Cognitive Critique

SAPIR, HARRIS AND CHOMSKY IN THE TWENTIETH CENTURY

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ABSTRACT

The concept of linguistics has isolated language from other natural systems, and linguistics has remained overwhelmingly a descriptive, rather than a theoretical science. The idea of language universals has thus been a matter of finding shared properties among the highest levels in the organization of language, rather than an attempt to understand the connections of language to other natural systems at all levels of its organization. Language basics such as discreteness have been treated as axiomatic or refractory. The origin of language has been treated as an exercise in continuity, rather than an attempt to understand the organization of language. These trends have been driven by the personalities of Edward Sapir, Zellig Harris and Noam Chomsky, more than by scientific considerations. Sapir's eagerness, Harris's indecision, and Chomsky's magnetism have generated a perfect scientific storm.

INTRODUCTION

In the 1960s, the gossip was still current that linguist Edward Sapir (1921), in the 1920s, had promoted the study of his favorite subject as an independent science, in reaction to the meteoric rise of physics that followed the Eddington eclipse expedition of 1919. Whatever his real motivations, it is possible to watch Sapir (1921, p. 58) abandon the image of speech-sounds as "atoms" (from chemistry) or (1925/1957, p. 20, 22) as "points in a pattern" (from geometry), in favor of the "phoneme" (1925/1957, p. 22, 25). By the next year (Bloomfield 1926/1957, p. 27), the purely linguistic word *phoneme* was standard, and the scientific study of language took its place side by side with physics, chemistry and biology as the independent science of linguistics. However, while the study of the atomic nucleus, for example, is clearly a matter for physics, not chemistry, the natural connections of language have never been clear. But the emergence of linguistics as an independent science carried with it, as an unintended rider, the hidden idea of language as an independent system. Linguistics has never recovered. Nevertheless, some scientific mistakes can only be seen in the perspective of hindsight. The present paper is written with the understanding that there is a model for language, and that that model is based in foundations of number and algebra (Abler 1989, 1997, 2005, 2010). Thus, to make a long story short, phonemes share their source with digits, words share their source with numbers, and sentences share their source with equations.[1] With the understanding that an alternate view of language is possible, I will try to provide perspective on the scientific study of language in the twentieth century.

By the end of World War II, linguistics had retreated into a doctrinaire hyper-objectivism in the form of descriptive linguistics. After all, theory always carries the risk of being wrong, but description is more objective, more *scientific*, and much safer. When the greatest scientist, and physicist, of them all, Isaac Newton, proclaimed, *Hypotheses non fingo* (*I don't dream up theories* — theories, of course, in the colloquial sense of educated guesses), it is not clear whether he took his own slogan seriously. But the linguists did. Zellig Harris's (1951) *Methods in Structural Linguistics*, the bible of the new science, was scrupulously descriptive, that is, Harris

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[1.] See my paper *On isolating, identifying, and defining the uniquely human component of mind* (Cognitive Critique Vol. 7) for a more complete treatment.

reported what he saw and did not dream up theories (p. 20, 372). At that time, it was impossible to believe that nickels are called *nickels* because they are made of nickel - because that would be a case of allowing real-world knowledge to intrude into your linguistic descriptions. Words and sentences do not resemble the objects or actions or ideas they represent. Language was seen as a purely abstract system, and the job of the linguist was to describe it.

The most pervasive property of language is distinctness, or the discreteness of its speech-sounds (*phonemes* — represented roughly but faithfully by the letters of alphabets), and of its words and sentences. Harris (1951) recognizes the discreteness property of perceived phonemes, and of meaningful words or word fragments (morphemes). He contrasts this with the continuity property (p. 20, 25, 367) of speech articulation or the acoustic signal of speech. But the direct contrast of discreteness in opposition to continuity was too abstract and too theoretical for Harris, who never suggested it. *Hypotheses non fingo*. Harris was able to write (1951, p. 21),

> "...we associate with each utterance the smallest number of different elements which are themselves just small enough so that no one of them is composed of any of the other elements," apparently unaware of Dmitri Mendeléeff's remark (1868/1905, p. 20): "Substances which cannot be formed from or decomposed into others are termed *simple substances* (elements)" — Mendeléeff's italics.

