Peter W. Culicover & Andrzej Nowak, Dynamical grammar: minimalism, acquisition and change (Foundations of Syntax 2). Oxford: Oxford University Press, 2003. Pp. xxii+324.

HANS VAN DE KOOT

How to cite this article:
HANS VAN DE KOOT (2006). Journal of Linguistics, 42, pp 452-457 doi:10.1017/S0022226706234091

Request Permissions : Click here

Peter W. Culicover & Andrzej Nowak, *Dynamical grammar: minimalism, acquisition and change* (Foundations of Syntax **2**). Oxford: Oxford University Press, 2003. Pp. xxii + 324.

Reviewed by HANS VAN DE KOOT, University College London

Dynamical grammar is the second part of a two-volume work entitled 'Foundations of Syntax'. Volume I, *Syntactic nuts: hard cases, syntactic theory, and language acquisition* (Culicover 1999), investigated the properties of language itself, with the aim of establishing the boundary conditions on the learning mechanisms responsible for language acquisition. It focused especially on aspects of (syntactic) learning that do not exemplify the regular and exceptionless properties of human language, but rather the irregular, the

marked and the downright idiosyncratic. Volume 2, *Dynamical grammar*, turns to the internal properties of the learner and investigates whether it is possible to model the process of language acquisition in terms of a complex adaptive system. While *Syntactic nuts* was aimed predominantly at syntacticians with a primary interest in language acquisition, *Dynamical grammar* should be of interest to a wider audience, as it addresses fundamental questions about the nature of grammar and its relation to the mind, including issues relating to the computational properties of human language.

The book consists of three parts. Part I, 'Foundations', which includes two chapters, outlines the dynamical perspective on language and discusses problems with the Principles and Parameters view of language acquisition. Part II, 'Simulations' (chapters 3–6), contains computational simulations of lexical learning, syntactic learning, and language change. Part III, 'Grammar', which comprises the final chapter of the book, explores the adequacy of the kind of syntactic analyses to which the dynamical system approach gives rise.

Chapter 1, 'The dynamical perspective', presents the authors' view of grammar as a dynamical system and discusses how this differs from the I-language view held by Chomsky and his followers. The key claim advanced here is that there is no such thing as a mental grammar. Rather, the fact that human languages have properties that appear to lend themselves to description in terms of a grammar is a consequence of a combination of factors. First, language expresses thought, whose representations are themselves highly compositional. As a result, so it is argued, it is only natural that the structure of thought should reveal itself in the medium through which it is expressed. Second, the mechanisms for language learning are capable of generalization, and generalizations give rise to what appear to be rules. Finally, the favoured methodology in linguistics is to disregard exceptions and counterexamples. According to the authors, a linguistic theory does not characterize the mental object of study but rather the regularities in its external behaviour.

According to the dynamical perspective, what is present in the learner prior to acquisition is the representational system in which meaning is expressed, that is, Conceptual Structure (see Jackendoff 1990), itself a highly structured and principled system, and some minimal mechanisms for learning how to relate a string of words to a representation in Conceptual Structure. This dynamical system takes shape over time and eventually comes to behave as if it embodied a set of rules, but in fact the grammar is merely an emergent property of the dynamical system.

This view of grammar as an emergent property is contrasted with the Chomskyan perspective, which adopts a 'static' view of language, according to which we are born with a mental grammar upon which we draw to speak and understand our language. On this view, language acquisition amounts to setting parameters in this mental grammar on the basis of linguistic experience.

The chapter concludes with a description of the general properties of a dynamical system. Words and sentences are represented in a mental space. A sequence of words corresponds to a trajectory through this space. An often-traveled trajectory will have a lower energy requirement than a less commonly traveled trajectory. By requiring the system to minimize its energy requirements, it is forced into self-reorganization, grouping similar trajectories into 'flows'. The sequence of internal states that the system passes through as a result of these reorganizations should reflect the way humans learn and generalize.

Chapter 2, 'Language acquisition and linguistic theory', is a critical evaluation of the Principles and Parameters model of language acquisition. The authors outline various problems and paradoxes associated with the idea that the learner must parse input in order to set parameters. This outline converges on the conclusion that the Principles and Parameters model 'seeds' the learning environment to an unwarranted extent: if the generalizations embodied in parameters can be extracted from the environment without prior knowledge, then Occam's razor requires that the relevant generalization must not be attributed to an innate property of the learner.

