goal, instrument, locus, etc.). This can be done because the structure of language is itself componential: an effectively unlimited set of words is formed from a small set of sounds, and an infinite number of sentences can be formed from the words. This difference is the grounds of the "practically infinite divergence" in the communicative capacities of human and nonhuman animals. How did evolution bridge the gap?

To resolve the Continuity Paradox, Bickerton argues, we must recognize that language is primarily not a means of communication, but "a system of representation, a means for sorting and manipulating the plethora of information that deluges us throughout our waking life" (p. 5). Before we can talk, we have to have something to say, and language is, in the first instance, a means of representing to ourselves what we have to say. If this is so, the history of language is a history not of animal communication, but of animal systems of representation. More broadly, the history of language is the history of consciousness.

By representation Bickerton means simply "responding or having a permanent propensity to respond to x , an entity or event in the external world, in terms of y , a particular pattern of neural activity" (p. 76). On this definition, every creature with a nervous system, from earthworm to human, has a representation of the world. Representations are normally veridical (if they were not, how would the creature survive?), but incomplete, adequate to their function, but not optimal. Each species has evolved sensory systems to pick up information about the world necessary for survival, motor systems to respond to that information, and representational systems to link information with behavior. Thus, each species carves reality into a set of

functional categories that constitutes its characteristic "primary representational system (PRS)" (p. 82).

PRSs can be simple or complex. Natural selection has favored the emergence of increasingly complex systems, not because prior systems were inadequate (cockroaches and frogs are still with us, and thriving), but because sensitivity to more and subtler aspects of the environment permits an animal to gain an advantage over its fellows, to leave more offspring, and ultimately perhaps to found a new species. Thus, there is a true "*scala naturae* . . . based on the degree to which creatures are capable of representing the world around them" (p. 102).

By the time the more advanced primates arrived on the scene, much of the infrastructure for language, a secondary representational system (SRS) grafted onto the first, had been laid down. All that was needed was the appropriate selection pressures to "make the development of secondary representations advantageous, and some means through which such representations could be made both concrete and communally available" (p. 101). Notice that, on this view, evolution has a direction (not a popular idea among evolutionists) toward increasingly comprehensive systems of representation. Language then lies "in the mainstream of evolution . . . merely a single (if admittedly rather a large) step in an orderly process, the development of more and more sophisticated ways of representing (that is, knowing) a world external to the creature" (p. 102). This is how Bickerton resolves the Continuity Paradox.

In what sense, then, is language a system of representation? Bickerton adopts the metaphors of a map and of a handbook of itineraries: the map is the lexicon, a chart of semantic space, and the itineraries are the sentences, an infinity of paths through that space. At first, we must presume, symbols on the lexical map (that is, words) referred only to categories, or concepts, in the human PRS, corresponding to objects and events in the external world - as they still do for the child first learning to talk. However, because words refer to concepts of the world, not to the world itself, language was able to evolve into an autonomous system of representation, deploying words that refer to abstract concepts for which there are no perceptual correlates and even to imaginary objects that do not exist. Thus, words mirror not reality, but a speaker's, a culture's, or a species' view of reality.

If we want to clear a path through semantic space, that is, if we want to represent unambiguously "who did what with which to whom," we cannot simply string words together in any sequence we like. Not all paths across a terrain are passable, and not all strings of words form sentences. Permissible strings are shaped by structural principles (predictability, grammaticization, syntax) of which the most important, and the one that "most decisively separates us from other species" (p. 57), is syntax. In a scant, but lucid, 15 pages Bickerton sketches the descriptive principles of the X-bar theory of phrase structure, "the very core of universal syntax" (p. 61), the "universal" (p. 67) argument structure of verbs, and the principles by which the latter is mapped onto the former according to a hierarchy of thematic roles. He

emphasizes that talkers and listeners put their syntactic machines to work automatically and unconsciously, and he concludes that "we are in the presence, not merely of a system that determines what we can and cannot say, but of a system wholly below the level of consciousness that cannot have been acquired through instruction, induction, or any of the other recognized processes by which learning takes place" (p. 73).

With the division of language into two autonomous components, lexicon and syntax, Bickerton effectively also divides the question of language origins into two distinct questions: (1) How did arbitrary elements acquire reference? (2) How did syntax develop? For the first step, "all that was necessary was for some kind of label to be attached to a small number of preexisting concepts" (p. 128). Evidence for this step comes from "the fossils of language" (Chapter 5). Here Bickerton turns on its head the argument that, since the utterances of a signing chimpanzee and a talking 2-year-old child are formally identical, the chimpanzee is at least learning the rudiments of language. On the contrary, Bickerton responds, neither chimpanzee nor child is learning language. Instead, both are using "protolanguage," a phylogenetic precursor of true language that is recapitulated in the child and can be elicited by training from the chimpanzee, because an SRS is already latent in its well-developed conceptual representation of the world.

