

The Biolinguistic Program: Where does it stand today?

Before discussing language, we have to be clear about what we mean by the term. Sometimes it is used to refer to human language; sometimes it is used to refer to any symbolic system or mode of communication or representation, as when one speaks of the language of the bees, or programming languages, or the language of the stars, and so on. Here I will keep to the first sense: human language, a particular object of the biological world. The study of language, so understood, has come to be called the *biolinguistic* perspective.

Among the many puzzling questions about language, two are salient: First, why are there any languages at all? Second, why are there so many languages?

According to a fairly general consensus among paleoanthropologists and archaeologists, the questions are very recent ones in evolutionary time. Roughly 100,000 years ago, the first question did not arise, because there were no languages. About 50,000 years ago, the answers to both questions were settled: our ancestors began their trek from Africa, spreading over the entire world, and as far as is known, the language faculty has remained essentially unchanged – which is not surprising in such a brief period. An infant from a stone age tribe in the Amazon, if brought to Boston, will be indistinguishable in linguistic and other cognitive functions from children born in Boston who trace their ancestry to the first English colonists; and conversely. The actual dates are uncertain, and do not matter much for our purposes. The general picture appears to be roughly accurate.

We are therefore concerned with a curious biological object, *language*, which has appeared on earth quite recently. It is a species property of humans, a common endowment with no significant variation apart from serious pathology, unlike anything else known in the organic world in its essentials, and surely central to human life since its emergence. It is a central component of what the co-founder of modern evolutionary theory, Alfred Russel Wallace, called “man’s intellectual and moral nature”: the human capacities for creative imagination, language and symbolism generally, recording and interpretation of natural phenomena, intricate social practices and the like, a complex that is sometimes simply called “the human capacity.” This complex seems to have crystallized fairly recently among a small group in East Africa of whom we are all descendants, distinguishing contemporary humans sharply from other animals, with enormous consequences for the whole of the biological world. It is commonly and plausibly assumed that the emergence of language was a core element in this sudden and dramatic transformation. Furthermore, language is one component of the human capacity that is accessible to study in some depth. The general principles of our “intellectual and moral nature” remain a considerable mystery, but they play a central role in our lives, and we can hardly doubt that they are in some fundamental way rooted in our very nature. They come to us from “the original hand of nature,” in David Hume’s phrase. This is commonly denied, but not credibly, in my opinion.

From the biolinguistic perspective, we can think of language as, in essence, an “organ of the body,” more or less on a par with the visual or digestive or immune systems. Like others, it is a subcomponent of a complex organism that has sufficient internal integrity so that it makes sense to study it in abstraction from its complex interactions with other systems in the life of the organism. In this case it is a cognitive organ, like the systems of planning, interpretation, reflection, and whatever else falls among those aspects of the world loosely “termed mental,” which reduce somehow to “the organical structure of the brain,” in the words of the 18th century scientist and philosopher Joseph Priestley. He was articulating the natural conclusion after Newton had demonstrated, to his great dismay and disbelief, that the world is not a machine, contrary to the core assumptions of the seventeenth century scientific revolution – a conclusion that effectively eliminated the traditional mind-body problem, because there is no longer a coherent concept of *body* (*matter, physical*), a matter well understood in the 18th and 19th centuries. We can think of language as a *mental organ*, where the term “mental” simply refers to certain aspects of the world, to be studied in the same way as chemical, optical, electrical and other aspects, with the hope for eventual unification – in the past, often in completely unexpected ways, not necessarily by reduction.

Though I will not pursue the matter here, it is of some interest that the post-Newtonian understanding has recently been rediscovered and presented rather dramatically as the thesis of the new biology that “**Things mental, indeed minds, are emergent properties of brains, [though] these emergences are...produced by principles that... we do not yet understand.**” I am quoting neuroscientist Vernon Mountcastle, summarizing the American Academy of Arts and Sciences review of the “decade of the brain,” which ended the last millennium. Other distinguished scientists and philosophers have recently described the same thesis as an “astonishing hypothesis” of the new biology, a “radical” new idea in the philosophy of mind, “the bold assertion that mental phenomena are entirely natural and caused by the neurophysiological activities of the brain,” opening the door to novel and promising inquiries, a rejection of Cartesian mind-body dualism, and so on. All such pronouncements reiterate formulations of centuries ago, in virtually the same words, after mind-body dualism became unformulable with the disappearance of the only coherent notion of body (or physical, material, etc.). These facts may serve as reminders that much as in social and political life, so also in the life of the mind, it is not a wise idea to forget history.