The discreteness property of the gene, and the necessity of it, had been well known for twenty years (Fisher 1930, p. 7), but Harris, again, takes no notice. The phoneme chart (IPA 1949), well-enough known in Harris's day, is a periodic table, but, characteristically, Harris takes no notice. Sentences are discrete linguistic objects, but, yet again, Harris takes no notice. The isolation of linguistics, and of language, was complete.

Harris's objective resolve sometimes weakens, but never breaks. He explains (1951, p. 364) that,

> "...we state what limitations there are on the random distribution…of each element relative to each other element," and continues (p. 367): "It is this representation of differences which gives us discrete combinatorial elements."

This is as close as Harris gets to stating that the difference between random distribution of linguistic elements and their actual distribution in language amounts to the rules of language, and is Harris's most nearly scientific idea. But, faithful to his scientific ideal, Harris stops short of spinning theories.

Sapir's legacy, then, is the isolation of language from other naturally-occurring systems, and the consequences of isolation. The most severe of these is the implication that fundamental structures and properties of language are axiomatic and refractory, and cannot be referred to other natural systems outside of language, with the result that they must be assumed, or even taken for granted. The study of the origin of language, then, is treated as a matter of detecting language antecedents in the behavior of apes and monkeys, or even of birds and grasshoppers, not in questioning the idea of language. Harris's legacy, in refusing to spin theories, is that he never defined structuralism, his own implicit theory. There is no definition of sentence or of language, and no indication that such definitions would be valuable. Linguistics in the new millennium continues to rest on Sapir's isolation and Harris's descriptive objectivism.

CHOMSKY'S REBELLION

The psychology of the Chomsky revolution may never be fully understood, but there is plenty of it. Chomsky's rebellion in linguistics took place in parallel with his rebellion against the Vietnam War, and, while some of Chomsky's readers in politics may have been unaware of his linguistics, all of Chomsky's readers in linguistics were aware of his writings in politics. And in the collective imagination of the linguists, Chomsky's two parallel careers cannot be fully separated.

Then there is the politically correct idea that people evolved by natural selection, the same as any other animal, and the idea that we need Darwinism as a defense against Creationism. But religion has stopped berating physics in the way that it did in Galileo's day, and we no longer have to defend physics as a non-religious understanding of natural properties. So we tend to forget about it. Until a fully mature theory is available, the possibility must not be dismissed that the idea of language evolution is driven by a reaction against the racism and speciesism of the nineteenth century, and as a defense against the Creationism of the nineteenth and twentieth centuries, rather than by strictly scientific ideas.

The Chomsky revolution developed more seamlessly, and less completely, than is generally thought. And there may be general principles at work, too. It is the rare scientist who can let go of old ideas completely. Copernicus could not; Francesco Redi could not; Darwin and Wallace could not. Mendel and Einstein are rare examples of scientists who could let go completely of what they had been taught. Chomsky had reverted to structuralism even before his rebellion against it had begun; and he continued to cling to it even as he was trying to disprove it. In spite of the phrase *Chomsky's theory*, Chomsky remained too descriptive to have a theory. A phrase like *discrete infinity*, or *recursively embedded* is a description, not a theory. In other words, it contains no element of explanation or understanding. As a conjecture, I will guess that people who are deeply interested in language are not so deeply interested in, say, chemistry or genetics or geometry or algebra.

THE SEAMLESS REVOLUTION

The definitive last work in the old linguistics (Harris's *Methods in Structural Linguistics* (1951) — later changed to *Structural Linguistics*) and the first work in the new (Chomsky's *Syntactic Structures* (1957)) were published only six years apart. Harris (p. v) mentions *N. Chomsky* in his introduction, and Chomsky (p. 6) mentions *Zellig S. Harris* in *his* introduction. Chomsky was Harris's student at Penn and his neighbor in Philadelphia, and both authors knew both books, and each other, well. Chomsky was approximately 22 years old when Harris's *Methods* was published, and younger than 30 when *Syntactic Structures* was published.

