

## COORDINATION AND SURFACE STRUCTURE

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**Abstract:** This article discusses the problems that the surface structure of coordination poses for a description of coordinate structures in terms of identical conjuncts. It investigates the role of both linear structure and context for the form and content of conjuncts. An alternative view of coordination is proposed in which a coordination part, consisting of coordinator and second conjunct, is defined on the basis of structural information derived from its preceding context, including the first conjunct.

**Keywords:** coordination, surface structure, linear structure.

### 1. INTRODUCTION

The description of coordination has been a challenge to linguistics for many decades. The most common approach is a definition of the coordinate structure in terms of identical conjuncts:

$$X \rightarrow X \text{ and } X$$

(henceforth: the 'X and X'-hypothesis). Underlying this hypothesis are the following two assumptions:

- The conjuncts are identical in nature.
- The resulting coordinate structure is of the same nature as the conjuncts.

While this approach is seldom challenged, its application in a surface structure account of coordination is not without problems. When studying corpus data, one comes across many cases of coordinate structures that pose problems for this view. In particular, such examples give rise to the following questions:

- What is the nature of the conjuncts 'X'?
- Can the 'identity of conjuncts'-requirement always be upheld in surface structure analysis?

Let us look at these issues in more detail.

### 1.1 *On the nature of conjuncts.*

Usually, the conjuncts are defined in terms of the regular units of description that a model employs. The conventional view defines conjuncts in terms of syntactic categories; however, it is now generally accepted that this view is too simplistic.<sup>1</sup> Many counter-examples occur for which a description of conjuncts in terms of identical categories cannot be upheld. The following examples may serve to illustrate this point. (Unless indicated otherwise, the examples in this paper are derived from the Nijmegen corpus; see (Keulen, 1986). In some instances the original sentence has been abbreviated or simplified to focus on the coordinate structure, leaving out irrelevant parts.)

- (1) The examiner is *old and a stinker*.
- (2) He was *unshaven and in a dressing gown* but he looked much better.
- (3) I came upon Charles *in a state of considerable agitation, and trying to contact a strange doctor*.
- (4) Valentine understands both *the technique of romantic love-making and how to adapt that technique to the special case of the new woman*.

In accounting for such cases of coordination, models employing units of analysis other than syntactic categories have a bigger chance of success. For example, the coordinate structures above can be described in terms of identical conjuncts if the conjuncts are defined in terms of syntactic functions, see e.g. (Dik, 1968; Oostdijk, 1991). In other words, models employing the concept of syntactic function have some level of abstraction that makes it possible to define the nature of conjuncts for these cases. For other cases of coordination, it is the concept of syntactic feature that provides a potential solution. Such an analysis is possible in models like GPSG (Gazdar, *et al.*, 1985) or HPSG (Pollard and Sag, 1994). The following

<sup>1</sup> Cf. Gazdar *et al.* (1985:174), who say that "[t]he conventional wisdom on this topic has it that conjuncts must all be of the same category, say C, and that the mother of these conjuncts will also be of category C. But the conventional wisdom is wrong, in ways that are fairly widely known."

examples can be accounted for by a definition of conjuncts in terms of syntactic features, but not in terms of syntactic categories or functions:

(5) He was *laughing and very happy*.

(6) The tiny oxygen tank on his back was *uncomfortable but deemed necessary*.<sup>2</sup>

The problematic nature of the coordinate structure in these cases is caused by the lexical ambiguity of the verb *be*, which functions as passive or progressive auxiliary in the context of one conjunct, and as copula in the context of another. Oostdijk (1991:200) refers to this phenomenon as “neutralization”. Feature-based models can account for such coordinate structures by referring to underspecified feature structures that the conjuncts have in common; in this case, the features [+PRD, BAR 2], which are shared by all complements of the verb *to be* (cf. Gazdar, *et al.*, 1985:111; 174-175).