The following three chapters set out to test, through a series of simulations, how much and what kind of prior knowledge must be attributed to the learner in order to account for language acquisition. Chapter 3, 'The computational simulation of language acquisition: Aqui', investigates the limitations of a purely distributional approach to the acquisition of syntactic categories and concludes that such an approach is inadequate. The best a distributional technique can achieve is to discover semantically determined distributional regularities (unless the input to the system is seeded with the syntactic information it is meant to discover in the first place). Chapters 4, 'Computational simulation of language acquisition: CAMiLLe', and 5, 'Experiments with CAMiLLe', explore a dynamical system, CAMiLLe (Conservative Attentive Minimalist Language Learner), that has access to the meaning of the expressions to which it is exposed. A meaning corresponds to a representation in Conceptual Structure. Since these representations are themselves hierarchically structured and compositional, the learning mechanism has 'considerable information about the likely syntactic structure of the linguistic expression' (102). The authors argue that this information may be sufficient for successful language acquisition.

CAMiLLe has two representational systems, one for syntax and one for semantics. The system's learning task is to formulate correspondence rules that map a string of words onto a representation in Conceptual Structure. This process can be understood as the formation of couplings between trajectories in a syntactic space and trajectories in a semantic space. Self-organization has the effect that couplings that are similar (for example, those that differ in only one element in each representation) will migrate towards each other. In other words, the same organizational process that is active within the syntactic

space and is responsible for grouping trajectories into flows is also at work in the mapping system between the syntactic and the semantic space.

Parsing is viewed as the process of reducing a string to a head. For example, when the string *tall man* is coupled with the meaning MAN(TALL), this causes *tall man* to be reduced to *man*. Furthermore, the parser has no way of representing anything resembling a movement chain.

The experiments with CAMiLLe focus on categorization, structure and word order. Successful categorization seems to be hampered by the small size of the artificial data sets. The problems are mostly related to the lack of 'complete exemplification': for successful categorization to take place a word must be presented in sufficiently many and sufficiently varied examples with associated meaning. But since the meanings for a data set must all be supplied by hand, the samples on which CAMiLLe learns are of necessity quite small.

The experiments with structure are concerned with the acquisition of the internal structure of Determiner Phrases, argument structure and parsing. The system does not perform well on the first task, for reasons that remain unclear. By contrast, the extraction of argument structure correspondences is more successful. The discussion of parsing explains the system's limited ability to reduce adjacent words to a head. The process of finding a correct reduction 'is complex and involves many wrong guesses' (165). The basic system is also unable to deal with words that it recognizes but cannot assign a meaning to. The authors conclude that CAMiLLe's strategy of reducing a string to a head is in principle able to assign correct structure at the phrasal level.

The experiments with word order, finally, produce mixed results. Thus, the system is unable to arrive at correct generalizations in the domain of scrambling, apparently because too much information at the start of learning offers too many opportunities for spurious generalizations from which the learning system cannot recover. In a similar vein, the presence of too much diversity in form and interpretation associated with inversion phenomena appears to present an insurmountable challenge for CAMiLLe (see Elman 1993 for related discussion).

In chapter 6, 'Language change', the authors argue that social networks can be modeled as dynamical systems and that language 'gaps' (logically possible but non-existent languages) may result spontaneously from the transmission of linguistic properties in such networks (see also Culicover, Nowak & Borkowski 2003). It is suggested that the existence of Greenbergian implicational universals can be understood along these lines. An extension of the model concerns a hypothesis about the main force driving reorganisation of the dynamical system, put forward by Culicover & Nowak (2003). They argue that computational complexity associated with a particular cluster of grammatical properties results in a bias against that cluster, which will in turn lead to gaps in the set of (logically) possible languages.