Why are there so many languages?

As I mentioned at the outset, with regard to the curious mental organ *language*, two obvious questions arise. One is: Why does it exist at all? Second: Why is there more than one language? In fact, why is there such a multitude and variety that languages appear to “differ from each other without limit and in unpredictable ways” and therefore the study of each language must be approached “without any preexistent scheme of what a language must be.” I am quoting the formulation of the prominent theoretical linguist Martin Joos 50 years ago, summarizing the reigning “Boasian tradition,” as he plausibly called it, tracing it to the work of one of the founders of modern anthropology and anthropological linguistics, Franz Boas. The publication that was the foundation of

American structural linguistics in the 1950s, Zellig Harris's *Methods of Structural Linguistics*, was called "methods" because there seemed to be little to say about language beyond the methods for reducing the data from limitlessly varying languages to organized form. European structuralism was much the same. Nikolai Troubetzkoy's classic introduction to phonological analysis was similar in conception. More generally, structuralist inquiries focused almost entirely on phonology and morphology, the areas in which languages do appear to differ widely and in complex ways, a matter of broader interest, to which I will return.

The dominant picture in general biology was rather similar, captured in molecular biologist Gunther Stent's observation that the variability of organisms is so free as to constitute "a near infinitude of particulars which have to be sorted out case by case."

The problem of reconciling unity and diversity has constantly arisen in general biology as well as in linguistics. The study of language that developed within the seventeenth century scientific revolution distinguished universal from particular grammar, though not quite in the sense of the contemporary biolinguistic approach. Universal grammar was taken to be the intellectual core of the discipline; particular grammars were regarded as accidental instantiations of the universal system. With the flourishing of anthropological linguistics, the pendulum swung in the other direction, towards diversity, well articulated in the Boasian formulation I quoted. In general biology, the issue had been raised sharply in a famous debate between the naturalists Georges Cuvier and Geoffroy St. Hilaire in 1830. Cuvier's position, emphasizing diversity, prevailed, particularly after the Darwinian revolution, leading to the conclusions about near infinitude of variety that have to be sorted out case by case. Perhaps the most quoted sentence in biology is Darwin's final observation in *Origin of Species* about how "from so simple a beginning, endless forms most beautiful and most wonderful have been, and are being, evolved." I do not know if the irony was intended, but these words were taken by evolutionary biologist Sean Carroll as the title of his introduction to "the new science of evo-devo [evolution-development]," which seeks to show that the forms that have evolved are far from endless, in fact are remarkably uniform.

Recent discoveries tend to reinforce the general approach of D'Arcy Thompson and Alan Turing, much earlier, on the principles that constrain the variety of organisms. In Turing's words, the true science of biology should regard each "living organisms as a special kind of system to which the general laws of physics and chemistry apply," sharply constraining their possible variety and fixing their fundamental properties. That perspective may sound less extreme today after the discovery of master genes, deep homologies and conservation, and much else, perhaps even restrictions of evolutionary/developmental processes so narrow that "replaying the protein tape of life might be surprisingly repetitive." I am quoting a report on feasible mutational paths in the journal *Science*, reinterpreting a famous image of Steven Gould's, who had suggested that the tape of life, if replayed, might follow a variety of paths. Biochemist Michael Sherman, writing in *Cell Cycle*, argues that a "Universal Genome that encodes all major developmental programs essential for various phyla of Metazoa emerged in a unicellular or a primitive multicellular organism shortly before the Cambrian period" about 500

million years ago, when there was a sudden explosion of complex animal forms; and, further, that the many “Metazoan phyla, all having similar genomes, are nonetheless so distinct because they utilize specific combinations of developmental programs.” According to this conception, there is one multicellular animal from a sufficiently abstract point of view – the point of view that might be taken by a scientist from a much more advanced civilization viewing events on earth. Superficial variety would result from various arrangements of an evolutionarily conserved “developmental-genetic toolkit,” as it is sometimes called. If ideas of this kind prove to be on the right track, the problem of unity and diversity will be reformulated in ways that would have surprised recent generations of scientists.