Feature-based accounts of coordination may be successful as long as there exists an underspecified feature structure that underlies both conjuncts. If the conjuncts are required to be fully specified categories, or at least specified for the major features [BAR], [N] and [V], then a feature-based approach runs into difficulties in cases like (2)-(4) above, where an adjective phrase ([+N, +V, BAR 2]) is coordinated with a prepositional phrase ([-N, -V, BAR 2]); a prepositional phrase ([-N, -V, BAR 2]) with a non-finite verb phrase ([-N, +V, BAR 2]), or a noun phrase ([+N, -V, BAR 2]) with an infinitive clause ([-N, +V, BAR 2]). We see, then, that a feature-based account of coordination may be successful where a function-based account is not, but also vice versa. This suggests that there may be a more or less *random* aspect in a description of coordination based solely on the units of analysis that a model employs. If, by referring to different units of analysis, models may solve coordinate structures of one type while creating problems for those of a different type, there is a real possibility that a generalization about coordinate structures *as such* is being missed.

The method by which feature and function-based accounts are able to define coordination of different categories is by using a level of abstraction that may refer to a *set* of different categories. The conjuncts themselves still consist of only a single element of that set, i.e. a simple category. However, there are also cases where conjuncts consists of *multiple* categories. Examples are the following:

(7) In *most multicellular and many single-celled creatures* there is an alternation in the life-cycle between cells with two homologous sets of chromosomes and cells with one set of chromosomes only.

(8) The change from *belief in, and fear of*, an awe-inspiring and vindictive God to a conviction that there is no God provides a feeling of relief.

(9) But Vivie has been to Newnham and owns a trained mind, capable of *standing back from and analysing* sentiment.

The coordinate structures in these examples can be regarded as instances of *conjunction reduction*. They can be accounted for by models which have some way of referring to incomplete constituents. Categorical Grammar (Steedman, 1985; 1990) is a typical example of such a model. HPSG's [SUBCAT]-feature may be used in a similar sense (Mela and Fouqueré,

<sup>2</sup> Derived from the TOSCA-corpus; see (Oostdijk, 1991).

1996). In general, the description of reduced conjuncts is accomplished by referring to constituents that are lacking with respect to a higher level of hierarchical structure. Models that are able to encode this information in their category-system have a wider coverage of coordinate structures than ones that cannot; however, it should be emphasized that such an approach involves an extended use of the notion *category* when compared to the original view underlying the 'X and X'-hypothesis.

In addition to the above cases of conjunction reduction, one may also find instances where conjuncts consisting of multiple constituents cannot readily be analyzed in this way. These cases seem to contain an *additional* constituent with respect to a particular hierarchical level, rather than one that is lacking. Examples (10)-(12) below illustrate.

- (10) There is no attempt to hold a balance between *all this frailty and absurdity on the one hand and any genuine capacity for suffering on the other*.
- (11) Do I resent *the wind when it chills me or the night when it makes me stumble in the darkness?*
- (12) Thus a worker may be *lazy and slow in a firm where he feels victimized, and a keen and enthusiastic labourer in one that he likes*.

In these examples, the constituents making up the conjuncts do not group together as a regular category defined by its endocentric or exocentric relations: they seem to contain two independent constituents, one of which has an adverbial-like function. Under an 'X and X'-analysis of these surface structures, there is no immediately obvious choice of 'X' for these cases of non-constituent coordination.

## 1.2 On the identity of conjuncts.

The examples discussed in the previous section suggest that, even though there may not always be an immediately obvious level of abstraction at which conjuncts can be defined, they are at least parallel in structure. That is to say: the cases discussed so far are compatible with the 'X and X'-analysis of coordination, although the exact nature of 'X' may as yet be unresolved. However, the following examples seem to suggest that even the identity-requirement for conjuncts may be subject to discussion.

- (13) *The primary, and in some respects the secondary* groups are exactly the opposite in their characteristics.
- (14) *The first consisted of those who were definitely unstable; the second of students who were reasonably well-adjusted.*
- (15) Yet the comparative weakness of *this and later* plays scarcely consists in Shaw's having nothing new to say.
- (16) The figures available for *electrostatic and Van der Waals* forces in cell membranes are very approximate.

Example (13) shows the occurrence of an adverbial-like constituent in the second conjunct only; in fact, this is the more common case. Example (14) illustrates *gapping*; a phenomenon which, by definition, gives rise to conjuncts that are not identical in structure. Sentence (15)



contains a coordination of two elements at different levels of hierarchical structure. This is illustrated by the fact that the categories realizing the two conjuncts, the demonstrative pronoun (*this*) and the comparative adjective (*later*), may also be used jointly: cf. *these later plays*, which is perfectly grammatical. This means that the two elements cannot be the realization of the *same* slot in the description of the noun phrase (or determiner phrase). In example (16), finally, we see coordination of a premodifier and the first part of a compound noun. In this case the problem could be solved by analyzing the compound noun as consisting of premodifier and head; however, this would imply that the first part of compound nouns had equal status to the other units of description in the grammar. Also, it would conceal the fact that the relation between the two conjuncts and the following noun is somewhat different.

