

What Can Chimps Tell Us About the Origin of Language?

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If the current flurry of interest in nonhuman primate-language research accomplished nothing else, it has succeeded in getting us to think seriously again about the origins of language in *Homo Sapiens* (see Harnad, Steklis, & Lancaster; 1976; Parker & Gibson, 1979). Long the subject of legend and myth, the problem of language origin blossomed with the rise of modern science during the 17th and particularly the 18th centuries, bearing myriad speculative theories aimed primarily at displacing the traditional supernatural accounts about the beginnings of language. These naturalistic proposals variously pointed to animal cries, expressions of emotion and love, gestures, mimicry, human reason itself, or some sort of social evolution, as responsible for human language. Virtually everyone during the 17th century seemed to have something to say on the subject.¹ La Mettrie (1709-1751), Buffon (1707-1788), Rousseau (1712-1778), Condillac (1715-1780), and the Scottish Lord Monboddo (1714-1799), for example, developed surprisingly sophisticated biological-social evolutionary perspectives that I discuss later. The German, Herder (1744-1803) won the 1770 Berlin Academy of Science essay contest for his answer to the question, "Are men, left to their natural faculties, in a position to invent language, and by what means do they, by themselves, accomplish that invention?" Herder's answer, although adamantly against "Divine-Origin" proposals, remains frustratingly vague in his effort to promote human language as a species-specific characteristic of *Homo sapiens* (Herder, 1772/1966):

I do not wish, on metaphysical grounds, to pursue further the hypothesis of the divine origin of language, for psychologically its baselessness has been shown in the fact that, in order to understand the language of the gods on Olympus, man must come endowed with reason and hence endowed with language [p. 127].

Nearly a century later, speculation on the origin of language became an important part of the vigorous controversies in the wake of Darwin and Wallace's 1858 publication of their work on evolution. Although religious critics like Bishop Wilberforce saw human qualities and human speech, in particular, as "utterly irreconcilable with the degrading notion of the brute origin of

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¹ G. W. Hewes (1973, 1975, 1979) has collected an extensive bibliography of both historical and contemporary references on language origins. A more detailed discussion of historical interests in ape language generally is forthcoming in my monograph on language in child and chimp, in preparation.

him who was created in the image of God...(1860/1971)" many scientists and other thoughtful critics also could not fully accept the Darwinian account of human evolution despite the best efforts of Darwin, Huxley, Haeckel, and others to minimize the anatomical and mental gaps between humans and their putative cousins, the chimpanzee and newly discovered gorilla. Prominent natural scientists, grossly underestimating the age of the Earth, doubted natural selection alone could have worked its way from protozoa to Homo sapiens; many scientists viewed Darwin's theory as an interesting but untestable conjecture. Others more or less accepted the notion of anatomical evolution but balked at the Darwinian arguments as to the origin of human mental abilities and human language in particular. Darwin predictably argued that language was a human instinct that had been slowly and unconsciously developed in many steps and that the faculty of articulate speech offered no insuperable objection to the claim that human nature had evolved from lower forms (Darwin, 1871/1955):

I cannot doubt that language owes its origin to the imitation and modification of various natural sounds, the voices of other animals, and man's own instinctive cries, aided by signs and gestures...It is, therefore, probably that the imitation of musical cries by articulate sounds may have given rise to words expressive of various complex emotions... may not some unusually wise ape-like animal have imitated the growl of a beast of prey, and thus told his fellow-monkeys the nature of the expected danger? This would have been a first step in the formation of a language... As the voice was used more and more, the vocal organs would have been strengthened and perfected through the principle of the inherited effects of use; and this would have reacted on the power of speech. But the relation between the continued use of language and development of the brain, has no doubt been far more important... we may confidently believe that the continued use and advancement of this power would have reacted on the mind itself, by enabling it and encouraging it to carry on long trains of thought [pp. 297-301].

These remarks reflect not only Darwin's conception of evolution as an active feedback system (cf. Wallace, 1858/1970) and his belief in a Lamarckian theory of acquired habits, but also his recognition that language offered Homo sapiens something more than just an efficient communication device.²

² Today Jean-Baptiste Lamarck (1744-1829) is generally given the credit, or more often the discredit, for the idea that behavioral and morphological modifications resulting from an organism's acquired habits may be genetically passed onto that organism's offspring. In reality "Lamarckism" was accepted by nearly everyone believing in the modifiability of species in the late 18th century and up to the beginnings of this century when August Weismann discovered the difference between germ cells and other somatic cells (cf. Burkhardt, 1977). Twentieth century Lamarckism is briefly discussed further later in this chapter.

Darwin's arguments, needless to say, were not universally accepted. F. Max Müller (1866), a noted Sanskrit scholar then at Oxford, rebutted Darwin's analysis directly:

The one great barrier between the brute and man is language. Man speaks, and no brute has ever uttered a word. Language is our Rubicon, and no brute will dare cross it. This is our matter of fact answer to those who speak of development, who think they discover the rudiments at least of all human faculties in apes, and who would fain keep open the possibility that man is only a more favored beast, the triumphant conqueror in the primeval struggle for life. Language is something more palpable than a fold of a brain, or an angle of the skull. It admits no cavilling, and no process of natural selection will ever distill significant words out of the notes of birds or the cries of beasts [p. 354].

It is perhaps too easy today to discuss Müller as a somewhat pompous populizer, whose contemporary significance is limited to being the source of the "bow-wow" and "pooh-pooh" theories of language origin. Müller, of course, was not the first to propose that language arose from imitative onomatopoeia (the "bow-wow" theory) or from the cries and interjections of pain, fear, or joy (the "pooh-pooh" theory). He coined the terms, one suspects, to suggest how trivial those theories were in relation to the problem. Müller's criticism of natural selection is also not trivial, given *inter alia* --the inadequate provision in Darwin's theory for innovation, either biological or social. Darwin himself recognized the enormous burden placed on natural selection as the mechanism for language origin.³ Consider the letter he wrote to Müller (July 3, 1873; cited in Chaudhuri, 1974) upon receipt of a collection of Müller's (1873) comments about "Mr. Darwin's Philosophy of Language":

... I should have been glad to have avoided the whole subject, but was compelled to take it up as well as I could. He who is fully convinced, as I am, that man is descended from some lower animal, is almost forced to believe *a priori* that articulate language has been developed from inarticulate cries; and he is therefore hardly a fair judge of the arguments opposed to this belief.

We have here a species of "what-else" argument, similar to Chomsky's contemporary arguments concerning the genetic basis of human-language acquisitions (Limber, 1977). Such arguments in fact abound in language-origin theories. Johann Peter Sussmilch, Herder's target in his essay against the Divine Origin of language, also utilized a "what-else" argument--or more accurately a "who-else" argument (cf. Stam, 1976). In essence Sussmilch argued that the design of language presupposed a reasonable being; humans without language are without reason; ergo, who else but God could have invented language? Not surprisingly, such arguments are rarely

³ See, for example, Darwin's own comments on this issue in *Descent of Man* (1871/1955).

convincing to firm believers of alternative theories.⁴ Of course, what sets Darwin's thinking far apart from the many others like Herder and Müller, who also believed human language was natural or instinctive, was Darwin's conviction that the origins of those instincts themselves must find explanation within a natural evolutionary framework.

APES AND LANGUAGE ORIGINS

Speculation about the language potential of apes began with the first specimens brought to Europe during the 17th century. Samuel Pepys (Wheatley, 1946) records in his diary for August, 1661, his observations on a "great baboon" from Guiny: "I do believe it already understands much English; and I am of the mind it might be taught to speak or make signs [p. 307]."

Although the Cartesian controversy about language and reasoning in animals raged throughout the 17th century (Boas, 1933/1966; Limber, in preparation), it was not until towards the middle of the next century when La Mettrie, Buffon, Rousseau, Monboddo, and others began speculating on the language capacities of the newly discovered large primates in Africa and the East Indies in connection with language origins.

Common among these writers is a notion of social evolution whereby human nature, unlike that of animals, shows increasing "social progress." The origin of language, of course, was the most important and obvious step in the human rise from its natural animal state. La Mettrie (1742/1943) proposed that apes might well be taught language:

Then he would no longer be a wild man, nor a defective man, but he would be a perfect man, a little gentleman, with as much matter or muscle as we have, for thinking and profiting by his education ... What was man before the invention of words and the knowledge of language? An animal of his own species with much less instinct than the others [p. 103].

Rousseau (1772/1966) recognized that animals that live and work together, such as beavers, ants, and bees, have some natural language for communicating amongst themselves:

The animals that speak them possess them a-borning: they all have them and they are everywhere the same. They are entirely unchanging and make not the slightest progress. Conventional language is characteristic of man alone. That is why man makes progress, for good or ill, and animals do not. That single distinction would seem to be far-reaching [p. 10].

Monboddo brought together many of the increasingly frequent anecdotes and reports on the behavior of apes and primitive cultures in his extraordinary, multivolumed *Of the Origin and*

⁴ In his later days, Herder may have finally succumbed to the power of Sussmilch's arguments.

Progress of Language (cf. Cloyd, 1969, 1972). Unlike his other compatriots who speculated on the origins of language, for example, Adam Smith or James Beattie, Monboddo made what appears to be an unusual effort to base his thinking on first-hand knowledge or reliable reports whenever possible. The orangutans that Monboddo saw in London, along with various romantic accounts of their nature, led Monboddo to suppose that they were of the same species as humans but had not yet progressed enough culturally to have invented language. Orangutans served for Monboddo and Rousseau to exemplify the manner of life for humans in their natural state before the invention of language and subsequent civilization. Language has thus progressively evolved from the languageless apes through the primitive languages of the New World and finally to the highly evolved languages of Europe through the ancestral languages of Latin, Greek, and Sanskrit. In Monboddo's work and to some extent even in Leibniz's a century earlier (see footnote 7 later in the chapter), one can see a conception of language origin and evolution that has certain parallels with the 19th century Darwinian account of human evolution--a scale of language corresponding to the scale of nature. Nearly a century after Monboddo, Haeckel (1896)--known as the originator of the "biogenetic law" and vocal advocate of Darwinism--comments on this relationship:

Ever since Darwin, by the theory of Natural Selection, infused new life in Biology ... attention has been called to the remarkable parallelism, which exists between the evolution of the various human languages and the evolution of organic species ... All philologists ... now unanimously agree that all human languages have developed slowly and by degrees from the simplest rudiments. On the other hand, the strange proposition which till thirty years ago was defended by eminent authorities, that language is a divine gift, is now universally rejected... Such brilliant results have been attained in Comparative Philology that only one who is willfully blind can fail to recognize the natural evolution of language [p. 20].