The logic of structuralism was severe, relentless, and, sometimes, obtuse. Phonemes were identified when two words, a *minimal pair*, could be distinguished on the basis of a single phoneme distinction. Thus, *bat* and *rat* form a minimal pair because they are different words that differ from one another by a single sound that cannot be decomposed into others. In this way, *b* and *r* are identified as distinct and separate phonemes. So far, so good. But Harris (p. 24) then concludes that the words *ekenamiks* and *iykenamiks* (both spelled *economics*) "have to be considered two distinct morphemes."

Harris had painted himself into a logical corner from which Chomsky (1957, p. 95) escapes by pointing out that,

> "...there are utterance tokens that are phonemically dis-
> tinct and identical in meaning (synonyms) and there are
> utterance tokens which are phonemically identical and
> different in meaning (homonyms)."

As an example of homonyms, Chomsky cites "such pairs as 'bank'
(of a river) and 'bank' (for savings)." But, as an example of *absolute
synonyms*, Chomsky cites *ekInamiks* and *iykInamiks*. If Chomsky's
commonsense decision was the beginning of his rebellion against
structuralism, he might have taken it straight from Harris (1951,
p. 39), who presents "[ekenamiks] and [iykenamiks] as repetitions
of each other." Harris's indecision stems from his refusal to solid-
ify his position by spinning theories. Thus, he presents methods in
structuralism, but not a theory of structuralism. Chomsky follows
Harris's lead. He wanted to disprove structuralism as it applied to
words, but, without a precise theory or definition of structuralism, it
was never clear exactly what was being disproved.

By the middle 1960s, Chomsky had introduced his most fa-
mous sentence, "Colorless green ideas sleep furiously", to show
that grammar in language is a matter of organization, not of mean-
ing. Since only sentences assert truth and falsity, Chomsky's con-
clusion was misleading, if provocative at the time. He also intro-
duced a pair of twin sentences, "John is eager to please" and "John
is easy to please", which have the same description under structur-
alism because they have the same constituent parts. But it is clear
that the two sentences are actually very different. In the first, John
pleases other people, and is the subject of the sentence, while in
the second, other people please John, and John is the direct object.
With *eager* and *easy*, Chomsky tried to disprove structuralism as it
applies to sentences. But, again, with no precise definition or theory
of structuralism, it was never clear exactly what was supposed to
be disproved.

Chomsky's three great disproofs — his disproof of structural-
ism as it applies to words, his disproof of structuralism as it applies
to sentences, and his disproof of the idea that syntax carries mean-
ing — are all disproofs by counterexample. And here, as far as I
know, even the philosophers have been asleep, explaining disproof-
by-counterexample by giving an example, rather than by holding it
to the same standard as other proofs. Usually, disproof by counter-
example is explained by applying it to Goldbach's conjecture: the
proposition that every even integer greater than 2 can be expressed
as the sum of two primes. If some even number should be found

that cannot be expressed as the sum of two primes, Goldbach's conjecture would be disproved — but we would not know why it was wrong. Further, we are merely lucky in knowing what prime numbers and even numbers are. With no requirement to define exactly what is being disproved, as there would be in a conventional proof, imagination rushes in to fill the void, and imagination never disappoints. Structuralism, then, here defined, as far as I know, for the first time, is the theory that words are built by attaching phonemes to other phonemes, and sentences are built by attaching words to other words. Linguistics still lacks any definition of sentence or language.

If any linguist in the twentieth century had defined structuralism, counterexamples to the counterexamples would have been noticed. Especially in syntax, the process of agreement shows a grammatical relationship between words in a sentence. Pronouns in English, for example, are said to *agree* with their nouns in gender and number, as *the man–he*, *the men–they*, *the woman–she*, *the women–they*. And, a case could be made that words in sentences actually are attached to other words.

Chomsky's (1957) remedy for structuralism was transformationalism, or linguistic transformations, under which (p. 80) language consists of "probably a finite number [of] simple, declarative, active" kernel sentences, "and that all other sentences can be described more simply as transforms" of the kernels. For example, the passive form of a sentence might be derived from its active kernel by a transformation, as follows: *NounPhrase1 - Verb - NounPhrase2 is re-written as NounPhrase2 - was - Verb+en - by NounPhrase1*. But, rearranging the parts of a sentence and attaching endings to them to show that they have been rearranged is structuralism. And Chomsky's most current theory of language (Hauser et al. 2002) holds that sentences are formed by a process of recursion, or the embedding of one linguistic structure into another. Recursion, however, is a theory in structuralism, since linguistic material cannot be embedded between linguistic objects that are not attached to one another in the first place. Thus, Chomsky had reverted to structuralism even before he tried to disprove it, and stayed with structuralism even after he thought he had disproved it.

