tually salient property, his or her restaurant order. Still, from a developmental perspective, we should explore how far the infant can go with the "close correspondence" hypothesis.

The issue of the source of compositionality in the conceptual system or in syntax is not a trivial issue, as it has massive impact on learnability. Learnability issues generally evoked in the "poverty of stimulus" framework focus largely on the complexity of inducing regularities derived from syntactic compositionality. This complexity could be significantly reduced if the compositionality were already present in the conceptual system. In this context, acquisition does not necessarily imply that the child perform a (demonstrably impossible) task of grammar induction on reduced input (see target article, sect. 4.6). Rather, it implies that the child learns how to interpret the meaning of sentences by any method. In his discussion of lexical storage versus online construction (p. 188) Jackendoff outlines an approach in which the infant initially is "storing everything," and begins to generalize regular patterns "and extract explicit patterns containing typed variables;" allowing the system to "go productive," via variable-based structures similar to those discussed by Marcus (2001). The resulting lexical construction-based developmental trajectory described in section 6.9 makes interesting contact with the usage-based account of language acquisition as developed by Tomasello (1999b; 2003). In making this connection, Jackendoff has quietly performed a remarkable stunt in theoretical diplomacy, by (at least partially) integrating the construction grammar framework into the parallel architecture.

What becomes interesting from this dual perspective of (1) the combinatorial precedence of the conceptual system, and (2) the use of a construction grammar style approach as suggested in Chapter 6, is the potential reduction in the processing complexity associated with language acquisition. Across languages, meaning is encoded by individual words, word order, grammatical marking, and prosody (Bates & MacWhinney 1982). Within a language, grammatical constructions will be identifiable based on their characteristic configurations of these cues. These grammatical constructions will each have their respective form-to-meaning correspondences – which the learner is expected to acquire. Thus, the mappings can be learned and subsequently accessed, based on the configuration of grammatical cues that serves as an index into the lexicon of stored constructions. A model based on these principles made interesting predictions concerning the neural bases of these operations (Dominey et al. 2003), and has also been effective in miniature language acquisition contexts, in which grammatical constructions are learned and productively generalized to new sentences (Dominey 2000; 2003). This suggests that when the brunt of the compositional load is put on the conceptual representation, a reliable scaffolding is thus in place, upon which syntactic compositionality may naturally repose.

Generative grammar with a human face?

Shimon Edelman

Department of Psychology, Cornell University, Ithaca, NY 14853-7601.
se37@cornell.edu **http://kybele.psych.cornell.edu/~edelman/**

Abstract: The theoretical debate in linguistics during the past half-century bears an uncanny parallel to the politics of the (now defunct) Communist Bloc. The parallels are not so much in the revolutionary nature of Chomsky's ideas as in the Bolshevik manner of his takeover of linguistics (Koerner 1994) and in the Trotskyist ("permanent revolution") flavor of the subsequent development of the doctrine of Transformational Generative Grammar (TGG) (Townsend & Bever 2001, pp. 37–40). By those standards, Jackendoff is quite a party faithful (a Khrushchev or a Dubcek, rather than a Solzhenitsyn or a Sakharov) who questions some of the components of the dogma, yet stops far short of repudiating it.

In *Foundations of Language,* Jackendoff (2002) offers his version of TGG, in which the primacy of syntax ("an important mistake," p. 107) is abolished, the related notions of Deep Structure and Logical Form ("the broken promise," cf. Précis, sect. 3) are set aside, the links to other domains of cognition are discussed, and a hand is extended in peace to psychologists and other cognitive scientists. *Foundations* is an enjoyable, thought-provoking and useful book that fulfills the promise of its title by presenting – and attempting to tackle – foundational issues in linguistics. It is an excellent overview of the ground that must be covered by any serious contender for a linguistic "theory of everything." Its nondogmatic style engages skeptical readers of cognitive and empiricist persuasions ("can my theory explain this set of facts better?") instead of alienating them.

Among the more positive aspects of Jackendoff's stance in *Foundations* are: the emancipation of semantics as one of the three equal-status components of the "parallel architecture" (p. 125); the realization that not all rules are fully productive (admitting constructions p. 189); and the construal of meaning as a system of conceptual structures (p. 306). The pervasiveness of TGG dogma is, however, very prominent throughout the book. On the most abstract level, the dogma manifests itself in the bizarre mentalistic nomenclature (*f-knowledge,* etc.) that Jackendoff uses instead of the standard explanatory machinery of representation found in all cognitive sciences. Jackendoff shuns a representational account of linguistic knowledge because of his (understandable) wish to avoid joining Fodor and Searle in the philosophical quagmire of intentionality. There exist, however, psychophysically and neurobiologically plausible accounts of symbolic representation that hinge on counterfactual causality and manage to stay clear of the Fodorian mire (Clark 2000; Edelman 1999).