Speakers (or signers) of a protolanguage have a referential lexicon but - with the possible exception of some negators, question words, and quantifiers - no grammatical items and no syntax. Specifically, their utterances display no regularities of word order, no systematic expansion of structure in phrases and clauses, no obligatory expression of subcategorized arguments, and no automatic identification of null elements. Nonetheless, we are justified in regarding protolanguage as a unitary mode of representation, peculiar to our species, because it emerges naturally by mere exposure to words not only in children under age 2, but also in older children deprived of language during the "critical period" (e.g., Genie, the well-known "wild child" of California), and even in adults obliged to communicate in a second language of which they know only a few words. This last was the fate of entire communities of slaves, speakers of diverse native languages, who were thrown together in European colonies of the Caribbean and Pacific. Forced to communicate in the language of their masters, but denied (due to the adverse ratio of learners to speakers) the opportunity to learn that language fully, they developed "pidgins," formally identical, Bickerton tells us, with the protolanguage of under 2-year-olds.

Now if chimpanzees and an indefinite number of other species do indeed possess a latent SRS so close to the surface that it can be elicited by laboratory conditioning, why did an SRS evolve only in the hominid line? The answer, Bickerton speculates, lies in the conditions of life on the savanna. There, lacking the steady food supply of the forests, hominids were obliged to hunt, gather, and scavenge. Lacking too the speed, strength, teeth, and claws of rival predators (to which they themselves might fall prey), hominids had to live by their wits. These conditions set a premium on continued

evolutionary sharpening of such primate skills as stereoscopic vision, bipedal locomotion (affording a wide field of view while tracking game), and manual skills, including tool use. More broadly, the conditions set a premium on the evolution of curiosity, close observation, long-term memory, and a generally enriched PRS. Eventually, a point was reached at which any further gain in knowledge of the world could only come from the emergence of an SRS.

We shall probably never know when hominids first stumbled on the discovery that arbitrary grunts and mouthings could be associated with an absent referent, and the exact date is not in any case critical to the argument. But from a careful consideration of the palaeoanthropological evidence, Bickerton concludes that protolanguage probably emerged in *Homo erectus* (c. 1.5–0.5 million years ago [mya]). This would be consistent with the substantially higher brain/body ratio of *Homo erectus* than of *Homo habilis* (c. 2.5–1.5 mya) and with the substantially lower brain/body ratio of *Homo erectus* than of *Homo sapiens*, the initiator of true language.

The advantages of being able to communicate in a protolanguage, even if its lexicon is modest, are not difficult to imagine. However, consistent with his view of language as primarily a system of representation, Bickerton emphasizes not communication, but “the way in which protolanguage would have remodeled . . . [the hominid’s] . . . internal world” (p. 156). The greatest conceptual gain would perhaps be in learning. Here Bickerton distinguishes among three modes of learning: experiential, observational, and what he terms “constructional.” A creature capable of constructional learning can increase its knowledge of the world by forming propositions about objects, events, behaviors that are not immediately present to its senses. For example, such a creature might have observed that a certain kind of predator tends to avoid water. The creature could then “construct a kind of propositional machine: ‘Predator avoids water. Suppose predator chases me. I cross water. Predator does not cross water. I escape.’ Thus despite the absence of any direct example, the first time the creature is pursued by that predator, it escapes by swimming” (p. 159).

Virtually all animals can learn by experience (for which operant conditioning is the paradigm), and many species can learn by observation. But few (perhaps only one) can learn by constructing propositions. Certainly, chimpanzees can solve novel problems by stacking boxes or using a stick to reach otherwise inaccessible food, but seemingly they can do so only if all the elements needed for the solution are present in the immediate environment. Arguably, then, only a creature with an SRS can construct an abstract model of possible behaviors with respect to absent objects and try them out in its mind to see if they work. The advantages that will accrue to such a creature are obvious. Bickerton indeed proposes that the large increase in brain/body ratio during the million or so years from *erectus* to *sapiens* was mainly due to a continuous feedback process between constructional learning, made possible by the evolving protolanguage, and the need for neural space to store an increasingly subtle conceptual representation of the world.