Despite Haeckel's confident belief in the "natural evolution" of language, enormous problems remained. Linguists increasingly questioned assumptions about the existence of structurally primitive languages just as A. R. Wallace (1870) and various anthropologists doubted the simplicity of supposedly primitive cultures.⁵ At the same time there was little reliable knowledge about the "language" of apes beyond the most romantic anecdotes. The early observational reports of Garner (1896) on the "speech" of apes did little to minimize the obvious

⁵ Wallace's later disagreement with Darwin on the evolution of human capabilities (e.g. Wallace, 1870) arose in part because of Wallace's experiences with some of the so-called primitive cultures. Other critics such as Müller were also offended by the racial implications of certain advocates of Darwinism. Both of these issues are alive today; the question of adaptive differences in human languages is one of the most important problems in the origin of human language. See Hymes (1971).

differences between species, despite Garner's tendency to exaggerate ape-human similarities. Several efforts at teaching chimpanzees articulate speech in the early part of this century proved unsuccessful (e.g. Furness, 1916, Yerkes & Yerkes, 1929) and there seems to have been somewhat of a decline of interest in the entire matter of human-language origins--with some important exceptions, such as DeLaguna, 1927; Jespersen, 1922. At least one reason for this may be reflected in Yerkes (1943) remark that his own early suggestions about setting up a primate research lab at Harvard were rebuffed out of concern that this might be taken as unseemly support for Darwinism.

Recent years have seen an extensive resurgence in the question of language origins. This resurgence is due to diverse forces, including theoretical developments within linguistics, anthropology, evolutionary biology, and, of course, recent studies of gorilla and chimpanzee "language." This includes the important field observations of Schaller (1963), Lawick-Goodall (1968), and others, along with the several highly publicized efforts by behavioral psychologists to train large apes in the use of language-like symbol systems. Although the puzzle of human-language origins holds obvious fascinations for various disciplines from anthropology to zoology, the relevance of these ape-language studies to the solution of the puzzle is far from straightforward.

The universal belief appears to be something to the effect that the study of ape language will somehow establish a "substrate" or base line from which the magnitude of the language gap between *Homo sapiens* and the other large primates might be estimated. The extent of this language gap will determine the degree to which human language is truly a species-specific capacity. Plausible and stimulating as this strategy might be, it incorporates several assumptions about evolution and language that are not above suspicion.

Subsequent Evolution

Everyone recognizes that humans and the large apes are only indirectly related through a common ancestor that presumably existed at least 5 million and maybe closer to 20 million years ago (e.g. Issac, 1978). This means obviously that our contemporary great apes have considerable evolutionary of their own. (Consider that in Darwin's day, a common estimate of the age of the Earth was 6000 years; Darwin himself thought it was certainly far more than Lyell's [1835] publicly cautious 20,000 years--perhaps 20 million years or so). Although most language-origin theorists recognize this divergence, there sometimes is a tacit assumption that this parallel evolution primarily leads to *differences* in behavioral potential and that any similarities reflect characteristics of the putative protoancestor. Under this questionable assumption, looking for ape-human behavioral similarities does make considerable sense in the quest for language origins. For example, Parker and Gibson (1979) write of the evolution of play: "This similarity between great ape and human children in terms of symbolic play suggests, by homology, that

early hominid children displayed symbolic play... [p. 375]. They may well be right about this but it is surely an a priori possibility that these observed similarities, as well as differences, are the product of parallel or convergent evolution within similar evolutionary environments. This point has been made repeatedly since the first edition of the *Origin of Species* and recently for example, Mayr (1963) and Hodos & Campbell (1969). But it deserves reiteration in discussions of language origins because communication systems among highly social species necessarily share a number of physical, biological, and sociological constraints that are relatively independent of genetic similarities. This problem of factoring out the similarities imposed by common ancestry from those imposed by continuing similarities in the raw material of evolution--in this case including the requirements of any communication system--is not a trivial one. Clearly, the two factors are highly confounded; recently diverged species may continue to share environments as well as morphology that directs subsequent parallel evolution. In other words, it strikes me as likely as not that closely related species with relatively long, independent evolutionary histories have undergone considerable parallel or even convergent evolutionary development for similar complex cognitive capacities. Thus, superficially similar behavior among primates such as gestural communication (cf. Hewes, 1973) may just as well reflect the operation of quite different cognitive/neural substrates as not. I return to this later when I suggest that human language almost certainly evolved as a result of the *joint development* of a number of variables--not all of which necessarily evolved in response to direct natural selection.

Direct Selection and Gradualism in Evolution--Overworked?

Perhaps no other idea has had greater scientific and emotional impact than the notion of natural selection jointly put forth by Wallace and Darwin in 1858. Over a century later it remains the cornerstone of biology and much of contemporary psychology. Konrad Lorenz (1965) remarks in a reissue of Darwin's (1872) *The Expression of Emotions in Man and Animals* that:

...When Charles Darwin discovered natural selection, the explanatory principle that was destined to change our outlook on man and the world more than any other before it, he decidedly did not overestimate the number of phenomena that could be explained on its basis. If anything, he erred on the side of understatement ...Modern biologists are much more "Darwinistic" than Darwin, and with reason. We are more insistent in our quest for a definite selection pressure whenever one of nature's more elaborate constructions arouses our curiosity and our demand for a causal explanation. Since the days of Darwin, repeated success has given us great confidence that, whenever one of evolution's more intriguing products provides us with a puzzle, a diligent and circumspect search for specific selection pressure will provide us with a solution...[p. x].

Such confidence in natural selection helps explain the significance many psychologists have attached to the trained ape-language studies. This is reflected, for example, in Passingham's (1979) remarks:

It is puzzling that chimpanzees should have these capacities because, although they can be demonstrated in the laboratory, they do not appear to be used in the wild. Yet evolution could not build into an animal a capacity of which it has no need, because there can be no selection pressure if there is no value for survival...[p. 221].

Passingham goes on to conclude that either chimpanzees do in fact use their language abilities in the wild or that their laboratory-language abilities reflect general abilities of importance also in the wild. If the latter is true, he points out, then perhaps human language also is not the species-specific specialization that some believe it is (e.g. Chomsky, 1972, 1980).

Whatever the origin of the laboratory apes' symbolic capabilities may be, it is worth remembering that there are obvious alternatives to the "no need-no-capacity" doctrine. Perhaps the laboratory environment merely elicits long-latent capacities of one of our hominid ancestors. But this, of course, would send us back into prehistory looking for answers--just what we wish to circumvent by studying the behavior of contemporary apes. Or perhaps these symbolic capabilities are actually "by-products" of some other combination of evolutionary forces. Again, there would be no specific "value for survival" directly associated with the origin of those abilities. And, of course, there is always the possibility of mutation--an inexplicable alteration of genetic material independent of any direct selection pressures.

Although the reality of mutational processes is accepted by everyone, many apparently resist the idea that important evolutionary changes can be brought about abruptly. Instead, they continue to suppose that language evolved gradually in Darwinian fashion, with the selection of successive slight modifications--each modification being profitable in some way to the organism. The optimistic promoters of the laboratory ape-language studies--for example, Linden (1975), Sarles (1974), and Fouts (1974), among others--view these contemporary ape-language studies as reaffirming evolutionary continuity among species and finally breaking down Müller's "one great barrier between the brute and man"--or even better, striking the final blow against Cartesian dualism. Now, whatever the merits of continuous evolution, the laboratory performance of contemporary apes can hardly have any direct implications for that controversy.⁶ It was, ironically, the Darwinian conception and exposition of hierarchical evolution that finally allowed a naturalistic account of evolution without, in fact, supposing that each link in the chain of species was derived from the preceding one. Notice that it was quite reasonable for La Mettrie,

⁶ This is true regardless of the quality of the performance with respect to children. See my brief comments on "chimpanzee simulation" in Limber, 1977. The point is discussed further in Limber (in preparation).

Monboddo, and others in the 18th century to expect some sort of linguistic continuity between apes and humans to the extent that they held onto the Markovian chain of evolution implicit in pre-Darwinian notions of evolution (e.g. Greene, 1959). There was, to be sure, frequent confusion about continuity and "missing links" even after *Origin of Species*; much of this was due to the grossly underestimated time scale with which 19th-century scientists were working, Darwin's own curious preference for gradualism, as well as a total ignorance of genetics. Moreover, as Eiseley (1958) suggests, there was on occasion a tendency for ardent evolutionists in the heat of argument to exaggerate the similarities among primates. Today, however, there is little theoretical reason to demand continuity in behavioral capacities or other phenotypic characteristics across even closely related species (for example, Frazzetta, 1975).

It is therefore, more than a bit puzzling to observe the romantic and uncritical significance attached to the behavioral studies of contemporary apes in regard to language-origin questions. Without overly discounting the importance of these primate studies, I can see no a priori reason to suppose that they promise special or privileged insight into language origins beyond what careful studies of any organism--especially phylogenetically unrelated ones--might reveal about evolutionary processes in similar ecological conditions (for example, Hill, 1974; Marler, 1975).

On the Oversimplification of Human Language

Just as language-origin proposals that oversimplify evolutionary processes are likely to be inadequate, so are those origin proposals that neglect or oversimplify fundamental characteristics of human language. Although it is certain that human language serves multifarious functions, language-origin theories typically single out one or another of these as *the* selective advantage associated with human language. Far less credible are those origin proposals that fail to deal directly with the universal features of human language, including its phonology, syntax, and semantics. Although it is at least conceivable that one particular function of language did in fact, via selection, carry the others along with it as by-products, it is difficult to take seriously any proposal that does not even address the origins of something as fundamental as, say, syntactic structure. The situation in language-origin discussions is reminiscent of the ape-language research in which language behavior is all too often taken primarily as any sort of symbolic activity (Limber, 1977). The fundamental problem for language origin is not the origin of symbolic or semiotic structures, which, as Darwin observed, appeared not to be so different among dogs, monkeys, or very young children. That is a different problem; not trivial, not irrelevant, just different. Instead, the language-origin problem lies in the origins of those largely *conventional* rule systems that map symbolic structures into articulated vocalizations.

