BOOKS: LINGUISTICS

New Vines on Old Roots

Merrill Garrett

Noam Chomsky's monograph *Syntactic Structures* (Mouton, The Hague, 1957) established the perspectives that have dominated linguistics for the past 45 years. Chomsky aggressively affirmed linguistics as a kind of theoretical psychology—a special science of human minds. Linguists of the prior era might have said their work was to describe the structure of human languages. From the Chomskian vantage point, to describe language is to describe a central feature of human minds. *Foundations of Language* reflects the forces Chomsky set in motion. With the book, Ray Jackendoff, a professor of linguistics at Brandeis University, raises the ante on this tradition in several ways.

Foundations of Language
Brain, Meaning, Grammar, Evolution
by Ray Jackendoff
Oxford University Press, New York, 2002. 497 pp. $40, £25. ISBN 0-19-827012-7.

"Generative linguistics," the brand of theory that Chomsky led to ascendancy in the 1960s, continues as the dominant framework, but it now encompasses a diversity of forms not always readily or willingly identified as variants of the Chomskian paradigm. Jackendoff notes this fractionalization and also discerns a "distancing" of generative linguistics from cognitive science over the years. One of his major objectives is a rapprochement among the sciences relevant to understanding language.

In addition to this fragmentation, much linguistic theory remains determinedly formalist, with little concern for how claims about language structure relate to other domains. Nevertheless, the field as a whole is far more inclusive than it was in the 1960s and 1970s. Today, mainstream linguistics journals encompass an array of exotic entrées—psycholinguistics, neurolinguistics, experimental acquisition, computational modeling—along with the meat and potatoes of phonological types, inflectional paradigms, constituent ordering, quantifier scope, and the like. Practice in linguistics is more eclectic than Jackendoff's description of estrangement might suggest. However, he quite correctly observes that this inclusive state of affairs is largely unrationalized with respect to core linguistic theory. On these grounds, his book is aimed at a lofty target.

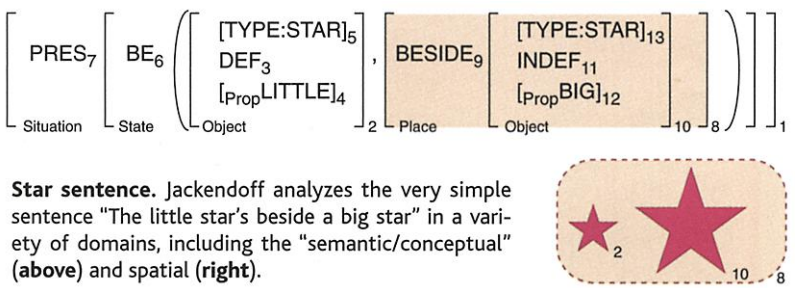
Jackendoff takes a two-pronged approach. Identifying core features of grammatical theory that must be preserved, he seeks to clarify their role in the contemporary scene. He also identifies flaws in foundational assumptions that he believes must be changed. He wants to recast the architecture of grammatical theory to achieve greater coherence within linguistics and to more effectively embrace psycholinguistics and neurolinguistics.

The core generative theses to be preserved are mentalism, combinatoriality, and nativism. The mentalist thesis is that languages reflect human capacities, not disembodied formal objects. Combinatoriality refers to the feature of symbol systems that builds, without limit, novel complexes from elemental sets. When joined with the mentalist claim, it represents a classic insight about behavior: the computational capacity of minds confers unbounded expressive powers. Nativism holds that the essentials of language arise from innately specified mental structure. The nature of such constraints and the way they interact with experience to yield mature language have been keys to the development of theory within the generative framework. Jackendoff lays out his interpretation of the three theses and defends each against a variety of criticisms, which he argues have arisen from misunderstandings across the disciplinary boundaries.

These are the strands to be preserved. What should be changed? Syntactocentrism and its consequences. By this, Jackendoff means theories in which syntax is the sole generative source of language structure, the only system with unbounded combinatorial capacities. He argues for an architecture of three parallel systems (each with generative capacity) operating simultaneously to express linguistic structures. The book begins with an engaging exercise that sets the stage for this idea. Jackendoff details the analysis of a short sentence: "The little star's beside a big star." He lays out its dimensions in terms of sounds (phonological theory), grammatical categories (syntactic theory), and concepts ("semantic/conceptual" theory). Throughout the book, he returns to this example and its tripartite architecture. His discussions of the linguistic structure of the sentence are not superficial, but they can still be grasped by the nonspecialist. They reflect the nature of the book itself, which is not a treatise intended only for the professional. Although the book contains technical material, it is meant to communicate substantive questions about formal linguistic theory to the larger scientific community.

Each of the three generative systems has its own structure and compositional principles. Elements of one system may be invisible to rules in others. Sound features are not referenced by syntax or conceptual systems, nor conceptual distinctions by sound or syntax, etc. Thus, there is a substantial degree of system autonomy (a feature the author makes good use of in his discussion of modularity issues). But the systems must also be closely coordinated. Correspondence rules relate compositions in each system to compositions in the others. These interface systems constitute a major component of the overall theory. Indeed, Jackendoff treats the lexicon entirely in terms of interface systems (a move closely tied to his efforts to connect linguistic theory to psycholinguistic and neurolinguistic domains).

