

ROUTLEDGE LEADING LINGUISTS

Primitive Elements of Grammatical Theory

Papers by Jean-Roger Vergnaud and
His Collaborators

Edited by
Katherine McKinney-Bock and
Maria Luisa Zubizarreta

ROUTLEDGE



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First published 2014
by Routledge
711 Third Avenue, New York, NY 10017

and by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

*Routledge is an imprint of the Taylor & Francis Group,
an informa business*

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Library of Congress Cataloging-in-Publication Data

Primitive elements of grammatical theory : papers by Jean-Roger Vergnaud and his collaborators / Jean-Roger Vergnaud ; Edited by Katherine McKinney-Bock and Maria Luisa Zubizarreta.

pages cm. — (Routledge Leading Linguists ; 20)

Includes bibliographical references and index.

1. Grammar, Comparative and general. 2. Linguistics—Methodology. 3. Grammaticality (Linguistics) I. Vergnaud, Jean-Roger. II. McKinney-Bock, Katherine editor of compilation. III. Zubizarreta, Maria Luisa, editor of compilation.

P151P745 2013

415—dc23

2013012620

ISBN: 978-0-415-70539-4 (hbk)

ISBN: 978-1-315-88982-5 (ebk)

Typeset in Sabon
by Apex CoVantage, LLC

Printed and bound in the United States of America by Publishers Graphics, LLC on sustainably sourced paper.

Primitive Elements of Grammatical Theory

This book is a compilation of manuscripts and publications from 2001 to 2010 by Jean-Roger Vergnaud, in collaboration with colleagues and students. This work is guided by the scientific belief that broader mathematical principles should guide linguistic inquiry, as they guide classical biology and physics. From this, Vergnaud's hypotheses take the representation of the computational component of language to a more abstract level: one that *derives* constituent structure. He treats linguistic features as primitives and argues that a $2 \times n$ matrix allows for multiple discrete dimensions to represent symmetries in linguistic features and to derive the fabric of syntax (and perhaps of phonology as well).

Three primary research questions guide the core of these papers. (A) Methodologically, how can broadly defined mathematical/cognitive principles guide linguistic investigation? (B) To what extent do general mathematical principles apply *across* linguistic domains? What principles guide computation at different levels of linguistic structure (phonology, metrical structure, syntax)? (C) How is the computational domain defined?

In these manuscripts, Vergnaud's goal is not to radically depart from the Minimalist Program within generative grammar but rather to take the underlying goal of the generative program and bring it to an even more general scientific level. The themes of *symmetry* and *periodicity* in this book reflect his goal of scientific progress in linguistics, and he has opened the doors to new exploration of old empirical problems in linguistics that may, someday, have deeper biological and physical explanations through the theory presented in this publication.

Katherine McKinney-Bock recently completed her PhD in Department of Linguistics at the University of Southern California, USA and is joining Reed College for the academic year 2013–14 as a visiting assistant professor of linguistics.

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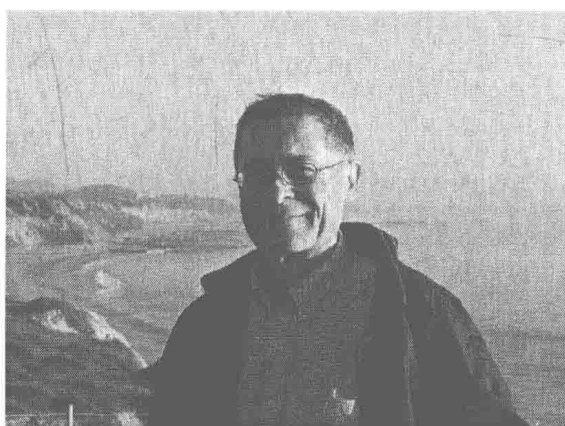
Edited by Carlos P. Otero, University of California, Los Angeles, USA

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Bock and Maria Luisa Zubizarreta*



**Dedicated to the memory of
Jean-Roger Vergnaud**

formalism to characterize natural language grammars. His thoughts were abstract, deep, and elegant, with a knack for uncovering new connections or parallelisms among divergent linguistic phenomena and subfields.