Nonetheless, the protolanguage of *erectus* had its limits. There is no evidence from the fossil record that *erectus* was the cognitive equal of *sapiens*. One limit was perhaps on the size of the lexicon due to the relatively small number of discriminably different words that *erectus* could articulate with its still not fully developed vocal tract. A second limit was set by the lack of grammatical items (verbal inflections, auxiliaries, prepositions) for representing the time, locus and direction of objects, actions and events. The third and most serious limit was on thinking itself, due to the lack of syntax. For human thinking, Bickerton argues, is intrinsically syntactic, "since it depends crucially on the existence of structures like: *x* happened because *y* happened; whenever *x* happens, *y* happens; unless *x* happens, *y* will not happen; if *x* happens, *y* or *z* will happen; although *x* happened, *y* did not happen; *x* thinks, believes, says, hopes, fears, knows that *y* will or will not happen; *x* does *y* in order to *z*; *x* wants the *y* that *z*-ed, not the *a* that *b*-ed; and so on" (p. 162).

To *Homo sapiens*, then, was left the great leap into syntax. That it was indeed a leap, a saltation not a gradual development, is the final step in Bickerton's argument. He adduces three lines of evidence against gradualism. First is ontogenetic evidence, from two areas, that protolanguage can change into true language without an intervening stage. In a typical normal child, Bickerton argues from transcripts of a certain child's utterances at 21 months and 27 months, at least four (and perhaps all) of the five properties noted earlier as being absent from protolanguage come in as a cluster within a 6-month period (grammatical items, systematic expansion of phrase structure, obligatory expression of subcategorized arguments, automatic identification of null elements, and, perhaps, systematic variation of word order). All five properties also appear in creole languages, the languages spoken by first generations of children raised among pidgin-speaking adults. If these children were indeed exposed only to protolanguage, as seems to have been the case, then their language is a "direct expression of a species-specific biological characteristic, a capacity to recreate language in the absence of any specific model from which the properties of language could be 'learned' in the ways we normally learn things" (p. 171). The ontogenetic evidence demonstrates that a leap from protolanguage to language is possible.

A second line of evidence (or at least argument) against gradualism demonstrates, on linguistic grounds, that a leap is not only possible, but necessary. Any proposal for an "interlanguage" is likely to entail either a partial application of full language rules or a contravention of them. As far as partial applications go, there is no reason to suppose that it is easier to apply a rule in some contexts, but not in others, than to apply it across the board. And as for contraventions, such as mapping thematic roles directly onto surface ordering (e.g., all grammatical subjects are agents, all objects are patients), this would require "unlearning" the interlanguage rules to make the step into language - a biologically implausible detour on the road from protolanguage to language.

A final line of evidence against gradualism comes from recent studies of

mitochondrial DNA (mtDNA) in modern populations. MtDNA molecules are inherited maternally through the oocyte and, unlike nuclear genes, cannot be lost through recombination. Studies tracing the history of mtDNA molecules have given rise to the so-called African Eve hypothesis that *Homo sapiens* originated as a distinct species due to (in Bickerton's words) "an event, presumably a mutation of some kind, that affected a single female living in Africa . . . between 140 and 290 Kya [thousand years ago]" (p. 165). The hypothesis of a single, common ancestor is widely, though not universally, accepted by both geneticists and palaeoanthropologists. The issue is a technical one that, as Bickerton remarks, must be decided by professionals in the field. Nonetheless, he himself adopts the common ancestor hypothesis, terming it the "catastrophic" view, largely on the basis of the fossil record. This record shows remarkably little change in the hominid "tool kit" over the million or so years of the *erectus* period. But around 70 Kya, soon after the appearance of *sapiens*, the record is suddenly enriched by bladed tools, cave paintings, stone figurines, moon calendars – a panoply of artifacts that, Bickerton argues, could only have been produced by a creature with the powers of thought and constructional learning that language affords.

Bickerton is aware of the difficulties that a catastrophic account brings in its train, and he devotes many pages to puzzling them through. For example, he lists a minimal set of eight "quasi-independent entities" (p. 189) or components in the current generative model from which all the subtle phenomena of descriptive syntax (including the five criteria of true language noted earlier, and many more) might be deduced: hierarchical structure (X-bar theory), binding, control, bounding, theta theory, conditions for government, conditions for case-assignment, and movement processes. He considers how these components might be collapsed into a smaller number, thereby reducing the number of required mutations. But even if we managed to reduce the eight "entities" to a single principle, he believes that we would still not be out of the woods, because "our species is distinguished from all others not merely by syntacticized language, but also by changes in the features and dimensions of the skull and by our typical supralaryngeal tract. How could any single genetic event . . . occasion so many and such diverse changes?" (p. 190). In the end, after much intellectual writhing, Bickerton pins his hopes for a solution on advances in our understanding of how brains are organized and how they develop.