Chomsky is not alone. In his book *The Language Instinct*, Steven Pinker (1994, pp. 84-twice, 85-twice, 89, 92, 93, 97, 127, 162, 163-twice, 179, 237, 269, 334, 351, 362) explains that language is a "discrete combinatorial system"*,* a description of struc-

turalism that Pinker might have adapted from Harris's (1951, p. 367) "discrete combinatorial elements", or from Harris's (1951, p. 34) "discrete elements which can be combined together." On page 127, Pinker calls the discrete combinatorial system "the engineering trick behind human language", but does not mention this foundational property in his index or glossary. In the end-notes for his page 84, Pinker (1994, p. 434) refers the discrete combinatorial system, among other things, to "Abler, 1989", that is, to the particulate principle of self-diversifying systems (see Pinker 1994, p. 447). The particulate principle was the first hint that language is based on physical principles, not biological ones, and is in no sense a return to structuralism. Following Chomsky, Pinker describes linguistic tree structure, or "deep structure" (1994, p. 98). He explains correctly (p. 97) that a "sentence is not a chain but a tree", and (p. 99) that phrases, not words, "snap into any of several positions inside other components", i.e., the beginning of Pinker's return to structuralism. In the end, following Chomsky, Pinker (1994, p. 163) returns to the discrete combinatorial system without reference to deep structure: "Phonemes snap cleanly into morphemes, morphemes into words, words into phrases." This is a perfect description — not a theory — of structuralism.

We can only guess why no one defined structuralism, and why everyone mistook the descriptive nature of structuralism for theory (Mackay 1841/1932). Chomsky's idea of linguistic deep structure (1957, p. 27) actually represents the beginning of a theory of language, but Chomsky explained it away on the same page, and eventually abandoned it. If ancient science has any lesson to teach the modern linguist, it is that genius, even a thousand geniuses, unaided by method (Redi 1688/1909), is helpless to solve the problems of science.

UNIVERSALS OF LANGUAGE

The idea of a project in language universals was introduced in a letter from Joseph Casagrande to Joseph Greenberg in 1958 or 1959. Casagrande's suggestion was that, if those features that are shared by all languages could be assembled and examined, the underlying design features of language itself might be deduced. The result was a conference and, in 1963, Greenberg's book, *Universals of Language*. Neither Chomsky nor Harris attended the conference or contributed to the book, or is mentioned in the bibliography. A

project examining universals of language seems energetically scientific: *Let's get the facts before we go jumping to conclusions*. But, actually, the universals project is one of the best examples in the history of science, along with blending inheritance in the nineteenth century (Wallace 1885, p. 140), of the theory selecting the facts. In the case of language, the theory was tacit, and all the more powerful because no one knew it was there to be questioned. Nevertheless, the theory stated that language is an independent system, that is, independent from the rest of nature. Its fundamental components were therefore primitive, axiomatic and sui generis. They had to be taken for granted, and only higher-level components were ever examined.

Our tacit idea that language is an independent system can be seen in the way we have tried to understand its origin. We take for granted that people are animals, that animals evolve by natural selection, and that language therefore has its origin in biology. We take for granted that the components of language are primitive and refractory, not subject to analysis, and that their antecedents in biology are therefore miniature versions of themselves — linguistic pre-adaptations, or homunculi. We try to assemble language from the parts we can see. Thus, with the emergence of the vocal tract, speech articulation originated in movements of the jaw. Words emerge from alarm calls, with mechanical and thus acoustic differences depending on whether we are looking up (at an eagle) or down (at a snake). Syntax is the result of recursion, which was already present in the behavior of gorillas, and maybe even grasshoppers. Children learn language from their parents in the way that birds learn bird songs from theirs. For the most part, our concept of language origins is structuralism in biological clothing. We think we assemble language from its component parts, and we regard a demonstration of continuity as an acceptable substitute for understanding how a thing works. We never entertain the possibility that the components of language might be manifestations of an underlying abstract order.