Summary and Prospectus

Recent efforts to deal with the origins of human language have tended to oversimplify an admittedly immense problem along several dimensions. We must be more critical about the evolutionary significance of contemporary ape behavior and discard the idea of a unidimensional human language gradually evolving in direct response to some specific selection pressures. One can, I think, entertain the following propositions about the evolution of language with clear scientific conscience:

1. It is important to distinguish those selective pressures or other evolutionary events that set the stage for language from those that served to maintain or "reinforce" the use of language once it appeared in the human repertoire.⁷ Of course, there is a certain arbitrariness here; for example, I see the problem of language origin beginning just where Parker and Gibson's (1979) thoughtful analysis leaves off. Moreover, because each of the diverse evolutionary developments leading to language essentially can feed back into the process, it becomes increasingly difficult in distinguishing the preadaptations from the adaptations. For example, questions about evolutionary relationships between cognition and language can become hopelessly confounded, just as Darwin foresaw in the passage cited earlier from *Descent* (1871/1955).

2. Any complex evolutionary development like language, which requires the assembly and organization of various morphological and behavioral "raw materials" before it can manifest itself, can hardly avoid appearing as a saltatory development or discontinuity when contrasted with ancestral phenotypic features, Darwin's assumption that *natura non facit saltum* was necessary, as his friend and supporter T. H. Huxley argued in the 19th century; it is unnecessary today.

3. If human-language origin involved a substantial element of cultural evolution, as La Mettrie, Rousseau, and others have envisioned, then any narrow biological explanation will be inadequate. There is, however, no reason to assume that cultural and biological approaches to language origin are incompatible. Indeed the distinction between biological necessity and historical accident dissolves in evolutionary contexts.

4. We do not lack evolutionary devices adequate to model language origins; instead we lack firm knowledge about the nature of human language. Thus the real missing links in our understanding of human-language origin lie in the ontogenetic functioning and phylogenetic

⁷ There is a well-known parallel between evolutionist applications of natural selection and behaviorists' application of reinforcement. They also share a common problem in accounting for the origins--phylogenetic for Darwinians, ontogenetic for behaviorists--of behaviors that are selected and reinforced. Behaviorists today are increasingly looking to evolutionary processes to provide "biological constraints" (e.g. Seligman, 1970) in order to save learning theory from oblivion. Even though the individual organism operates within a framework of millions of seconds, the species life span is on the order of millions of years. C. S. Peirce saw all of this clearly a century ago; in either the phylogenetic or ontogenetic case, one must be concerned about the species'/organisms' initial behavioral repertoire--Peirce's abductive process. That, of course, is the problem for this chapter; I return to this issue at its conclusion.

development of syntactic and phonological processes. Origin proposals that do not address these aspects of language surely cannot hope to bridge the language gap among primates.

LANGUAGE ORIGINS: PROBLEMS, EVIDENCE, AND SPECULATION

Underlying the recent renaissance of interest in human-language origins has been an enormous explosion of knowledge within biology, natural history, and linguistics--far beyond the dreams of any 18th-century write on the topic. It does not, however, appear to me that contemporary conceptualizations and analyses of the problem of language origin have kept pace with the increase in factual knowledge. For example, the recent very informative collection of papers edited by Harnad et al. (1976) has little more to say about the origins of syntax than do the essays of La Mettrie, Rousseau, and Monboddo. Most of the papers do not even raise the issue. Yet, it is syntactic/phonological encoding that is perhaps the most obvious element in the language gap among primates.

Human language is nearly unique on another dimension--its social/cultural nature, which Rousseau characterized as "conventional" in contrast to the "entirely unchanging" biologically fixed nature of most animal languages. Contemporary writers on language origin have had much to say about this, discussing the probable importance of such factors as cultural artifacts, socialization variables, the human family environment, and prolonged immaturity for the origin of language. Nevertheless, when one notes that most of these factors had been considered important throughout the 18th and 19th centuries, it is surprising that so few explicitly confront the primary problem of language origin: How did the rule governed, "conventional" open-symbol system we know as human language come to exist among a *population* that presumably had no comparable system beforehand?

In the remainder of the chapter, I explore a bit more these two very important subproblems in the origin of language: the origin of syntax and the "conventional" nature of language. Ultimately, of course, any adequate origin theory must explain how all of the many preadaptations recruited to compose human language might have evolved in a species without language. Next, it must show how these elements came to function together as a unit as language itself.

Social-Cultural Foundations of Language

Much of the current speculation about the origin of language has a distinct biological flavor to it, citing parallels to animal communication systems and emphasizing the adaptive significance of human language in transmitting information (e.g. Kimura, 1979; Savage-Rumbaugh, Rumbaugh, & Boysen, 1978). Darwin's own ideas were not so different from his and, indeed, no one is likely to want to dispute the relevance of this particular biological perspective to the origin problem. Nevertheless, such contemporary views of human language tend to slight equally important and traditional conception of language as a human invention--a cultural artifact--that is itself transmitted with variation and a degree of progressive development from generation to generation without the necessity of concomitant biological development. From this perspective--quite similar to the 18th century ones mentioned earlier--any explanation of language origin must include an account of the requisite preadaptations enabling the transmission of language across generations, along with some explanation of how it all got started, ultimately reaching the levels of complexity we observe today.

The obvious suggestion, then, is to look for preadaptations supporting the transmission of information or "acquired habits" from one generation to the next. Mechanisms that could mediate rule-governed or conventional behavior would be particularly interesting in this connection. Put another way, we might look for an explanation of language origin within the matrix of animal social-cultural (SC) mechanisms. The adaptive advantages of information transfer and accumulation across generations has long been recognized--mostly explicitly perhaps in the discredited Lamarckian notion of "inherited habits." So compelling were the adaptive advantages of "inherited habits" that awareness of those advantages in itself served to sustain a degree of belief in Lamarckism despite the lack of any substantial theoretical or empirical support.⁸

Although Lamarckism is dead today, biologists and psychologists such as Baldwin (1902) have long noted how SC mechanisms act in a functionally equivalent manner, transmitting information from one generation to the next. They differ obviously in that SC transmission bypasses any direct intervention or modification of the genes. Potentially important advantages exist for any species utilizing SC mechanisms. Qualitatively, there may be kinds of information that vary so much from time to time, individual to individual, that genetic encoding would be impractical or, even if possible, maladaptive. Quantitatively, the amount of

⁸ Consider, for example, J. B. Watson's (1923) reaction to the claims of the neo-Lamarckian biologist Paul Kammerer (1880-1924), of midwife-toad notoriety (cited in Koestler, 1971): "We all want to believe his facts if they are true. It means so much to the educator, to society in general, if they are true [p. 73]." Kammerer took his life in Vienna the following year, just as he was to take up a chair in genetics at Pavlov's Institute in Moscow. The interest in Lamarckism has not been limited to behaviorists (cf. Skinner, 1971) and socialists. Piaget, who was a contemporary of Kammerer, also had a deep interest in the matter that is unusual in that his early work on adaptation in pond snails led him to look for a Lamarckian mechanism whereby environmental conditions are able to act directly on the genes. (See Waddington's [1975] discussion.) Much of James Baldwin's (1902) work was addressed to finding a viable alternative to Lamarckism.

information potentially available to an individual with SC mechanisms far exceeds that available through the genes. If seen as an external memory device with great capacity, SC mechanisms considerably extend the computational power of even moderately complex brains. In order to attain these advantages, evolution has come up with a number more or less similar means of circumventing the disadvantages of genetic transmission of information, the most interesting being those underlying what psychologists generally put under the heading of socialization of social learning.

Both of these concepts imply a communication system that enables information flow between individuals, typically without explicit encoding. Socialization refers to intergenerational communication--from parents to offspring--of appropriate values, attitudes, and behaviors. Social learning is generally used to refer to a much less restrictive process in terms of information, directionality, and participants. It is impossible here to go much into many subtleties and refinements distinguishing among these concepts and related notions such as imprinting, social facilitation, imitation, identification, and observational learning. What is worthwhile, however, is to speculate on how any SC-communication system might serve as a preadaptation for human language, and where possible to indicate what evidence might support these analogies.

Implicit Communication. SC processes reflect a capacity of the organism to make more or less rapidly converging generalizations about appropriate behavior from example behavior exhibited by others of its species.⁹ In most cases, the role of explicit tutelage is minimal. The prerequisites for any inductive processes include a perceptual cognitive vocabulary for expressing possible generalizations, along with a means of selecting and evaluating specific hypotheses (for example, Fodor, 1975; Limber 1977). Rapid accumulation of information--learning--may result from several quite different circumstances. For example, it may be difficult to distinguish between efficient induction based on a genetically limited range of initial hypotheses from that based on utilization of affective or motivational mechanisms that serve to direct attention to "good" exemplars of the behavior to be acquired, with a less restrictive initial state.

At this functional level of analysis, there are obvious parallels between human-language acquisition and a host of animal capacities from the acquisition of bird-song dialects to extensive observational learning capacities in primates (for example, Marler, 1975; Beck, 1974; Bonner, 1980; Beck, 1974; Hall, 1963; McGrew, 1977; Money & Ehrhardt, 1972). In each case there exists the capacity for transmitting information--whether complex tradition or simple food-

⁹ The notion of "species" itself must be in part a social-cultural phenomenon rather than strictly a biological one insofar as the tendency for species to vary infinitely is limited in many birds and mammals by the operation of SC processes in early development, as suggested, for example, by the work of Lorenz, Harlow, and many others. Baldwin (1902) saw this very clearly in his elaboration on "psychophysical variations."

gathering ritual--primarily through analysis of exemplars.¹⁰ There is, of course, no implication here that identical information-processing capacities necessarily underlie such disparate abilities. Each species will naturally have its own specific constraints having to do with its own perceptual-cognitive vocabulary, attentional devices, inductive power, and so forth. The major point to be made is that anyone interested in the origins of human language ought to redirect his or her attention from a narrow focus on explicit animal-communication systems to the much more complex implicit communication processes underlying SC mechanisms. Recently Jerison (1976), as did Rousseau some 200 years before, questioned the idea that human language evolved in response to a need for improved communication:

The evolution of an elaborate communication system in early hominids should have been an elaboration of such systems to be consistent with primate or other mammalian patterns. The most probable picture that an evolutionist should draw... would be one in which a rigidly fixed language was fairly completely genetically encoded. We would all then "speak" the same language... [p. 377-378].