Finally, chapter 7, 'Concrete minimalism', turns to the question of whether the dynamical model lends itself to adequate accounts of well-known

linguistic phenomena. It starts off by explaining how various design features of a minimal grammar, such as lexical categories, phrasal categories, structure and movement, can be represented in a dynamical system. This is followed by 'concrete minimalist' treatments of head-complement order, verb raising to the inflectional head I, verb second and inversion, clitic ordering, null arguments, *wh*-movement and scrambling. The analyses put forward are in terms of a very much simpler syntax than those in current minimalist work, allowing for syntactic representations that map onto representations in Conceptual Structure in a more transparent fashion than their counterparts in current minimalist theories.

Dynamical grammar makes an important contribution to the ongoing debate about how much innate structure must be attributed to the language learner. It explores a form of Linguistic Cognitivism that attempts to restrict innate structure to the domain of semantics (Conceptual Structure). As far as syntax is concerned, all that the learner starts out with is a minimally specified dynamical system. The exploration is backed up by actual simulations, using a simple version of the kind of dynamical system that the authors envisage. This allows the authors to evaluate the strengths and weaknesses of their proposals, and gives the reader a much better perspective on the issues at stake than an abstract presentation of the ideas on its own ever could. On the whole, this is a thought-provoking and worthwhile exercise that bears fruit in a number of ways.

Alongside proposals about the nature of language acquisition, *Dynamical grammar* also presents arguments for what one could call a 'simpler' syntax. Although these two aspects of the book are intertwined – the simpler syntax is much more suited to the dynamical view of language acquisition on offer – readers who find themselves unable to accept several of the arguments against the Principles and Parameters theory may still find much of value in the arguments for a simpler syntax.

I would like to single out two points for further discussion. Part I of the book moves smoothly from an argument against mental grammar (and in favour of emergence) to an argument against innately specified properties of syntax. My own view is that it is unhelpful to conflate these issues, which are logically independent. One could reject the view that a speaker-hearer's I-language is explicitly mentally represented and still accept that Universal Grammar is a correct theory of the emergent properties of our language faculty that our genes have been selected for. Put differently, our genetic endowment does not have to take the form of a mental grammar, present at birth. Instead, it may impose constraints on the way a dynamical system 'unfolds' over time.

The authors devote a lot of effort to establishing that the dynamical system can learn various aspects of natural language, but very little is said about what it canNOT learn. This is an important omission because a general learning mechanism may be able to learn regularities that are not in fact

found in natural languages. It could perhaps be argued that the mapping of strings to representations in Conceptual Structure, coupled with pressure to keep this mapping simple, is sufficient to rule out such unwanted consequences (after all, the properties of Conceptual Structure are themselves innately specified). But it is far from clear that this logic will be sufficient in the general case. Consider an example. A′-movement gives rise to a freezing effect: the A′-moved constituent is an island for extraction. It seems implausible to attribute this to semantic properties of the resulting structure. If it is attributed to issues of computational complexity or 'extreme twisting in the correspondence between the string and the C[onceptual] S[tructure]' (236), then why are freezing effects absent in the case of A-movement?

Overall, I found this a very enjoyable and worthwhile book. Its provocative stance forces the reader to reconsider the adequacy of a number of fundamental assumptions in linguistics, which cannot be a bad thing. Several of the results reported in this book, and particularly those about language change, deserve every linguist's careful consideration.

REFERENCES

Culicover, Peter (1999). *Syntactic nuts: hard cases, syntactic theory, and language acquisition* (Foundations of Syntax 1). Oxford: Oxford University Press.
Culicover, Peter & Nowak, Andrzej (2003). Markedness, antisymmetry and complexity of constructions. In Pica, Pierre & Rooryck, Johan (eds.), *Linguistic variation yearbook* (vol. 2). Amsterdam: John Benjamins. 5–30.
Culicover, Peter, Nowak, Andrzej & Borkowski, Wojciech (2003). Linguistic theory, explanation and the dynamics of grammar. In Moore, John & Polinsky, Maria (eds.), *The nature of explanation in linguistic theory*. Stanford, CA: CSLI Publications. 83–104.
Elman, Jeffrey (1993). Learning and development in neural networks: the importance of starting small. *Cognition* **48**. 71–99.
Jackendoff, Ray (1990). *Semantic structures*. Cambridge, MA: MIT Press.

Author's address: Department of Phonetics and Linguistics, University College London, Gower Street, London WC1E 6BT, U.K.
E-mail: hans@ling.ucl.ac.uk
(Received 18 February 2006)