Three-Dimensional Grammar

Mark de Vries

1. Introduction

The current model of generative syntax focuses on hypo/hypertactic relations. This is the result of restrictions on phrase structure and transformations, "binary branching" for instance. Arguably, these restrictions establish a fruitful research strategy. However, at present we face the problem that a whole range of paratactic constructions such as coordination and parentheses cannot satisfactorily be dealt with.[1] I think the scope of this problem can hardly be exaggerated. Therefore we need a solution of a fundamental type, which generalizes in some way over all different paratactic constructions. And this solution may be the introduction of a so-called third dimension into the syntax. In essence, it amounts to the addition of the relation *behindance*, next to *dominance* and *precedence*. In this article I intend to outline the research program on three-dimensional grammar. For reasons of space, the discussion can only be suggestive here. In section 2 I will show why paratactic constructions lead to the assumption of behindance. Section 3 discusses some of the implications for syntactic theory. Section 4 is on linearization and the number of degrees of freedom. Section 5 is the conclusion.

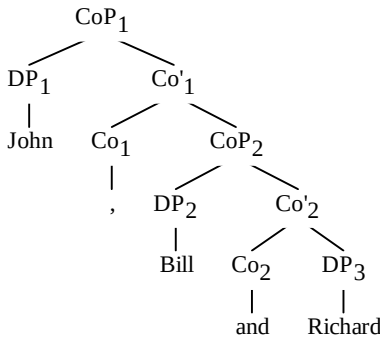
2. Parataxis as behindance

The prototypical example of parataxis is common coordination. See (1).

(1) Alice saw John, Bill and Richard.

A Kayne (1994)- or Johannessen (1998)-type analysis of the direct object is drawn in (2), where CoP is a coordination phrase.

(2)



However, the informal analysis in (3) has a more intuitive appeal:

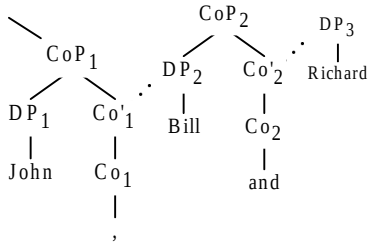
(3) Alice saw { John / Bill / Richard }

Here the members of the complex object are paratactically construed, that is, they are not hierarchically ordered with respect to each other. They can be viewed as being behind each other. This idea is confirmed by the fact that there is no c-command relation between conjuncts, which is one of the conclusions by Progovac's (1998) overview article on coordination. An illustration in Dutch could be (4), where binding of the anaphor is blocked:

(4) a. * een gesprek tussen [Joop$_i$ en zichzelf$_i$]
a conversation between Joop and SE-SELF
b. * een gesprek tussen [[Joop en Jaap]$_i$ en [elkaars$_i$ buren]]
a conversation between Joop and Jaap and each.other's neighbours

Note that (4a) is correct if we use *hemzelf* 'PRON-SELF', which is not an anaphor in the strict sense.[2]

Therefore, I agree with e.g. Goodall (1987) that coordination involves "parallel structures". However, Johannessen (1998) and others are right in that, for several reasons, we need a coordination phrase. For instance, a conjunction meets the criteria of a functional head.[3] Furthermore, we simply need a node to assign the plural feature to. Thus it seems that a mixed analysis is necessary, i.e. an analysis in which a CoP and behindance are combined. This is what Grootveld (1992, 1994) has claimed, too. An example of such an analysis is (5), from De Vries (2002b).

(5) 

Here the dotted lines indicate behindance.

Furthermore, G. de Vries (1987, 1992) has shown that the possibility of a parallel structure can be used to explain right node raising, on the assumption that sharing of structure is allowed. An informal example in Dutch is (6):

(6) dat Joop graag voor
maar Jaap na
het ontbijt doucht.

that Joop preferably before, but Jaap after | the breakfast takes.a.shower
'…that Joop likes to take a shower before breakfast, but Jaap … after breakfast'

Since the shared part is not even a constituent, a traditional analysis in terms of rightward movement is out of the question. Moreover, it is well-known that RNR may violate locality and that the conjuncts do not need to be parallel, as long as the rightward part is similar. This differs from gapping, hence an analysis in terms of ellipsis or deletion is also difficult.[4]

A related phenomenon is across-the-board movement. In the traditional approach of the example in (7), *who* must relate to two different traces:

(7) Who_i did you say that [[Joop saw t_i] [and [Jaap greeted t_i]]] ?