With language, then, came the only forms of thought, mind and consciousness that we as a species can know. In the last two chapters of his long argument, Bickerton explores some philosophical implications and presumed historical consequences of the assumptions that language is the essential mode of human thought and the source of our self-reflexive consciousness. Only by understanding language and its evolution, Bickerton concludes, will we understand ourselves and our place in nature.

The most interesting and original aspect of this book is also the most speculative: the formulation and resolution of the Continuity Paradox.

Discussions of language origins seldom acknowledge the vast infrastructure of knowledge and beliefs about the world that underlies even a simple spoken utterance. No other writer whom I have read places the issue, where it belongs, at the center of an evolutionary account of language. Of course, any story about the origins of "mind" will be speculative, but I found Bickerton's notion of increasingly complex systems of primary representation, from which language emerges as a secondary system, persuasive and intuitively appealing. He argues his case for the continuity of animal mind and human mind clearly, subtly, and with great erudition.

However, if we ask how successful Bickerton is in reconciling linguistic theory with neo-Darwinian theory, the answer is, not very. The broad reason for this is that he forces all the concessions out of biology, and none out of linguistics. Given the central, unifying role of evolutionary theory in modern biology, and the uncertain, still developing role of generative grammar in linguistics, this is the wrong way round. More narrowly, there are, in my view, two main flaws in Bickerton's argument. First, he rejects gradual, step-by-step evolution in favor of "catastrophic" saltation. Second, he disregards the communicative aspects of language function, thereby shutting himself off from explaining many aspects of linguistic form.

In Darwin's (1859/1964) often-quoted discussion of "organs of extreme perfection and complication" (of which we can take the neural underpinnings of language to be a supreme example), he remarked: "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down" (p. 189). For many years Darwin's claim was the target of attack from proponents of alternative "saltationist" accounts, but the development of Mendelian genetics in the first half of the 20th century made clear that the only way complex structures finely adapted to their function can evolve is through a long sequence of mutations with small effects. By the centenary of the publication of the *Origin* it was possible for Mayr (1960), the greatest living authority on evolutionary theory, to write:

The genetic work of the last four decades has refuted mutationism (saltationism) so thoroughly that it is not necessary to repeat once more all the genetic evidence against it. Most important is that the phenotype (in higher organisms) is the product of a long developmental pathway and . . . any part of it, any "character," depends on the harmonious interaction of many, if not all, the genes of the organism. (p. 356)

Bickerton is certainly aware of the established dogma. Indeed, in his earlier book, *Roots of Language* (1981), he accepted it as part of the "biological reality" (p. 294) to which any serious theory of language and language origins has to conform. He was at pains to chart a plausible step-by-step course for the possible evolution of a stripped-down innate core of language structure, the "bioprogram," through lexicalization of the presumed primate semantic space, the emergence of thematic roles implicit in verbs, grammaticization of lexical items, the development of recursion from the serial stringing of verbs, and so on (Chapter 4). In that book too

he poured scorn on those who believe that language sprang "in its entirety from Jove's brow by some beneficent and unprecedented mutation" (p. 215), and he stressed that "evolution has advanced not by leaps and bounds but by infinitesimal gradations" (p. 221).

Why then does he now baldly, without acknowledging the eccentricity of his step, adopt a saltationist account of language origins and allow himself to become mired beyond rescue in the attempt to extricate himself from the consequences? From internal evidence, as scholiasts say, the answer seems to be that in the interval between the books two things happened to change Bickerton's mind. First, the influence of Chomsky, acknowledged in the preface as "long resisted" (p. x), came to bear; the change is signaled by a switch from the vigorous, even truculent, polemic with which he attacked Chomsky's work in the first book to the tone of chastened respect adopted in the second. For no doubt sound reasons that he unfortunately does not explain to us, Bickerton abandoned his language bioprogram hypothesis (1984) and adopted in its place the "universal grammar" of current generative theory.

