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INTERFACE EXPLORATIONS

Syntax and Morphology Multidimensional

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Introduction: Multiple dimensions in syntax and morphology

Andreas Nolda and Oliver Teuber

The present volume collects papers that approach theoretical and empirical problems in syntax and morphology from a multidimensional point of view. In such an approach to syntax or morphology, syntactic phrases, morphological words and the like are conceived of as syntactic or morphological constructs with multiple, interrelated components, each representing morphosyntactic properties of different kinds. Thereby one can describe, say, hierarchical structure and linear order, or morphosyntactic categories and functions in their own right, without neglecting their interrelations.

The aim of this introductory article is to clarify what we mean by "multidimensionality" and to provide an overview of the volume. We proceed as follows. Section 1 discusses the distinction between multidimensionality and monodimensionality. Section 2 exemplifies monodimensional approaches by a Government and Binding analysis. Section 3 characterizes multidimensional frameworks insofar as they are represented in this volume. Section 4 finally shows how the papers of the volume relate to its general topic.

1. Multidimensionality vs. monodimensionality

Morphosyntactic objects such as syntactic phrases or morphological words are conceived of in different ways by different theoretical approaches. They are modeled as constituent structures, dependency structures, feature structures, etc. or as combinations thereof.[1] Assume, for instance, that in a certain theoretical framework morphosyntactic objects are modeled jointly by a constituent structure – representing, say, hierarchical structure, linear order, and phonological form – and a feature structure – representing morphosyntactic categories and functions. Then we shall take the pair consisting of the constituent structure and the feature structure to be a two-dimensional morphosyntactic construct. If,

1. Note that constituent structures, dependency structures, and feature structures can themselves be formalized in different ways, e.g., by set-theoretical or graph-theoretical means.

however, all of those properties are represented by a constituent structure only, the latter is a one-dimensional morphosyntactic construct.

In more general terms, then, morphosyntactic constructs are *multidimensional* if they are composed of several components, each representing morphosyntactic properties of (at least partially) *different* kinds. Otherwise morphosyntactic constructs are *monodimensional.* By extension, we shall say that a theoretical framework is *multidimensional* itself if it models morphosyntactic objects by multidimensional constructs. Similarly, a framework is *monodimensional* if it models morphosyntactic objects by monodimensional constructs.

From a metatheoretical point of view, monodimensional frameworks may appeal because of the uniformity and ontological parsimony of their morphosyntactic constructs. The number of their components is reduced to the bare minimum: one. By contrast, morphosyntactic constructs in multidimensional frameworks are more complex. They are composed of several components, that do not only represent different kinds of morphosyntactic properties, but often also differ with respect to their type (constituent structure, dependency structure, feature structure, etc.). In addition, multidimensional frameworks have to provide means for relating corresponding parts in different components of a given morphosyntactic construct.

On the other hand, monodimensional frameworks tend to posit rather intricate structures for their morphosyntactic constructs because the latter have to represent, and distinguish, properties of various kinds. In multidimensional frameworks, however, the individual components of morphosyntactic constructs can have relatively simple structures, which are specifically adapted to the one or few kinds of morphosyntactic properties they represent.

Another advantage of multidimensional frameworks is that different kinds of morphosyntactic properties can be described in their own right, such that mismatches between them are accounted for easily. Assume, for instance, that in a given multidimensional framework hierarchical structure and linear order are represented by different components of morphosyntactic constructs. Then discontinuous constituents can be directly represented (instead of being 'simulated' by movement operations or other technical devices).