### 1.3 The surface structure of conjuncts: summary and discussion.

The results of the analysis in the previous sections can be summarized as follows:

- Conjuncts are not necessarily describable in terms of identical categories, functions or features.
- Conjuncts are not necessarily made up of single constituents. Moreover, when consisting of multiple constituents, conjuncts are not necessarily describable by referring to a single constituent that is lacking with respect to a higher level of hierarchical structure.
- Conjuncts do not necessarily have the same internal structure, and they do not necessarily function at the same level of hierarchical structure.

These observations create a number of problems for the 'X and X'-approach to coordination. These problems lie on a practical, as well as a theoretical level. In particular, the following questions can be raised.

- *Practical:* How far can/must coverage of 'X' be expanded in order to cover all cases? Should it cover parts of phrases and clauses? Phrases and clauses plus additional constituents? How may different realizations of conjuncts be accounted for? How can an 'accidental' definition of coordinate structures be avoided? The latter question also has more fundamental implications on the theoretical level.
- *Theoretical:* Is the potential content of conjuncts determined *only* by the units of description that a particular model employs? Or is there another defining characteristic that determines the potential make-up of conjuncts. In other words, is there a *principled* definition of conjuncts?
- *Theoretical:* Should conjunction reduction, gapping, and other coordinate structures that contain 'deviant' configurations be described separately from conjuncts that fit the regular pattern? What kind of analysis could capture the relation between such deviant coordinate structures (e.g. gapping) and regular ones? (What is 'deviant'; what is 'regular'?)

These questions, ultimately, lead to the following: is there an *alternative* to the description in terms of identical conjuncts?

## 2. TOWARDS AN ALTERNATIVE ANALYSIS OF COORDINATION

### 2.1 The 'X and X'-hypothesis revisited.

A solution to the issues raised above emerges when, instead of focusing on the realization of particular conjuncts, one looks for characteristics that the conjuncts of all coordinate structures (problematic and unproblematic ones) have in common. We can do this by showing the relation between the surface structure of coordination and the definition in terms of identical conjuncts, in the following manner:

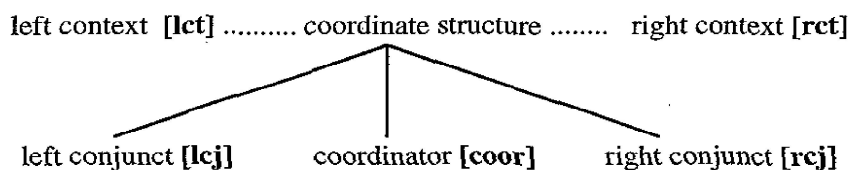


Fig. 1. Relation between surface structure and 'X and X'-analysis of coordination.

On the basis of this figure, the surface structure of a sentence containing a coordinate structure can be represented as a string consisting of **lct + lcj + coor + rcj + rct**. To accommodate gapping, we can also define a middle context **mct**, resulting in the following, general surface structure for any string containing a coordinate structure:

$$\text{lct} + \text{lcj}_a + \text{mct} + \text{lcj}_b + \text{coor} + \text{rcj}_a + \text{rcj}_b + \text{rct}$$

Fig. 2. Abstract surface structure for a sentence containing a coordinate structure.

Analyzing the different cases of coordination in terms of these surface strings, we can make the following observations:

1. Analyzing conjuncts individually in an otherwise identical context gives regular hierarchical structure. That is, these substrings together form a regular syntactic pattern that can be accounted for in terms of usual phrase structure, abstracting from lexical realization and semantic relations. For gapping, the substring covering what is elided in the second conjunct is taken as part of the context (i.e. the middle context).