After the universals project was in place, only the presence or absence or linguistic role of specific universals was questioned. The project itself was taken for granted. If he could have shaken himself free from Harris's refusal to spin theories, Chomsky might have saved linguistics from more than half a century of wandering. While no science ever enjoys complete unanimity of opinion, the current state of language universals can be summarized by two

examples. One of these is the question of word order in sentences. Greenberg states (1963, p. 61) that,

> "[In] declarative sentences with nominal subject and object, the dominant word order is always one in which the subject precedes the object."

And, he explains (p. 76) that this preference is driven by psychological factors. Although agreement is never universal, Evans and Levinson found a prominent forum (2009) to explode what they call "the myth of language universals." They asked the following (p. 432): "How do listeners actually parse a free word order language?" We will answer that question elsewhere. But, surveying nearly 2500 languages in four language families, Dunn et al. (2011) show that it is language history, and not universal psychological forces as proposed by Greenberg, or universal grammar (UG) as proposed by Chomsky, that determines word order in languages, and, by extension, the entire structure of language. Evans and Levinson, and Dunn et al., were so persuasive that the British journal Nature warned (anonymous 2011, p. 136) that, "universal equations are all very well, but the world actually consists of particular solutions."

Data, even mountains of data, do not add up to evidence unless they are applicable. How much has actually changed in the field of word order since the publication of Greenberg's book in 1963? If we move in a universe defined by the question, *What determines the word order in the sentences of the world's languages?*, we find that the old linguistics has been swept away. But we are moving in a universe that is too narrow. We assume that if we cannot verify the Greenberg-Chomsky universals, there must be no universals, and therefore no system at all. No one has questioned whether the Greenberg-Chomsky universals are the right ones, or whether the question of universals is the right question. In docile fashion, we have allowed the Greenberg-Chomsky assumptions to define the discussion. But it is only by taking for granted the language-universal existence of phonemes and words, sentences, nouns and verbs, subject and object, and the meaningful nature of word order within sentences, that the determination of sentence word order in different languages can even become a topic.

The real questions not only go unasked, but unimagined. Recent investigations of languages of the world have turned up a language (Everett 2005) that lacks one of the supposed universals (recursion), causing Everett to doubt the existence of language universals. Everett has a point. Recursion is not a basic component of language,

and its absence in an otherwise normal modern language is a wake-up call. But theories are not made of counterexamples, and the path to understanding lies elsewhere.

The most direct result of the decay in the universals project has been the Kluge hypothesis (Marcus 2008), in which language emerges as a congeries of unrelated fragments thrown together by the accidents of history. After all, no orderly system would have *go-went-gone* and *drink-drank-drunk* and *think-thought-thought* when all the verbs could be like *turn-turned-turned* and *bake-baked-baked* and *listen-listened-listened*. But the idea that irregular verbs make language a hodgepodge depends on the assumption that the words themselves are somehow basic, when the real basics lie in the foundations of the number system and algebra.

LANGUAGE AND THOUGHT

Another idea that has seen a renaissance in recent years (Boroditsky 2011) is the Sapir-Whorf hypothesis, which holds (Whorf 1956) that what we say influences what we think about, and what we think about influences what we say. For instance, the ability to point to true north and say, *That way is north*, even in unfamiliar surroundings, is evidence of a constant awareness of geography. And the sentence *He broke the window* expresses a hidden intentionality, although the action might have been accidental (Boroditsky 2011). While such studies are undoubtedly worthwhile and interesting on their own terms, they do not "[help] us understand the very essence of what makes us human" (Boroditsky 2011). The ability to say, *That way is north* or *He broke the window* depends on the ability to make sentences and assertions, a sense of truth-and-falsity, and the ability to recognize the meaningful nature of word order and the identity of words — nouns, verbs, subject and object, and phonemes. This is what makes us human, and the rest is ramifications.