For whatever reasons, Max Müller was on the right track when he argued that no amount of natural selection could distill human language from the cries of beasts.

Convention and biology. Rousseau's remark that human language is "conventional" was neither novel nor without controversy. The ancients, Epicurus and Lucretius, among others, had long debated to what extent language was either "natural" or "conventional" (e.g. Stam, 1976). In Rousseau's time, the matter was seen as part of the more general questions raised about human nature itself in the social-political philosophies of Hobbes, Locke, Hume, and others. Although not everyone devoted efforts specifically towards the origin of language, there was extensive consideration of the origins of conventional social behavior--including human language--in connection with the foundations of government, justice, property, and economics.

Despite its importance in the history of language-origin theories, the conventionalist view of language origin has been largely ignored in the recent enthusiasm for "natural" or biological and evolutionary approaches to the problem. This neglect stems from the overemphasis on explicit animal communication and the ape-language studies discussed earlier; it also reflects severe criticism of the conventionalist conception of language itself (e.g. Alston, 1964; Quine, 1961). Bertrand Russell's (1921) skepticism about conventionalism is obvious: "We can hardly

¹⁰ By "analysis" I simply wanted to indicate that more than mere exposure to a behavior may be necessary; for example, a certain amount of trial and error still may be required on the part of the organism to converge on the "target" behavior. The effect of the SC information, like that of genetic information, is to short-circuit the trial-and-error process by providing a "trial" (i.e. hypothesis) that has a relatively high *a priori* chance of success. This is the essence of Peirce's abduction.

suppose a parliament of hitherto speechless elders meeting together and agreeing to call a cow a cow and a wolf a wolf [p. 190]." More recently, Alston (1964) argued:

By the nature of the case, making agreements and conventions presupposes that people already have a language in which to carry on these activities. No one knows how language originated, but at least we can be certain that it was in no such way as this [p. 57].

Although the point of the critics is clear, it is hardly so compelling that anyone should drop the conventionalist line of inquiry into language origins. In his 1969 work on *Conventions*, Lewis takes up these and other criticisms of conventionalism. Against Alston's point, for example, he (Lewis, 1969) replies:

an agreement sufficient to create a convention need not be a transaction involving language or any other conventional activity. All it takes is an exchange of manifestations of a propensity to conform to a regularity. These manifestations might simply be displays of conforming action in various appropriate situations, done during a face-to-face meeting in order to create a convention. [p. 88].

At the very least, Lewis' extensive analysis of conventions, along with those of Bennett (1976) and Grice (1969), particularly language conventions, ought to convince anyone that it would be shortsighted indeed to foreclose upon any conventionalist theory of language origin. Nor should it surprise anyone to find analogies in animal behavior to Lewis' "exchange of manifestation." The comparative psychology and ethology literature is just teeming with examples and discussions of behavior involving ritual (e.g. Huxley, 1966; Lorenz, 1966), observational learning (e.g. Hall, 1963), or conventionalized behavior itself (e.g. Maynard Smith, 1978). The recent discussions of conventionalized behavior in animal "contests" by Maynard Smith and others (e.g. Dawkins & Krebs, 1978) are particularly striking in their parallels to Lewis' work, coming as they do out of a totally different background yet drawing--as does Lewis--upon the formalisms of game theory.

Game theory provides a means of expressing the outcomes or "pay offs" of an individual's actions when these are determined jointly by the actions of all the agents of some situation. It is the essence of conventional behavior that the impact or "pay off" of an individual act--for example, threat display or utterance--is determined by its meaning within the symbolic system held by the *population*. The problem for any language-origin theory, as well as any evolutionary theory of animal conventions, is to explain how natural selection--presumably operating upon individuals--promotes a system of convention held in common by an entire population.

That this quasi economic perspective on evolutionary biology (Maynard Smith, 1978) should find common ground with language-origin theories would come as no surprise to Adam Smith (1761/1967) and many of his contemporaries.¹¹ Nevertheless, there is little immediate danger that the major questions of human-language origin will find answers soon in studies of crabs, butterflies, and the hosts of species apparently exhibiting some sort of conventional behavior. The origin of even the simplest conventional behavior is not obvious. Yet, the parallels between human language and some of these animal conventions are intriguing; they surely demonstrate that the conventionalistic view of language origin need not be contradictory or in any way at odds with a "natural" or biological origin theory. This was clear to Baldwin (1902), whose "Baldwin effect" essentially explains how ontogenetic "software" can become phylogenetically "hardwired." Although many puzzling questions remain on every facet of the issue, the existence of conventional behavior in numerous unrelated species offers some promise that specific evolutionary principles governing the origins of conventions may be found.

Language and the Family Buffon and others of the 18th century speculated that the origin of human language was to be found in the evolution of the human family. Evidence accumulating over the past few hundred years has only served to make that idea even more plausible. Most of this centers about the implications of human socialization processes for language origin. Julian Jaynes (1976) and others (for example, Erikson, 1966) have discussed much of this recently and it is unnecessary to review these ideas extensively here. The relevant factors include "pairbonding"--the establishment of relatively permanent mates, the subsequent increased protection offered the offspring, which in turns permits an increased period of immaturity--neoteny (Gould, 1977; Lorenz, 1971)--with a correspondingly prolonged learning period, an intimate emotional relationship, and in general greater parental investment in each offspring associated with *K* reproductive strategies (Pianka, 1970). Any and all of these can be expected to promote development of SC mechanisms suitable as language preadaptations.

The scenario for the evolution of language in such an environment might go something like this: Pairbonding itself facilitates the development of conventional behavior, including the many tacit, shared associations any intimate and lengthy relationship acquires. The extent of conventional symbol use may be just a function of shared time, but qualitative changes in the structure of the system come about as the offspring form their own unique generalizations capturing the changing system of parents. This would be comparable to the process of "restructuring" or "reanalysis" underlying linguistic change (Halle, 1962; Kiparsky, 1976) and

¹¹ Nor would Dawkins and Krebs' (1978) manipulative and cynical view of communication come as news to Bernard de Mandville (1714, cited in Stam, 1976) a supporter of Hobbes: "I am of the opinion that the first design of speech was to persuade others or else to act or suffer such things, as he would compel them to act or suffer, if they were entirely in his Power [p. 124.]"

a primitive form of the "overgeneralization" phenomena seen in language acquisition (e.g. Slobin, 1979). Each offspring's reanalysis depends not only on its inductive equipment as discussed earlier, but also crucially upon the available data (parents' symbol system) and the time span over which the individual may collect and analyze that data (offspring's period of immaturity). Changes in any one of these three would readily effect changes in the familial language. For example, just as encephalization (e.g. Jerison, 1976) can provide increased computational power through internal memory expansion, the growing "cultural memory" of the family provides an expanding data base without concomitant biological evolution.

It takes only a little imagination to see that this situation could lead to an explosive acceleration in the development of language with only a minimum of biological restructuring, perhaps only in regulatory growth mechanisms (Goldschmidt, 1940; Gould, 1977) and in the CNS "inductive templates," or whatever, resulting from selection for early acquisition of the familial language. I see no point in speculating on just how rapidly this synergistic system might evolve, but if the changes in language that have occurred during the brief years of recorded history are any indications, development may proceed quickly indeed.¹² Jaynes (1976) was widely criticized in the discussion of his paper (Harnad et al, 1976) for suggesting that language may have originated only some 50,000 years ago. Those critics may be quite right about this. However, I cannot but wonder if that criticism was merely reflecting their doubt that the human biological under-pinnings sufficient for the origin of language as we know it could have advanced so far in such a short evolutionary time period. Yet, the heart of the conventionalist view of language origin is that there are no sufficient biological conditions for the beginnings of language. Indeed, on this scenario it is conceivable that something like Chomsky's (1965) biological "language faculty" has been structured in part by cultural artifact through a process of genetic assimilation (Baldwin, 1902; Waddington, 1975), that is, a genetic encoding or hardwiring of adaptive "inductive templates" or whatever.

Causes and conventions. Undeniably difficult questions remain to be addressed in connection with the evolution of conventional behavior of all sorts; even the concept of "convention" remains in doubt itself. For much of this century, biological analyses of language and language origin were seen as antithetical to conventionalism. Darwin himself remarked that surely language was not art whereas behavioristic psychologists and linguists believed that human language with its apparent infinite cultural variation could bear only the most indirect

¹² It is, of course, an important yet unresolved question to what extent any of these changes should be seen as progressive or even directional. Linguists interested in origins, such as Jespersen (1922) and Swadesh (1971), have worked on the problem but aside from analyses of lexical development, I am not aware of anything as interesting as, say, a diachronic comparative analysis of complex nominalizations of the sort that Keenan (1976) has been working on synchronically. However Sankoff and Brown's (1976) discussion of Tok Pisin relative clauses is quite intriguing in connection with my speculative remarks on speech production and syntax.

relationship to the human nervous system. Furthermore, explicitly biological explanations still suggest to many social scientists undesirable limitations or constraints on human potential. Many have an intuitive notion of convention that implies a freedom from causal constraints that was incompatible with genetic or innate accounts of language. Consider, for example, the anthropologist Kroeber's peculiar (1952) reaction to Von Frisch's then recent bee-"language" discoveries:

If we knew that bees individually acquired this system of direction indications from one another by learning, I believe that even the most isolationist linguists would accept the communication as constituting part of a symbolic or true language. We have no evidence whatever that this is so [pp. 755-756].

Kroeber seems somewhat perplexed here to find the very real possibility of symbolic language coupled with what was in all likelihood a system transmitted entirely via genetic pathways. Language, in those days when relativism and behaviorism were still running wild, was nearly synonymous with convention. Yet, what could be conventional about behavior that is genetically predetermined and therefore presumably fixed or inviolate?