We present Jean-Roger's unfinished work in this volume with the hope that it will inspire others to pursue and explore the theoretical and empirical ramifications of the ideas contained therein. This endeavor would not have been possible without the contributions of his students Tommi Leung, Weiwen Roger Liao, and Katy McKinney-Bock and the support of his lifetime colleagues Robert Freidin, Alain Rouveret, and Henk van Riemsdijk. Very special thanks go to Katy—without her leadership and vision, this project would have never seen the light—and to the editor of the series, Carlos Otero, for encouragement and support. We also thank Elsevier/Lingua for permission to reprint chapter 2 and de Gruyter for permission to reprint chapter 3.

—Maria Luisa Zubizarreta

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1 Introduction

*Katherine McKinney-Bock and
Maria Luisa Zubizarreta*

This book is a compilation of manuscripts (chapters 4–7) and publications (chapters 2 and 3)¹ from 2001–2010 by Jean-Roger Vergnaud, in collaboration with colleagues and students.² This work is guided by the scientific belief that broader mathematical principles should guide linguistic inquiry as they have guided biology and physics, under the ‘Galilean style’ of science, or the “search for mathematical patterns in nature” (see chapter 2).

From this, Vergnaud’s hypotheses take the representation of the computational component of language to a more abstract level: one that *derives* constituent structure. He treats linguistic features as primitives, and argues that a $2 \times n$ matrix allows for multiple discrete dimensions to represent symmetries in linguistic features and to derive the fabric of syntax (and perhaps of phonology as well).

Three primary research questions guide the core of these papers. (A) Methodologically, how can broadly defined mathematical/cognitive principles guide linguistic investigation? (B) To what extent do general mathematical principles apply *across* linguistic domains? What principles guide computation at different levels of linguistic structure (phonology, metrical structure, syntax)? (C) How is the computational domain defined?

Looking to (A), this book approaches methods used in the relatively young field of generative grammar as guided by thought in theoretical physics and biology, particular that of the Galilean style:

A significant feature of the Generative Revolution in linguistics has been the development of a Galilean style in that field. And, to a great extent, the recent developments within MP [the Minimalist Program] must be viewed in this light—specifically, as Dirac’s mathematical procedure (method) at work within linguistics. Dirac has identified two main methods within the mathematical procedure itself: one is to remove inconsistencies, the other, to unite theories that were previously disjoint (see Dirac, 1968). In linguistics, the inconsistencies primarily concern overlapping grammatical conditions, as discussed earlier, which conflict with the basic assumption that C_{HL} has an optimal design. Note further that this assumption itself

relates directly to the quest for mathematical beauty, which informs the Galilean style. (chapter 2 of this volume, p. 37)

Coming from this philosophy, an overarching theme of this book that emerges is the general principle of *symmetry* (chapters 2, 5, and 7) and how it may guide syntactic thought. Empirically, Vergnaud explores the parallels between nominal and verbal domains, *deriving* them from his grammatical architecture. To cross linguistic domains, (B), Vergnaud uses a formal notion of periodicity (chapter 3) to derive stress patterns in metrical structure and *wh*-chains in syntactic structure *in the same formal way*. Then, looking to (C), Vergnaud explores notions of *long-distance dependency* and clausal domains and what it means to be non-local. The book gravitates toward a theory that derives all grammatical relationships as inherently *local*, and the appearance of displacement (or cyclicity; see chapter 3) is a product of how the formal computational system spells out. Dealing with higher-level operations, such as coordination and *wh*-quantification, leads to an extension of copy theory that has copying and deletion *at the level of phases*, triggering phase reduplication that allows for the appearance of displacement/movement.

The empirical applications of this book are broad, and in some sense, these manuscripts barely scratch the surface of the empirical consequences of these foundational proposals. Empirically, this book addresses relativization, the problem of split-antecedent relative clauses (chapter 6; cf. Perlmutter and Ross 1970), simple *wh*-questions and focus (chapter 5), classifier constructions in Chinese and *few/little* in English (chapter 7), as well as empirical parallels between the nominal and verbal domains (chapter 5; though see Megerdooomian 2002, 2008 for further empirical exploration as well). The book's purpose is not to resolve unresolved empirical problems (though it has some positive consequences in this direction; see chapters 6 and 7), but rather to clarify *what scientific principles can be used to guide linguistic thought*: a methodological, as strongly as a theoretical, proposal is put forth in these pages. The lines of inquiry proposed by Vergnaud in the final 10–15 years of his life open doors to further empirical research, and this book (almost by necessity) remains empirically incomplete. It is up to linguists to take the architecture proposed in this book and explore further empirical consequences.