The preponderance of Chomskian bricks in *Foundations* is revealed in Jackendoff's official insistence, in the introductory chapters, on rule-based combinatoriality. His initial formulation of this concept (pp. 38–57) is so strong as to be incompatible with his own views on constructions (pp. 152–87) and on their graded entrenchment (p. 189), expressed later in the book. It is satisfying to observe that those latter views are on a convergence course with some of the best-known and most promising work in cognitive linguistics (Goldberg 1998; Langacker 1987). As such, they can stand on their own: Computationally explicit construction-based accounts of linguistic productivity need no extra propping (Solan et al. 2003). In any case, Jackendoff should not count on any help from TGG, a Protean theory that, despite decades of effort, has failed to garner empirical support for the psychological reality of the processes and entities postulated by its successive versions, such as movement and traces (Edelman, in press; Edelman & Christiansen 2003). In a recent attempt to obtain psycholinguistic evidence for traces, for example (Nakano et al. 2002), only 24 subjects out of the original 80 performed consistently with the predictions of a trace/movement theory, while 39 subjects exhibited the opposite behavior (the data from the rest of the subjects were discarded because their error rate was too high). Jackendoff's continuing to cling to TGG (complete with movement and traces), despite its empirical bankruptcy and despite his self-proclaimed openness to reform, is difficult to explain.

Even Jackendoff's highly commendable effort to treat semantics seriously may be undermined by his continuing commitment to TGG. Conceptualist semantics is an exciting idea, but to develop it fully one must listen to what cognitive psychologists have to say about the nature of concepts. Instead, Jackendoff erects his own theory of concepts around scaffolding left by the generative linguists, which, in turn, is only as sound as those decades-old intuitions of Chomsky and Fodor. In particular, incorporating Marr's and Biederman's respective theories of visual structure (pp. 346–47), themselves patterned on TGG-style syntax, into the foundations of semantics cannot be a good idea. Jackendoff's acknowledgment, in a footnote 10 on p. 347, that Marr is "out of fashion" with the vision community holds a key to a resolution of this issue: Current perceptually grounded theories of vision (Edelman 1999; 2002) and symbol systems (Barsalou 1999) are a safe, additive-free alternative to TGG-style semantics.

In summary, Jackendoff's book is one of several recent manifestations in linguistics of the equivalent of the Prague Spring of 1968, when calls for putting a human face on Soviet-style "socialism" began to be heard (cf. the longing for "linguistics with a human face" expressed by Werth [1999, p. 18]). Jackendoff's stance, according to which the "mistakes" that were made do not invalidate the TGG framework, amounts to a bid to change the system from within. In a totalitarian political system, this may only work if the prime mover behind the change is at the very top of the power pyramid: Czechoslovakia's Dubcek in 1968 merely brought the Russian tanks to the streets of Prague, whereas Russia's Gorbachev in 1987 succeeded in dismantling the tyranny that had sent in the tanks. In generative linguistics, it may be too late for any further attempts to change the system from within, seeing that previous rounds of management-initiated reforms did little more than lead the field in circles (Edelman & Christiansen 2003). If so, transformational generative grammar, whose foundations Jackendoff ventures to repair, may have to follow the fate of the Communist Bloc to clear the way for real progress in understanding language and the brain.

Complexity underestimated?

Péter Érdi

Center for Complex Systems Studies, Kalamazoo College, Kalamazoo, MI 49006; and Department of Biophysics, KFKI Research Institute for Particle and Nuclear Physics of the Hungarian Academy of Sciences, H-1525 Budapest, Hungary. **perdi@kzoo.edu**
erdi@rmki.kfki.huhttp://cc.kzoo.edu/~perdi
http://www.rmki.kfki.hu/biofiz/cneuro/cneuro.htm

Abstract: Instead of commenting directly on *Foundations of Language: Brain, Meaning, Grammar, Evolution,* I provide some remarks from an interdisciplinary view. Language theory is examined from the perspective of the theory of complex systems. The gestural-vocal dichotomy, network theory, evolutionary mechanisms/algorithms, chaos theory, and constructive approach are briefly mentioned.

