

# On the representation of coordination

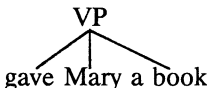
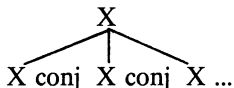
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## 1. Coordination

For several decades, linguists (e.g., Dougherty 1970, Neijt 1979) have assumed that coordination could be described by  $X \rightarrow X (\text{conj } X)^*$  or a variant of this phrase structure rule, where the Kleene star expresses that there is no limit to the number of recursions.<sup>1</sup> Actually, two kinds of recursion obtain, namely, by the Kleene star and by embedding, as will be exemplified below. In the following the rule above is referred to as the *Kleene rule*. A coordinate structure was regarded as a number of occurrences of  $X$  alternating with coordinating conjunctions like *and* and *or*. According to this rule, the categorial status of the whole structure is identical to the categorial status of the conjoined parts. Another facet of this proposal is the unlimited number of daughters, since the right-hand side collapses the expansions

- (1)  $X \text{ conj } X, \quad X \text{ conj } X \text{ conj } X, \quad X \text{ conj } X \text{ conj } X \text{ conj } X, \dots$

The current theory of Government and Binding differs in several respects from this origin. A majority of GB-linguists have accepted the Binary Branching Principle (BBP), proposed by Kayne (1984). For our purposes, we formulate this principle such that a mother node may have two daughters at most, thereby ruling out ternary structures like (2).

- (2) a  b 

Observe that the Kleene rule for coordination generates structures that violate the BBP as well (cf. (2b)): although the first expansion contains only two conjuncts, it does not fit into a binary structure, unless one suppresses the conjunction. It is conceivable, that someone should wish to argue that the Kleene rule does in fact ignore the conjunctions, because the rule contains no condition on the nature of the conjunction: *John and Bob or Bill* seems a

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legitimate instantiation of the second expansion in (1) and yet combination of *and* and *or* causes hierarchies that are not mirrored in the flat enumerative structure of (1): *John and (Bob or Bill)* vs. *(John and Bob) or Bill*. But even if one concludes from this discrepancy that the conjunction plays no role in the Kleene rule, all expansions after the first violate the BBP. Which proposal is going to win: the Kleene rule for coordination or the BBP? The BBP is actually a hypothesis about syntactic structure, which may be proven wrong by language facts and perhaps coordination will provide such devastating facts. This is not what we will claim, however.

Another assumption nowadays is that structure sprouts from heads: a verbal head projects verbal levels above it, a nominal head higher nominal projections and so on. This happens to every head and is expressed in the so-called X-barschema, where a single X is the head. Every expansion of the Kleene rule then consists of more than one X, that is, more than one head, although the corresponding higher projections per head are absent. It is evident that no multiplyheaded structure can be defended if one accepts the X-bar-schema. Therefore, we have to rephrase the description of the contest: either one gives up the Kleene rule for coordination, or both the BBP and the X-bar-schema are to be modified. The latter option would be much more radical, on the one hand because of the fact that two principles are involved instead of one, and on the other hand because of the ramifications for the large amount of data that are accounted for by the Binary Branching Principle and the X-bar-schema in their present-day definitions. It is evident that the Kleene rule must lose the contest.

## 2. *The nature of the conjunction*

The Kleene-type of recursion observed in coordination, also called 'enumeration', entails that the conjuncts should be expressed as truly co-ordinating: all conjuncts are sisters and thus positioned at the same level of the tree. This, however, is impossible in the current GB-framework. The depth of a tree structure is not subject to limitations in the way the breadth is limited by the BBP; there exists no a priori maximal depth. It seems therefore that a sub-ordinating analysis is a possible alternative.

To our knowledge, all proponents of a subordinating representation (Munn 1989, Larson 1990, van Zonneveld 1992) include the conjunction in their theory at a syntactic level. In this respect, these theories are preferable to the more naive Kleene rule, since we have seen that the actual conjunction can be pertinent to the representation. Accounting for conjunctions, but delaying their insertion to the level of phonetic form (PF) (cf. e.g. Goodall 1987:32) also incorrectly predicts that all conjunctions behave in the same fashion.