Now, the formal apparatus of generative grammar is purely descriptive, a matter to be explained rather than itself explanatory. Nothing intrinsic to its principles demands a homemade biology to account for them. Yet, for reasons perhaps having more to do with protecting the autonomy of their field than with science, generative theorists find the only acceptable "explanation" to be that the principles are "innate." Attempts to understand how they might have become innate in the first place, that is, to trace their functional origins in evolution and development, are dismissed out of hand (see, for example, many of the commentaries on Pinker & Bloom, 1990). However, why did Bickerton, hitherto a sturdy functionalist, fall into line? My guess is that he finally recognized (what was obvious to a reader of the first volume) that the pin of his entire argument - the claim that children raised among pidgin speakers invented creole languages in a single generation - was no more than an extreme statement of the familiar argument from "the poverty of the stimulus," combined with "the Chomskyan idealization of 'instantaneous acquisition'" that he once ridiculed (Bickerton, 1981, p. 142).

In any event, having bartered functionalism for descriptive power, Bickerton was momentarily beached, caught between the entirely orthodox evolutionary functionalism, which he had adopted to resolve the paradox of the continuity of human and animal mind, and the flagrant antifunctionalism of generative grammar. Then, the second event occurred. In 1987, Chance lowered onto the stage the *deus ex machina* of the African Eve hypothesis, granting (Bickerton evidently believes) a new license to saltationism. He interprets the discovery of a possible common ancestor for all living humans as evidence that *Homo sapiens* emerged full-blown, with all its diverse species-specific characters, from a single "crucial mutation" (p. 190). Yet the researchers who first proposed the hypothesis of a common ancestor, in a paper that Bickerton cites, explicitly deny the necessity of this interpretation:

Our placement of the common ancestor of all human mtDNA diversity in Africa 140,000–280,000 years ago need not imply that the transformation to anatomically modern *Homo sapiens* occurred in Africa at this time. The mtDNA data tell us nothing of the contributions to this transformation by the genetic and cultural traits of males and females whose mtDNA became extinct. (Cann, Stoneking, & Wilson, 1987, p. 35)

Accordingly, even if we accept the Eve hypothesis, we are not obliged to believe that evolution stopped with her birth. Much can have happened during the $210,000 \pm 70,000$ years between the hypothesized point of the species' origin and its radiation out of Africa, marked by the relatively sudden appearance of novel artifacts (roughly 70 Kya). If we accept, further, Bickerton's argument that syntax began with *Homo sapiens*, we would then have, at four generations to a century, between roughly 3,000 and 8,000 generations for its basic principles to evolve. Whether this span would have been enough to do the job, I do not know. Certainly, it does not seem so short that we should be pressed into abandoning a basic tenet of evolutionary theory.

However, Bickerton's flight from gradualism was abetted by a second, closely related flaw in his argument that springs from a misconception of how genes relate to the structures they help to form. The misconception is evident, for example, in his notion that, if we could collapse the eight quasi-independent components of the current generative model to, say, three or four, we would similarly reduce the number of mutations required to account for them. The objection to this notion, implicit in the quotation from Mayr (1960), is that there is no one-to-one correspondence between genes and phenotypic characters – “Mendelism is a theory of particulate inheritance, not of particulate embryology” (Dawkins, 1982, p. 116) – and still less, we may add, of particulate behavior, or particulate structures underlying behavior. A single phenotypic character may depend on the action of many genes, and a single gene may contribute to the formation of many characters. If we recall further that some forty genes work together to form the wing of a fruit fly (Waddington, 1975, p. 72), it seems wildly implausible that one or even one hundred genes suffice to encode the (perhaps) specialized neural structures underlying human language capacity.

What all this means is that the goal of mapping language onto genes is, at present, and perhaps indefinitely, scarcely intelligible. For example, Gopnik (1990) recently reported the results of a pedigree analysis of an extended family consistent with the hypothesis that a certain form of dysphasia, which she termed “feature blindness,” arose from a defect in a single dominant gene. Let us suppose that further analysis of this family were to isolate the chromosome, and even the precise stretch of DNA on the chromosome, where the defect lies. We would then have our hands on *a* gene, but not on *the* gene, for feature sensitivity. The reason for this is simply that many other genes are likely to be no less crucial for the development of normal sensitivity to features than the one we have isolated. In fact, if we were to conduct a similar study of another family, in which there ran the same form of dysphasia, we would be quite likely to end up

isolating a different gene, perhaps even on a different chromosome. In short, neither genetic fantasy nor genetic fact can restore Eve to the saltationist Eden from which genetic knowledge drove her out.