The uniformity had not passed unnoticed in Darwin’s day. The naturalistic studies of Darwin’s close associate and expositor Thomas Huxley led him to observe, with some puzzlement, that there appear to be “predetermined lines of modification” that lead natural selection to “produce varieties of a limited number and kind” for each species. The conclusion is reminiscent of earlier ideas of “rational morphology,” a famous example being Goethe’s theories of archetypal forms of plants, which have been partially revived in the “evo-devo revolution.”

Over the years, in both general biology and linguistics the pendulum has been swinging towards unity, yielding new ways of understanding traditional ideas.

Let us return to the first of the two basic questions: Why should there be any languages at all? As I mentioned, very recently in evolutionary time the question would not have arisen: there were no languages. There were, of course, plenty of animal communication systems. But they are all radically different from human language in structure and function. Human language does not even fit within the standard typologies of animal communication systems – Marc Hauser’s, for example, in his comprehensive review of evolution of communication. It has been conventional to regard language as a system whose function is communication. To the extent that the characterization has any meaning, it appears to be incorrect. Language can of course be used for communication, as can any aspect of what we do: style of dress, gesture, and so on. And it can be and commonly is used for much else. Statistically speaking, for whatever that is worth, the overwhelming use of language is internal – for thought. It takes an enormous act of will to keep from talking to oneself in every waking moment – and asleep as well, often a considerable annoyance. Not only in the functional dimension, but also in all other respects – semantic, syntactic, morphological and phonological – the core properties of human language appear to differ sharply from animal communication systems, and to be largely unique in the organic world.

How, then, did this strange object appear in the biological record, apparently within a very narrow evolutionary window, perhaps about 50-100,000 years ago? There are of course no definite answers, but I will sketch what seem to me some reasonable speculations, which relate closely to work of recent years in the biolinguistic framework.

Anatomically modern humans are found in the fossil record several hundred thousand years ago, but evidence of the human capacity is much more recent, not long before the trek from Africa. Paleoanthropologist Ian Tattersall reports that “a vocal tract capable of producing the sounds of articulate speech” existed over half a million years before there is any evidence that our ancestors were using language. “We have to conclude,” he writes, “that the appearance of language and its anatomical correlates was not driven by natural selection, however beneficial these innovations may appear in hindsight” – a conclusion which raises no problems for standard evolutionary biology, contrary to illusions in popular literature. It appears that human brain size reached its current level recently, perhaps about 100,000 years ago, which suggests to some specialists that “human language probably evolved, at least in part, as an automatic but adaptive consequence of increased absolute brain size” (neuroscientist George Striedter). With regard to language, Tattersall concludes that “after a long -- and poorly understood -- period of erratic brain expansion and reorganization in the human lineage, something occurred that set the stage for language acquisition. This innovation would have depended on the phenomenon of emergence, whereby a chance combination of preexisting elements results in something totally unexpected,” presumably “a neural change...in some population of the human lineage,...rather minor in genetic terms, [which] probably had nothing whatever to do with adaptation” though it conferred advantages, then proliferated. Perhaps it was an automatic consequence of absolute brain size, as Striedter suggests, or perhaps some minor chance mutation. Sometime later – not very long in evolutionary time – came further innovations, perhaps culturally driven, that led to behaviorally modern humans, the crystallization of the “human capacity,” and the trek from Africa.

