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Language as Digital:
A New Theory of the Origin and Nature of Human Speech

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The "language", so-called, of an electronic digital computer is based on a single, binary, contrast symbolized as 0/1 which is used to create a vocabulary of "bits" (0 or 1) combined into sets of eight, called "bytes", a set number of which, typically two or four, is called a "word". The meanings to be assigned to these computer "words" are supplied by the programmer who then uses them to perform computations. My claim is that in human spoken languages we similarly make up words out of combinations of consonants and vowels, referred to collectively as phonemes, of which every language has a well defined, limited, set. This is in contrast to the inarticulate cries of pain, fear, surprise, etc. that, as Darwin noted, we humans share with other animals. The reshaping of the human vocal tract on which Philip Lieberman has placed such emphasis was certainly necessary, but could not by itself have created language. As Darwin suggested, the first use of the voice was probably to enable humans to sing, not to talk. Furthermore, as Merlin Donald has proposed, bipedalism would not only have been a first step towards oral language but would also have freed the hands to communicate by gestures. Donald proposes a mimetic stage of consciousness at the time of Homo erectus between the episodic consciousness of lower animals and the mythic consciousness of speaking humans. The final leap to digital phonology and, in Donald's terms to mythic consciousness, must have been a change in brain structure that took place when Homo sapiens came with their Cromagnon culture from Africa to Europe and after a period of coexistence replaced the culturally inferior Neanderthals.

0. Introduction

It is generally agreed that the ability to use language is the defining characteristic that above all else distinguishes our own species, *Homo sapiens*, from all other animals. Yet, it is by no means easy to say what this really means or how this unique capacity could have evolved. In spite of increasing efforts by researchers in a wide variety of fields in the last half century nothing like a consensus has yet emerged.

As I have recently come to see it, human spoken language is a new, digital, form of communication and cognition, superimposed on the analogue forms of cognition through the senses and communication through cries, gestures and pheromones that we share with other animals. The 'language', so-called, of an electronic digital computer is

based on a single, binary, contrast symbolized as 0/1 which is used to create a vocabulary of "bits" (0 or 1) combined into sets of eight, called "bytes", a set number of which, typically two or four, is called a "word". The meanings to be assigned to these computer "words" are supplied by the programmer who then uses them to perform computations. In human spoken languages we similarly make up words out of combinations of consonants and vowels, referred to collectively as phonemes, of which every language has a well defined, limited set.

With the exception of small inventories of interjections like English *sh!* 'be quiet', single phonemes, like computer bits, are meaningless by themselves. It is combinations of these consonants and vowels, not the separate phonemes, to which meanings are assigned. This is surely what lies behind the much cited observation of Wilhelm von Humboldt in the early nineteenth century that language "must make infinite employment of finite means" (1988:91). Other linguists have used different terms to refer to the same thing. André Martinet (1949) called it double articulation. In his enquiries into language origins Charles F. Hockett used the term duality of patterning (Hockett 1960, 1978, Hockett and Ascher 1964).

There is, of course, a further stage in human spoken language, the combining of words by rules of syntax to form sentences. Noam Chomsky, the dominant figure in the generative school of linguistics that has come to the fore since the middle of last century, has taken this rather than phonology to be the essential foundation of human language. He has frequently cited von Humboldt but, rather than referring, as I do, to phonology as the finite base on which the infinite structures of language rest, he emphasizes the role of syntax as the means by which humans construct infinitely many sentences. As he himself recently pointed out, however, already in the 16th century Galileo Galilei, the founder of modern experimental science, "describe[d] with wonder the discovery of a means to communicate one's most secret thoughts to any other person … with no greater difficulty than the various collocations of twenty-four little characters on a paper." (Chomsky 2002: 46). But this is surely a clear reference to phonology as the defining characteristic of human language; for what Galileo referred to by his "twenty-four little characters", were the letters of the Italian alphabet. How humans acquired the ability to attach meanings, not holistically to individual sounds produced by their vocal organs but to combinations of what are discrete but meaningless phonemes to which no meanings are attached separately is surely the fundamental problem if we are to account for the power of human language as a unique communicative and cognitive tool that distinguishes us, as far as we can tell, from all other living organisms on planet earth.

This duality of patterning, that is, combining consonants and vowels to make words, is what makes possible alphabetic writing. At a more basic level it is what enables us to hold in memory the 60,000 to 80,000 or more words that are estimated to be the working vocabulary of an educated adult speaker of a language like English and to add freely to this list as required by the progress of knowledge or by changes in current patterns in expression. Imagine having to memorize such a vocabulary if the individual

items were perceived simply as holistically different sounds rather than combinations of a strictly limited set of consonants and vowels according to definite rules. Moreover new words are constantly being added, as technical terms, as borrowings through contacts with other languages, as slang, so that dictionaries have to be constantly rewritten. Proper names are also an arbitrary, infinitely extendable list for each of us. Consider the telephone books that we constantly make use of.

1. Syllables as Basic Units in Phonology

If we think of the phonemes of a language which the letters of an alphabet of the Graeco-Roman tradition are designed to represent as referring to interchangeable vocalizations of the same basic kind, it may not be immediately obvious how they can give rise to the kind of either/or duality that is required to make language a digital system. My claim is that consonants and vowels are two basically contrastive types of vocalization. In every language they combine into syllables according to definite rules and it is, generally speaking, the syllables that count as the computing bytes to which meanings are attached. The words so defined are then further organized by syntactical rules into sentences and longer discourses. Individual phonemes can be treated, alone or in combinations, as morphemes prefixed, suffixed or infixed to modify the meaning of words or show their relations to other words in a sentence but it is only in combination that individual consonants and vowels are capable of having meaning.