The reader who has happily followed Bickerton in his resolution of the first Continuity Paradox may be taken aback by his blithe introduction of a second Continuity Paradox to "solve" the puzzle of syntax. Nonetheless, the story hangs together. If we add to the new Discontinuity a defensible (though, in this book, weakly defended [p. 115]) assumption that language development recapitulates, within limits, language evolution, many otherwise puzzling aspects of Bickerton's argument fall into place: the sharp division of lexicon from syntax, the notion of an encapsulated protolanguage distinct from true language, the denial of a language mode intermediate between the two, the supposed ontogenetic "leap" (albeit of 6 months' duration) by a normal child into syntax, the uncritical acceptance of a critical period for language acquisition, and, not least, the assumption that language is primarily a system for representing, rather than communicating, propositions.

This last assumption, a crucial first line of defense against functionalism, oversimplifies the relation between language and thought. We can certainly think without speaking, but we also often speak to find out what we think. In other words, communication facilitates thought no less than the reverse, as indeed Bickerton acknowledges in the preface: "How can you know what you think until you've disagreed with someone?" (p. x). In fact, Bickerton concedes that: "Communication . . . was perhaps the only means by which either [language or protolanguage] could have bootstrapped its way up from mere latency to the status of a useable representational system" (p. 146). But instead of treating the communicative and representational functions as mutually reinforcing components of a feedback system - the more you say, the more you have to say, and vice versa - he disregards the communicative function almost entirely. The result is that he seriously weakens his account of the origins of language form because he shuts off explanations of properties that presuppose a listener - most notably, the rules of phonetics and phonology instantiated in "articulate speech."

Curiously, although phonology is touched on only three times in the book (pp. 14, 144-145, 162) and earns no entry in the index, Bickerton does recognize "commonalities between phonology and syntax which suggest that the evolution of the two may have been linked" (p. 144). He does not say what these commonalities are. But if they are evolutionarily based, they must extend beyond mere formal analogy at least to the types of selection pressures that shaped them, and perhaps even to homologies in their neural substrates. With regard to the pressures, Bickerton goes so far as to suggest that the words of the first hominid talkers may have been "unanalyzable wholes," and that as vocabulary grew, it would have exerted a selective pressure toward reliable articulation and comprehension (p. 145). Here he is on the edge of sketching an account of the origin of sound systems along the lines of the only quantitative model so far proposed (Lindblom, 1988, and references therein). This model predicts the phone-

mic elements in a system of sound contrasts from competing selection pressures toward ease of comprehension and ease of articulation, within the presumed constraints of auditory and articulatory capacity. While we still have everything to learn about possible non-linguistic neurobehavioral constraints on syntactic form, we have no reason to suppose that pressures toward ease and clarity of expression ceased to operate just for the evolution of syntax.

Had Bickerton pursued such a functionalist line of thought, he might have been led toward more serious consideration of the social uses of language, and even toward reflections on the possible social, rather than purely linguistic, origins of a self-reflexive consciousness (De Waal, 1984; Humphrey, 1983). On such a view, as consciousness of self (and so of other selves) developed, new words with their implicit syntactic requirements would have sprung up to capture the increasingly subtle concepts and feelings of individual and social life (cf. p. 187). From there the path into a grammar projected by the lexicon - explored in Bickerton's first book and briefly scouted again in this one (pp. 181-188) - would have been straight. No doubt, such a lexicalist account of syntax would have left much to be explained, but surely a good deal less than we are left with here. Of course, that would have been another book by another writer - perhaps, indeed, by Bickerton's former self!

I have said enough about the book's weaknesses. Let me end with its strengths. Perhaps there are those, like Chomsky himself, who view questions about the origins of language as unanswerable and therefore of no more interest than questions about the origin of the heart or the arm (see Chomsky's remarks in Harnad, Steklis, & Lancaster, 1976, p. 57). But more than a century of evolutionary studies has demonstrated that such questions are not necessarily unanswerable. Moreover, there are many who consider them to be of quite extraordinary interest because in trying to answer them, we throw light on the structure and function of the organs examined. This is a book for such people. Bickerton calls it "a machine for thinking about language and what language has done for our species and how it has made us different from other species" (p. 6). The book commands a large and diverse range of knowledge, constantly raises unexpected questions leading into new lines of thought, and adjudicates every issue with an admirable, even-handed rationality. Few readers will come away without a deepened understanding of the scope and limits of human language. I believe that Thomas Huxley, concerned as he was with where humans fit into the scheme of things, would have been pleased to read it, and even more pleased to have written it.

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