The answer will be found in appropriately revising and sharpening our notions of convention as well as maintaining a sufficiently complex conception of causal constraints upon behavior. The causal issue and related matters are often raised in analyses of complex behavior (e.g. Bennett, 1964; Chomsky, 1980; Dennett, 1978). It is important to remember that at least two quite different sorts of causes may underlie aspects of an organism's behavior. One may explain the organism's failure to fly with a straightforward analysis of its physical characteristics, reading its aerodynamic inadequacies directly off of its physical structures. In contrast, other aspects of its behavior--say its failure to attack one of its own species in certain circumstances--may have no such straightforward physical explanation. For example, we may know that it routinely attacks under other circumstances and thus is not physically incapable--in the usual sense--of the required actions. Unlike its failure to fly, this failure to attack cannot be read off the organism's physical structure, relying exclusively upon principles of mechanics or biochemistry. It is just these cases that are typically characterized as "conventional" or "intentional" or "rule-governed" behavior not because there are no physical states determining that behavior, but because those states only make sense to us when interpreted or decoded functionally in terms of behavior. These states are important because of what they represent. No laws of physics or biochemistry by themselves are likely to tell us this. There are, therefore, physical states causally effective in determining behavior whose effects are manifested in quite different ways--in some cases directly in terms of physical principles and in others remotely mediated through the organism's information-processing mechanisms.

Human-speech production offers a rich array of examples of behavior constrained

simultaneously by physical principles (directly) and by rule (remotely). The relationship between these two is quite close indeed and naïve speakers often incorrectly believe that their inability to articulate phones of another language is a physical inability. The importance of the rule-governed or representational controls on articulation become obvious when individuals with damaged vocal tracts are examined; such individuals often find remarkable alternative physical means to carry out the intended articulation. I have discussed the general issue of vocal tract deficits in humans and other primates elsewhere (Limber, 1977). For now, it suffices to reiterate the point that in speech as well as other socially important behaviors it is the representational constraints on behavior that --within limits--are the most interesting to us. The evolution of such representational controls on vocalization is precisely the sort of adaptation required for the cultural transmission of complex "vocal habits." Apes, noted for their mimicking ability, have failed to develop the cortical representations necessary for vocal mimicry--a prerequisite for human language (e.g. Andrew, 1976; Jurgens, 1979; Kellogg, 1968).

It seems fair, then, to say that conventional behavior is, in part, behavior that is the product of physical states--call them conventional states--that govern behavior in representational fashion rather than directly. Returning to Kroeber's concern about bee language, there remains the matter of the origin and modifiability of those states. Kroeber is, I believe, reflecting another common yet unnecessary element in the traditional conventionalism--namely, that conventional states themselves must be acquired individually from one's culture and to a certain extent are modifiable by the individual--say, in a decision not to conform. Like the objections that conventions presuppose language, none of these points strike me as any impediment to the suggestions made here. There seems no reason to deny convention status to those conventional states even programmed entirely via the genes as long as they remain representational and had their origin phylogenetically as "frozen" conventions through some Lamarckian analogue like the Baldwin effect or other versions of genetic assimilation (Waddington, 1975). Whether or not such states are individually modifiable or under any sort of voluntary or intentional control would depend on subsequent evolutionary developments. Certainly the cognitive advances necessary to achieve some degree of intentionality may have been important for the origin of human language (Bennett, 1976, Terrace & Bever, 1976)--say, in the utilization of conventional behavior. Nevertheless, this should not lead anyone to assume that the presence of conventional behavior itself in any species necessarily implies anything about intentionality, voluntary control, or related issues. Many conceptual and empirical questions about the phylogenetic and ontogenetic origins of conventional behavior, of even the most elementary form, still remain to be asked.

ON THE ORIGIN OF SYNTAX

Syntax is the most distinctive aspect of human language; yet it probably has been the most ignored. As I have suggested elsewhere, this derives primarily from a preoccupation with the "naming paradigm" of language, along with a curious long-standing bias against any kind of unconscious psychological process (Limber, 1976a; 1977). It is, therefore, to be expected that very little attention has been given to the origin of syntax. The only recent discussions even marginally relevant are those pointing out some interesting parallels between language and the structure of other skilled actions (e.g. Kimura, 1979; Reynolds, 1976). Lieberman (1976) in particular aptly stresses the importance of automatized behavior in the development of speech production and perception.

Vague as all this is, it does fit well with the suggestion that an important element in language origin lies in those socialization mechanisms that convey tacit rules of behavior from one generation to the next. These rules, dealing with everything from styles of walking, singing, and dancing, to gender-role behavior, are primarily expressed in, and acquired from, unconsciously performed actions. The acquisition of these rules requires at a minimum an inductive device that abstracts in resonance, so to speak, from observed actions in order to recreate those actions appropriately within the observer's own body.

The Functions of Syntax

These discussions as well as others for example, Geschwind, (1965) relating acting action and syntax are not at all specific. Notably lacking is explicit consideration of the function of syntax. As a result, there has been correspondingly very little in the way of speculation on the adaptive advantages a syntactic language might have, for instance, over a finite, nonprojective naming-paradigm language. We need, therefore, to develop some ideas about how syntax functions within human language and ultimately how natural selection might have come to develop those functions.

Let me begin by presenting a brief outline of syntactic development in an individual child. I do not attempt to defend these views here, but they have emerged out of my own work on acquisition and sentence processing (e.g. Limber, 1971; 1973; 1976a; 1976b) and are not, as far as I know, incompatible with any relevant data--although there are surely other ways of interpreting some of the same evidence. A major theme of this analysis is that there are two communication systems that develop somewhat independently, one cognitive and the other linguistic. The cognitive system is universal, as reflected both in the sensorimotor activities of the first two years but, most importantly for our purposes, in the child's nonlinguistic communication. As Descartes (1637/1960) long ago observed and recently Goldin-Meadow (1978) has documented, even deaf children without conventional linguistic input usually invent for themselves some signs by which they make themselves understood.

Language gradually becomes integrated with these cognitive structures, at first in naming-paradigm fashion, where individual "cognitions" are associated with individual linguistic expressions. This *presyntactic* period typically is observed between about 12 and 24 months of age; and (cf. Limber, 1977) is perhaps comparable to the level of language accomplishment in some of the ape-language studies. Recently, Parker and Gibson (1979) have proposed that the common hominid ancestor of apes and humans had a language capacity similar to that in 2-year-old infants today. They suggest further that this was reflected primarily in a gestural rather than vocal modality, and that vocalized language was a subsequent evolutionary development. All this--studies of hearing and deaf children, contemporary ape-language studies, and historical reconstruction--is consistent with the notion that large primates including humans share an old, genetically and cognitively structured nonlinguistic communication system that is reflected primarily in gestures and relatively unstructured vocalizations. Syntax, I suspect, evolved out of this system in concert with increasing reliance upon the auditory/vocal input-output channels. Vocalization would thus be more than just an incidental evolutionary development; it is an essential part of the complex matrix from which human language emerged.

Syntactic language emerges towards the end of the second year as the child begins to display the products of the analysis (or reanalysis) of his or her collection of cognition-utterance pairs. This analysis results in a recursive characterization of that limited finite set. It is this recursive reanalysis that underlies the creative or projective potential of human language. The child's task now is essentially one of code breaking--that is, of finding general rules for assigning appropriate meanings to the recursively enumerable set of possible utterances. There are numerous extraordinarily complex questions about the relation between sentences and their meanings for which I have no answers here. One point seems reasonably certain, however: The child must obtain meanings for at least some utterances nonlinguistically--that is, cognitively--in order to extract the rules that generally relate utterances to their meanings--much as the interpretable Greek passage on the Rosetta stone led to the solving of the mystery of Egyptian hieroglyphics.

Some of the child's primary evidence about meanings comes from the nonlinguistically derived interpretations of the naming-paradigm period, perhaps acquired in a fashion not unlike that suggested in mediational accounts of meaning (e.g. Osgood, 1953). The so-called "semantic strategies" widely discussed in developmental psycholinguistics (e.g. Cromer, 1980; Slobin, 1979) are even more sophisticated nonlinguistic means by which children can get reasonably valid glosses for utterances they are yet unable to interpret syntactically.

Thus, two quite different modes of interpreting utterances exist side by side, a cognitive system and a syntactic system. The cognitive system offers a partially valid means of interpreting utterances--particularly those that are highly constrained by perceptual salience and immediate context. On its own, this system may be an adequate communication system for our ancestral hominids, contemporary chimps, and prelinguistic infants. Its effectiveness has led

Rousseau, Jerison, and others to discount a need for communication as a motivation for the evolution of human language. This cognitive system was, I believe, not only a necessary preadaptation during the evolution of language, but remains a necessary component in the ontogeny of language acquisition.

The syntactic system, in marked contrast, guarantees appropriate interpretations, to a point, by rule--particularly important in representing abstractions or any topics out of the immediate context. Similarly, the syntactic system facilitates consideration and communication of improbable events or very unlikely relationships among associated concepts--for example, *The ball kicked the boy*, which may baffle the cognitive system. Elsewhere, I have examined (Limber, 1972a) the example of *The player kicked the ball kicked him*, in which the syntactic cues are so reduced and ambiguous that cognitive interference typically precludes an appropriate interpretation of that sentence. The availability of this dual interpretation system, with its generally correlated output, creates difficulties for experimental investigations of language development much as the availability of perceptual-estimation strategies confound studies of physical conservation in the Piagetian tradition.¹³

The adaptive advantages of a syntactic communication system over a cognitive one are significant, although possibly not as important in the early stages of culture as later. There are probably even greater advantages for a species' having syntactic language in the realm of cognitive abilities in connection with reasoning, creativity, and so forth. Unfortunately, all of these putative advantages of syntax only suggest how natural selection might acceleratively "reinforce" syntax once it had the opportunity. But, as always, the toughest problem is coming up with a credible account for the origin of the "hypothesis" of syntax. Where did it come from?