The presence of the conjunction may correlate with another change in linguistic theory: the postulation of functional categories. Apart from the traditional parts of speech (noun, adjective, verb and preposition), other categories have entered the stage. On some of them there is a broad consensus, for instance on I (for inflection) and C (for complementizer). Others, like D (for determiner) are more under discussion. Whatever the outcome of the discussion will be, the relevance of functional categories in general is not disputed. Functional categories have been adopted on the assumption that the X-bar-schema also holds for them and this seems to turn out well. In the remainder of this section some observations about functional categories in general will be presented; further, these observations will be compared to the behaviour of conjunctions. The conclusion will be that conjunctions can in principle be treated as functional elements. The next section will elaborate on subordinating accounts of coordination.

Abney (1987:64-65) observes some phenomena that functional categories have in common:

1. Functional elements constitute closed lexical classes.
2. Functional elements are generally phonologically and morphologically dependent. They are generally stressless, often clitics or affixes, and sometimes even phonologically null.
3. Functional elements permit only one complement, which is in general not an argument (i.e., which is not a CP, PP, or DP).
4. Functional elements are usually inseparable from their complement.
5. Functional elements lack 'descriptive content'.

We will check this list with regard to the conjunction. It is evident that the first two properties are present, though perhaps not in every single language (Dutch has no affixed conjunction, but Latin has). If we consider the comma in writing to represent a phonologically null conjunction, we can provide each conjunct with a selecting coordinator. While postponing discussion of property 3 for the moment, we notice that property 4 holds as well, with the usual exception of parentheticals like *as far as I know*, which also may separate C's and D's from their complements.

Conjunctions have the fifth property as well. Abney refers to Aristotle, who defines functional elements as 'words without meaning', in contrast to thematic elements, 'words with meaning'. Evidently, conjunctions do not belong to the latter group of thematic elements.

The only troubling property is the third one. To begin with, the first proposition - functional elements permit only one complement - is ambiguous, especially for those who are concerned with coordinated structures. The first interpretation refers to one complement *token*, in contrast to an arbitrary number of complement tokens. Someone who wishes to account for

coordination is easily trapped like that. However, the second and apparently intended interpretation deals with the number of complement *types*. Under this reading, the first proposition is of course false with respect to conjunctions, as nearly all kinds of constituents may be conjoined.

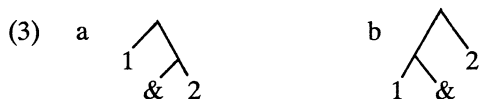
The second proposition - the complement is in general no argument - is false too, unless we assume that all coordination is coordination of IP, VP, or NP. This provisional solution is falsified by the existence of CP, VP, and DP coordination such as *Either you win or you lose, John will both sing a song and dance a jig* and *either a book or a CD*, respectively.

Because of our opinion that a theory of coordination should account for the coordinating conjunction in an illuminating way, we welcome the observation that the conjunction agrees with the majority of what seem to be characteristics of functional categories. This similarity suggests that an analysis of coordination is probably possible in an independently motivated way.

### 3. Sub-ordination

It appears that subordinating analyses come in different versions. In some, the top node bears the category label of (one of) its conjuncts, as was also the case with the Kleene rule for coordination. In others, however, the conjunction is the head of the structure. A comparison of these two types is deferred; we will focus now on what the proposals have in common, hence on potential characteristics of subordination.

The first property has already been mentioned, viz., the presence of the conjunction. A second property is the narrow bond between the conjunction and the second conjunct, as sketched below in (3a).

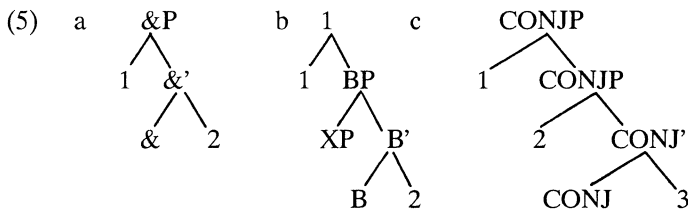


- (4)    a    And John.                      (first conjunct. And second conjunct)  
           b    \*John and.                    (\*first conjunct and. Second conjunct)

A reason for preferring (3a) to (3b) is the grammaticality of (4a) versus the ungrammaticality of (4b). The distribution of prosodic breaks confirms this. A second argument against (3b) involves the position of the specifier. In the X-bar-schema for English, the specifier is the left daughter of the maximal projection, but in structure (3b) it is at the right side. Since this argument goes to prevent a problem internal to the theory, however, it is of less significance than the former, which is supported by empirical observations.