What was that neural change in some small group that was rather minor in genetic terms? To answer that, we have to consider the special properties of language. The most elementary property of our shared language capacity is that it enables us to construct and interpret a discrete infinity of hierarchically structured expressions: discrete because there are 5 word sentences and 6 word sentences, but no $5\frac{1}{2}$ word sentences; infinite because there is no longest sentence. Language is therefore based on a recursive generative procedure that takes elementary word-like elements from some store, call it the lexicon, and applies repeatedly to yield structured expressions, without bound. To account for the emergence of the language faculty – hence for the existence of at least one language -- we have to face two basic tasks. One task is to account for the “atoms of computation,” the lexical items – commonly in the range of 30-50,000. The second is to discover the computational properties of the language faculty. This task in turn has several facets: we must seek to discover the generative procedure that constructs infinitely many expressions in the mind, and the methods by which these internal mental objects are related to two *interfaces* with language-external (but organism-internal) systems: the system of thought, on the one hand, and also to the sensorimotor system, thus *externalizing* internal computations and thought. This is a way of reformulating the traditional conception, at least back to Aristotle, that language is sound with a meaning. All of these tasks pose very serious problems, far more so than was believed in the recent past, or often today.

Before turning to these questions, it is useful to add a historical observation. The fact that the language faculty provides the means to generate infinitely many expressions is virtual truism, but one finds scant attention to it until about 50 years ago. One reason is that it was only by mid-twentieth century that the concept of recursive generation was clearly enough understood within logic and mathematics so that it became possible to pose seriously the question of how language makes use of some such procedure. However, the basic observation can be traced back to the early scientific revolution: to Galileo, in side remarks, and particularly to Descartes, for whom it was at the core of his theory of mind and body. The most striking difference between humans and animals or machines, Descartes argued, was that all humans, but no animal or machine, can freely express their thoughts in a creative fashion: without limits, independently of external events or internal states, in novel ways that are nevertheless interpretable by others. Notice that Descartes is simply presupposing the components of the language faculty that I mentioned: the lexicon, the generative procedure, and the relations to language-external systems (the system of thought and the sensorimotor system). But he is focusing attention on a different element of mind: the limitless capacity to use these mechanisms of the language faculty in a manner appropriate to circumstances but not caused by them, a crucial distinction. This capacity is not specific to language: it holds of action generally. Descartes emphasized the case of language because the facts are so clear in this case. The further development of these issues is a fascinating topic, which I will put aside. I bring them up only to stress that even if we can give satisfactory answers to the basic questions about the faculty of language – difficult problems of science, of which we have only a limited grasp – that will leave unanswered the fundamental question of the creative *use* of the language capacity.

Let us turn then to the basic elements of language, beginning with the generative procedure, which, it seems, emerged some time in the 50-100,000 year range, barely a flick of an eye in evolutionary time, presumably involving some slight rewiring of the brain. At this point the evo-devo revolution in biology becomes relevant. It has provided compelling evidence for two relevant conclusions. One is that genetic endowment is deeply conserved. A second is that very slight changes can yield great differences in observed outcome – though phenotypic variation is nonetheless limited, by virtue of the deep conservation of genetic systems, and laws of nature of the kind that interested Thompson and Turing. To cite a simple illustration, there are two kinds of stickleback fish, with or without spiky spines on the pelvis. About 10,000 years ago, a mutation in a genetic “switch” near a gene involved in spine production differentiated the two varieties, one with spines and one without, one adapted to oceans and the other to lakes. Much more far-reaching results have to do with the evolution of eyes, an intensively studied topic. It turns out that there are very few types of eyes, in part because of constraints imposed by the physics of light, in part because only one category of proteins, opsin molecules, can perform the necessary functions. The genes encoding opsin had very early origins, and are repeatedly recruited, but only in limited ways, again because of physical constraints. The same is true of eye lens proteins. The evolution of eyes illustrates the complex interactions of physical law, stochastic processes, and the role of selection in choosing within a narrow physical channel of possibilities.

Much of this work derives from discoveries about regulatory circuits by François Jacob and Jacques Monod, for which they won the Nobel prize in 1965. As Jacob speculated 30 years ago, before major discoveries that provided substantial empirical support for these ideas, superficial differences among organisms, say the difference between an elephant and a fly, may result from very slight changes in timing and arrangement of regulatory mechanisms that activate genes. Jacob's observations provided a suggestive model for the development of the Principles and Parameters approach to language, a matter discussed in lectures of mine shortly after (see my *Rules and Representations*). The approach is based on the assumption that languages consist of fixed and invariant principles connected to a kind of switchbox of parameters, questions that the child has to answer on the basis of presented data in order to fix a language from the limited variety available in principle – or perhaps, as Charles Yang has argued, to determine a probability distribution over languages resulting from a learning procedure for parameter setting. For example, the child has to determine whether the language to which it is exposed is “head-initial,” like English, a language in which substantive elements precede their objects, as in “read the book” or “in the room”; or whether it is “head-final,” like Japanese, where the counterparts would be “book read” and “room in.” As in the somewhat analogous case of rearrangement of regulatory mechanisms, the approach suggests a framework for understanding how essential unity might yield the appearance of the limitless diversity that was assumed not long ago for language (as for biological organisms generally).