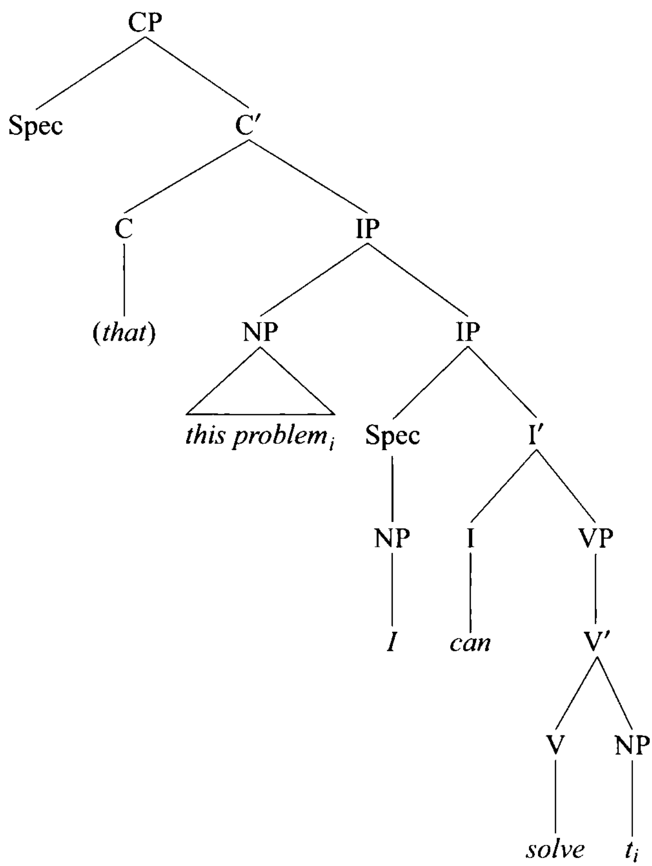
As a matter of fact, monodimensional frameworks are often multistratal ones. In a multistratal framework morphosyntactic objects are modeled by sequences of derivationally related constructs. In such a sequence all constructs are of the same type (e.g. constituent structures) and represent morphosyntactic properties of (at least partially) *identical* kinds. Typically, though not necessarily, they are assigned to different 'descriptive levels' or 'derivational stages' (such as 'deep' and 'surface structures'). Multidimensional frameworks, however, normally happen to be monostratal ones. Due to the multidimensional nature of their morphosyntactic constructs there arises no need for assuming more than a single 'descriptive level'.

2. A monodimensional example

A well-known monodimensional, and multistratal, framework is the Government and Binding (or Principles and Parameters) incarnation of Generative Grammar (Chomsky 1981, 1986). Ouhalla (1999: 136–137), for example, models clause (1) in this framework by a sequence of constituent structures with (2) as the S-structure (roughly, 'surface structure') member:

(1) (*that*) *this problem, I can solve*

(2)



(2) is a monodimensional syntactic construct, representing at the same time hierarchical structure, linear order,[2] syntactic categories, and – to a certain degree – syntactic functions. In addition, it contains a coindexed trace t_i, linking (2) with the D-structure (roughly, 'deep structure') member of the sequence (another constituent structure, not given here).

As a rule, syntactic objects are modeled by constituent structures with a root constituent of a phrasal category *XP*, and morphological ones by constituent structures with a root constituent of a lexical category *X*. According to *X*-bar theory, the syntactic functions head, complement, adjunct, and specifier are relations between positions in local tree configurations. In a local tree of category *X'*, for example, the relation of a *YP* daughter to an *X* daughter counts as a complement relation, while its relation to an *X'* daughter counts as an adjunct relation. In a local tree of category *XP*, in turn, the relation of a *YP* daughter to an *X'* daughter counts as a specifier relation, while its relation to an *XP* daughter counts again as an adjunct relation.

In order to represent syntactic functions in an unambiguous way,[3] *X*-bar theory has to assume relatively complex constituent structures. The non-branching VP configuration in (2) is a direct consequence of representing syntactic functions by means of *X*-bar theoretic relations between constituent structure positions.[4] Regarding hierarchical structure (in terms of part-whole relations), the non-branching configuration is redundant: both the VP node and the V' node stand for the same verbal constituent. But without the intervening V' node between the VP and the contained NP, the syntactic function of the latter could not be determined by reference to *X*-bar theoretic principles.

The joint representation of hierarchical structure, linear order, and syntactic functions by the same constituent structure can lead to further complexity, since Chomskyan Generative Grammar does not allow for discontinuous constituents. In (1) *this problem* is a complement (the direct object) of *solve*, that is

2. In the Minimalist Program of current Generative Grammar, syntactic structures do not directly represent linear order. According to Chomsky's (1995) 'bare phrase structure' conception, syntactic structures are unordered sets. Their linearization is delegated to the phonological component.
3. As a matter of fact, functional ambiguities *can* occur in *X*-bar theoretic tree structures despite their relative complexity. This is the case in adjunction configurations where mother and daughters are of the same category *XP*. Unless further principles are stipulated for the distinction between head and adjunct (such as their relative linear order; cf. Kayne 1994), the direction of the adjunct relation cannot be uniquely determined.
4. By giving up *X*-bar theory, the Minimalist Program avoids non-branching structures (cf. Chomsky 1995).

topicalized for information-structural reasons. In order to represent the complement function of *this problem* in accordance with *X*-bar theory, *solve* and *this problem* would have to form an *X'* constituent with *solve* as an *X* daughter and *this problem* as a *YP* daughter. Due to the topicalization of *this problem*, that *X'* constituent would be discontinuous, though. In the Government and Binding framework one resolves this sort of dilemma by representing syntactic functions on D-structure but not necessarily on S-structure; surface linear order, in turn, is represented on S-structure, but not necessarily on D-structure.