The trick here, as in any effort to explain the evolution of a complex organism, is to minimize the reliance upon mutation by seeking as many independently motivated stable evolutionary stages as possible. These stages serve individually or collectively then, as a preadaptation for the next until the revolutionary objectives are attained. This seems nothing more than taking Darwinian gradualism as a research strategy rather than as a necessity of evolutionary theory. Let me reiterate that there is no reason to doubt the potential efficacy of mutation in the evolution of language; it is just impossible to say very much interesting about it. In fact, it now appears that there is even more variation within genetic structures than believed just a few years ago; genetic variation itself is an extraordinarily adaptive evolutionary development. Moreover, even the traditional objections against mutation strike me as particularly weak in connection with language evolution (Frazzetta, 1975). Mutations involving

¹³ Periodically, one hears claims of children found to "conserve" earlier than expected. Typically, such studies have failed to control for reliance on perceptual cues rather than on the required "logical necessity" (Limber & Chiseri, 1974). I suggest that frequent claims about children's comprehending utterances before they produce them may be similarly misleading, given the extreme difficulty in completely decorrelating the cognitive and syntactic systems as has been done in the reversible passive paradigm.

the central nervous system's mental functioning have a greater chance to be viable than those forced to articulate directly with biomechanical and social structures of the species. Imagine increasing cortical mass by evolving two heads rather than encephalization! Those mutations dealing with representational or computational structures or "inductive templates" underlying the kind of genetic assimilation discussed earlier may have virtually no interactions with other aspects of the organism other than to speed up acquisition in the individual by building in the neural circuitry that shows up in linguistic theory as language universals. Language, when compared with walking, for example, would seem only a relatively minor evolutionary problem. Nevertheless, whatever the possibilities are for mutation, I still think it is reasonable to look further for the origins of syntax.

At the moment the best chance of locating the origin of syntax appears to be somewhat in the interaction of human cognitive structure with the constraints imposed on communication via the human auditory/vocal channels. Cognitive structure, whatever else it is, has generally been conceived of as hierarchical in structure. Lashley (1951) for example, directly compared the organization of the nervous system with language structure; more recently Simon (1962), Arbib (1971), and Grossberg (1980) have discussed biological and evolutionary advantages associated with hierarchical organization and distributed processing. The auditory/vocal channels in sharp contrast are very much sequential and time dependent. How can an organism communicate hierarchically organized messages, reflecting the structure of their origin, across an auditory/vocal channel?

There are only two ways to do this. If the message is finite, then one might just establish as a convention within the population an arbitrary simple sequence of articulated sounds as the code for that message, however complex the structure of the message itself. This is clearly an effective and efficient system, particularly for important complex messages--a system adopted by most animal species and Western Union as well. On the other hand, if the message set is infinite or even fairly large, this obviously will not do. Instead, the organism must somehow evolve a combinatorial encoding system that conventionally conveys the hierarchical structure of every message within the temporarily ordered sequential structure of the input-output channel, and at the same time remains within the overall information-processing constraints of the organism.

Syntax provides one such combinatorial coding system, employing articulated syllables as the code "units." Of course, one of the intrinsic features of human language is that both of the just-described techniques are used. Thus, although a syntactic structure must quite directly reflect its message structure in code, arbitrarily assigned morphemes generally do not. Because of this obvious potential trade off between lexical and syntactical structure, there is little chance of finding any interesting correlations between cognitive structure and linguistic structure. One can express the most complex messages with the simplest linguistic structures if enough message structure is packed into the individual morphemes. Within limits, then, cognitive complexity bears relatively little relationship to syntactic complexity. Syntax is constrained much more by

the input-output requirements of the system than what is talked about using syntax. This presumably is just what Lenneberg (1967) and others have in mind when they say that human language does not reflect individual differences in intellect. These differences are reflected in lexical development rather than syntactic structure.¹⁴

It is certainly fair at this point to ask if there is actually any evidence supporting the idea that syntax had its origins somehow in the human auditory/vocal channels. The idea that language itself had its origins in vocalization has been a recurring one; the full title of Rousseau's essay is "Essay on the Origin of Languages Which Treats of Melody and Musical Imitation." Max Müller's sarcastically titled "bow-wow," "pooh-pooh," and "yo-ho-ho" theories in various ways relate language origin to vocalization. There is nothing much, however, in any of this beyond vague speculation.

Even without syntax, the adaptive advantages of vocalization over gestural communication can be significant (e.g. Marler, 1975; Parker & Gibson, 1979).¹⁵

Vocalization can capture attention in the dark or brush, and while visual attention is engaged elsewhere. Moreover, it frees the limbs for other activities while replacing a less energy-efficient modality with a more efficient modality both in terms of energy expenditure and, in certain respects (Grosjean, 1977), communication efficiency (bits per minute). Perhaps even more important in setting the stage for syntactic evolution, the vocal/auditory channels strip away many of the possibilities of using iconic representational schemes for messages, thereby forcing the organisms into seeking alternative encoding strategies that are more purely symbolic and depend much more on temporal rather than spatial structure. Vocalization thus might have served to phylogenetically develop those cortical areas in *Homo sapiens* implicated in temporal sequencing and voluntary fine control of the articulators, functions apparently quite undeveloped in other primates (e.g. Campbell, 1974; Kimura, 1979; Limber, 1977; Woodrow, 1929). The information-carrying potential of a vocal-communication system sending three or four syllables a second, in which each syllable is drawn from a set of 10^2 to over 10^3 alternatives, is far beyond what most of us have any use for.

No one will be surprised to find that my sketch of the origin of language blurs right at the juncture of evolving syntax itself within the context of the auditory/vocal channel. It is not that we lack evolutionary devices sufficient to model the origins of syntax; it is that we lack sufficient firm knowledge of speech perception and production to know what to model. Rather than

¹⁴ There are some important conventional relationships between cognitive structure and syntax that do deserve attention in connection with both language origin and acquisition. This is what Slobin (1979) refers to as the "mapping problem." Also, see my remarks (Limber, 1973) on the development of "promise" constructions.

¹⁵ Of course, vocalization can also be disadvantageous. The vocal behavior of the young and adult chimpanzee contrasts notably with that of young and adult humans in that young chimps are quiet whereas adults are noisy. Almost the reverse situation obtains for humans. This is another illustration of the difficulty in using chimpanzee behavior as a kind of "base line" in order to estimate the language gap, as discussed previously.

engaging in continued unbounded speculation, I conclude this chapter by forecasting those interdependent aspects of language that strike me as most promising to any future inquiries into the origin of syntax.

Acoustic and Articulatory Structures

We know that human auditory perception, and probably that of all species, is highly structured in terms of acoustic, nonlinguistic parameters (e.g. Bregman, 1978; Kuhl, 1979). We also know that young infants are very sensitive to the rhythms of speech and it is a good bet that a child's initial organization and segmentation of the speech stream is based on purely nonlinguistic acoustic parsing of the signal (Limber, 1973). In other words, a primitive syntactic function is attained directly through acoustic processes. This would surely not be the first time that anyone has suggested that language ontogeny might tell us something about phylogenetic origins (Lamendalla, 1976).

More significantly, syntax in mature speech serves a similar although far more abstract organizational and segmental function that serves to organize cognitive structures into packages or "chunks" that must be compatible with articulatory-acoustic processes and related short-term memory capacities. Hence, it is probably not a coincidence that syntactic structures bear close relationships with phonological structures, particularly suprasegmentals that function in organizing both speech input and output (Boomer, 1965; Chomsky & Halle, 1968; Lehiste, 1970). The result is "packages" of simple clauses--for example, *The cat is on the mat.*--containing six or seven syllables with a duration of 1 to 2 seconds. These are clearly appropriate parameters for any language interacting with human memory; it is the constancy of these parameters that reflects in another way the relative independence of cognitive structure and linguistic structure. Further language-origin inquiries should pay close attention to the role of syntax in perception and memory of speech. At the very least, syntax must have evolved within universal perceptual and production constraints existent long before human language itself.

Syntactic Complexity

During the initial naming-paradigm stage of language acquisition, both the interpretation of the utterance and the perception of the utterance are largely accomplished by nonlinguistic means in that cognitive strategies supply the meaning whereas acoustic parsing isolates the relevant segment. This is just to say that in this primitive language, the functions of syntax are directly accomplished by auditory/articulatory mechanisms. In the simplest complex sentences, two clauses or clause fragments are sequentially conjoined and may fall under one or two intonation contours according to length and, later, syntactic type. In any event, the syntactic packaging of these utterances produces perceptual packages that not only satisfy input-output, the

requirements indicated earlier, but also packages that are semantically or cognitively coherent (cf. Limber, 1969; 1976a). In other words, each perceptual package, whatever its internal structure, corresponds to a unit at the cognitive level of analysis. Within a few years, by age 5, one can observe the use of even more complex sentence forms in which the elements of the clause are no longer invariably found in contiguity with one another or even within the same intonation contour. Center embedding or "nesting" one clause within another has this effect (Limber, 1976b). Yet such utterances, within memory limits (e.g. Fodor, Bever, & Garrett, 1974), are readily produced and perceived. Complex syntax--along with phonology--now allows the sequential utterance structure to bear an increasingly arbitrary and abstract relationship to the message it conveys, at the same time enabling more cognitive stuff to be encoded within each package. As I remarked in my 1973 paper on the genesis of complex sentences, the same forms begin to take on an increasingly abstract semantic burden. The perceptual advantages of this system have been mentioned earlier and studied to some extent in recent psycholinguistic research (Fodor et al, 1974). What remains vague and poorly understood is the function of syntax in reference--that is, in the human ability to syntactically generate linguistic expressions or "names" for concepts (Limber, 1973, 1977). I foresee little progress in understanding the origin of human language without a much deeper understanding of this projective feature of human language. Is it an evolutionary outcome of linguistic structures per se or does it reflect some more general cognitive property of the human mind?