The Principles and Parameters research program has been very fruitful, yielding rich new understanding of a very broad typological range of languages, opening new questions that had never been considered, sometimes providing answers. I think it is no exaggeration to say that more has been learned about languages in the past twenty-five years than in the earlier millennia of serious inquiry into language. With regard to the two salient questions with which we began, the approach suggests that what emerged, fairly suddenly, was the generative procedure that provides the principles, and that diversity of language results from the fact that the principles do not determine the answers to all questions about language, but leave some questions as open parameters. Notice that the single illustration I gave has to do with ordering. Though the matter is contested, I think that there is by now substantial evidence that ordering is restricted to externalization of internal computation to the sensorimotor system, and plays no role in core syntax and semantics. There is much more to say about this, but I will put it aside, merely noting here a suggestion about diversity to which I will return.

The simplest assumption, hence the one we adopt unless counterevidence appears, is that the generative procedure emerged suddenly as the result of a minor mutation. In that case we would expect the generative procedure to be very simple. Various kinds of generative procedures have been explored in the past 50 years. One approach familiar to linguists and computer scientists is phrase structure grammar, developed in the 1950s and since extensively employed. The approach made sense at the time. It fit very naturally into one of the several equivalent formulations of the mathematical theory of recursive procedures – Emil Post's rewriting systems – and it captured at least some basic

properties of language, such as hierarchic structure and embedding. Nevertheless, it was quickly recognized that phrase structure grammar is not only inadequate for language but is also quite a complex procedure with many arbitrary stipulations, not the kind of system we would hope to find, and unlikely to have emerged suddenly. Over the years, research has found ways to reduce the complexities of these systems, and finally to eliminate them entirely in favor of the simplest possible mode of recursive generation: an operation that takes two objects already constructed, call them X and Y, and forms from them a new object that consists of the two unchanged, hence simply the set with X and Y as members. Call this operation Merge. Provided with conceptual atoms of the lexicon, the operation Merge, iterated without bound, yields an infinity of hierarchically constructed expressions. If these can be interpreted by conceptual systems, the operation provides an internal “language of thought.”

A very strong thesis, called the “strong minimalist thesis,” is that the generative process is optimal: the principles of language are determined by efficient computation, and the language of thought is computationally perfect. Language is something like a snowflake, assuming its particular form by virtue of laws of nature – in this case principles of computational efficiency – once the basic mode of construction is available, and satisfying whatever conditions are imposed at the interfaces. The basic thesis is expressed in the title of a recent collection of technical essays: “Interfaces + Recursion = Language?” Optimally, recursion can be reduced to Merge. The question mark is of course highly appropriate: the questions arise at the border of current research. I will suggest below that there is a significant asymmetry between the two interfaces, with the “semantic” interface – the link to systems of thought and action – having primacy. Just how rich these external conditions may be is also a serious research question, and a hard one, given the lack of much evidence about these thought-action systems that is independent of language. A very strong thesis, suggested by Juan Uriagereka and Wolfram Hinzen, is that central components of thought, such as propositions, are basically derived from the optimally constructed generative procedure. If such ideas can be sharpened and validated, then the effect of the semantic-pragmatic interface on language design would be correspondingly reduced.

The strong minimalist thesis is very far from established, but it looks much more plausible than it did only a few years ago. Insofar as it is correct, the evolution of language will reduce to the emergence of the operation Merge, the evolution of conceptual atoms of the lexicon, the linkage to conceptual systems, and the mode of externalization. Any residue of principles of language not reducible to Merge and optimal computation will have to be accounted for by some other evolutionary process – one that we are unlikely to learn much about, at least by presently understood methods.