3. Multidimensional frameworks

We shall now characterize selected multidimensional frameworks – those frameworks that are presupposed in papers of this volume. These are Lexical-Functional Grammar, Head-driven Phrase Structure Grammar, the Parallel Architecture, and Integrational Linguistics.[5]

3.1. Lexical-Functional Grammar

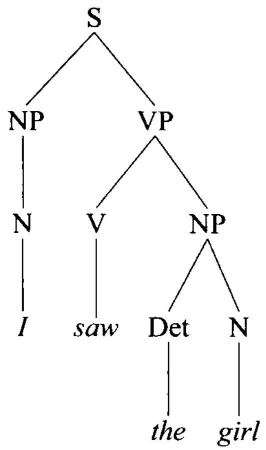
Lexical Functional Grammar (LFG) in the original version of Kaplan and Bresnan (1982) models morphosyntactic objects by constructs containing a *constituent structure* (*c-structure*) and a *functional structure* (*f-structure*). Newer versions assume additional components such as *argument structure* (*a-structure*) (cf. Bresnan 2001).

Kaplan (1995: 10–11), for instance, models sentence (3) jointly by the c-structure (4a) and the f-structure (4b):

(3) *I saw the girl.*

5. Multidimensional frameworks that are not represented within the present volume include Construction Grammar approaches such as Berkeley Construction Grammar (cf., *inter alia*, Fillmore 1999; Kay 2002).

(4) a.



b.

$$\begin{bmatrix} \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`pro'} \\ \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{TENSE} & \text{PAST} \\ \text{PRED} & \text{`see } \langle (\uparrow \text{SUBJ}), (\uparrow \text{OBJ}) \rangle \text{'} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`girl'} \\ \text{DEF} & + \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}$$

The c-structure (4a) represents hierarchical structure in terms of constituents and constituent categories. Since (4a) is formalized as an ordered tree graph, it also represents linear order. The f-structure (4b) represents morphosyntactic categories such as first person and singular, grammatical functions, and lexical meanings. Linear order is not accounted for by (4b), being formalized as a set-theoretic function.

C-structures and f-structures are linked by a structural correspondence function (not given here; for details cf. Kaplan 1995: 15–18), mapping constituents of (4a) to parts of (4b). Note that c-structures and f-structures need not be isomorphic. In (4a), for example, the constituents *saw*, *saw the girl*, and *I saw the girl* all correspond to (4b) as a whole.

3.2. Head-driven Phrase Structure Grammar

Head-driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1987, 1994) models syntactic and morphological objects exclusively by means of typed feature structures. They are described by constraints, which are equally formulated in terms of feature structures.

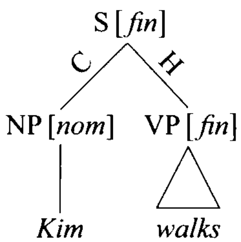
(6), for example, is a (simplified) model of sentence (5) (cf. Pollard and Sag 1994: 32; type specifications are suppressed):

(5) *Kim walks.*

(6)
$$\begin{bmatrix} \text{PHON} & \langle \textit{Kim, walks} \rangle \\ \text{SYNSEM} & \text{S}[\textit{fin}] \\ \text{DTRS} & \begin{bmatrix} \text{HEAD-DTR} & \begin{bmatrix} \text{PHON} & \langle \textit{walks} \rangle \\ \text{SYNSEM} & \text{VP}[\textit{fin}] \end{bmatrix} \\ \text{COMP-DTRS} & \left\langle \begin{bmatrix} \text{PHON} & \langle \textit{Kim} \rangle \\ \text{SYNSEM} & \text{NP}[\textit{nom}] \end{bmatrix} \right\rangle \end{bmatrix} \end{bmatrix}$$

Informally, (6) can be notated as in (7):

(7)