Speech Production

No one would doubt that speech-production processes played an important role in the evolution of language (Lieberman, 1975). Nevertheless, our knowledge of everyday, normal speech production seems so limited that as yet it offers very little insight into the origins of language and in particular syntax. The usual conception of speech production, however counterintuitive it may seem, is roughly that we have a general idea or intention that is communicated by transforming some cognitive code into a linguistic code. Furthermore, the basic planning units of this production process are presumably something like clauses (e.g. Fay, 1979; Ford & Holmes, 1978; Goldman-Eisler, 1972). Lacking any alternative to this, let us suppose that it is a fair first approximation to the truth. Syntax, then, from a production perspective is a sort of scheduling and gate-keeping operation that mediates between a more or less hierarchically organized, distributed cognitive processor and a primarily sequential articulator output. Syntax must have evolved biologically or culturally, so as to take inputs in whatever order they arrive from a somewhat amorphously structured cognitive system and in turn output them in temporal sequence following the local conventional format. Using word order, inflection and morpheme choice, and suprasegmentals like stress and intonation, human languages have remarkable flexibility in allowing alternate sequencing of semantic elements that convey nearly the same

message and yet remain within the established syntactic conventions. Osgood (1971), for example, has demonstrated this, showing how shifts in attention and focus can be reflected in alternative linguistic expressions containing much the same semantic content.

An advantage of any distributed processing computer is that complex problems can be broken down and subcontracted out to a number of simultaneously operating processors who then return nearly completed subparts to a final assembly point. With sufficient subprocessors and well-defined subtasks, exceedingly complex computations may be effected very rapidly. It does not take much imagination to see how complex sentences--particularly relative and complement clauses--might be put together by such a computational system. As the main proposition is being formulated in linguistic code, the arguments of the proposition (e.g. agent, object, etc.) are having their linguistic expression computed more or less simultaneously using exactly the same code. This is what recursion and the transformational cycle in linguistic theory is all about. There is an obvious linguistic advantage to this multiple processing capacity; typically the pragmatics of referring expressions involve decisions unrelated to the main thrust of the message itself. Those decisions depend on such things as judging whether or not the listener can see the object being referred to or perhaps if the listener has certain background information--of course, this is just the sort of thing readily subcontracted out to another linguistic processor. To summarize this line of speculation, human-language evolution has taken advantage of distributed processing in the central nervous system to develop a recursive language such that the same linguistic conventions may be used more or less simultaneously by all processors.

Substantiating any of this is quite another matter. Conceptual and neurophysiological breakthrough of the most futuristic kind are required. One might try, as a long shot, to simulate parallel production processes by setting up a host of more or less gratuitous assumptions about intentions and the nervous system, formulating referential descriptions, and the like. Possibly, such models could reveal how the problems of communicating between parallel processors constrain the language of those units, particularly in regards to anaphora and movement transformations.

Broca's Aphasia and Agrammatism

The most promising source of untapped evidence about the origin of syntax may not lie in normal speech production but in that cluster of language disabilities collectively known as Broca's aphasia. Broca's aphasia is typically described as a loss of expressive fluency including a loss of syntactic morphemes (function words and inflections) resulting in "telegraphic" or agrammatical speech often accompanied by more or less obvious articulatory difficulties (cf. Berndt & Caramazza, 1980; Lesser, 1978; Mohr, 1976). There have always been several unresolved questions about Broca's syndrome. One concerns the extent to which comprehension is impaired along with the expressive dysfunctions. Another concerns the extent to which the

dysfunctions specific to Broca's aphasia can in fact be reliably localized within the posterior third of the left frontal gyrus (Mohr, 1976). Finally, there is a most intriguing related question in connection with language origin--to what extent is Broca's truly a unitary language disorder that at once disrupts phonological and syntactic processes? On the one hand, there are those who have emphasized the articulatory/phonological aspect of the disorder, arguing that agrammatism is in effect a side effect, resulting from, for example, differential stress of function words or simply efforts of the speaker to economize or minimize on production by resorting to telegraphic agrammatical speech. On the other hand, there are those who have argued that one or more independent linguistic functions can be disrupted in Broca's aphasia, functions whose only connection is that they are localized more or less nearby one another in the nervous system.

Settlement of these questions could offer, I believe, some important information about the origins of syntax. At present, it appears that contrary to Broca's formulation, there is some comprehension loss in patients with Broca's symptomology. But it is a subtle loss reflecting syntactic comprehension alone and not cognitive comprehension. In their recent review of this point, Berndt and Caramazza (1980) suggest that these patients in fact do have an impaired comprehension based on an inability to use syntactic cues in analyzing sentences. These patients, for example, have particular difficulty in decoding the same reversible passive constructions that give young children problems. Bradley, Garrett, and Zurif (1980) have demonstrated that these agrammatic speakers have curiously abnormal word-retrieval capacities for the function or closed-class morphemes that are normally used in encoding syntactic relationships. All of this suggests that Broca's aphasics have essentially lost their syntax, and like young children and chimpanzees, rely on cognitive interpretation strategies to understand language. If Berndt and Caramazza (1980) are correct about this, the confusion and contradiction about comprehensions in Broca's aphasics only further attests to the effectiveness of the various nonsyntactic comprehension processes available to humans.

On the question of localization, Berndt and Caramazza (1980) do not find any theoretical reasons, linguistic or psychological, sufficient to jointly explain both the articulatory dysfunction as well as the agrammatism that is symptomatic of Broca's aphasia. They conclude (Berndt & Caramazza, 1980) that the basis for the correlated dysfunctioning of two presumably independent language components is neuroanatomical: "Specifically, we assume that the articulatory and syntactic functions are subserved in spatially adjacent areas. Brain damage in this area will affect both speech output and syntactic operations [p. 272]." From a language-origin perspective, however, there would be an excellent theoretical reason to expect just these two language components to be anatomically associated--if, in fact, syntax did evolve out of the functioning of these cortical structures mediating vocalization. It remains anyone's guess, for the moment, as to how or why this evolutionary development might have occurred beyond what I have already considered. What is needed is a much deeper understanding about the functioning of Broca's area than we currently have, as well as continued efforts to discover interrelationships

between articulatory, perceptual, and syntactic components in language. For example, as I suggested briefly earlier, syntactic functions in young naming-paradigm children are initially carried out on a direct perceptual basis. In addition there are some interesting descriptive parallels between phonological theory and syntactic theory that may be more than simply the application of a common formalism. It also appears worth continuing the effort to provide a unitary synchronic account of Broca's aphasia (e.g. Kean, 1977) despite what seems to be a certain amount of counterevidence (Kolk, 1978).

There is one additional reason for pursuing the evolutionary relationship between vocalization and syntax. Reconsider the language behavior, such as it is, of chimpanzees. A fair, if not generous, assessment of those findings is that chimps have good cognitive skills, auditory discrimination comparable to humans, and are capable of a certain amount of cognitive communication. But they are also inarticulate and their language is a syntactic. To put it another way, one might conclude that chimpanzees are innately endowed with Broca's aphasia.

SUMMARY REMARKS ON APES AND LANGUAGE ORIGINS

Charles Darwin remarked, in regard to questions about the intellectual differences between human and ape, that it was unreasonable to expect anything very definite in the way of answers beyond (Darwin, 1871/1955) "general causes, considering our ignorance with respect to the successive stages of development through which each creature has passed [p. 297]." Precisely the same might be said for current efforts to account for the language gap among primates. We are loaded with general causes--natural selection, mutation, parallel evolution, convergent evolution, genetic assimilation, and so forth--but lacking in specific knowledge of how those causes might have worked together to generate the obvious language differences between humans and other primates.

Efforts to reconstruct the natural history of primate languages are thus blessed with an increasing abundance of evolutionary principles that may add or subtract abilities as needed. But, at the same time, they are forever cursed by the lack of any hard evidence about the actual stages of development through which each species has passed. As I have suggested in this chapter, the only realistic prospect for ever understanding human-language origin is to focus our efforts on a deep understanding of human language itself. The missing links in the evolution of language are not likely to be found in the behavior of living apes but in the analysis of the functions of those various language components that jointly comprise human language. Perhaps with a deeper knowledge of syntactic and phonological processes and an understanding of Broca's area, we could then go back and link together a plausible chain of evolutionary events culminating in human language.

Even if we never attain satisfactory answers to language-origin questions, the effort would prove worthwhile nonetheless should it advance our knowledge of synchronic linguistic processes. No other perspective on language so forces us to consider the simultaneous integration and embodiment of all the diverse aspects of language in one 1500 cm³ package. Any theory of language origin will have somehow nested within itself theories of language acquisition, speech production, and perception. An evolutionary perspective, therefore, offers another set of reciprocal constraints on synchronic functional theories. Just as those functional theories must be compatible with neuroanatomical structure, they must also fall within the constraints of evolution. I have indicated, for example, how an evolutionary perspective might explain the correlation between syntactic and phonological deficits in Broca's aphasia. Let me conclude this chapter by indicating how an evolutionary perspective might at least clarify an issue touched upon variously in this chapter--the empirical-nativist controversy in theories of language acquisition.

The issue goes back at least into the 16th century when Locke and other empiricists argued that knowledge or ideas were acquired primarily through our senses according to some very general inductive principles that operated without regard to the content of those ideas. Locke (1690/1959) contrasted his view with nativist or rationalist beliefs that certain substantive ideas might exist "as it were stamped upon the mind of man [p. 37]" prior to any sensory experience. Twentieth-century psychology incorporated these empirical themes into its behavioristic learning theories. Such theories purported to account for all learning with very general content-free inductive "laws of learning" valid for any species, with perhaps some adjustment for differing sensory systems. Although it may have appeared to the outsider that American behaviorism was largely ignoring human language in its peculiar concern for rat and pigeon behavior, the truth is that language behavior was considered just another instance of behavior for which no special theory was needed. Expressions of this point of view can be found in O. H. Mowrer's (1954) presidential address to the American Psychological Association, and in B. F. Skinner's *Verbal Behavior* (1957) in which Skinner makes an explicit attempt to extrapolate from operant animal studies to explain human-language behavior.

Skinner's book had a singular impact on the recent language-acquisition controversy as a result of Chomsky's (1959) harsh review and subsequent debates within linguistics, psychology, and philosophy (e. g. Chomsky, 1980; Hook, 1969). The major point of Chomsky's critique of empiricist acquisition theories deals with the ineffectiveness of induction.

The data available to children are just too uninformative or impoverished to enable children following an empiricist acquisition theory to reliably acquire the necessary grammatical information, especially considering the speed and uniformity with which this is universally accomplished. What else, Chomsky argues, might explain every normal child's success in this endeavor other than utilization of genetically acquired information about the universal structure of human language? Of course, we know that "what else" arguments are not always convincing.