Just on the basis of observation, then, the universals of language are phonemes, words and sentences, nouns and verbs, subject and object. All these components exhibit a property of discreteness; and an understanding of discreteness is possible only on the basis of theory. Observation alone is inadequate. Furthermore, sentences uniquely possess the power of assertion, and the property of truth and falsity. Since language is unique to human beings, these are the founding faculties of the human mind. While a project describing all the existing languages of the world is obviously desirable, and

should be pursued for its own sake, it will not disclose the underlying structure of language because the underlying structure of language is not directly visible. Languages are like snowflakes. Each has its own individual shape (Bentley and Humphreys 1931/1962) and can be described on that basis. But snowflakes are also manifestations of a single underlying order. By refusing to construct theories, linguists have convinced themselves that, in principle, language has no underlying order. As a means of discovering the basis of language, the project in universals is wrong-headed and hopeless. The linguists might take a hint from the chemists of the nineteenth century, who deduced the tetrahedral structure of CH_2Cl_2 by discovering that, although it appears as two chemical compounds on paper, in reality it is only one (Greenaway 1966, p. 215). Thus they might try to deduce the underlying mechanisms that generate the nouns, verbs, sentences and assertions that we see in language. And the linguists might take a hint from the physicists of the twentieth century, who realized that "any fundamental discovery [does] not follow logically from anywhere" (Ponomarev 1973, p. 214), and let go of description in favor of theory. This will require a leap into the unknown.

ORIGIN OF LANGUAGE

I will close this review with a few comments on a comprehensive position paper published by Chomsky and two colleagues (Hauser et al. 2002), presenting Chomsky's view of the current state of linguistics, and proposing his program for the future of linguistics. Chomsky's article (Hauser et al. 2002) *The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?* presents the outline of his program for investigating the biological origins of human language, asking (p. 1570, column 1) "how we get from there to here", thus taking for granted the evolutionary theory that he wants to prove. Chomsky focusses on the period, approximately six million years ago, following the divergence of the human line from our last common ancestor with the chimpanzee, and calls for,

> "...a collaborative effort among linguists, biologists, psychologists and anthropologists [to determine] ... what was inherited unchanged from this common ancestor, what has been subjected to minor modifications, and what (if anything) is qualitatively new."

Chomsky distinguishes between the language faculty considered in the broad sense, FLB, which includes all faculties involved in the use of language, such as (p. 1571, column 1) "memory, respiration, digestion, circulation, etc", and the faculty of language in the narrow sense, FLN, which consists of "the abstract linguistic computational system alone." While FLN is a component of FLB, Chomsky limits his program to FLN, maintaining that,

> *"...*a core property of FLN is recursion," that is, "FLN takes a finite set of elements and yields a potentially infinite array of discrete expressions." He adds (p. 1571, column 2): "Sentences are built up of discrete units."

Chomsky's program is a kind of comparative linguistic ethology, but the number, variety, and obvious relatedness of languages is no more evidence of an origin in biology than the number, variety and obvious relatedness of snowflakes is evidence of an origin in biology. Between 1967 and 1992, I pursued my own program in evolutionary linguistics. I built a working model of the human vocal tract and obtained a doctorate in linguistics, held a fellowship in neuropsychology and participated in ape-language studies. I studied the skulls of fossil man, and studied honey bees and made Golgi and cresyl violet sections of their brains. I excavated dinosaurs in the field and studied them in the laboratory. To my own satisfaction, I carried out Chomsky's program in evolutionary linguistics, and can report that it is a case of the cart before the horse. Language is too vast and too complicated to be understood by an empirical approach. Its structures are hidden and not accessible to direct observation. Only a new theory can show the structure of language, and inform the experiments that will reveal its organization in the brain.

Chomsky then considers a comprehensive inventory of biological-evolutionary mechanisms, and their possible relationship to the origin of language. Thus, categorical perception (Liberman et al. 1967) is not limited to language as it was once thought to be (p. 1572, column 1); and evolutionary convergence may play a bigger role than was previously thought (p. 1572, column 2). Chomsky mentions (p. 1572, column 3) "close parallel*s"* between the critical period in the acquisition of song by birds and the acquisition of language by children. Chomsky recommends "casting the comparative net more broadly"*,* but he casts his net entirely within biology rather than seeking a wider context in nature. Chomsky mentions "the definitions of the faculty of language" and suggests that any or all of the known evolutionary mechanisms might have played a role.