Notice that there is no room in this picture for any precursors to language – say a language-like system with only short sentences. There is no rationale for postulation of such a system: to go from seven-word sentences to the discrete infinity of human language requires emergence of the same recursive procedure as to go from zero to infinity, and there is of course no direct evidence for such “protolanguages.” Similar observations hold for language acquisition, despite appearances, but I will put that aside.

Crucially, the operation Merge yields the familiar *displacement* property of language: the fact that we pronounce phrases in one position, but interpret them somewhere else as well. Thus in the sentence “guess what John is eating,” we understand “what” to be the object of “eat,” as in “John is eating an apple,” even though it is pronounced somewhere else. This property has always seemed paradoxical, a kind of “imperfection” of language. It is by no means necessary in order to capture semantic facts, but it is ubiquitous. It surpasses the capacity of phrase structure grammars, requiring that they be still further complicated with additional devices. But it falls within Merge, automatically.

To see how, suppose that the operation Merge has constructed the mental expression corresponding to “John is eating what.” A larger expression can be constructed by Merge in two ways: *Internal Merge* can add something from within the expression, so as to form “what John is eating what”; and *External Merge* can add something new, yielding “guess what John is eating what.”

That carries us part of the way towards displacement. In “what John is eating what,” the phrase “what” appears in two positions, and in fact those two positions are required for semantic interpretation: the original position provides the information that “what” is understood to be the direct object of “eat,” and the new position, at the edge, is interpreted as a quantifier ranging over a variable, so that the expression means something like “for which thing x, John is eating the thing x.”

These observations generalize over a wide range of constructions. The results are just what is needed for semantic interpretation, but they do not yield the objects that are pronounced in English. We do not pronounce “guess what John is eating what,” but rather “guess what John is eating,” with the original position suppressed. That is a universal property of displacement, with minor (and interesting) qualifications that we can ignore here. The property follows from elementary principles of computational efficiency. To externalize the internally generated expression “what John is eating what,” it would be necessary to pronounce “what” twice, and that turns out to be a very considerable burden on computation, when we consider expressions of normal complexity and the actual nature of displacement by Internal Merge. With all but one of the occurrences of “what” suppressed, the computational burden is greatly eased. The one occurrence that must be pronounced is the most prominent one, the last one created by Internal Merge: otherwise there will be no indication that the operation has applied to yield the correct interpretation. It appears, then, that the language faculty recruits a general principle of computational efficiency for the process of externalization.

The suppression of all but one of the occurrences of the displaced element is computationally efficient, but imposes a significant burden on interpretation, hence on communication. The person hearing the sentence has to discover the position of the gap where the displaced element is to be interpreted. That is a highly non-trivial problem in general, familiar from parsing programs. There is, then, a conflict between [computational efficiency and interpretive-communicative efficiency](#). Universally, languages resolve the conflict by keeping to computational efficiency. These facts at

once suggest that language evolved as an instrument of internal thought, with externalization a secondary process. There is a great deal of evidence from language design that yields similar conclusions; so called “island properties,” for example.

There are independent reasons for the conclusion that externalization is a secondary process. One is that externalization appears to be modality-independent, as has been learned from studies of sign language in recent years. The structural properties of sign and spoken language are remarkably similar. Acquisition follows the same course, and neural localization seems to be similar as well. That tends to reinforce the conclusion that language is optimized for the system of thought, with mode of externalization secondary.

More generally, the core principle of language, unbounded Merge, must have arisen from some rewiring of the brain, hence in an individual, not a group. The individual so endowed would have had many advantages: capacities for complex thought, planning, interpretation, and so on. The capacity would be partially transmitted to offspring, and because of the selective advantages it confers, it might come to dominate a small breeding group. At that stage, there would be an advantage to externalization, so the capacity would be linked as a secondary process to the sensorimotor system for externalization and interaction, including communication as a special case. It is not easy to imagine an account of human evolution that does not assume at least this much, in one or another form. Any additional assumption requires both evidence and rationale, not easy to come by.