The alphabets of India in the Brahmi tradition, show much greater insight than our own alphabet into the way language actually works. They begin by listing the separate vowel signs, arranged in a logical order, *a*-*i*-*u*, etc., based on place of articulation. Then come the consonantal signs similarly arranged by place and manner of articulation. The consonantal signs, which cannot be pronounced separately in isolation, are assumed to have an inherent -*a* vowel that can be modified by diacritics or deleted in case the consonant comes at the end of an utterance. Works on the history of writing commonly credit the Greeks with perfecting the alphabet that they borrowed from the Phoenicians by adding vowel signs but what the Greeks did was merely to interpret some of the Phoenician consonantal signs as vowels in order to suit the structure of their own language. Because Indian alphabets treat consonantal signs as implying an inherent -*a* vowel, they are sometimes dismissed as “mere syllabaries”. In fact, the ancient Indian grammarians were far ahead of the rest of the world before the nineteenth century in their analysis of the structure of language.

2. Vowels as Consonants and Consonants as Vowels

It must be stressed that the contrast between 0 and 1 in digital computing has nothing to do with the numerical value of these symbols in mathematics. Their role is simply to provide a two-way contrast. What 0 represents in one such language may correspond to what the same programmer represents by 1 in another computer language. In the same way spoken languages may without contradiction use the point vowels [**i**] and [**u**] as semivowels [**j**] and [**w**] occupying consonantal positions in a syllable. In English

this occurs with the letters *y* and *w* in words like *you* and *say* or *we* and *how*. In the original Latin alphabet, which did not distinguish upper and lower case, the letters I and V were used without confusion both for the vowels [**i**] and [**u**] and for the corresponding semivowels [**j**] and [**w**]**:** thus IVLIVS for Julius and VENVS for Venus. Modern European languages like English that have adapted the Latin alphabet to their own needs usually distinguish the vowels and the semivowels but this does not affect their identity in terms of articulation.

Whether one needs to recognize a semivowel corresponding to the low back vowel [**ɑ**] is more controversial. No semivowel [**ɑ̯**] is recognized in the International Phonetic Alphabet. I have long been arguing, however, that one needs to recognize the role of such a pharyngeal glide. It plays the role of coda in words like *far* [**fɑɑ̯**] and *near* [**niɑ̯**] as pronounced in r-dropping dialects such as southern British or Boston English and also in Mandarin Chinese in words like *dé* 得 [**təɑ̯**] 'get'. See, among others, Pulleyblank 1998 and 2003.

Not only can vowels invade the territory of consonants in this way. Sounds that are primarily consonantal can also appear from time to time in place of vowels in the nuclei of syllables in many languages. Thus, in Mandarin Chinese words like *si* 絲（IPA [**sɹ̩**] 'silk' and *shí* 十 (IPA [**ʂɹ̩**] 'ten' have no vowel as such. The initial sibilant becomes voiced and spreads into the syllabic nucleus. (For the phonetic interpretation see Chao 1968:24.) In both cases an earlier high front vowel [**i**], still preserved in other dialects, has been lost. Compare Xiamen dialect [**si**] 'silk' and [**sip**] 'ten'. There are also languages like Berber in which obstruents (stop consonants) can occur in syllabic nuclei (Dell and Elmedlaoui 1985). It is even claimed that in the Salishan language Nuxalk, on the west coast of Canada (also known as Bella Coola), although many words do have vowels forming syllables in a normal way, some words consist of strings of unsyllabified obstruents (Bagemihl 1991, Shaw 2002). What does seem clear is that representatives of the three point vowels [**a**, **i**, **u**] are found in all languages, even though the two high vowels, **i** and **u**, may sometimes be present underlyingly only as semivowels, alone or attached to consonants as secondary articulations. In all languages the generalization holds that words are made up of a strictly limited set of phonemes—vowels and consonants—that have no inherent meaning in themselves but can be combined in unlimited ways to convey meanings. As for the way in which vowels, becoming semivowels, can invade the territory of consonants, and consonants can invade the territory of vowels in some languages, this corresponds to the fact that in computer language 0 and 1 have no numerical significance and merely function as a two-way contrast.

3. Theories of the Origin of Language

How did the human brain in evolving its vocal communication system, achieve this infinite capacity for symbolization, which has enabled mankind to achieve unparalleled dominance over the planet? In the west enlightenment thinkers of the eighteenth century who challenged the traditional account in the Christian Bible sometimes speculated

on how language could have arisen or been invented in prehistoric times but, lacking any scientific concept of evolution, could not get very far. In the following century Darwin's theory of evolution implied that the language faculty must have arisen by the same process of natural selection that has been responsible for the vast differentiation of life forms on the planet. Darwin himself had insightful remarks on the subject in *The Descent of Man*. After describing the ways in which various birds and animals make a variety of expressive sounds, he went on to say:

> "The use of articulate language is, however, peculiar to man; but he uses, in common with the lower animals, inarticulate cries to express his meaning, aided by gestures and movements of the muscles of the face. This especially holds good with the more simple and vivid feelings, which are but little connected with our higher intelligence. Our cries of pain, fear, surprise, anger, together with their appropriate actions, and the murmur of a mother to her beloved child, are more expressive than any words. That which distinguishes man from the lower animals is not the understanding of articulate sounds, for, as everyone knows, dogs understand many words and sentences. In this respect they are at the same stage of development as infants, between the ages of ten and twelve months, who understand many words and short sentences, but cannot yet utter a single word. Nor is it the mere capacity of connecting definite sounds with definite ideas; for it is certain that some parrots, which have been taught to speak, connect unerringly words with things, and persons with events. The lower animals differ from man solely in his almost infinitely larger power of associating together the most diversified sounds and ideas; and this obviously depends on the higher development of his mental powers." (1998:88)

What Darwin did not succeed in making fully clear was the difference between articulate human language and the limited, holistic recognition of human words that dogs are capable of understanding or parrots can imitate. Darwin commented that, although language had to be learned and so could not be called a true instinct, the babbling of infants showed that humans had an instinctive tendency to speak. Another interesting comment that has been largely overlooked by those who have developed theories of language origin in more recent time is Darwin's remark: "When we treat of sexual selection we shall see that primeval man, or rather some early progenitor of man, probably first used his voice in producing true musical cadences, that is in singing." (1998:90).

