

**This view of language** # 741

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The authors are to be honored for a paper that goes a long way toward countering the intemperate anti-Darwinism that has become the mode in some cognitive science circles over the past decade. They show, for the first time and in some detail, how Maynard Smith's (1969) concept of "adaptive complexity", elaborated by Dawkins (1983; 1986) for the mammalian eye, bat sonar, and other complex biological systems can be extended to language. By so doing, they have taken an important step toward reconciling modern linguistic theory with Darwinian natural selection. I have three points on which I want to comment.

My first point concerns the physical basis of language that has made possible its evolution by natural selection. As is common in discussions of the nature of language, Pinker & Bloom (P&B) lay heavy emphasis on syntax, relatively little on phonology. Yet phonology is logically prior to syntax (without phonology, no lexicon; without a lexicon, no syntax) and perhaps evolved earlier in our hominid ancestors, as it still develops earlier in the child. The hierarchical relation between syntax and phonology springs from a crucial principle of language design that distinguishes language from all other known systems of animal communication, enabling its speakers to finesse the physical limits of their signaling machinery and, ultimately, in the words of Von Humboldt that Chomsky made famous, to "make infinite use of finite media" (Von Humboldt 1836/1972, p. 70). This is the principle by which a limited set of discrete elements (gestures, phonemes, morphemes) is repeatedly sampled, combined, and permuted to yield larger elements (phonemes, morphemes, phrases) having properties quite different, in structure and functional scope, from those of their constitutive elements.

The principle, so familiar as to seem obvious, is quite rare in the natural world. Abler (1989), terming it "the particulate principle of self-diversifying systems," has shown that it is shared by two other systems: chemical interaction, for which the particulate units are atoms, and biological inheritance, for which the particulate units are genes. Abler contrasts particulate systems with blending systems, such as geology or the weather, in which the result of combining structures is an average, so that properties of the original components are lost, and no new level of discrete structure emerges. If words were formed by blending portions of the acoustic spectrum, or if sentences were formed by blending words, we would rapidly exhaust the communicative potential of the medium. By contrast, the particulate principle affords a vast range of typological variation – effectively unbounded sets of potential phonetic segments, lexical items, and lexical combinations – that is then subject to competing psychophysical, memorial, and motoric selection pressures toward ease of production and ease of comprehension (Lindblom 1983; 1984; in press). Each language is thus one of an uncountable set of solutions to the problem of selecting from the available variants a finite set that will afford "a kind of imped-

ance match between an open-ended set of meaning[s] . . . and a decidedly limited set of signaling devices" (Studdert-Kennedy & Lane 1980, p. 29). Each phonological solution is a system of sufficiently contrasting phonetic elements, and the phonotactic rules for their combination in morphemes; each syntactic solution is a set of lexical categories and the rules for their combination in phrasal structures. Thus, the evolution of language became possible when our hominid ancestors chanced on a simple principle of the physical world from which the hierarchical structure of phonology and syntax could emerge despite the intrinsic limits of their signaling devices.

My second point concerns possible parallels between evolution and individual development. P&B infer from the need for arbitrariness that "language evolution and language acquisition not only *can* differ, but *must* differ" (sect. 3.4.3, italics theirs). In my opinion, this statement is too strong. The conditions of language acquisition are certainly quite different from those under which language evolved, if only because the child is guided into language by speakers of a fully evolved system. Certainly, too, the rate and order of acquisition of certain linguistic structures may vary across languages, due to differences in the transparency of the arbitrary devices used for particular syntactic functions (Slobin 1982). Finally, it is true that Haeckel's "biogenetic law" ("Ontogeny recapitulates phylogeny") has been thoroughly discredited (Gould 1977).

Nonetheless, in an adaptively complex system, such as language, where the function of any one part may depend crucially on another, at least the broad lines of development are likely to be parallel, phyletically and ontogenetically. Among the reasons for this are that evolution is a succession not of adults, but of the ontogenies that give rise to them (Garstang 1922; Raff & Kaufman 1983). For an evolutionary change, in morphology or behavior, to give an adult organism a reproductive advantage, the change must occur in development. As Darwin (1859/1964, p. 447) recognized, changes tend to occur late rather than early in development, because early changes may ramify through the system, forcing changes in other structures that depend for their development on the changed structure. This conservative mode of evolutionary change is one source of the parallel between ontogenetic and ancestral sequences (Gould 1977). Another source is that the main lines of both processes necessarily proceed through "successive grades of differentiation" (Garstang 1922, p. 84) from the general to the specific. We may accordingly gain insight into how a complex system hangs together by studying its development in a cautiously recapitulatory framework. Such an approach has already begun to pay off in studies of early phonological development where a view of the phoneme or feature as "innate" has begun to give way to accounts of their emergence by differentiation of the syllable (Ferguson & Farwell 1975; Macken 1979; Menn 1986; Studdert-Kennedy 1987). A computational model of the self-organization of a phonological system of segments and features by implicit syllable differentiation, under competing selection pressures for ease of articulation and ease of perception, has also been implemented (Lindblom et al. 1983; the results have broadened our view of the processes of both evolution and development. Perhaps analogous studies of syntactic and semantic development will reveal hitherto unsuspected functional dependencies among those stages in the sequence that are general enough to be universal.

My final point concerns the question of phyletic continuity between language and nonlinguistic behaviors and neural mechanisms. P&B are surely right to reject the notion that the adequacy of an evolutionary account of language origins depends on the discovery of antecedents to modern structures in existing (or even fossilized) species. They are also right, in my view, to reject any unqualified claim that motor programs, *tout court*, are preadaptations for syntactic rules. Nonetheless, several facts and bodies of knowledge do suggest that language rests on a specialized capacity for endogenous control of rapid, di-

verse (i.e., nonrepetitive) sequences of movements (Kimura 1979), and that this capacity has antecedents in the primate line. First is the well-established link between lateralized control of manual praxis and language, hinting at related systems for the control of rapid, precise movement and for unilateral coordination of a bilaterally innervated effector apparatus. Second are the discoveries that manual sign languages have a dual formational ("phonological") and syntactic structure parallel to that of spoken languages (Klima & Bellugi 1979), and that the two modes of language may be homologues, supported by closely related, lateralized neural structures (Poizner et al. 1987). Third is the growing body of evidence that lateralized control and coordination of the limbs (hands and feet) did not emerge *de novo* in *Homo sapiens*, but had its beginnings in neural regimes for control of posture and feeding in other primates (MacNeilage 1987; in press; MacNeilage et al. 1987; 1988). Future research in these and related areas may throw light on the origins and mechanisms of the specialized system for endogenous motor control that both makes language possible and sets limits on its phonological and syntactic forms.

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#### NOTE

1. The commentator is also affiliated with the University of Connecticut and Yale University.