For example, in sentence (8), containing the coordinate structure *belief in, and fear of*, placement of the left conjunct in the left and right context yields the regular (noun) phrase: *the change from belief in an awe-inspiring and vindictive God to (...)*. The same applies to placement of the right conjunct in context. Likewise, the pattern resulting from placement of the left conjunct *this* in the context of the coordinate structure *this and later plays* (15) is the syntactically regular sequence of a demonstrative pronoun followed by a noun (abstracting from lexical realization determining agreement). The right conjunct placed in context yields the regular sequence of comparative adjective followed by noun. This example also illustrates the following point.

2. Placement of the left conjunct in context does not necessarily yield the same analysis as placement of the right conjunct in context. In other words, the conjuncts may play a *different* role in the context of the coordinate structure as a whole.

This observation holds in particular for cases of non-parallel conjuncts such as examples (15) (*this and later plays*) and (16) (*electrostatic and Van der Waals forces*), but applies equally to the examples of neutralization of *be* in (5) and (6). Also, it applies — rather unexpectedly perhaps — to the case of conjunction reduction in (9) (*standing back from and analysing sentiment*). However, in this case it is the right context that fulfils a different role with respect to each of the conjuncts, rather than the conjuncts themselves.

Two further observations relate to the substring consisting of [left context + left conjunct]. These are the following:

3. The occurrence of the coordinator signals an obligatory right context when the substring [left context + left conjunct] forms an 'unsaturated' unit of description (i.e. in cases of conjunction reduction). For example, the coordinator immediately following the substring *in most multicellular* (7) signals that the noun phrase functioning as prepositional complement is as yet incomplete. This provides an important structural clue.
4. The content and structural analysis of the right conjunct depends on the structural characteristics of the substring [left context + left conjunct]. For instance, in the case of *gapping*, the interpretation of the right conjunct is relative to the left context and left conjunct (including the middle context).

On the basis of these observations we may conclude not only that the conjuncts stand in an *individual* relation to the context of the coordinate structure as a whole, but also, that there seem to be arguments for treating the substring consisting of [left context + left conjunct] separately from the right conjunct. Further, the left-to-right information flow seems to be relevant for the structural description of coordination. These different observations provide an immediate pointer to the alternative view of coordination that I will now turn to; one that exploits the role of *linear* structure.

## 2.2 Coordination and surface structure: the linear hypothesis.

The standard, 'X and X'-analysis of coordination defines the conjuncts independently of their context. This was illustrated in Fig.1. However, the observations made above suggest that an analysis of coordinate structures where conjuncts are defined in relation to their context may be more successful. This may be realized by dividing up the surface string as follows:

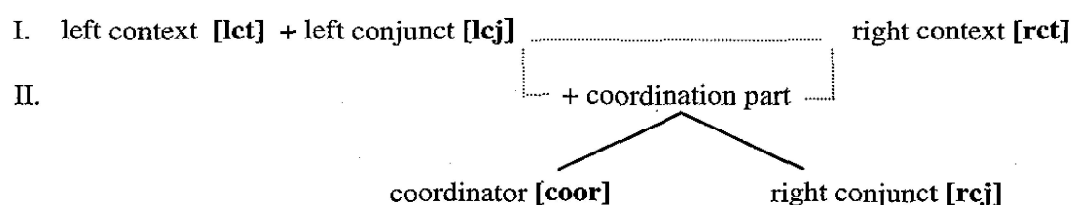


Fig. 3. Alternative analysis of conjuncts in surface structure.

In this division of the surface string of a sentence containing a coordinate structure, substring (I) forms a regular hierarchical pattern (abstracting from lexical realization and semantic relations) and substring (II) is the coordination part that may be defined on the basis of the rules involved in (I), up to its insertion point. To accommodate gapping, we may rephrase this view in the following manner (the *linear hypothesis*):

- ♦ The surface structure of a sentence containing a coordinate structure, consisting of the substrings  $lct + lcj_a + mct + lcj_b + coor + rcj_a + rcj_b + rct$ , is to be analyzed as:

$$\begin{array}{ll} \text{I.} & lct + lcj_a + mct + lcj_b \quad \cdots \cdots \cdots + rct \\ \text{II.} & \quad \quad \quad \cdots \cdots + coor + rcj_a + rcj_b \cdots \cdots \end{array}$$

where (I) forms a regular hierarchical structure (abstracting from lexical realization and semantic relations), (II) is the coordination part that is interpolated at some point within this regular structure, and the realization of (II) depends on the structural characteristics of (I) up to its insertion point.