By the time of Darwin the recognition of the close relationship between Sanskrit, the classical language of India, and Greek and Latin, the classical languages of Europe had given rise to the new discipline of comparative philology devoted to reconstructing the parent language from which all these languages had developed over time, referred to as Indo-Germanic or Indo-European. This seemed to have achieved the status of a science and to its practitioners speculation about the origins of the human language faculty seemed a frivolous waste of time, leading to a famous ban on papers on the subject by the Linguistic Society of Paris in 1866.

4. Research on the Evolution of Language in the Twentieth Century

The Parisian injunction did not put an end to speculation on the origin of language in the hundred years that followed. One may mention, for example, the book *Language: Its Nature, Development and Origin* by the eminent linguist, Otto Jespersen, first published in 1922, which is an excellent account of the history of linguistics up to his time. He had, however, little of substance to add on the evolution of the human language capacity, to the purely speculative conjectures that had been current since the eighteenth century. More recently there has been no lack of attempts to propose a solution, without achieving anything like a consensus. The series of articles by Charles Hockett in which he attempted to define the distinguishing characteristics of human language as compared to vocal communication in other animals has been referred to above. Most notable from our present point of view is his singling out of duality of patterning as a basic characteristic of language in contrast to communicative use of vocal cries by non-humans (Hockett and Ascher 1964:139).

An important line of inquiry in the twentieth century has been investigation of the cognitive and communicative abilities of our closest living relatives, the anthropoid apes. In the 1940s attempts were made to bring up infant chimpanzees in a human environment and get them to learn to speak as if they were human babies. Although one of these infant chimpanzees named Viki was eventually able to recognizably produce a few words, it was soon realized that it was futile to try to go beyond this. Such primate vocal tracts are simply not equipped to produce the sounds of human speech. Attempts to train primates to communicate by using the hand shapes of ASL (American Sign Language) or by using lexigrams—arbitrary symbols placed on a board to represent words—have been somewhat more successful. Most impressive are the achievements of Kanzi, a bonobo or pygmy chimpanzee that as an infant spontaneously learned to use a keyboard to communicate his wishes to his human caretakers while his mother Matata was being taught unsuccessfully to do so. From listening to his human guardians Kanzi also acquired a passive understanding of a number of spoken English words, without, of course, being able to reproduce English sounds or to go on adding to this vocabulary without limit in the way that human children can as they become fluent speakers and listeners of their native languages.

There is much disagreement as to how much can be concluded from these experiments about the linguistic potential in the brains of non-human animals. What does seem clear is that, for all the non-human animals that have been studied in this way, the symbols interpreted as equivalent to words, whether ASL hand shapes or lexigrams, are recognized and learned holistically, not broken down into recognizable but separately meaningless components like the phonemes of spoken language. So also the names and words of command that dogs or horses can learn to recognize from their human masters. The same is surely also true of ‘talking’ birds such as parrots that, unlike non-human primates, can recognizably imitate human speech sounds and even develop a limited vocabulary of words to which they can holistically attach meanings. What they evidently cannot do is to

enlarge this vocabulary without limit as humans can by breaking down the words that they learn into meaningless subordinate units, consonants and vowels.

5. The Evolution of the Human Vocal Tract — Song as the Stimulus for its Evolution?

In the last half-century the studies on the evolution of the human vocal tract by Philip Lieberman and colleagues have defined at least one *sine qua non* for the attainment of human language capacity.[1] There is a clear anatomical difference related to speech between humans and the anthropoid apes, namely the position of the larynx. In the anthropoid apes of Africa the larynx is positioned high, close to the opening to the nose, with which it can make a watertight seal in such a way that air can pass through it to the lungs while food or drink can pass around it to the stomach. This is also the case for newborn human infants. In adult humans, on the other hand, the larynx is much lower down, with the result that, as noted already by Darwin in the *Origin of Species*, food or drink can go down the wrong way and cause choking. It seems likely that the change in the position of the larynx was initiated by bipedal locomotion and upright posture.

Its positive contribution to the evolution of language, as Philip Lieberman has emphasized, was to increase the length of the passage between the larynx and the lips, allowing the tongue to divide the oral tract at different points in such a way as to produce efficiently and reliably the formants (overtones) of the three 'point vowels' [**a**, **i**, **u**].

While Lieberman is certainly right to emphasize the importance of the reshaping of the human throat in preparing the way for the acquisition of language, his apparent assumption that this was all that was needed for the holistic emotive sounds of non-human animals to turn into articulate words is hard to justify. We still use inarticulate screams and murmurs to express surprise or other emotions but there is no confusion between this and spoken language. Lieberman seems to imply that the proto-hominoids somehow already foreseeing their destiny as masters of life on the planet, subconsciously understood that acquiring language was necessary to this end and from generation to generation tried to reshape their throats to make this possible. This is surely not the way that Darwinian evolution works. Small changes that unexpectedly lead in quite new directions are typical of how major changes get started.