Apparent throughout Vergnaud writings is the belief, in line with Chomskyan inquiry, that linguistic methods should have foundations in scientific methods. Using, for example “the heuristic of eliminating overlapping conditions” (chapter 2), the move from Government and Binding (GB) to the Minimalist Program (MP) allowed for the elimination of the Case Filter and government to the more general principle of Full Interpretation. Here, this work lays the foundation for an extension of the Minimalist Program, collapsing conditions such as the EPP, checking, and the Mirror Principle into

a single formal mechanism (see chapter 5) based on a guiding principle of symmetry. For example, the feature/category *D* is *T*, but found in a general nominal context rather than a verbal context.

In the pages of this detailed introduction, we begin to introduce the key ideas and key illustrations that Vergnaud provides in the pages of these manuscripts, as well as introducing the extensions to his theory in chapters 6 and 7. The ideas and innovations remain Vergnaud's and his coauthors', and any errors in argumentation, representation and interpretation are ours to bear.

PART I: GUIDING IDEAS IN LINGUISTIC SCIENCE

Chapter 2 in this volume is a reprint/republication of Freidin and Vergnaud (F&V) 2001. Here, the roots of Vergnaud's thought leading to the final 10 years of his work is represented, on a broader scale, setting the tone for the line of inquiry pursued in chapters 3–7 in this volume. F&V explore how general mathematical principles guide linguistic theory, and how methods used in the physical sciences should be used in linguistic thought as well.

Chapter 2 compares the general use of economy principles guiding computation across scientific disciplines to those used in linguistics, appealing to notions of conceptual naturalness like simplicity or economy which have been developed in other scientific disciplines. This appeal “is not unique to generative grammar. It has been employed fruitfully in the more developed natural sciences—in particular, theoretical physics. The discussion of physics that follows [in chapter 2] attempts to elucidate this notion in a way that, ultimately, should illuminate its role in contemporary theoretical linguistics” (p. 35).

Akin to the principle of *least time* used in physics to explore light travel (Fermat c. 1650), F&V suggest that the principle of economy of derivation used in the Minimalist Program (MP), the shortest derivation or restriction to unidirectional movement, is as valid to linguistic inquiry as *least time* is to physical inquiry. But even more importantly, chapter 2 illustrates that contributions by physicists go beyond just *physical* principles—they tell us something about the general nature of *computation* rather than just facts about the physical world. This gives us a “link between physics and linguistics”—at least “metaphorically”—which allows for principles such as the one mentioned above to guide linguistic thought.

Chapter 2 pushes the idea of economy further, and proposes that a general principle of *symmetry* may govern linguistics, as it does other fields of science, such that symmetries “enhance the economy of computations” (p. 42).³ They provide a preliminary empirical illustration of how working under a general symmetry principle derives Principle C, demonstrating that general principles can govern our linguistic research, with the right empirical consequences.

Looking to Dirac (1968), chapter 2 also explores the diversity of methods used in science; namely, Dirac's distinction between "experimental" and "mathematical" procedures. A key example of both procedures at work in physics would be the Heisenberg/Schrödinger discovery of quantum mechanics. Heisenberg used spectroscopy, experimental methods, to arrive at a similar conclusion as Schrödinger's theoretical work regarding spectral frequencies. Then, linking back to linguistics, F&V defend the "mathematical" procedure, contra an article by Lappin, Levine and Johnson 2000, which pushes the "experimental" procedure using Compton's 1923 methods in physics. But, a closer look by F&V show that Compton's experimental result was predated by Einstein 1917, using a "mathematical" procedure and providing principles without even making an experimental prediction. In light of this, F&V suggest that the scientific method of deriving facts from "first principles," such as that used within MP, is a valid and promising approach to understanding syntactic structures (as defined in *Syntactic Structures*).

Chapter 2 reminds the reader that "the mathematical perspective informs GP," and "because the MP is a particular implementation of GP [the Generative Program], the notion of perfection often invoked within MP is ultimately a mathematical notion, calling for a higher level of mathematical formalization in syntax" (p. 40; see also Chomsky 1995, 2004).