The SYNSEM features in (6) specify, *inter alia*, syntactic categories (denoted by feature structures, abbreviated here as "S[*fin*]", "NP[*nom*]", etc.). The HEAD-DTR and COMP-DTRS features represent hierarchical structure and syntactic functions, conforming to the *immediate dominance* (*ID*) *schemata* of the grammar. The PHON value represents phonological form and linear order, the latter being constrained by the grammar's *linear precedence* (*LP*) *constraints*. Since in classical HPSG LP constraints apply to sister constituents only, discontinuous structures cannot be described.[6]

The restriction to continuous constituents, however, is lifted in linearization-based HPSG, notably developed by Reape (1992, 1996). According to him (1992: 17) "syntactic structure should be formulated independently of word order and then the relation between the two investigated". To this aim, he

6. The HPSG distinction between ID schemata and LP constraints takes up the ID/LP rule format of Generalized Phrase Structure Grammar (GPSG) (Gazdar et al. 1985). Note that in a GPSG-style ID/LP grammar, ID rules still impose *some* constraints on linear order, since the domain of LP rules is restricted to sister constituents.

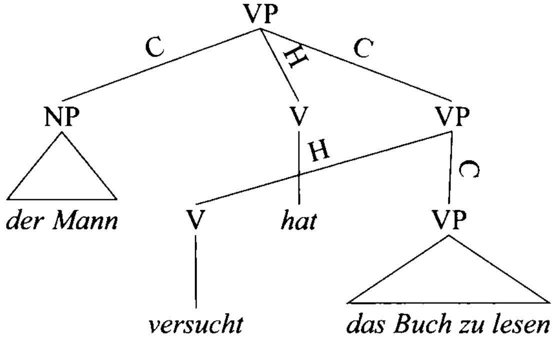
introduces a separate component for representing word-order – so-called *order domains*, conceived as lists of *domain objects.*

Consider (8) as an example:

(8) (*dass*) *der Mann versucht hat, das Buch zu lesen*
that the man tried has the book to read
'(that) the man tried to read the book'

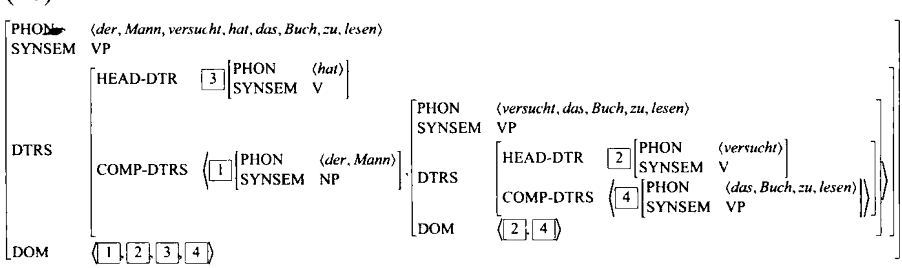
According to Reape (1996: 217–218), the unordered hierarchical structure of (8) involves a constituent *versucht das Buch zu lesen*, that is discontinuously linearized in the corresponding order domain. Using the same informal notation as in (7), the essentials of Reape's (1996) analysis can be sketched as in (9):

(9)



A more formal representation is given in (10):[7]

(10)



7. In his version of linearization-based HPSG, Reape uses the features "SYN" and "ARG-DTRS" instead of "SYNSEM" and "COMP-DTRS", respectively. Boxed numerals indicate token-identical values.

The PHON value of (10) now results from concatenating the PHON values of the domain objects in the DOM list, to which LP constraints apply in linearization-based HPSG. Note that domain objects may be immediate constituents or non-immediate ones. In the latter case (as in the top-level DOM list in (10) with the domain objects *versucht* and *das Buch zu lesen*), constituents can be discontinuously linearized.

The classical approach to morphology in HPSG is an item-and-process one: feature structures modeling morphological objects (e.g. stems) are mapped onto feature structures modeling morphological or syntactic ones (stems or words) by *lexical rules* (Pollard and Sag 1987: chap. 8). For a recent overview, including also alternative item-and-arrangement approaches, cf. Müller (2008: chap. 19).

3.3. The Parallel Architecture

In the Parallel Architecture (PA) framework (Jackendoff 1997, 2002; Culicover and Jackendoff 2005) the grammatical structure of a syntactic (or morphological) object is conceived as a triple containing a *(morpho)phonological structure*, a *(morpho)syntactic structure*, and a *semantic structure*. Each structure can in turn be composed of several tiers.