But this is at variance with standard assumptions such as the bi-uniqueness principle.[5] If, however, the coordinated clauses are partially behind each other ("in different planes"), the possibility of ATB-movement becomes more or less obvious. This is informally sketched in (8):[6]

(8) Who_i did you say that
Joop saw
and Jaap greeted
t_i

Next, consider the phenomenon of specifying coordination. An example from Kraak & Klooster (1968) is (9):

(9) Fik is een hond, *en wel* een poedel.
'Fik is a dog, namely a poodle.'

If we construe this asyndetically at the DP-level, we get an apposition:

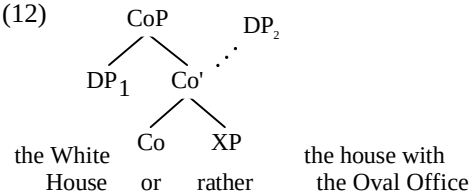
(10) a. John, our boss
b. something miraculous, a golden bicycle

If we make the second conjunct more complex, it becomes an appositive relative clause; see (11):

(11) John, who is our boss

I have argued in my dissertation that appositions and appositive relatives must be analysed in terms of specifying coordination. This is in accordance with Koster (2000). What has gone unnoticed so far is that specifying coordination provides an additional argument for a three-dimensional analysis of coordination. Consider the specifying connection in the constructions at hand. It can be asyndetic or *or, or rather, namely, and that is to say*, etc. depending on the particular construction and meaning. Clearly, there can be a phrase between the coordinative head and the second conjunct. Therefore this conjunct cannot be the syntactic complement of the coordinative head. Rather it is the intervening phrase that is the complement of Co, and the second conjunct is behind Co'; one could call DP_2 the "paratactic complement". The complex Co' as a whole denotes a specifying conjunction. A picture of this idea is (12). The category of the phrase XP does not concern us here.

(12)



But there is more to parataxis than just coordination. Van Riemsdijk (1998, 2000a/b, 2001a/b) has drawn our attention to cases of sentence entanglement, "syntactic amalgams" in Lakoff's (1974) words. These are: parentheses, hedges, comment clauses, transparent free relatives, interjections, tag questions, *wh*-prefixes and infixes, German *wh*-imperatives, the Dutch and German type of parasitic gaps,[7] internally headed relative clauses, matching free relatives, the so-called Horn cases, and 'far from' phrases. I have no doubt that some of these

can be satisfactorily treated in a more traditional grammar, but several of them are extremely problematic. Thus consider a Horn-type sentence such as (13):

(13) Jan is gisteren naar [ik dacht dat het *Marseille* was] vertrokken.
Jan has yesterday to [I thought that it Marseille was] left
'Jan left for I thought it was Marseille yesterday.'

Here the preposition seems to select a noun phrase, *Marseille*, that is in the middle of a parenthetical clause (which shows verb second). We could make sense of the construction if this clause is in a parallel structure and the DP *Marseille* is shared with the main clause. InVan Riemsdijk's terms this would be a "saddle graft".

Another example is the so-called transparent free relative (TFR) construction:

(14) Balkenende is een wat critici noemen waardeloze premier
Balkenende is a what critics call worthless prime.minister

In (14) the TFR is *wat critici noemen: waardeloos*. The ending *-e-* of the adjective *waardeloze* shows that it interacts somehow with the main clause, which seems to be: *Balkenende is een waardeloze premier*. The bracketing paradox in (14) could be relieved if the TFR is in a parallel structure, and the adjective is shared with the main clause. This analysis is supported by (15), taken from Van Riemsdijk (2000b), which shows a Case matching effect in German TFRs.[8]

(15) a. Ich habe mir [was man als *einen schnellen Wagen*$_{acc}$
I have me what one as a fast car
bezeichnen^{+acc} könnte] gekauft^{+acc}.
characterize could bought
'I have bought what one could characterize as a fast car.'

b. * Ich habe mir [was von vielen als {*ein schneller Wagen*$_{nom}$,
I have me what by many as a fast car
einen schnellen Wagen$_{acc}$} bezeichnet werden würde^{+nom}] gekauft^{+acc}.
a fast car characterized be would bought
'I have bought what by many would be characterized as a fast car.'