Related suggestions have been made by eminent evolutionary biologists. At an international conference on biolinguistics in 1974, Nobel laureate Salvador Luria was the most forceful advocate of the view that communicative needs would not have provided “any great selective pressure to produce a system such as language,” with its crucial relation to “development of abstract or productive thinking.” The same idea was taken up by François Jacob, who suggested that “the role of language as a communication system between individuals would have come about only secondarily.... The quality of language that makes it unique does not seem to be so much its role in communicating directives for action” or other common features of animal communication, but rather “its role in symbolizing, in evoking cognitive images,” in molding our notion of reality and yielding our capacity for thought and planning, through its unique property of allowing “infinite combinations of symbols” and therefore “mental creation of possible worlds.” These ideas trace back to the cognitive revolution of the 17th century, which in many ways foreshadows developments from the 1950s.

We can, however, go beyond speculation. Investigation of language design can yield evidence on the relation of language to the sensorimotor system and thought systems. As noted, I think there is mounting evidence to support the natural conclusion that the relation is asymmetrical in the manner illustrated in the critical case of displacement.

Externalization is not a simple task. It has to relate two quite distinct systems: one is a sensorimotor system that appears to have been basically intact for hundreds of thousands

of years; the second is a newly emerged computational system for thought, which is perfect, insofar as the strong minimalist thesis is correct. We would expect, then, that morphology and phonology -- the linguistic processes that convert internal syntactic objects to the entities accessible to the sensorimotor system -- might turn out to be quite intricate, varied, and subject to accidental historical events. Parametrization and diversity, then, would be mostly -- maybe entirely -- restricted to externalization. That is pretty much what we seem to find: a computational system efficiently generating expressions that provide the language of thought, and complex and highly varied modes of externalization, which, furthermore, are readily susceptible to historical change.

If this picture is more or less accurate, we may have an answer to the second of the two basic questions: Why are there so many languages? The reason might be that the problem of externalization can be solved in many different and independent ways, either before or after the dispersal of the original population.

We have no reason to suppose that solving the externalization problem involved an evolutionary change -- that is, genomic change. It might simply be a problem addressed by existing cognitive processes, in different ways, and at different times. There is sometimes an unfortunate tendency to confuse literal evolutionary (genomic) change with historical change, two entirely distinct phenomena. As already noted, there is very strong evidence that there has been no relevant evolution of the language faculty since the trek from Africa some 50,000 years ago, though undoubtedly there has been a great deal of change, even invention of modes of externalization (as in sign language). Confusion about these matters could be overcome by replacing the metaphoric notions "evolution of language" and "language change" by their more exact counterparts: evolution of the organisms that use language, and change in the ways they do so. In these more accurate terms, emergence of the language faculty involved evolution, while historical change (which continues constantly) does not.

Again, these seem to be the simplest assumptions, and there is no known reason to reject them. If they are generally on the right track, it follows that externalization may not have evolved at all; rather, it might have been a process of problem solving using existing cognitive capacities. Evolution in the biological sense of the term would then be restricted to the mutation that yielded the operation Merge, along with whatever residue resists explanation in terms of the strong minimalist thesis. Accordingly, any approach to "evolution of language" that focuses on communication, or the sensorimotor system, or statistical properties of spoken language, and the like, may well be seriously misguided. That judgment covers quite a broad range, as those familiar with the literature will be aware.

Returning to the two initial salient questions, we have at least some suggestions -- reasonable ones I think -- about how it came about that there is even one language, and why languages appear to vary so widely -- the latter partly an illusion, much like the apparent limitless variety of organisms, all of them based on deeply conserved elements with phenomenal outcomes restricted by laws of nature (for language, computational efficiency).

There are other factors that may strongly influence language design – notably properties of the brain, now unknown – and there is plainly a lot more to say even about the topics to which we have briefly alluded here. But instead of pursuing these questions, let us turn briefly to lexical items, the conceptual atoms of thought and its ultimate externalization in varied ways.

Conceptual structures are found in other primates: probably actor-action-goal schemata, categorization, possibly the singular-plural distinction, and others. These were presumably recruited for language. However, lexical items/concepts appear to be uniquely human.