These arguments in favour of (3a), convincing though they are, do not answer all questions. How, for instance, can structure (3a) be extended in order to achieve the same coverage of data as the rejected Kleene rule purported to have? That is, how will enumerations like *A and B and C* fit into (3a)? Is it the branch now leading to the first conjunct that will split, or the one leading to the second conjunct? In the proposal by van Zonneveld (1992) - the only one to take enumerations into account - enumerations exploit neither of these options, but make use of adjunction to the top node. In short, a wealth of possible structures is at our disposal, but since it exceeds our needs, this constitutes a problem rather than an advantage. Second, it is an open question how structure (3a) will ever accommodate initial coordination like *both A and B*: where do we put *both*? Even van Zonneveld's proposal allows for just one (lexical) conjunction, immediately before the final conjunct, despite his paying attention to enumerations.

The skeletal tree in (3a) becomes more substantial in (5a) (Larson 1990, van Zonneveld 1992 for binary coordination), (5b) (Munn 1989; the conjunction is labelled *B* for Boolean) and (5c) (van Zonneveld 1992 for n-ary coordination,  $n > 2$ ).



It is time to evaluate the different top nodes: which label is, in what way, assigned to them? Proponents of the respective answers have argued against the competing structures, and these arguments are summarized here. Munn (1989) rejects structure (5a) with reference to GB-theory, especially to Chomsky (1986). Categories may or may not select NP's, VP's, etcetera, but no category at all demands a conjunction phrase as an argument. Therefore the existence of the &P in (5a) is unlicensed, hence sometimes illicit (namely, in case the conjuncts have argument status). To overcome this problem, Munn (1989) adjoins his BP in (5b) to the first conjunct (labelled 1). The eventual top node is of an ordinary category. At the same time, the specifier position of BP is available for an operator, which, according to Munn, is needed for the analysis of Across-The-Board effects. (We will not go into this aspect in this paper.) Van Zonneveld, who basically adheres to (5a), seems to assume an ATB-analysis that does not need the specifier position, for he claims that the absence of a lexical specifier in the BP is a problem for the X-bar-schema.

We appreciate Munn's scruples about the licensing of coordinate structures, but they may be superfluous. Recall that functional heads are non-distinct from their complements. This feature makes the complement more or less accessible for coordination-external elements. In the same sense as a DP is both a projection of D and nominal, a conjunction phrase is both a projection of a conjunction and ... whatever the nature of the conjuncts (assuming for the moment that all conjuncts have the same category).

To resume: the main advantage of the subordinating approach is its care over the conjunction. The theoretical drawback of the subordinating approach is the observation that no proposal captures initial coordination or enumerations in an obvious and well-motivated fashion. There is also an intuitive aspect: members of an enumeration are felt to exist at the same level, being ordered only with respect to precedence. A subordinating representation clearly does not reflect this intuition; a coordinating one does, but has other drawbacks, as argued in section 1. To make our position quite clear: we had rejected the coordinating approach already and now lay aside the subordinating analysis as well.

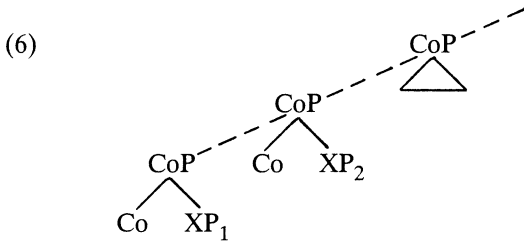
#### 4. *Tertium datur*

It is unlikely that anyone can contemplate coordination unambivalently, for the relation between coordination and the rest of syntax is unclear. On the one hand, since almost anything can be a conjunct, it is counter-intuitive to analyse coordinate structures without much reference being made to already present principles. On the other hand, the image emerging from the discussion above shows that coordination is something special, entitled to an analysis of its own. That a stable balance between the competing views has not yet been found will be evident. Corresponding to this pair, a distinction can be drawn based on the degree of divergence from the main syntactic theory. The authors mentioned above attempted to find an analysis by moulding coordination into existing notions and structures, accepting in exchange (or overlooking) violations of syntactic principles. We will take the alternative tack of tailoring an analysis to the needs of coordination and no such violations will follow. It is the third dimension, expressed in the relation of behindance, that constitutes the crux of our analysis.