PART II: THE FORMAL SYSTEM

From Phonology to Syntax: A Formal Notion of *Occurrence* and *Chain* Is the Same in Both

A theory of metrical structure from Vergnaud's 2001–2004 line of thought (chapter 3) provides the roots of the grammatical architecture for both phonology (chapter 3) and syntax (chapter 3, section 8.4; developed in chapter 5). Vergnaud begins with a comparison of "clocks and number systems" to metrical structure, looking to the general mathematical notion of circular permutation, which he then uses to formalize metrical structure (and the notion of *chain*, which runs formally through both phonology and syntax). Vergnaud returns to the hypothesis that metrical structure and (syntactic) constituent structures are both hierarchical, and that the 'congruence' between the two is reduced to a correspondence between the two independently defined hierarchical structures. From this, chapter 3 looks to potential correspondence from clocks, and derives a notion of *occurrence* that allows for a formalization of chain in both metrical structure and syntactic structure. Each object used in a derivation (of stress, or of syntax), has two roles: that of a *goal* (chapter 3) or *item/interpretable* feature (chapter 5), or of a *source* (chapter 3), or *context/uninterpretable* feature (chapter 5). Then, a *checking*

mechanism allows for the generation of strings and a single pronounced item, from the two roles it plays.

Formalizing the Notion of Occurrence: A Comparison of Circular Permutations and Metrical Structure

Vergnaud illustrates a useful relationship between 'beats' of metrical structure (syllables and stressed syllables) and a clock system with two hands (a big hand and a little hand). To do this, Vergnaud begins with a metrical grid for the word *nominee*:

(1)

		*
*	*	*
1	2	3
n	o	m i n e e

Here, the lower tier represents the syllable, and the higher tier represents the stressed syllable, at the level of the word. One could repeat the metrical grid periodically to create a 'beat' (imagine repeating the word *nominee* over and over):

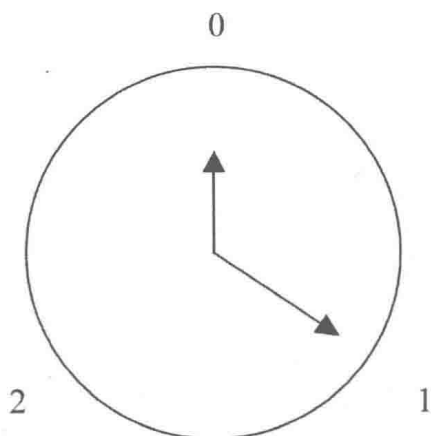
(2)

...	*		*		*		...
...	*	*	*	*	*	*	...
...		1	2	3
		n	o	m i n e e			

A *metrical constituent* is defined as a group of positions (syllables), and the stressed position is the *head* of the metrical constituent, representing the 'projection' of the head. This is the Hypothesis of Metrical Constituency (HMC), and it allows syntactic structure and metrical structure to be a correspondence between two *constituent structures* (Halle and Vergnaud 1987).

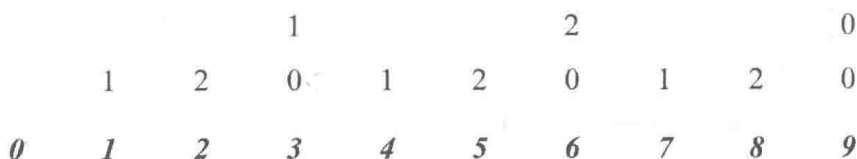
The pattern in (2) resembles a clock system, or a *circular permutation*, that repeats infinitely (of course, linguistic structure does not—but Vergnaud shows that the formal nature of these periodic structures is relevant to linguistic structure nonetheless). *Nominee* has 3 beats, so Vergnaud uses a clock with three numbers as an analogy. The bottom tier/syllable level corresponds to the big hand of a clock, and the top tier/word level corresponds to the little hand.

(3)



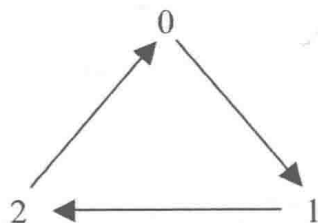
As the clock progresses, the little hand sits at 0 until the big hand makes a full revolution. When the big hand returns to 0, the little hand moves to 1, and sits at 1 until the big hand has made another revolution. This can be written out as in (4), with the bottom tier = big hand, and the top tier = little hand. This picture, in (4) resembles the metrical beat in (2).