Darwin himself supposed that song rather than language had been the first end to which the evolution of the human voice had been directed. In *The Descent of Man* Darwin said "When we treat of sexual selection we shall see that primeval man, or rather some early progenitor of man, probably first used his voice in producing true musical cadences, that is in singing, as do some of the gibbon-apes at the present day; and we may conclude from a widespread analogy, that this power would have been especially exerted during the courtship of the sexes, and would have expressed various emotions, such as love, jealousy, triumph and would have served as a challenge to rivals." (1998, 584 ff.) This insight of Darwin has been largely neglected in more recent study of human

[1] Lieberman and Crelin 1971, Lieberman 1991, etc.

evolution. It should be noted that in connecting the origins of music and language Darwin was following in the footsteps of enlightenment thinkers of the eighteenth century. See, for example, Downing A. Thomas, *Music and the Origins of Language* (1995).

In the twentieth century, long after Darwin's day, in the search for human origins most attention was paid to the African anthropoid apes—chimpanzees, bonobos and gorillas, none of which are songsters. The arboreal apes of Southeast Asia, gibbons, siamangs and orangutans, whose singing ability Darwin already knew about, have been much less studied. They sit on the branches of trees with an upright posture that makes them face forward and gives them a more human appearance than chimpanzees and gorillas. The name orangutan in fact means "person of the forest" in Malay. I have so far not been able to find in any publication a measurement of an orangutan throat but the physical resemblance to humans and their capability in song make it pretty clear that the shape of the throat is not what prevents them from making the vowels and consonants of human language.

As for human voices, I note that although Darwin refers to song as having a role in courtship, he doesn't explicitly mention the lowering of young men's voices at puberty, which is one of the first steps in distinguishing the two sexes in their roles in procreation —not as spectacular as a peacock's plumage but perhaps playing a similar role in differentiation of the sexes. Skeletal remains cannot tell us whether any of the fossil African hominids between Lucy (*Australopithecus*), the first African hominid to walk upright on two feet, and *Homo sapiens* were capable of song. The fact that there are still, today, singing apes in Southeast Asia does, however, suggest that this was probably already true for at least some of the bipedal African species from which humans are assumed to have evolved. The reshaping of the vocal tract on which Philip Lieberman has placed such emphasis can hardly from the beginning have been directed towards enabling us to talk. It may, however, have been encouraged by the pleasurable musical sounds that it made possible.

6. Universal Distinctive Features as the Basis of Phonemic Distinctions

In the prevailing theory of phonology in North America in the first half of the twentieth century, associated especially with the name of Leonard Bloomfield, phonemes of a language at any one synchronic stage were supposed to be defined 'objectively' by an outside observer using the principle of minimal pairs (minimal referring to their phonetic content). This was brought into question by members of the Prague school led by Nikolai Trubetzkoy who, by comparing the phoneme inventories of many languages, developed the concept of universal distinctive features, forming the basis for the phoneme systems of all human languages. This concept was introduced into North America after the Second World War by the exiled Russian linguist, Roman Jakobson.

As first presented by Roman Jakobson, Gunnar Fant and Morris Halle in *Preliminaries to Speech Analysis* (1951) the theory of distinctive features was defined primarily in acoustic terms like compact vs. diffuse, flat vs. plain, grave vs. acute, etc. In his own

writings Jakobson continued to emphasize such acoustic terms, but in *The Sound Pattern of English* by Noam Chomsky and Morris Halle (1968) there was a return to a more traditional analysis of the articulation of consonants and vowels in terms of place and manner of articulation. At the same time there have been great advances in the experimental measurement and analysis by phoneticians of speech sounds in a wide variety of languages, notably in North America in the work carried on by Peter Ladefoged and colleagues at the University of California at Los Angeles. There has also been much study of the stages by which infants in the first two years of life acquire competence in recognizing and producing the sound systems of their native tongues.

Children learn to speak their native languages by an unconscious process and it is by no means easy to step back and analyze what is involved in this familiar activity. Distinctive feature theory as developed by Chomsky and Halle was based primarily on place of articulation measured along the passive upper surface of the oral tract from the opening of the lips to the teeth, the hard and soft palates and the pharynx to the glottis. An important change introduced by a joint paper in 1998 by Morris Halle, a leading theorist of the generative school, and the experimental phonetician, Peter Ladefoged placed the emphasis instead on the role of the active articulators—lips (labial), tongue tip and blade (coronal), tongue body (dorsal), tongue root (pharyngeal) and the glottis.

There are still matters of disagreement. A matter of particular concern to me is the assumption in standard theory of a three-way distinction in the vertical dimension of tongue height in the articulation of vowels supplemented by a rather ill defined feature [±tense]. Thus, in standard theory English is said to have a three-way distinction in vowel height supplemented by a binary feature tense/lax as in the five 'front' vowels: [**i**] as in *Pete* [+high, +tense], [**ɪ**] as in *pit* [+high, -tense], [**e**] as in *pate* [-high, -low, +tense], [**ɛ**] as in *pet* [-high, -low, -tense] and [**æ**] as in *pat* [-high, +low, -tense]. The specification [-high, -low] for [**e**] and [**ɛ**] implies that the combination [+high, +low] is ruled out as self-contradictory. As pointed out by William S-Y. Wang, however, this implies that [±high] and [±low] are in a single dimension of tongue height and opens the possibility of adding a further feature [±mid] between them. The use of such multivalent features has been accepted by some theorists but seems to be incompatible with the hypothesis that phonology is organized in the brain like a digital computer.