FLB might be analogous to human communication, or it might be uniquely human. FLN might be uniquely human, or only the ability to generate discrete infinities might be uniquely human. Chomsky suggests that only empirical data can distinguish among the available hypotheses, mentioning evolutionary spandrels, the adaptive nature of recursion, the laws of physics, evolutionary by-products, evolutionary constraints imposed by existing brain structure, evolutionary pre-adaptation, the ability of nonhuman primates to distinguish between different languages on the basis of their different rhythmic structure. He concludes "that the continuity hypothesis deserves the status of the null hypothesis", which must be disproved on the basis of empirical findings.

Chomsky cites evolutionary difficulties. Observational learning is not as prevalent among non-human animals as once was thought; and mirror neurons do not facilitate imitation as once was hoped. The vocalizations of non-human animals do not express the full depth of their understanding as language does for humans, and even chimpanzees may lack a theory of mind. Animal vocalizations may not be referential in the way that human words are. And most human words are not of immediate biological relevance, nor do children struggle to learn vast numbers of them. The uniqueness of language, then, is (p. 1576, column 3),

> "...its capacity for limitless expressive power, captured by the notion of discrete infinity, [that is, a] ... capacity to recombine meaningful units into an unlimited variety of larger structures." Chomsky (p. 1577, column 2) defines the "generative property of human language [as] (column 3) recursive embedding of phrases within phrases." He closes with what he calls "the (extremely difficult, and still distant) accomplishment of finding the principles of…language" (p. 1578, column 1), and looks forward to a research program "paralleling 40 years of optimal foraging research." (column 2).

Chomsky has laid out all the logical possibilities, and the most striking feature of his program is its similarity to the Greenberg-Chomsky program in universals. While one program sends linguists all over the world to study people, the other sends ethologists all over the world to study animals. Although the study of animals is desirable, and worth pursuing for its own sake, it is not the way to discover the mechanism of language. It also creates the appearance of postponing a solution rather than pursuing it. Chomsky freely

uses the words *sentence* and *language*, but his definition, the ability to generate discrete infinity, is a description, not a theory, and in effect generates the vagueness upon which his program thrives. Casting a wide net is good, but solving the problem is better. Chomsky's net is limited to biology. It is big, and generates plenty of work, but ignores the possibility that the structure of language may arise outside of biology.

The title of the article is *The Faculty of Language: What Is It...?* But *discrete infinity* is not a definition of language, or even of a sentence. Chomsky's concept of recursion as the mechanism of discrete infinity is a concept from structuralism, the theory that he allegedly disproved but never formulated in the 1960s. Chomsky's statement (p. 1571, column 2) that sentences "are built up of discrete units" is a perfect description of structuralism. Chomsky's only specific linguistic remark comes near the end of the paper, where he mentions the "recursive embedding of phrases within phrases." This is the closest that he gets to explaining what is *recursed* under recursion. Chomsky is describing what he sees, instead of trying to imagine its underlying structures and mechanisms. He learned Harris's lesson well.

How should we assess the Chomsky vision? In an accompanying article entitled *Noam's Ark*, authors Thomas Bever and Mario Montalbetti (2002) implicitly compare Chomsky to the Biblical hero. They show (p. 1566) Chomsky and Darwin facing one another in profile over the caption *The descent of language.* Is this the right comparison? Since the closest physical system to language is the gene (Abler 1989, 1997), it is perhaps better to compare Chomsky to Gregor Mendel. Why was Mendel able to discover the laws of inheritance 34 years before anyone else was able even to recognize them? Because, where,

> "...previous experimenters in hybridization were working haphazard," suggests Mendel's biographer Hugo Iltis (1932, p. 113), "Mendel was the first to deal with the whole problem purposively and with unvarying attention to the possibility of its solution."

In other words, Mendel succeeded not by casting a wide net but by pursuing the intention to solve the problem, whereas Chomsky asks only for more research.