In this section we present our version of the 3D-analysis, which is called 'XYZ'. The next section contains an overview of differences between XYZ and an earlier 3D-proposal by Goodall (1987). (The name XYZ refers both to our computer implementation, which consists of three modules - X-bar, Y-parse and Z-parse - and to a coordinate system with three axes, viz. x, y, and z.) We will argue that our theory complies with the BBP and the X-bar-schema, to mention just the principles that a varying number of the proposals

discussed above did not respect completely. What is more, we claim that XYZ does not introduce new shortcomings. The gist of the argument is this: nothing that is particular to our analysis of coordination can apply to non-coordinate structures, so every string that according to GB-minus-XYZ is grammatical, is still grammatical and everything that GB-minus-XYZ regards as ungrammatical is still ruled out. (Implicit in this formulation is the assumption that GB-minus-XYZ does not cover coordination.) Behindance, in other words, does not interfere with other notions.

Which of the merits of co-ordinating and sub-ordinating approaches to coordination are to be preserved in the XYZ-analysis? The (attempt to give an) account of recursion and the assumption that the conjunction (Co below) should be present. We take it that Co is a functional category, has a complement at its right side and projects a Conjunction Phrase (henceforth CoP) that is categorially non-distinct from the head's complement. We propose the following structure, where the dotted line indicates expansion into the third dimension. Every CoP stands in a plane of its own.



What is evident from the structure in (6) is the uniform treatment of conjunctions, to the extent that a Co precedes even the first conjunct. It will be phonologically null in some cases (*John and Mary*), but not in others. Naturally, not only the leftmost conjunction need not be spelled out, but the same holds for conjunctions that appear as commas. In our view, this uniform representation is appropriate: as a hypothesis, it is simple and strong and it captures the generalization (cf. section 3 on subordination) that a conjunction has a narrow bond with the subsequent conjunct, rather than with the preceding one.

CoP seems the proper candidate for the connection between postordinated elements, for it is the CoP that reflects relevant properties of the complements such as their number and gender. If we assume the opposite, a coordination like *John and Bill always lie to me* causes a lot of tree-walking. In order to ascertain a plural subject, the flow of information goes via the linearly first CoP - the frontal top node - to  $XP_1$  and  $XP_2$  and via the second CoP to the second Co, for the nature of the conjunction is relevant as well: *John or Bill* is singular. This implies, that information must spread to almost every node, which is inefficient. In the reverse view, which we argue for, the

CoP is able to reflect the characteristics both of its head daughter and of the complement, since it is a functional projection. For this reason, the dotted line connects the CoP's. (The argument suggests a top-down flow of information, for instance for sentence generation, but a similar argument can be constructed with respect to sentence parsing, where information from conjuncts percolates upwards.)

As soon as CoP's are lined up behind each other, information about the respective CoP's is checked for compatibility. (Just to give an impression: a CoP with a *both*-head is incompatible with a CoP with a *but*-head.) Our 3D-analysis does not make use of a rewriting rule for coordination, since that is a typically two-dimensional device and cannot express the behindance relation which holds between postordinated nodes (cf. section 5 for a computational argument.) Likewise, feature percolation does not only take place between a top node and its daughters, as usual, but also between the frontal top node (i.e., the CoP in the foremost plane) and its postordinated nodes, in order to check CoP-compatibility.

The XYZ-analysis restricts GB-principles as much as possible to their original territories. This is especially clear with respect to the BBP: as nothing in Kayne (1984) suggests a third dimension, his analysis can be taken to refer to branches that lead to sister nodes in a two-dimensional tree, i.e., from left to right. In view of the fact that the BBP has not been formulated with respect to a third dimension, the occurrence of more than two items behind each other (i.e. from front to back) is irrelevant to the BBP. Obviously, this statement is invalidated if one, with hindsight, reformulates the BBP in such a way that it refers to elements stacked behind each other as well. If that were to happen, however, we would consider the new BBP to be falsified by the coordination data. It is simpler, then, to maintain the Binary Branching Principle in its current form and to assume that behindance is not subject to it. It is clear that enumerative recursion is no longer problematic then, as the structure in (6) already showed.

In the preceding sections we gathered some goals, results we wanted to achieve (presence and classification of the conjunction, recursion and initial coordination) and things we intended to prevent (violation of syntactic principles). Actually, we are fairly content now, for we obtained a representation which can express recursion and initial coordination. Further, the conjunction seems well accounted for as a functional category, since it resembles commonly accepted functional elements in many respects and allows for the conjuncts to be visible. As promised, our representation violates neither the X-bar-schema - since Co is an ordinary head that ordinarily projects to a CoP and ordinarily demands one complement - nor the Binary Branching Principle, since postordination is not subject to it.