Since the concerning DP *ein schneller Wagen* is embedded in a free relative, the interaction with he main clause is completely unexpected, unless the TFR is in a parallel structure and the DP is shared with the main clause.

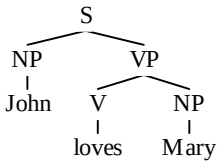
So far, I have shown that a third dimension could be a useful addition to syntax in principle. In general we can say this: paratactic material interferes with the linear order of the matrix, but it backs out of the dominance relations.

Therefore I will assume that two nodes in a syntactic structure can be related not only by dominance, but also by "behindance". The next section shows that behindance, like precedence and dominance, must be a local relation between nodes.

3. Behindance as a local relation

Goodall (1987) has formulated coordination in terms of union of reduced phrase markers (RPM) of the Lasnik & Kupin (1977) type. An example of a RPM is *{S, NP loves Mary, John VP, John V Mary, John loves NP, John loves Mary}*. It is an unordered set of strings that contain one non-terminal each, plus the complete terminal string. The strings are related by dominance and precedence, and the reduced phrase marker can be represented (or, "abbreviated") by a tree structure:

(16)



But the union of two of these is an object that cannot be represented by a regular tree. It contains strings that do neither dominate nor precede each other. See (17), taken from G. de Vries (1992:62):

(17) { S,
NP loves Mary, NP hates Susan,
John VP,
John V Mary, John V Susan,
John loves NP, John hates NP,
John loves Mary, John hates Susan }

Again the strings are unordered, but rendered suggestively; (17) can be spelled out as "John loves Mary and hates Susan".

However, I don't think this formalism can be translated into the present derivational framework (e.g. Chomsky 1995). Moreover, the linearization procedure is unclear and it gives rise to certain ambiguities, as argued by Van Oirsouw (1987). According to Grootveld (1992) the source of the problems is the fact that the third dimension is not defined in terms of a relation. She even states that "Goodall does not take the third dimension seriously".

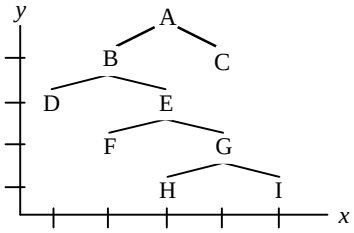
So let us assume, as argued before, that next to dominance and precedence we have a third relation called *behindance*. We can then say that syntactic

relations are defined in terms of dominance, whereas behindance encodes paratactic relations, and precedence is related directly to word order.

Independent relations are mathematically orthogonal to each other. Since we have three degrees of freedom here, we may envisage the syntactical space as a cube.[9] The x-axis encodes precedence, the y-axis dominance and the z-axis behindance.

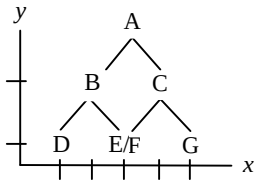
Does this mean that the nodes in the tree can be identified with absolute coordinates? The answer must be a clear *no*. First look at a syntactic tree in an x-y plane. An example is (18). Ask yourself whether node I should follow or precede C.

(18)



In terms of absolute coordinates I follows C, but this is at odds with standard conventions. Another example is (19), where B is a complex specifier of F:

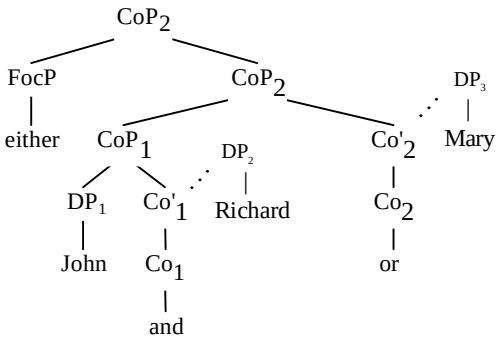
(19)



In (19) E and F have the same absolute coordinates, which is unwanted.