As I have been arguing for some time (see most recently Pulleyblank 2003), this particular problem can be solved by recognizing that so-called 'low' vowels, in particular IPA low back [**ɑ**] and low front [**a**], are not articulated by increasing the separation of the surface of the tongue from the hard palate beyond the so-called mid point but by positioning the root of the tongue relative to the back of the throat, that is, retracting the root of the tongue toward the wall of the pharynx or advancement of the root of the tongue away from the wall of the pharynx, giving the features [+RTR] and [-RTR]. Just as in the feature [±high] one either raises the tongue towards the roof of the mouth for [+high] [**i**] and [**ɪ**] or lowers the tongue from the roof of the mouth for [-high] [e] and [**ɛ**]. For what are traditionally called 'low' vowels, one either draws the root of the tongue towards the

pharynx for [+RTR] [ɑ] or advances the root of the tongue from the pharynx for [-RTR] [a]. Not all languages make use of [-high] or [-RTR]. Thus, Mandarin Chinese has [+high] [i] but does not have [-high] [e]. It also has a neutral [a] (or [ɑ]) but does not distinguish the two possibilities (which do contrast as short and long respectively in Cantonese). In addition to the voiceless and voiced pharyngeal fricatives [ħ ʕ] recognized by the IPA my claim is that we need to recognize a pharyngeal approximant, that is, semivowel [ɑ̟], which is not at present recognized by the IPA though it is implied by Ladefoged's erst-while proposal to mark pharyngealization, as in the so-called emphatic consonants of Arabic, by raised [ɑˤ] (Ladefoged 1982:211). He did not at that time cite an example of such an approximant but in *Sounds of the World's Languages* (1996) he and Ian Maddie-son have a section called 'Vowel-like Consonants' in which they explicitly identify initial 'r' of Danish as a 'pharyngeal approximant' Moreover, as I have argued, Arabic pharyn-geals as separate consonants behave phonologically like fricatives, not semivowels, since they are subject to final devoicing and voicing assimilation rules that otherwise apply to obstruents. See also Pulleyblank (2003:719ff) for additional evidence for the need to posit [ɑ̟] as a pharyngeal semivowel in a variety of languages.

If we abandon the ill-defined feature [±tense] and add [±RTR] the five front vowels of English can be redefined as [i] [+front, +high, -RTR], [ɪ] [+front, +high, +RTR], [e] [+front, -high, -RTR], [ɛ] [+front, -high, +RTR], [æ] [+front, -RTR] with no specifi-cation for the dorsal feature [±high], the assumption being that in the last case the roof of the tongue is not used as an articulator. Historically in Germanic languages the distinction between the vowels labeled [tense] and [lax] was one of length and the English lowest so-called 'front' vowel [æ] was earlier not a front vowel but the short form of the low unrounded vowel [ɑ] in *father* which I would specify simply as [+RTR], with no specification for the coronal and dorsal articulations responsible in other languages for the features [±front] and [±high]. The corresponding [-RTR] vowel can be identified in IPA as a low central [a] or slightly raised central [ɐ]. This is what we find in German corresponding to the vowel which in English was fronted to [æ].

When [±RTR] was first identified as the basis for African vowel harmony, the correspondence with [±tense] in European languages was noted but abandoned because it seemed to work differently for the two systems. This can be explained, however, by the different function in the two cases. In African languages with Tongue Root vowel harmony [±RTR] serves to link affixes with corresponding root syllables by making them agree in respect of this feature. In English and German, on the other hand, the length distinction in the case of what are traditionally called high and mid vowels with the Dorsal feature [±high] was strengthened by applying the feature [+RTR] to the short vowels, while what are traditionally called low vowels do not in fact have a Dorsal articulation. In both English and German the maximal long back vowel is simply [+RTR] [ɑ]. In German the corresponding short vowel is [-RTR], = IPA [a] or [ɑ], while in English it has lost its tongue root articulation and been further fronted to [æ] (Pulleyblank 2003:722-24).

The claim is that these four articulators are used separately or in combination, along with modifications at the larynx and velum (for ± nasal), to produce all the consonantal and vowel sounds that are used in human speech. I have shown elsewhere how this theory throws light on the history of the Chinese language and I will not go into details here. The significance of the claim for understanding the evolution of language as a unique achievement of human intelligence is that it implies a special adaptation in the human brain to attach meanings, not to separate sounds, whether consonantal or vocalic, but to their syllabic combinations.

7. An Intermediate Mimetic Stage between Anthropoid Apes and Humans — Sign Language as Preceding Vocal Language?

It is generally agreed that a decisive first step in the evolution of our own species from the anthropoid apes of Africa, chimpanzees, bonobos, and gorillas, from whom we are ultimately descended was the emergence of bipedal australopithecines, of which the skeletal remains, nicknamed Lucy, found in Ethiopia in 1973 were a first example. Bipedalism would have had the inevitable effect of making the animal pull its chin down so that its eyes could look forward along a path in front. It would also have given a more human appearance and effected an enlargement of the oral cavity, a first step towards providing necessary space for musical sounds and to form the sounds of speech as we know it.

Upright posture freed the hands for making stone tools, for throwing stones and eventually spears, and also, as for communicating by pointing and gestures. The earliest examples of the genus *Homo*, first *Homo habilis* and then *Homo erectus*, appear about two million years later. Apart from the improved cultural artifacts that begin to appear there is evidence of increasing brain capacity. The neurologist Merlin Donald (1991) has proposed that at this time the hominid brain progressed from what he calls the episodic consciousness, characteristic not only of anthropoid apes but of mammals in general, first to mimetic consciousness and finally, with the achievement of language, to what he calls mythic consciousness. He associates the mimetic stage with the appearance of *Homo erectus*, about 1.5 million years ago. *Homo erectus* had a brain capacity considerably larger than the preceding *Homo habilis*, about 80% of that of a modern human. The stone tools of the associated Acheulian culture which lasted for over a million years represent a considerable advance over anything found coming from the time of the preceding *Homo habilis*.