Crucially, even the simplest words and concepts of human language and thought lack the relation to mind-independent entities that appears to be characteristic of animal communication. The latter is held to be based on a one-one relation between mind/brain processes and “an aspect of the environment to which these processes adapt the animal's behavior,” to quote cognitive neuroscientist Randy Gallistel, introducing a major collection of papers on animal communication. According to Jane Goodall, the closest observer of chimpanzees in the wild, for them “the production of a sound in the *absence* of the appropriate emotional state seems to be an almost impossible task.”

The symbols of human language and thought are sharply different. Their use is not automatically keyed to emotional states, and they do not pick out mind-independent objects or events in the external world. For human language and thought, it seems, there is no *reference* relation in the sense of Frege, Peirce, Tarski, Quine, and contemporary philosophy of language and mind. What we understand to be a river, a person, a tree, water, and so on, consistently turns out to be a creation of what 17th century investigators called the human “cognoscitive powers,” which provide us with rich means to refer to the outside world from intricate perspectives. The objects of thought constructed by the cognoscitive powers cannot be reduced to a “peculiar nature belonging” to the thing we are talking about, as David Hume summarized a century of inquiry. In this regard, internal conceptual symbols are like the phonetic units of mental representations, such as the syllable [ba]; every particular act externalizing this mental object yields a mind-independent entity, but it is idle to seek a mind-independent construct that corresponds to the syllable. Communication is not a matter of producing some mind-external entity that the hearer picks out of the world, the way a physicist could. Rather, communication is a more-or-less affair, in which the speaker produces external events and hearers seek to match them as best they can to their own internal resources. Words and concepts appear to be similar in this regard, even the simplest of them. Communication relies on shared cognoscitive powers, and succeeds insofar as shared mental constructs, background, concerns, presuppositions, and so on, allow for common perspectives to be (more less) attained. These properties of lexical items seem to be unique to human language and thought, and have to be accounted for somehow in the study of their evolution. How, no one has any idea. The fact that there even is a problem has barely been recognized, as a result of the powerful grip of the dogmas of referentialism.

Human cognoscitive powers provide us with a world of experience, different from the world of experience of other animals. Being reflective creatures, thanks to the emergence of the human capacity, humans try to make some sense of experience. These efforts are called myth, or religion, or magic, or philosophy, or in modern English usage, science. For science, the concept of reference in the technical sense is a normative ideal: we hope that the invented concepts *photon* or *verb phrase* pick out some real thing in the world. And of course the concept of reference is just fine for the context for which it was invented in modern logic: formal systems, in which the relation of *reference* is stipulated, holding for example between numerals and numbers. But human language and thought do not seem to work that way, and endless confusion has resulted from failure to recognize that fact.

We enter here into large and extremely interesting topics that I will have to put aside. Let me just summarize briefly what seems to me the current best guess about unity and diversity of language and thought. In some completely unknown way, our ancestors developed human concepts. At some time in the very recent past, maybe about 75,000 years ago, an individual in a small group of hominids in East Africa underwent a minor mutation that provided the operation Merge – an operation that takes human concepts as computational atoms, and yields structured expressions that provide a rich language of thought. These processes might be computationally perfect, or close to it, hence the result of physical laws independent of humans. The innovation had obvious advantages, and took over the small group. At some later stage, the internal language of thought was connected to the sensorimotor system, a complex task that can be solved in many different ways and at different times, and quite possibly a task that involves no evolution at all. In the course of these events, the human capacity took shape, yielding a good part of our “moral and intellectual nature,” in Wallace’s phrase. The outcomes appear to be highly diverse, but they have an essential unity, reflecting the fact that humans are in fundamental respects identical. Just as the hypothetical extraterrestrial scientist we conjured up earlier might conclude that there is only one language with minor dialectal variations, primarily -- maybe entirely -- in mode of externalization.

I will finish by recalling that even if this general story turns out to be more or less valid, and the huge gaps can be filled in, it will still leave unresolved problems that have been raised for hundreds of years. Among these are the question how properties “termed mental” relate to “the organical structure of the brain,” in the 18th century formulation; and the more mysterious problems of the creative and coherent ordinary use of language, a central concern of Cartesian science, still scarcely even at the horizons of inquiry.

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