(4)



As Vergnaud points out, "In essence, a clock/number system defines a hierarchy of equivalence relations among numbers." The classes can be constructed by mapping the circular permutation displayed in (5) onto the linear set of numbers (as in the bottom tier of 4, above).

(5)



(5) can be notated using pairs of numbers, or *coordinates*. For example, the edge going from 0 to 1, above, can be written as the pair (0, 1)—where the left coordinate represents the initial number, and the right coordinate

represents the final number. In (0, 1), the clock hand starts at 0 and ends at 1. Here is the full permutation:

(6) (i) (0, 1) (1, 2) (2, 0)

Mathematically, Vergnaud defines the pair as follows:

(ii) $[(x, y) =_{\text{def}} \text{"}y \text{ is the image of } x\text{"}]$: a circular permutation defined over the set $\{1, 2, 0\}$

The left coordinate, e.g. 0, *precedes* the right coordinate in a pair, e.g. 1. The clock hand starts at 0, and 0 *occurs first*, followed by the clock hand moving to 1, where 1 *occurs second*. So:

(iii) $[(x, y) =_{\text{def}} \text{"any occurrence of } x \text{ precedes an occurrence of } y\text{"}]$: a periodic distribution of 1, 2, and 0 defined over an infinite discrete linear set

The analogy Vergnaud draws between a metrical grid and a circular permutation is the beginning of his defining a formal notion of *occurrence* in linguistics, both in metrical structure and in syntax.

Notice, in (6), that each number occurs once as a left coordinate and once as a right coordinate. Similarly in (4), repeated here, the number 0 *occurs* three times in the bottom tier:

(7)

			1			2			0
	1	2	0	1	2	0	1	2	0
0	1	2	3	4	5	6	7	8	9

We can separate the *type* of object from the *instance*. The *type* of number 0, is an element of the set $\{0, 1, 2\}$, and it has some set of properties associated with it. There are three *instances* of 0 in (4)/(7), marked by the little hand of the clock: 0 occurs when the little hand is at 1, again when it is at 2, and again when it is at 0 (marked by positions 3, 6 and 9). Vergnaud defines a set of *occurrences* (e.g. of 0) as a *chain*. Here, the fact that 0 occurs three times is independent of the set of properties that define what 0 is; rather, it is based on the hands of the clock. Vergnaud calls ω the set of properties associated with some object (say, 0, or more linguistically, say, some grammatical object, e.g. T, which has a bundle of features), and he calls I the set of properties that can be freely associated with all objects, which can alternatively be called a set of *indices*—here, the system of the hands of the clock. Then, he defines an *occurrence* of ω (e.g. 0) as the pairing of ω with

some element in I . However, the indices here are not arbitrary; rather, they arise from the properties of the clock itself: they arise from the properties of the *formal system*.

Vergnaud discusses the difference between the clock system/permutation and metrical structure, which is topological: the former is two-dimensional, and the latter is one-dimensional. One can convert the two-dimensional clock to one dimension (see chapter 3, section 5), and end up with the following:

(8) 0112|0

The clock can be arranged linearly to generate any of the following sequences:

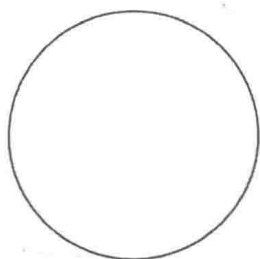
(9) (i) 0112|0

(ii) 112|01

(iii) 2|0112

Notice that, to preserve the effects of a permutation (or a circle) in one dimension, the ends must be repeated. To briefly illustrate, we can look to a circle such as that which follows. The circle is “topologically equivalent” to a line in which the two ends are “identified,” or equal to one another:

(10) (i)



(ii)



A

B

$A = B$

Here, A and B are two *occurrences* of the same object (e.g. 0 in (9), above), and constitute a *chain*.

Returning to the two-dimensional permutation, we see that each object/number occurs as a left coordinate and as a right coordinate:

(11) (i) (0, 1) (1, 2) (2, 0)