By the term mimetic Donald implies that *Homo erectus*, by standing on two legs, would have freed his hands and been capable of using them to communicate by signs. Gestural theories of language origin have appeared in the west since the time of Plato. The late Gordon Hewes who himself favored such a theory, gives a useful account of this idea in his article “The Current Status of the Gestural Theory of Language Origin”, published in *Origins and Evolution of Language and Speech*, edited by Horst B Stekles, Stevan R. Harnad and Jane Lancaster, the report of a Conference held in the New York

Academy of Sciences in October 1976. It seems to me very probable that, as Donald suggests, *Homo erectus* could have developed a mimetic form of communication by hand gestures referring to objects and actions in the environment. This would have helped the brain to focus on such units of meaning and to be ready to give them names and talk about them verbally when the brain made its leap to constructing vocal syllables and using them as the building blocks for spoken words.

8. The Cognitive Leap to Digital Phonology: *Homo Sapiens* Outlives *Homo Neanderthalensis*

In 1856 remains of what appeared to be either an abnormal modern human or an earlier very similar species was discovered in the Neander Valley in Germany. The discovery of other similar skeletons soon made it clear that they were indeed a separate species. The Neanderthals seem to have survived in Europe until about 30,000 years ago, by which time they were contemporary with modern *Homo Sapiens* who had arrived more recently from Africa. It is clear, however, that there were major and growing cultural differences between the two species. Lieberman has attempted to show that Neanderthals' vocal tracts were not so well adapted as those of *Homo Sapiens* to making the sounds of human language. Others have disagreed with his analysis.

If I am right, this is irrelevant. Whether or not our hominid ancestors down to and including the Neanderthals had the physical capability of making distinct consonants and vowels does not necessarily mean that they would have automatically begun to do so, treating them as the meaningless building blocks for the syllabic combinations that *homo sapiens* uses as the basis for spoken language. This would have required an adaptation within the brain. As far as I have been able to discover, neurologists still have no way to observe how this is achieved in the brains of living human beings. Still less is it possible to tell from examination of the skulls of extinct pre-modern hominids whether, even if their vocal tracts were physically capable of co-articulating language-like sounds, they actually had the capacity in their brains to combine them into syllables and attach meanings to them in the human way. My guess is that, as many investigators have supposed, the sudden efflorescence of cave art in France and Spain in the upper Paleolithic and given the name Cromagnon signals the appearance in Europe of our own species *Homo sapiens*. Neanderthals, who had just as large brains, survived along with our own species for some time. Yet, though similar in many ways, they remained culturally inferior.

One must, I think, assume that *Homo sapiens* underwent a decisive change in brain structure that enabled our species to distinguish consonants and vowels and use them as the building blocks of human speech. Just what would have caused this to take place is difficult to say. It is presumably the type of change that has been called a "spandrel" by Steven Jay Gould and Richard Lewontin, that is, a phenotypic characteristic that developed during evolution moving it in a new direction rather than direct adaptation in a continuing line. Although Neanderthals had as large brains as present day humans and in all probability were capable of making the same oral sounds, they were culturally inferior in

various ways. They could not compete with humans and eventually died out. Presumably they had not undergone the necessary change in brain structure to enable them to combine consonants and vowels to form words.

9. What Darwinian Advantage was Conferred by the Capacity to Produce Speech Sound

It is easy enough to see that the capability of forming doubly articulated language has been in the long run an enormous advantage to homo sapiens. As a cognitive tool even more than for communication it can be seen as the one adaptation of the human brain that gives us the superiority that we enjoy over all other life forms on the planet. It is also seems clear that the lowering of the larynx was a necessary pre-adaptation to make this possible. What is not so clear is the immediate selective advantage that this modification of the oral tract would have conferred when it was first achieved, especially when set against the increased possibility of choking.

To the extent that lowering of the larynx was simply a by-product of upright bipedal posture, necessitating a downward turn in the face, one may imagine that the better view that it gave over the grasslands in which it is thought hominids became differentiated from their primate fellows would have been an initial advantage. The capacity for song, that is, modulating the pitch of the voice in pleasurable ways, and the sexual dimorphism of the human voice are also, no doubt, related to the restructuring of the vocal tract that made speech possible and probably also need to be taken into account. In discussing "Sexual Selection in Relation to Man" Charles Darwin said:

> "The capacity and love for singing or music, though not a sexual character in man, must not be passed over. Although the sounds emitted by animals of all kinds serve many purposes, a strong case can be made out, that the vocal organs were primarily used and perfected in relation to the propagation of the species." (Darwin 1998: 587)

Admittedly, this does not necessarily have anything directly to do with the evolution of double articulation of vocal sounds as the basis of language but it seems possible that the communicative advantage of evolving doubly articulated language should be sought not only in such activities as co-operative hunting and gathering but also in the pleasurable qualities that the evolution of the vocal tract gave to the human voice. The ability to make a distinction between consonantal and vocalic sounds and attaching meanings to them in combination rather than separately would have required a further adaptation in the brain..

10. Prelinguistic and Non-linguistic Analogue Cognition

Much of the recent literature on the origins of language makes the question synonymous with the origin of consciousness and cognition. It seems to be assumed that because we cannot talk to our non-human fellow creatures and they cannot talk to us, human

cognition and consciousness are totally different from anything we share with other animals. In the ordinary meaning of consciousness, that is, being conscious as opposed to unconscious, or awake as opposed to asleep, with dreaming as an intermediate state, this is surely quite untrue at least as far as mammals and birds are concerned, creatures that share with humans diurnal rhythms of sleep and wakefulness.