In this section our proposal has been presented in comparison with co- and sub-ordinating proposals, but we still have to confront it with another



3D-analysis to find out whether the desirable results described above are typical for 3D in general. This confrontation takes place in the next section.

### 5. Goodall versus XYZ

Exploration of the third dimension is not a brand-new idea. Goodall (1987) develops a notion of parallel structures: trees pasted together, one on top of the other. The main reason for rejecting Goodall's account is the absolute lack of discussion about the nature of the conjunction. It is even lexically absent from all of the, indeed rather poor, figures and is only inserted at PF. Above we have argued at length in defence of a proper treatment of the coordination and we will not repeat ourselves here. Furthermore, we agree with remarks in de Vries (1987) and van Oirsouw (1987) about the formalism chosen (the reader is referred to these critiques, since lack of space prevents us from repeating them). The formal basis for Goodall's parallel structures consists in a modification of Lasnik and Kupin's (1978) *Reduced Phrase Marker* (RPM). Precisely the set of structures that is not described by the original definition, but that Goodall does allow, is the set of parallel structures. Roughly speaking, the difference lies in those members of the RPM's that neither dominate nor precede each other and are yet connected via other members of the RPM. Where do they come from? They result from the union of phrase markers, which is an important notion in Goodall's analysis. Underlyingly, coordination is made up of more than one sentence, each with its own phrase marker. The union of these sets contains such deviant members, which are not directly related by dominance or precedence. In the union of the RPM's of *The boys go home* and *The girls go home*, the lexical strings that instantiate the DP in *DP go home* are deviant in this sense. Their being unordered with respect to each other entails that they exist in parallel planes in the same phrase marker.

If we compare this approach with ours, there are obvious differences. For one thing, where Goodall uses phrase markers, XYZ builds and exploits a database of less informative units. This should be understood as informative with regard to node relations. Although a single element in a phrase marker, whether reduced or not, expresses merely precedence facts, a complete phrase marker informs us about both precedence and dominance relations between nodes. To put it differently, phrase markers are typically two-dimensional and dominance and precedence are inseparable in such an approach. In XYZ, however, knowledge of dominance and knowledge of precedence are gained independently and they also enter the database separately. Our original reason for distinguishing dominance from precedence has to do with parsing efficiency (cf. Marcus, Hindle and Fleck 1983): if the parser is certain about some dominance relation being present, but not about any precedence

relation (or the other way round), it ought to refrain from adding guessed precedence (dominance) information. This way, it is prevented from making wrong decisions based upon these guesses. An advantage that accrues to this strategy is the ease with which we can add the node relation of behindance, on a par with dominance and precedence. The absence of such a relation in Goodall's analysis suggests that Goodall does not take the third dimension seriously.

It is evident that a 3D-proposal must pay attention to the relation between structure and linearization, for instance because of the fact that speech is linear rather than three-dimensional. In a standard, two-dimensional, syntactic tree, the left to right order of the fringe nodes corresponds roughly to the output speech order, but three-dimensional graphs are different. (We prefer the general term *graph* to the term *tree*, to avoid the usual linguistic association with two dimensions.) In order to acquire linearization at PF, Goodall makes use of a linearization rule that orders parallel structures from left to right. Linearization ascertains that elements from the respective conjuncts do not occur in random order. This rule itself, as van Oirsouw (1987) points out, crucially needs an indexing mechanism, which Goodall does not provide: indexation is necessary to fix the order of conjuncts. This complex machinery has to make up for the unavailability of precedence information, for, as we saw above, it is characteristic of the parallel elements not to have precedence or dominance relations holding among them. The XYZ-analysis has no need for a rule like this, since nothing similar to the union of phrase markers exists in XYZ. XYZ assumes a phrasal analysis of coordination and as soon as a category A is generated with the intention of conjoining it to a category B, generated earlier, the fact that A is behind B is added to the database. When, at PF, linearization is called for, the rule *if A is behind B, then A comes after B* yields the correct results. (The reverse implication is false, of course: although *saw* comes after *John* in *John saw Mary*, nothing requires *saw* to stand in a plane behind *John*.) Therefore, XYZ needs no reordering of precedence relations. For this reason, van Oirsouw's point concerning the incorrect prediction that (7a) and (7b) have the same interpretation (van Oirsouw 1987:35-36) does not carry over to XYZ, where the order of the conjoined IP's is fixed from the beginning.

- (7) a She fell down the stairs and broke her arm.
- b She broke her arm and fell down the stairs.