Example (12) outlines the grammatical structure of sentence (11) (cf. Culicover and Jackendoff 2005: 193):

(11) *Pat gave Dan a book.*

(12) a. *Pat*$_2$ *gave*$_1$ *Dan*$_3$ *a book*$_4$
b. [NP$_2$ [$_{VP}$ V$_1$ NP$_3$ NP$_4$]$_1$]$_1$
c. GF$_2$ > GF$_3$ > GF$_4$
d. [GIVE (PAT$_2$, DAN$_3$, [BOOK; INDEF]$_4$)]$_1$

(12a) gives the phonological structure of (11) in orthographic terms, neglecting its articulation into several tiers. (12b) represents the hierarchical structure of (11) in form of a headed syntactic constituent structure. The grammatical function tier (12c) ranks unspecified grammatical functions. (12d) formulates the conceptual structure of (11) (further semantic tiers are ignored).

Each structure in (12) is constrained by a separate combinatorial component of the grammar with its own primitives and principles of combination. The primitives of the syntactic combinatorial component, which constrains syntactic constituent structures, are syntactic categories and features. Its principles of combination are principles of constituency and principles of linear order.[8] Correspondences between parts of different structures – expressed by numerical indices in (12) – are constrained by interface components of the grammar.

The multidimensionality of the grammar architecture allows Culicover and Jackendoff (2005) to design a 'simpler syntax'. Syntactic constituent structures can be as flat as possible, since they do not represent, e.g., any syntactic functions beyond the head function.

3.4. Integrational Linguistics

Ever since the seminal work of Lieb (1983),[9] Integrational Linguistics (IL) conceives structured syntactic objects as triples composed of a *syntactic unit*, a *syntactic structure*, and a *lexical interpretation*. Syntactic structures in turn are taken to consist of a *constituent structure*, a categorial *marking structure*, and an *intonation structure*.

(14) gives, in informal notations, the syntactic unit (14a), the syntactic intonation structure (14b), the syntactic constituent structure (14c), the syntactic marking structure (14d), and the lexical interpretation (14e) of sentence (13) (cf. Nolda 2007: 153–183):

(13) *Ich habe nur französischen Rotwein.*
I have only French red wine
'I only have French red wine.'

(14) a.

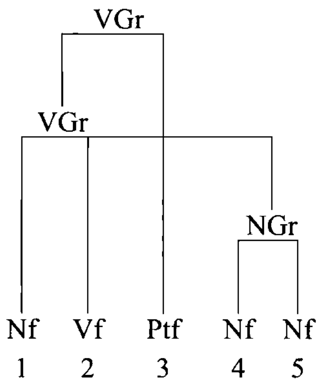
1	2	3	4	5
ich	*habe*	*nur*	*französischen*	*Rotwein*

8. In addition to GPSG-style LP rules, Culicover and Jackendoff (2005) make use of 'default' LP rules, specifying the default order of sister constituents, and 'edge' LP rules, linearizing constituents at the left or right edge of the mother constituent.
9. For recent introductions to the framework cf. Nolda (2007: chap. 7) and Sackmann (2008). The framework is presupposed, *inter alia*, by Eisenberg's (2006) German reference grammar.

b. 1 2 3 4 5

L | HL | H | L H_r L L | L_d L

c.



d.

1	2
PERS-PRON, 1PERS, . . .	MAIN-V, NOM+ACC, . . .
Nom, Sing_{Nf}, . . .	1Pers, Sing_{Vf}, Pres, . . .
	⋮

3	4	5
QUAL-W, . . .	ADJ, . . .	MASS-N, MASC, . . .
Unm_{Ptf}	Acc, Sing_{Nf}, Masc, . . .	Acc, Sing_{Nf}, . . .
		⋮

e.

1	2	3	4	5
·I·	·have_1·	c^0	·French_1·	·red wine_1·

From a formal point of view, all of those components are set-theoretical functions. Their domains consist of position numbers, or sets of such numbers, representing linear order and linking corresponding parts of different components. The syntactic unit (14a) is a function from positions to phonological words (notated here as orthographic words). The intonation structure (14b) associates the positions with one or several sets of auditive values (one set per syllable; only pitches are considered above). The constituent structure (14c) maps sets of positions to constituent categories such as Nf ('noun form', including substantival as well as adjectival word forms) or NGr ('noun group'). Note that the VGr ('verb group') *ich habe französischen Rotwein* is a discontinuous constituent in (14c), interrupted by the Ptf ('particle form') *nur*. For those position sets that are assigned basic constituent categories, the marking structure (14d) supplies further categorizations in terms of *lexical word categories* (e.g. ADJ) and