Cognition is also something that we commonly think of as depending on language and therefore belonging only to humans and not to other animals, but is this true? Direct perception of the world through the senses is something we share with other animals and it is easy to show that there are aspects of this perception that are impossible to put into words. If one meets an acquaintance on the street, one recognizes him or her instantly without being able to express in words how this is accomplished or to describe the person in words so that someone else who does not know the person could do the same. In the same way, one instantly recognizes a familiar voice on the telephone. Dogs go one better. They can distinguish individual people by their smell. Indeed, I would argue that such pre-linguistic, animal, apprehension through the senses is still the primary source of our knowledge of the world we live in. On the other hand, by using words, syllabic combinations of the vocalic and consonantal sounds made by our vocal organs, to focus on and refer to particular aspects of that sensory apprehension humans have been able to turn themselves into a new, uniquely powerful, form of life. But our primary source of knowledge of ourselves and our surroundings remains our analogue, sensory, apprehension.

Translating our sensory, analogue, apprehension of the world into the digital format of language is not a simple, straightforward matter. The applicability of a word is a yes/no question that may not be easily determined. Take the question of colour. The visible spectrum observable with the human eye is a continuum from infrared to ultraviolet. But languages have a limited, small, number of specific colour names from two, black and white, in the simplest case to six or seven, and the boundaries between colour terms are not necessarily exactly the same in different languages or even for individual speakers. The boundary between blue and green or between red and orange can differ for different individuals. This is obviously a severe restriction for someone trying to give an exact description of a colour in words. In choosing pigments to represent colours artists depend directly on their eyes, not on verbal descriptions.

Open your eyes and look around you. Whether inside a room or out in the open air, would it be possible for you to give a “complete” description, including names of all the objects large and small that are in your field of vision, their colours, including small shades of difference, bright spots and shadows, shapes and sizes. Sitting now in my study with my computer in front of me and a window partially slatted against the sunny, partly clouded, afternoon sky separating me from the outside, if I were ever to attempt such a pointless exercise as to try to make a list of every little detail, it would take me hours and, of course, I could never finish it because the view is constantly changing. Directly in front of me is a leafy tree blowing in the wind. Every now and then a bird flies by. That in itself makes a static, or even a changing list pointless. Of course, that isn’t what lan-

guage is all about. Language focuses on something of interest. If I were a dog, or even a chimpanzee, I am pretty sure that the physical sensation would be quite comparable, even though I wouldn't have the faintest idea of what things like the computer screen and keyboard were all about; but I would have eyes and ears and, no doubt, a nose that would be aware of smells that I, as a human, am totally unaware of. What I can do as a human is to focus on and give names to things, describe them and think about them, and find ways to control and modify them.

11. The Mental Evolution of Primates, from Episodic, to Mimetic, to Mythic

The psychologist, Merlin Donald (1991, 2001), has proposed a three-stage evolution of the mammalian brain from primate to human—from episodic to mimetic to mythic. The first, episodic phase corresponds to what I have referred to above as the analogue, direct awareness of our surroundings through the senses, which we share with other animals. It is still our simplest and most direct contact with the world we live in. We recognize directly through the senses a familiar face or voice as we do other features of the world we live in without infallibly being able to give it (or them) a name. Some animals such as bloodhounds can go one better and recognize individuals by their smell. Donald argues that the mimetic stage would have come about when hominids, standing on two feet, could use their hands to communicate with one another by imitating things that they observed in the environment.

12. Syntax: How do we get from Words to Sentences?

Our analogue apprehension of the world through the senses already distinguishes between objects and actions, that is, in linguistic terms, between nouns, such as man, woman, dog, tree, and verbs, such as walk, strike, eat, fall, fly, etc. It also distinguishes descriptive qualities of such objects and actions, the semantic basis of adjectives and adverbs. As perceived by the senses these different aspects of a situation are simultaneous but turned into spoken words they have to be strung together one after the other in some order that will make clear the relations between them. In other words, we need to develop rules of syntax. Although the kinds of relationships between words that have to be expressed in language may be common to all mankind, there is great variation in how this is actually achieved, whether by word order or declension and conjugation or by particles, and even within the same language, one finds unpredictable changes over time. This suggests to me that the idea that Universal Grammar is an inherent module in the human brain determining the rules of syntax is a mirage.

Let me illustrate this point by some examples in the history of the Chinese language. In the early days of generative grammar one started with the formula: S = NP+VP. "Sentence implies Noun Phrase plus Verb Phrase", a word order that was subject to transformations in the case of questions, commands, etc. At first sight this seems to work for English, which, apart from exclamations, does generally speaking require a verb to make a sentence. There are many languages, however, in which this is not the case.

This shows up, for example, very clearly in written Chinese in usages that correspond to the English verb 'to be'. In Chinese, ancient and modern, adjectives form predicates without a separate verb: **shān gāo** "mountain high" = "the mountain is high"; **shān bù gāo** "mountain not high" = "the mountain is not high". Constructions for predicating, "A is B" where A and B are both nouns, are even harder to fit into the Chomskyan formula. They have gone through a whole series of permutations from the earliest times to the present. In the pre-classical language there was a particle, now pronounced **wéi** (negative **fēi**), which was used as a copula to introduce a noun predicate: **wéi gǒu** "it is a dog" (note that there is no subject pronoun corresponding to English "it"). It differed from a transitive verb in various ways, for instance in how to form a question. In a question, a pronoun standing for the object of a transitive verb was placed in front of the verb: **hé yǒu** "[he/she] what has?" = "what has [he/she]?" In the case of the copula, the question particle followed the copula: **wéi hé** "[it] is what?" Later, in the classical language, **wéi** developed the more restricted meaning of 'only' and the function of predicating a noun was taken over by the particle **yě** placed at the end of the sentence: **gǒu yě** it is a dog", **hé yé** "it is what?" Still later, leading to the development of modern Mandarin, the demonstrative pronoun **shì** "this/that" introducing a noun predicate came to have the meaning of a copula and the final particle **yě** was dropped.