A similar effect can be obtained within the third dimension. Consider a double coordination of the type *either John and Richard, or Mary*. Here the three names are hierarchically ordered in the sense that the first conjunction CoP_1 as a whole is the first conjunct of the second conjunction CoP_2. See (20). (The initial coordinator *either* is treated as an adjoined focus phrase; cf. Hendriks & Zwart (2001). Again the dotted lines indicate behindance, as in (5) above.)

(20)



Clearly, then, the second and third DP have the same absolute z-coordinate. Still, we would want to claim that DP_3 is in a sense behind both DP_1 and DP_2.

Thus we arrive at an important conclusion: nodes cannot be assigned absolute coordinates, but they are *locally* related by the notions dominance, precedence and behindance. Non-local relations must be inferred from the transitivity property of these. Therefore it makes no sense to speak about "planes" in the third dimension (e.g. DP_2 and DP_3 in (20) would be in the x-y plane with absolute z-coordinate 2 if the matrix is in z=1). Similarly, the nodes on a vertical or horizontal line in a 2D structure are not (necessarily) related, e.g. A, E and H in (18).

4. Linearization and the independence of the three dimensions

One of the most salient issues concerning three-dimensional graphs is the matter of linearization. After all, a syntactic object must be transformed into a string of words before it can be pronounced. If every node has a fixed local relation to adjacent nodes, then it should not be too difficult to design an algorithm that scans the graph and maps it into a string. But this depends on the properties of the graph, so we have to find plausible ways to exclude ambiguities and, in general, restrict the possibilities. The most fruitful strategy, I think, is that we maintain binary branching in the y-z direction and the z-x direction, and fix a global direction of branching for each of the three dimensions.[10] These restrictions can be encoded in the definition of Merge. (For instance, if we $Merge_{xy}$ A and B into C, then C dominates both A and B hence the tree is downward and binary branching in the x-y cross-section.)

Linearization, then, is straightforward: you start at the top, scan the tree and add a terminal to the desired linear string if you encounter one. Scanning is this: go to the preceding daughter node first; if you have had that one, try the other ('right-hand') daughter; if there is no unscanned daughter left (or no daughter at

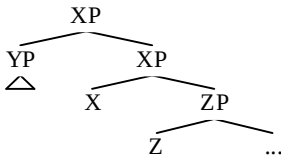
all) then go to the mother node ('one step up'). Whether daughter nodes are behind or below (i.e. dominated by) the mother is irrelevant for the linearization: the linear order is determined by precedence (between sisters) only; the rest is just a top-down scanning procedure.

The final issue I want to address here is this: are the three relations dominance, precedence and behindance really independent of each other? Both Kayne (1994) and Chomsky (1995:334ff) have claimed that precedence is derived from dominance. If they are right, we should ask ourselves if behindance can be derived from dominance as well, which would imply that syntax is really one-dimensional after all. This sounds too nice to be true, and I think their conclusions are incorrect. Merge does encode a direct asymmetry (i.e. precedence) between sisters.[11]

First consider the situation before Kayne proposed Antisymmetry (the Government & Binding period, roughly). The general X-bar system as such does not encode word order between sisters. Therefore, until the 1990s, people have assumed that there is a head-complement parameter: OV/VO for instance. Related to this parameter (or set of parameters if it is dependent on the type of projection) is the position of the specifier. Usually it is supposed to be on the other side of the head than the complement. In contrast, the position of adjuncts is free. What this amounts to is that the precedence relation has a real function in the grammar. In other words: the linearization process of a syntactic construct makes use of both dominance and precedence information.

In a more recent bare phrase structure grammar, precedence is not part of the core syntax. Chomsky explicitly relegates word order to the phonological component. This is in contradiction with the work of Kayne (1994), who places the conditions on basic word order at the heart of the grammar. These conditions are formulated as the Linear Correspondence Axiom, which enforces a rigid SVO pattern. Chomsky accepts Kayne's idea that syntax is antisymmetric. Antisymmetry seems to imply that the precedence relation is derived from the information on dominance, hence it has no independent status anymore. Syntax is therefore one-dimensional: it depends on dominance (which is inclusion). Therefore my suggestions about three dimensions could be mistaken: even if behindance is real, it is only the second dimension. As stated before, this is not the case. Of course in the simplest of all structures [a[b[c[d]]]] it is obvious that dominance and precedence coincide, but now consider (21), a perfectly normal projection, in which YP is the specifier of X and ZP the complement. (Note that in Kayne's system a specifier is an adjunct. X-bar nodes do not exist.)