Another consequence of this different attitude to the origins of coordination concerns can best be explained by means of an argument by van Oirsouw. Van Oirsouw (1987:33-34) observes that in Goodall's analysis (8) and (9) derive from the same set of sentences (10):

- (8) I gave Mary books and Sue records
- (9) I gave Mary and Sue books and records
- (10) {I gave Mary books, I gave Mary records, I gave Sue books, I gave Sue records}

Since linearization, which yields (8) and (9), takes place at PF, it is predicted that (8) and (9) have the same interpretations. This is not the case, however. Sentence (8) has just the *respectively* reading, but (9) may also be interpreted collectively. (*Sue* in sentence (8) is also interpretable as Agent, but this gapped reading cannot derive from (10). Gapping is outside the scope of this paper, although we might remark that Goodall's analysis of Gapping is quite ad hoc.) How can logical form (LF) yield these different interpretations as it has no access to the different linearizations, or, to put this question differently, how can LF lose the collective interpretation of (9)? We agree with van Oirsouw's argument up to this point, but his conclusion is far from inevitable: 'Note that these problems arise solely as a consequence of the 3D approach' (p.34). This is not true; it is the *sentential* analysis that causes this problem. A *phrasal* analysis assumes different D-structures for (8) and (9), to which their semantic difference can be attributed. There is no reason to expect a correlation between the choice between a two-dimensional and a three-dimensional approach on the one hand and the choice between phrasal and sentential origins on the other hand. Therefore, we disagree with van Oirsouw (1987) on the idea that this drawback is inherent in 3D. Likewise, his criticism does not threaten XYZ.

Finally, there is the question of how 3D relates to 2D, or better, when the third dimension occurs. In the XYZ-analysis, the first plane (which is the unique plane in non-coordinate structures) is always present. Initiation of another plane can only be triggered by a coordinating conjunction, i.e., non-coordinate structures will be assigned the usual two-dimensional structure. This is clearly the base step in delimiting the power of XYZ. We will not attempt to formalize the main limitation here, but in Grootveld and Neijt (1992) it is argued extensively that weird, improbable, computationally expensive, long-winding graph routes seem to have no counterpart in language. This economical finding can be taken to support the XYZ-approach.

Goodall, on the other hand, distinguishes three phenomena (coordination, causatives, and restructuring) for which he gives a parallel structures analysis. Parallelism takes place when a phrase marker cannot be represented as a tree. However, this appears to allow many phrase markers that do not belong to one of the three groups, but that are simply ill-formed. The 3D-representations that express such ungrammatical phrase markers have to be excluded by some extra device. In his discussion of the Law of the Coordination of Likes, responsible for the rejection of insufficiently parallel conjuncts, Goodall therefore assumes that X-bar-theory filters the RPM's. Future research

may reveal whether this difference between XYZ (economical from the beginning) and Goodall's proposal (with filtering constraints) is a real distinction or just a reflection of the well-known difference between computational linguists, who are interested in efficiency (among many other things) and theoretical linguists, whose Principles and Parameters model is evidently constraint-based. (Although there is no absolute consensus on this process, the general idea is that lots of structure are generated and, after that, tested by various syntactic principles and language specific parameter settings. This way, the principles and parameters are filtering constraints.)

This section has revealed a large number of differences between Goodall's approach and ours. The strongly underdeveloped view of the conjunction, the use of ill-fitting two-dimensional phrase markers, the cumbersome linearization rule and the sentential origins constitute sufficient reason to reject Goodall (1987) and advocate XYZ.

## 6. Conclusion

Where a co-ordinating approach to conjuncts is intuitively attractive but GB-theoretically impossible and where sub-ordinating proposals concerning coordination appropriately reckon with the conjunction, but fail to express initial coordination and enumeration of more than two conjuncts in an obvious way, post-ordination appears to provide a solution. However, three-dimensional proposals are not intrinsically perfect, as we have seen. The XYZ-analysis advocated in this paper replaces Goodall's (1987) typically two-dimensional phrase markers with three separate one-dimensional node relations (i.e. dominance, precedence, and behindance). This prevents the need for complicated linearization processes and also treats the third dimension on a par with the first and second one. As another argument in favour of XYZ, we recall the fact that XYZ assumes coordination to have phrasal origins, so objections to Goodall's sentential analysis do not carry over to XYZ. Finally, a treatment of the conjunction as a functional category seems rather felicitous. Since the area of coordinated structures is vast and quite insufficiently covered by Government and Binding theory, the current proposal intends to fill this gap.

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