Bever and Montalbetti lament "the absence of a clear model that delineates what language itself *is*" (their italics), and Chomsky mentions (p. 1571, column 3) that "language is directly analogous

to the natural numbers" but never notices that equations are sentences with a linguistic deep structure (Abler 2005, 2010), and that algebra is precisely the model wanted by Bever and Montalbetti. Instead, Chomsky (p. 1578, column 2) calls for "a concerted, multidisciplinary attack on the problems of language evolution, paralleling 40 years of optimal foraging research" — and 40 more years of foraging. Chomsky's vagueness, echoed by Bever and Montalbetti, emerges in his sly lament (p. 1571, column 3) that "Linguistic behavior does not fossilize." What if it did? Language is a mystery precisely because internal processes in the production of language are hidden; we cannot look at modern speakers and see the internal processes in the production of their sentences, and such processes would have been just as hidden in ancient speakers. Even a voyage in a time machine, that is, something that yields the same observations as a language fossil, only more of them, would reveal nothing (Müller 1862, p. 344). It would merely confirm to us what we already think rather than distinguishing between incompatible hypotheses.

What if Chomsky's program were to succeed? What would happen if, 40 years from now, it is shown that language is based on observational learning as found in birds, and on recursion as found in chimpanzees? How much would we know? After sending thousands of researchers into jungles and laboratories all over the world for 40 years, we would have no understanding of discreteness, the "Ariadne's thread" (Greenaway 1966, p. 211) that leads through all the structures of language, and binds language to atoms, genes and numbers. We would have no definition of a sentence, or of language, no knowledge of why word order is meaningful, no understanding of the parts of speech, nouns, verbs, prepositions, no idea of the relationship between language and mind. Chomsky's program in the origin of language, with continuity as its null hypothesis, is a kind of *Roots* project (Haley 1976). But knowing where things come from should not be mistaken for understanding how they work. The gathering of observations is directed by existing theory, and should not, in itself, be mistaken for new knowledge. And the promise that *everything will become clear from the data* is not reassuring. Understanding emerges from the focused efforts of a single individual, not from collective awareness. The grandeur and vast scope of Chomsky's program, its far-flung projects in the jungle and the laboratory, its collegial collaborative atmosphere and prospects for employment, its exhaustive logic, and the comforting illusion

that, if we just keep doing what we are doing, and if we all do our part, we will eventually reach our goal, becomes a shell game that hides the overwhelming vagueness of a diverging series in pursuit of the most precisely structured system known. Its rendezvous with the future only excuses its refusal to solve in the present, and the concept of language as a kluge or melange only elevates to the level of principle the linguist's refusal to contemplate theory. Chomsky's advice (p.1578, column 2) to pursue "a concerted, multidisciplinary attack on the problems of language evolution" might as well be Carl von Naegeli's advice to Gregor Mendel to pursue "experiments of an exhaustive character…made upon one single object in every conceivable direction" (Iltis 1932, p. 191). Chomsky's logic takes for granted the idea of an origin in biology, but, with the acknowledged connection of language to numbers, an origin in biology is not obvious.

Science is where you find it. We look at Gregor Mendel and tell ourselves that he did the experiments, he had the data, he drew the conclusions: he is the genius. But, at the time, Mendel was the "charming putterer" at Brunn (Eichling 1942) and Carl von Naegeli was the genius. In its own moment, proof in science is as subjective as a dream.

CONCLUSION

What, then, is the Sapir-Harris-Chomsky legacy? In hindsight, Sapir would have done better to stick with chemistry and geometry as models for language, instead of pushing language to the front as an independent science and an independent system. Chomsky himself was more disciple than rebel. By refusing to break entirely free from Harris, Chomsky remained a prisoner of Sapir's isolated vision of language, and of Harris's hyper-scientific, descriptive mindset. He might have defined structuralism and gone on to show why it is wrong, rather than trusting counterexamples. Putting words together does not make sentences, it makes compound words. A complete theory of structuralism might have prevented Chomsky from falling back into it. Like Sapir, Chomsky would have done better to stick with his original intuition, that is, that language is derived from a few simple, declarative sentences. He might eventually have realized that the sentences he sought are the equations $a=b$ and $a=b+c$, and that the symmetry property of equations is the basis of language, not any property of language itself. But, by

the time he reached the age of 30, Chomsky had discovered linguistic deep structure, although he never understood it, and eventually abandoned it. By the time he reached the age of 40, Chomsky had formulated a partial disproof of structuralism, although no one ever defined structuralism, and linguistics fell back into it. Maybe Chomsky had done enough.

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