Empiricists, long before Chomsky, have seen how a language-using chimpanzee would support their cause. The initial failures of the Kellogg's and the Hayes' chimpanzees were understandably attributed to peripheral articulatory or auditory species differences. Recently both the Premacks (1972) and the Gardners (1978) sought to circumvent any peripheral differences by shifting to visual/manual symbols. This move, so plausible within the empiricist framework, has apparently failed (Limber, 1977). However, from the evolutionary perspective of this chapter, those peripheral differences between humans and apes are much more than incidental species differences; they reflect critical historical events in the evolution of human language. Indeed, some version of the empiricist theory of language acquisition, on this view, had to play an important historical role in the earliest stages of language origin. At some point back then, inductive generalizations structured primarily by peripheral input-output mechanisms must have taken place.

Subsequently, as Peirce (1878/1965) and others for example, Dennett, (1978) have suggested, organisms making adaptive generalizations increasingly had natural selection building those generalizations about their environment into their offspring. In this genetic simulation of Lamarckism, the inductive burden on each generation becomes successively less as the adaptively significant information is increasingly encoded into the genome. In this way, through many generations, organisms of a species develop representational systems increasingly reflective of their anticipated environment and thus become relatively less dependent on direct sensory experience with their actual environment. In other words, ideas about the world are indeed stamped into their minds through evolutionary processes unknown to Locke or anyone in the 17th or 18th centuries. Nevertheless, it is interesting that Leibniz, in his 1704/1951 critique of Locke's *Essay*, did offer a metaphorical mechanism for innate structure that lends itself to a modern biological interpretation:

I have made use also of the comparison of a block of marble which has veins, rather than of a block of marble wholly even, or of blank tablets...what is called among philosophers *tabula rasa*...if there were veins in the block which should mark out the figure of Hercules rather than other figures, the block would be determined thereto, and Hercules would be in it as in some sort innate, although it would be necessary to labor in order to discover these veins and to cleanse them by polishing and by cutting away that which prevents them from appearing...[p. 372].

It is now known from the work of Ramon y Cajal and others of this century that fetal mammalian brains have a vast number of cells and interconnections that begin to wither away at birth or even before. As Cowan (1979) puts it, the dendritic trees are "sculpted out of the initial more or less chaotic forest [p. 71]." This sculpting process--the cutting and polishing--is very sensitive to the organism's early experience and underlies both the notion of neural plasticity and the adaptive value of neoteny. Now, it does not seem to be asking too much of evolution--which can build in

calluses on fetal feet, anticipating a future locomotive need (for example, Frazzetta, 1975)--to build in or hardwire the particularly resilient adaptive neural circuitry embodying "linguistic templates" in anticipation of a future language environment. Regulatory gene variation among primates might metaphorically serve the function of Leibniz' veins of marble.

The Leibniz metaphor thus suggests a mechanism by which natural selection might genetically internalize those self-organizing language structures that are so obviously lacking in nonhuman primates. Even when apes have been provided with artificially structured and less impoverished language environments in varying modalities, they do not demonstrate anything at all like the rapidly self-organizing potential of children. From Chomsky's perspective, this must appear as striking confirmation of his nativism.

Although many have now come to accept the point that considerable structure must be brought to the language environment by the individual, there remains a lively controversy about the nature and specificity of that structure. Chomsky, of course, has continually argued for a "language faculty" that incorporates specific linguistic information and that is independent in important respects from other functionally interrelated cognitive structures. One persistent criticism of Chomsky's "language faculty" is that there may be alternatives to his nativism account of language universals (for example, Putnam, 1967; Sampson, 1979). This misses the point of Chomsky's nativism, however; the uniformity of language issue is itself only a by-product of the "impoverished-data" argument. Plausible alternatives must simultaneously address the induction problem as well. Although the study of universals may be relevant in determining the content of innate principles, Chomsky's nativism is not intended to simply account for the origin of similarities among languages. Instead, the innate "language faculty" is an explanatory concept postulated in order to account for ontogenetic, not phylogenetic, facts.

One must take a sufficiently deep evolutionary perspective on this point. If evolution can adaptively internalize relevant aspects of an organism's environment, the original source of these environmental features scarcely matters ontogenetically. Language structures may be a product of previous evolutionary events or individual genius (as La Mettrie suggested), or even brought to Earth by extraterrestrials. Regardless of the origin of these structures, natural selection and genetic variation will work on "hardwiring" those structures within the species if it is adaptive to do so. One should expect that, other things being equal, the more adaptive that rapid acquisition proves to be for an organism, the greater likelihood that relevant language information would become genetically encoded. C. S. Peirce (1878/1965) put this clearly a century ago: "There would be a constant selection in favor of more and more correct ideas...[p. 348].

There is yet another proposed alternative to Chomsky's nativism--one that grants a certain amount of innate structure to children without assuming that the contents of these innate structures as necessarily linguistic in nature. The suggestion is that these nonlinguistic cognitive structures may be sufficiently isomorphic to language structures so as to make the induction problem simple enough to be handled by general learning principles and situational pragmatics.

The cognitive empiricism of Piaget, Osgood, Premack, and others of quite diverse backgrounds (e.g. Macnamara, 1972) typically seems more a reaction against Chomsky's "language faculty" than a positive proposal about the operation of these putative cognitive structures in language acquisition. A cognitive empiricist's demonstration that cognitive factors are necessary for normal acquisition is hardly evidence that they are sufficient for it or conversely that a "language faculty" is not necessary. Nevertheless, given our extreme ignorance about the actual contents of either the nativism of the cognitive empiricists or of Chomsky, everyone concerned is well advised to keep an open mind on the issue.

Somewhat aside, one can see how detailed knowledge of these nativist structures could be useful in unraveling the origin of language. According to the more or less conventionalist historical scenario I have constructed in this chapter, the adaptive generalizations about language structure made by our ancestors must still remain with us encoded within our "language faculty." Although I do not foresee any immediate reading of the neural code in answer to such questions, it is important to recognize that we have not yet exhausted all the potential information bearing upon theories of language origin. It could turn out, for example, that the neural code has lost any traces of intentionality it might have had, or even that no such "language faculty" exists--that is, that the cognitive empiricists are right.¹⁶

Personally, I am not optimistic about the cognitive empiricist's proposal. The fragmentary evidence available from comparative primate studies, though still equivocal, is not promising; cognitive differences between nonhuman primates and children appear to be less extensive than do the linguistic differences (e.g. Chevalier-Skolnikoff, 1976; Hayes & Nissen, 1971; Parker & Gibson, 1979). The major overt divergence in intellectual behavior among these young primates, in fact, appears only after the emergence of syntactic language in children. The evidence from human-language development is even less promising (e.g. Dennis, 1980; Lust, Flynn, Chien, & Clifford, 1980); however, a full discussion of these issues would go beyond the scope of this chapter. Perhaps the only contribution an evolutionary perspective can contribute to this general question about the relation between cognitive and linguistic structures is to suggest *why* language in humans may have become differentiated into a relatively independent faculty despite its close relationship with other cognitive faculties. For at least some cognitive empiricists, this may prove of interest insofar as they may have--with misplaced concern for Ockham's razor--felt that, other things being equal, one large unknown general "faculty" is simpler somehow than several smaller more modularized ones.¹⁷

¹⁶ Some of the discussion of Chomsky's (1980) paper, particularly that of R. J. Mathews, deals with these issues.

¹⁷ The matter is far too complex and speculative to go into here, but most experienced computer programmers will agree with me that in practice complex programs are most efficiently put together if the overall problem is cast into substructures or modules that are more or less independently written. To try to do the whole problem at once--although superficially appealing--leads to hopeless problems in attention span and debugging, and importantly, difficulty in future modification. I believe evolution operates in a similar fashion: taking old pieces of code from here and there, occasionally writing some new code, and ultimately putting the pieces together. I believe this very

Recall the scenario for language origin sketched earlier in this chapter in which language evolved out of socialization processes made possible in part by delayed maturation. The obvious adaptive advantage of this neoteny, as everyone in the 18th century observed, was that it allowed the acquired adaptive habits of parents to be passed on directly to their offspring. Although language may have initially been an affective component of socialization, it rapidly took on cognitive or informational functions according to the naming paradigm in which symbols reflected or "named" concepts. At this point, as the cognitive empiricists assume to be the case today, language structure was closely tied to cognitive structure. Yet, herein lies a dilemma for evolution. Delayed maturity was presumably necessary for the evolution of culture and, close on its heels, language. But if language itself was ever to become the efficient causal mechanism of socialization and cognition that it is for *Homo sapiens* today, then somehow language must be acquired by each child well in advance of its use--that is, well before the end of its prolonged immaturity. Language would be most adaptive if it could somehow function as much as possible independently of the content it might be called upon later to deal with rather than "shadowing" it as in the naming paradigm. In other words, a language with a projective capability (Limber, 1977) offers enormous advantages over a naming-paradigm language in which the form and content of each expression must be experientially linked together in each child.

There is an analogous parallel to be found in the evolution of writing. Historically, it appears that even though many writing systems were invented over the years, the phonetic alphabet has continually displaced numerous ideographic systems in which each visual word form was more or less arbitrarily paired with its pronunciation. The adaptive advantages of a phonetic system are obvious: Upon learning 50 or so phone-symbol (letter) pairs an individual has immediate written access to the existing spoken vocabulary and any new words he or she might acquire in the future. The ideographic system, in contrast, although offering some advantages in the initial acquisition of the system, rapidly becomes disadvantageous as the individual's vocabulary accelerates. The ideographic system, like a naming-paradigm language, cannot compete in an environment with increasingly many concepts against a phonetic writing system that, like a syntactic language, largely dissociates form from meaning.

Evolution, of course, has a long history of pragmatically solving dilemmas by maximizing advantages and minimizing disadvantages. The compromise effected in the case of human language is a classic. By partially dissociating the form of language expressions from their meanings--that is, inventing syntax--she was able to progressively encode the adaptive generalizations about the form into the genome and at the same time maintain the advantages of the naming paradigm in a lexicon that remains sensitive to one's individual experience. What else?

much underlies Simon's (1962) point about hierarchical structures, although Sampson (1979) comes to quite opposite conclusions from it than I do.

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