The predication of resemblance was even more variable. In the preclassical language there was a copula **rú** 如 "is like" that behaved like the noun copula **wéi**: **rú hé** "is like what?". In the classical language, however, the word order changed and **rú** was treated as a transitive verb: **hé rú** "is like what?" At the same time a new noun construction emerged in which, by using the particle **yóu**, which was an adverb "still, yet" with verbal predicates, a noun predicate in **yě** could be modified so as to imply similarity rather than identity: **yóu yuán mù ér qiú yú yě**: "it is like (literally: "it is still") climbing a tree to hunt for fish." As in English, there was also a verb **sì** "resemble" which took an object like an ordinary transitive verb.

Finding a way to express in digital yes/no terms of language the complex shades of resemblance between phenomena is not a straightforward matter. I suppose that this uncomfortable imprecision is what lies behind the ubiquitous peppering of conversation with "like" by the younger generation of English speakers in North America nowadays.

13. Do Languages Evolve?

That languages change over time is a matter of common observation. The discovery in the eighteenth century of similarities between Sanskrit, the classical language of India, Old Persian, the classical language of Iran, and Greek and Latin, the classical languages of Europe gave rise to the hypothesis that all these languages as well as many others including Celtic, Germanic, Slavonic, Armenian, etc. had a common origin and to the discipline of Comparative Philology, devoted to reconstructing this common origin and studying, step by step, how the later forms had developed. At first the prestige of the classical languages led to the common assumption that changes had generally been for

the worse. An observation that might seem to confirm this, is the perpetual tendency for the loss of distinctions through phonetic wear and tear as new generations of children learn their native language. In the case of English more than other European languages this has led to the phenomenon of silent letters preserved in conventional spelling but not pronounced, like the initial *k* in words like *know* and *knave* or *gh* in words like *though* and *fight*. A change of this kind that is currently in progress is the loss of initial aspiration in words traditionally spelled with initial *wh*. Growing up in Western Canada in the twenties of last century, I learned to distinguish words like *which* and *witch*. When I first went to Southern England, where they had already merged, I sometimes found this confusing. By now this distinction seems to have disappeared throughout the English speaking world.

All languages are subject to gradual change as they pass from one generation to the next and are adapted to new demands that are placed upon them by the needs of the cultures they serve. New words are acquired. Other words slip into obsolescence.

14. Problems Arising from the Digital Nature of Language

The applicability of a word is a yes/no question but many of the phenomena one wishes to talk about do not fit easily into yes/no categories. The word ‘kill’ seems simple enough but what about ‘murder’? My *Chambers Twentieth Century Dictionary* defines it first as a noun, “the act of putting a person to death intentionally and unlawfully” and then as a verb, “to kill (ordinarily a person) unlawfully with malice aforethought”. This seems clear enough but as we all know the applicability in a particular legal case is something that may be hard to prove, especially when the law provides for a distinction between first degree and second degree murder, as well as for a lesser degree of responsibility in the case of manslaughter, defined as homicide without malice aforethought. No doubt our ancestral pre-human hominids sometimes killed each other but they didn’t have to bother themselves about such niceties. I suspect, however, that the emotions of the parties to such situations involved were not all that different.

Humans create words for things that they cannot easily apprehend with their senses or show to others. Can anyone, for example, show me a ‘soul’ or tell me how to go about perceiving one? In this case my dictionary provides a number of suggestive definitions: “that which thinks, feels, desires, etc.: the ego: a spirit, embodied or disembodied: innermost being or nature: that which one identifies with oneself: moral and emotional nature, power or sensibility …”. These definitions, of course, reflect a traditional religious belief in an afterlife but even for speakers of English who have no such belief, ‘soul’ and its derivative ‘soulful’ are words that one needs to know and may find oneself using in ordinary discourse. The etymology of ‘soul’ is obscure. ‘Spirit’ which is sometimes used as a synonym for ‘soul’, originally meant ‘breath’, to which modern science has given chemical as well as a biological meaning but which in earlier times could be thought of as something that gave life to the body and might therefore continue after death and survive in some way. The Chinese word *qì*, also originally “breath”, has also had a long history in Chinese philosophy and medicine. God, with or without a capital G,

is an even more problematical word that presumably does not bother non-human forms of life but assumes enormous importance for good and ill among humans who can talk about it. Think not only of the catastrophic consequences that have been wrought by the conflicting claims of different religions but also of the wonderful works of art, poetry and music that humans have created in the name of religion.

15. Sign Language as Analogue Communication

Any comprehensive discussion of the human language faculty nowadays needs to say something about the sign languages of the deaf. Through the work started by William C. Stokoe on American Sign Language (ASL) and continued by many others over the last half century it does indeed seem clear that for face to face communication signing with the hands can function very efficiently. When we look at its inner structure, however, there are big differences. In spite of Stokoe's attempted analysis of ASL hand signs into elements of place (called *tab* for *tabula*), active hand (called *dez* for *designator*) and action of the hand or hands (called *sig* for *signation*), these are not really comparable to the distinctive features of phonemes. While phonemes are in principle by themselves devoid of semantic content, ASL signs begin as imitative and although they may be conventionalized and simplified, they retain traces of iconicity which, judging by dictionaries of ASL seem to be basic in learning and remembering. Stokoe's system has never been used as a medium for writing. Later dictionaries are arranged in order by English glosses and illustrate the hand movements by drawings. See, for instance, Sternberg 1994. Another feature of ASL that shows its limitation as a fully independent language is the not infrequent use of finger spelling, especially for proper names. To become literate the deaf have to learn to read English or whatever spoken language is in use in their country. This is, I am sure, a heavy burden. No doubt a sympathetic teacher who can communicate with students in their native sign language can be helpful.

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