1. The perspective. I do not have a background in generative linguistics, and read the book *Foundations of Language* (Jackendoff 2002) from the perspective of how the author managed to embed linguistics into an interdisciplinary framework. I remain slightly disappointed. The author clearly abandoned Chomsky's grand isolation decades ago, but the real integrative approach is missing. For example, the title of the first chapter is "The Complexity of Linguistic Structure," but the author gives only a few references from the community of complex-system researchers. Still, though the book seems to be primarily a text written by a linguist for linguists, I have learned very much from it. My comments here are directed not so much at the book itself as at articulating the potential ingredients for a more interdisciplinary approach.

2. The gestural-vocal dichotomy. Jackendoff assumes that language arose in the vocal-auditory modality, and states (in my view, surprisingly) that "a gesture-visual origin would not materially change my story" (p. 236). Based on the fascinating findings of mirror neurons (for reviews, see Rizzolati & Arbib 1998), the mirror system hypothesis of language evolution has been suggested (e.g., Arbib 2002a). Mirror neurons in monkeys are active both in order to execute motor actions and to observe similar actions of other monkeys or humans. The neural region involved in these operations is considered to be the homologue of Broca's area, the crucial speech area of humans. Language in humans evolved from a basic mechanism that was originally not related to communication, namely, the "capacity to recognize actions" (Rizzolatti & Arbib 1998). Should we believe now, in light of these newer results, that the gestural-visual systems implemented in the action-perception cycle might have a more important role in language evolution than was earlier thought? While I might see the difficulties in explaining the transfer from gestural to vocal modality, I don't see why we should not consider these findings as a big step toward a new Neurolinguistics.

3. Network theory: Static and (statistical) characterization; self-organizing algorithms. Real world systems in many cases can be represented by networks, and complex networks can be seen everywhere. The organization of biological, technological, and social structures might be better understood by using network theoretical approaches (Albert & Barabasi 2002; Newmann 2003). "Small-world" graph properties (highly clustered and small average length between nodes) and power-law distributions are the key properties of the networks. Complex networks are neither purely ordered nor purely random.

Motivated by the big success of network theory, several works have shown that certain networks assigned to human language have the characteristic patterns of complex organization. Cancho and Solé (2001) analyzed the British National Corpus, and a network of interacting words has been constructed by taking into account only short-distance correlations. The authors don't deny that their algorithm is based on the analysis of the surface structures of sentences. Another network of words was constructed from a thesaurus by Motter et al. (2002). Roughly speaking, words are connected if they express "similar" concepts. In any case, both networks showed statistical properties very similar to those of other complex networks.

Dorogovtsev and Mendes (2001) gave a self-organizing algorithm for the development of word networks based on elementary interactions between words. This algorithm might be the basis of a mechanism to produce a kernel lexicon of the language.

4. Evolutionary mechanisms/algorithms. Jackendoff certainly gives some credit to recent work "on mathematical and computational modeling of communities of communicating organisms" (p. 81). At least from the perspective of integrative approaches, it is interesting to see how model frameworks of population dynamics and evolutionary game theory can be extended to describe language evolution (e.g., Nowak & Krakauer 1999), and specifically grammar acquisition (Komarova et al. 2001), which offers a model framework for describing signal-object association, word formation, and the emergence of syntax with coherent concepts.

5. Chaos theory. Chaos theory might have some role in linguistics. It certainly contributed to the explanation of the occurrence of the celebrated Zipf's law (Nicolis & Tsuda 1989). (I understand that statistical-empirical laws might have nothing to do with architectures, so Zipf's law should not necessarily be mentioned in the book.) The population-dynamical/game-theoretical models elaborated for the acquisition and evolution of language might lead to chaotic behavior under certain conditions. Mitchener and Nowak (2003) recently argued that small learning errors may lead to unpredictable language changes.

6. Constructive approach. While there are different strategies to simulate language evolution, the constructive approach seems to be particularly interesting (e.g., Hashimoto 2001). Language, as a complex dynamical system, can be studied at different hierarchical levels. The origin of the first linguistic systems, the evolution of various languages and language structures, the normal development and acquisition of language in children and adults, and the sense-making process of giving meanings to words during communication take place in different levels of language organization. The constructive approach takes into account both the subjective language-users and the communication among them. The prerequisites of simulating language evolution are language-users, that is, communicative individuals with an established communication system.

Recent efforts to understand emergent biological and social structures adopt the constructive approach. Accordingly, structures and processes emerge as a result of the interaction between the components of complex systems. Specifically, one can understand the emergence of linguistic structures and behaviors. These components consist of interacting autonomous agents, their neural, sensorimotor, cognitive, and communication abilities, and their physical and social environment.

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