The essence of this hypothesis is that it brings about a different grouping of the substrings making up the surface structure of a sentence containing a coordinate structure. Instead of the usual division, which brings together the two conjuncts and separates them from the context, this hypothesis postulates the existence of a coordination part consisting of the coordinator and the second conjunct, leaving the first conjunct to be part of the context. The relevance of this division is that this coordination part can be regarded, as it were, as an optional *linear* interruption of regular *hierarchical* structure.

### 2.3 Some examples.

Let us look at some examples of coordinate structures in the light of this new analysis. First, consider example (2), the essence of which is repeated below:

(2') He was *unshaven* and in a dressing-gown.

This example contains coordination of two different categories, realizing the same syntactic function. In the new analysis, it is accounted for as follows. The analysis of the substring [left context + left conjunct] yields the following, regular hierarchical structure:

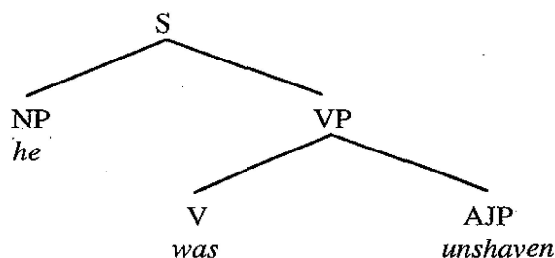


Fig. 4. Phrase structure tree for *He was unshaven*.

The coordinator is inserted following the verb complementation, realized by the adjective phrase. This level functions within higher levels of hierarchical structure. These levels reflect the rules that have been applied in the analysis of the preceding substring, and that have not

yet been terminated at the point where the coordinator is found. We may refer to these levels as active levels; the level at which the coordinator is found is the current active level. In example (2'), the current active level is that of verb complementation; the higher active levels are those of the VP and S.

In example (2'), the coordination part, consisting of coordinator and right conjunct, follows the substring displayed in Fig. 4, and in its definition may refer to the rules that were involved in the description of this substring. These rules include, among others, the rule describing the complementation of the verb *to be* (the current active level). The actual realization of this rule in the coordination part may be independent of that in the preceding substring [left context + left conjunct]. In other words, the complementation that is contained in the coordination part may have access to all potential instantiations that are ordinarily defined in the context of the verb *be*, one of which is the prepositional phrase. This leads to the current case of coordination. The coordinate structure of example (2') may be represented as follows (the internal structure of the PP is left unspecified):

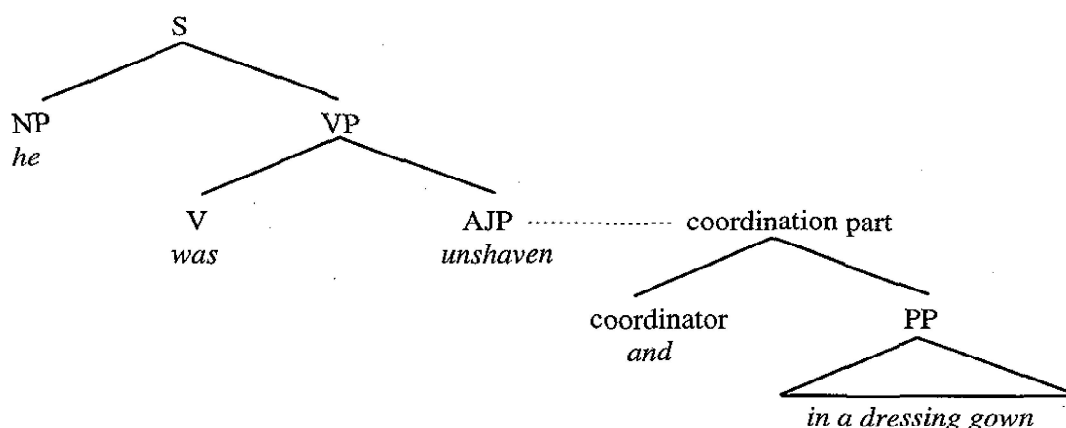


Fig. 5. Analysis of *He was unshaven and in a dressing gown*.

The coordinate structure of examples (5) and (6), containing neutralization of the verb *to be*, can be accounted for in much the same way. Coordination takes place at the level of verb complementation, and as long as the rule defining the coordination part has access to information regarding the specific verb used (in this case, *to be*), the appropriate possibilities can be defined.