The neurological instantiation of language is among the topics that receive unusual attention in the book. A good example is the discussion of the neural "binding problem," a general conundrum for cognitive neuroscience. How are the conjoint parts of cognitive structures linked at neural levels? Jackendoff compares the linguistic problem to corresponding problems in vision: separate neural processes (for color and shape, for example) must combine to make a single percept. An interpretation offered in the neuroscience community is that "synchrony of neural activation" achieves these effects: conjoint elements are phase-linked. The language



Star sentence. Jackendoff analyzes the very simple sentence "The little star's beside a big star" in a variety of domains, including the "semantic/conceptual" (**above**) and spatial (**right**).

CREDIT: AFTER R. JACKENDOFF IN *FOUNDATIONS OF LANGUAGE*

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version of the problem is acute. Many levels are concurrently active. For example, the internal parts of syntactic structures must cohere in specific ways, but they must also link externally to phonological and prosodic structures, to conceptual structure, and to transient background structures. Although the time course for elaboration of these intricately cross-linked structures during processing is not well understood, it is very likely that the same element must be simultaneously linked to multiple sites. Whether such linkages could be effected by degrees of synchrony is unknown. Jackendoff argues that these problems and their nonlinguistic analogs have not been addressed in current neural accounts, and plausible solutions must address the special structural constraints he outlines.

As the book's subtitle suggests, Jackendoff addresses many other topics—both unconventional and conventional. He uses the framework of the three generative systems to consider some provocative evolutionary ideas and language processing issues. He tackles questions of meaning and its treatment within linguistic theory head on: his tripartite architecture incorporates a conceptual system directly modeled on the combinatorial principles that animate syntax and phonology. His discussion of nativism ranges widely from traditional concerns about the nature of universal grammar (namely, the set of innate constraints on possible human languages) to questions about how specific behavioral constraints could be represented in the genetic code. It's a rich mix, but one laid out in refreshingly plain language.

Jackendoff also includes plenty of basic linguistics, but his emphasis is on linguistics in a broader cognitive mode. Reading the book, some linguists, psycholinguists, and artificial intelligence researchers may find themselves muttering, "Well, this is what I've been saying for years. What's the big deal?" The author does not claim that there are not multiple precedents for his perspective. What he does argue—and I think he is entirely correct—is that these views have not been articulated in a systematic way that ties the components of formal linguistic theory to the broader issues in human cognition. *Foundations of Language* advances a unified framework for building those links and offers a formidable array of examples and arguments in support of that framework. Whether or not you agree with Jackendoff's proposed revisions, he provides challenging ideas and a fruitful combination of observation and analysis. My advice is to read the book for the exceptional effort at synthesis that it is.

BOOKS: HUMAN EVOLUTION

Out of the Chattering Ice

Robert N. Proctor

Neocatastrophism has become fashionable in climatology and the geosciences. In the 1970s, there was the discovery that the Mediterranean every now and again pinches off from the Atlantic, dries up, and then catastrophically refloods when the Straits of Gibraltar are once again breached. The 1980s brought us the idea that meteorites could cause mass extinctions, notably the Cretaceous-Tertiary event later traced to the Chicxulub crater beneath the Yucatan Peninsula. The 1990s introduced the suggestion that all the world's oceans froze, perhaps as far down as a kilometer, for a few million years in the Neoproterozoic, and that the melting of this snowball Earth opened up some of the niches that made possible the Cambrian explosion. Today, geomorphologists are realizing that the Grand Canyon is surprisingly young: Five or six million years was the commonly cited age only a decade ago, but the uplift of the Colorado Plateau that led to the cutting of the canyon may actually be only a million or so years old—a revision creationists will no doubt try to exploit.

Cold from the warming. Calvin argues that increased global warming may flip the climate into a cold mode in which ice sheets again appear far south of these Greenland glaciers.

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Historians have not yet sorted out the causes of all this attention to calamity. It could have something to do with those apocalyptic scenarios fretted over in the Reagan era (e.g., nuclear winter), or with social critics of the 1960s and 1970s gaining professorships (Stephen Jay Gould used to call himself a "dialectical materialist"), or even with the fact that catastrophes make good television. One also has to reckon, though, with the blunt fact that nature has been reasserting itself against the blinders of gradualistic prejudices, as Gould and others began to stress more than 20 years ago. Some catastrophes are just plain real.

A Brain for All Seasons
Human Evolution and Abrupt Climate Change
by William H. Calvin
University of Chicago Press, Chicago, 2002. 349 pp. $25, £16. ISBN 0-226-09201-1.

The first two-thirds of William Calvin's *A Brain for All Seasons* is a creative attempt to incorporate abrupt climate change into theories of human origins. A neurobiologist at the University of Washington School of Medicine, Calvin builds on the discovery, a decade or so ago, that the temperature swings we have experienced over the past 8000 years are small compared with fluctuations in the deeper past. Contrary to previous assumptions of slow and stately coolings extending over millennia, ice cores from northern Greenland and elsewhere have shown that ice ages can begin quite suddenly, perhaps even within a space of only a few years. Climatologists believe that interruptions in the flow of the Gulf Stream may be one of the causes of such abrupt coolings: If, for some reason, the warming waters flowing from the south cannot reach higher latitudes in the North Atlantic, glaciers will start growing, reflecting more and more sunlight into space, causing runaway cooling.

Calvin argues that these repeated coolings had profound consequences for human evolution. Abrupt coolings were accompanied by prolonged droughts at lower latitudes, reducing herbivore populations and shrinking the numbers of predators eating those herbivores. In Africa circa 2 to 3 million years ago, when bipedal primates first began making and using stone tools, abrupt climate change rewarded those creatures able to improve their hunting powers. "Whiplash" climate fluctuations forced hominid populations through hundreds of severe-drought bottlenecks, during which those with the bet-