(21)



YP and ZP are maximal projections; hence they are complex by definition. We should ask ourselves what the relation precedence means exactly in a syntactic tree. It only encodes an asymmetry between sister nodes. Such an asymmetry can be translated into literal precedence when the tree is linearized into a string. As for X and its complement ZP, it may be claimed that this asymmetry does not need to be stipulated, because X is simplex and ZP complex. In Kayne's theory X asymmetrically c-commands the components of ZP, hence X will precede Z in the output string. The c-command relation between X and ZP itself is mutual, and therefore irrelevant for word order.

Now look at the specifier YP and its sister node, the lower segment of XP. Since both are complex, we cannot use the reasoning I just mentioned for the head and its complement. Our first prediction is that YP and XP mutually c-command each other and therefore no linear order between their terminals is established, which is not what we want. Therefore Kayne (1994:16ff) adds an *ad hoc* element; see the first proviso in the definition of c-command in (22):

(22) X c-commands Y iff
  (i) X and Y are categories, *and*
  (ii) X excludes Y, *and*
  (iii) every category that dominates X dominates Y.

By definition the lower XP in (21) is a segment and not a category. Therefore it cannot c-command anything. Hence YP can asymmetrically c-command all the components of XP, but XP cannot do the same with the components of YP; therefore the linear order can be established.[12] But notice that the whole point of the stipulation that a segment cannot c-command is to create an asymmetry between the sister nodes YP and XP. But that is equivalent to what precedence does. Kayne's definition of asymmetric c-command contains a notational variant of precedence.

Recall that an XP segment in Kayne's theory is X-bar in Chomsky (1995). In his Chapter four discussion of word order Chomsky explicitly excludes X-bar nodes from c-command, which is equivalent to the claim in (22i).[13] Therefore we cannot say that precedence follows from dominance; it is an independent relation. Thus if I am correct about behindance, it is the third degree of freedom in syntax.

5. Conclusion

I have argued that syntax is not one-, two-, or two-and-a-half-dimensional, but it has three degrees of freedom, which can be called dominance, precedence and behindance. I think the most efficient way to use these relations is to encode them at the Merge level, that is, the application of the operation Merge to the syntactic objects A and B, whereby C is created, translates into encoding the dominance, precedence and/or behindance relations between A, B, and C – see DeVries (in prep). The derivation of three-dimensional structures is a new line of research within syntax, which requires a lot of theoretical and empirical study. I have tried to show that this project may be worth pursuing, because many constructions cannot satisfactorily be dealt with within the usual grammar. The constructions involved are not only common coordination, but also specifying coordination, parenthesis and other types of syntactic amalgams. In many of these sharing of syntactic material between two more or less independent parts plays a role.

Notes

[1] See e.g.Van Es &Van Caspel (1975) for a description of paratactic constructions in Dutch.
[2] *Hemzelf* is an "identifying emphatic pronoun". See De Vries (1999) and the references there for the intricacies of the Dutch anaphoric system. Note that for some speakers '*mzelf* can also be an anaphor; this is not what I am after here.
[3] For instance, a conjunction is a word from a closed class. See further Johannessen (1998) and Van der Heijden (1999).
[4] See alsoTeVelde (1997) on minimizing deletion in three-dimensional coordinate structures.
[5] Cf. Koster (1987) and Koopman & Sportiche (1982).
[6] See also Williams (1978).
[7] See Huybregts & Van Riemsdijk (1985).
[8] Not all speakers of German are sensitive to Case matching effects in general.
[9] Obviously, this space is abstract. The dimensions must not be confused with the literal spacial dimensions length, heigth and width.
[10] Notice that (12) requires modification, then. See De Vries (in prep).
[11] This is what Jan-Wouter Zwart (p.c.) claims, too. He elaborates on Epstein (1999), who derives c-command directly from the operation Merge.
[12] The higher XP does not c-command YP either, since XP does not exclude YP.
[13] In e.g. *Barriers* (Chomsky 1986) there is no such claim.

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