As a second example, let us look at a case of conjunction reduction, such as *most multicellular and many single-celled creatures* in (7). The occurrence of the coordinator *and* following the premodifying adjective phrase signals an obligatory right context: the head of the noun phrase (and anything following it) has not yet been realized. This information is relevant for the realization of the coordination part. As before, the rule describing this coordination part may refer to all rules that are involved in the preceding substring, and that have not yet been terminated. These include the level at which the premodifier is found, as well as the next hierarchical level up, viz. that of the NP (cf. Fig. 6 below). This means that the coordination part could be defined as premodifier only (resulting in a coordination of premodifiers), but it may also repeat the realization of the noun phrase constituents from the very beginning; however, only up to the noun phrase head. The latter, as well as possible postmodifiers, necessarily belong to the right context, and may therefore not be described by the coordination part. This results in a coordination part consisting of the determiner and premodifier together, which is the current case of conjunction reduction. The analysis can be

represented by means of the tree structure in Fig. 6 below (in this representation I use flat tree structure; however, the argumentation applies also when a standard X-bar analysis is assumed).

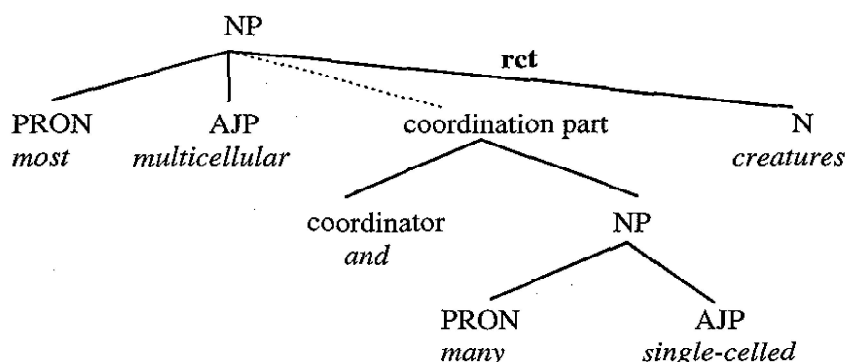


Fig. 6. Analysis of *most multicellular and many single-celled creatures* (conjunction reduction).

As this analysis makes clear, the content of the coordination part can be appropriately defined on the basis of structural information regarding the preceding substring.

Next, let us consider a case of coordination of multiple constituents of the type in sentence (11), repeated below for convenience.

- (11) Do I resent *the wind when it chills me or the night when it makes me stumble in the darkness?*

At the point where the coordinator occurs, all subcategorization requirements of elements in the preceding substring have been fulfilled; that is, there is no indication of an obligatory right context. In fact, the substring preceding the coordinator forms a complete sentence. As before, the coordination part may refer to all levels of analysis that are involved in this preceding substring. In this case, it refers to that of the entire sentence (or, alternatively, to the level of VP, depending on the level at which the adverbial is described). However, this does not mean that every constituent of that level must necessarily be realized in the coordination part (i.e. that there is coordination of full clauses). Constituents may be 'skipped', but that makes them part of the left context. In other words, the coordination part may be defined on the basis of the sentence level, but need not contain a complete sentence. When it does not, it must find structural completion in the left context. This possibility is ensured by the fact that it is the sentence level that serves as the basis for its definition in the first place.

Finally, let us look at an example containing non-parallel conjuncts; in particular, *gapping*. For this purpose, we may use a simplified version of example (14), given as (14') below:

- (14') *The first consists of A and the second of B.*

This example contains all the usual aspects of gapping, but as an additional interesting feature, shows the obligatory preposition *of* (cf.: *\*The first consists of A and the second B.*) This suggests that verb + preposition do not function as a single unit, but rather, that the preposition is part of an obligatory PP-complement of the verb *consist*. The PP must be headed by the preposition *of*; in other words, it is subcategorized for by the verb. This can be

regarded as lexical information in the same way as the lexical ambiguity of the verb *be* in examples (5) and (6). The hierarchical structure corresponding to the substring preceding the coordination part can be represented as follows (the internal structure of the subject NP is left unspecified; the form of the subcategorized PP is indicated by means of the feature [of]):

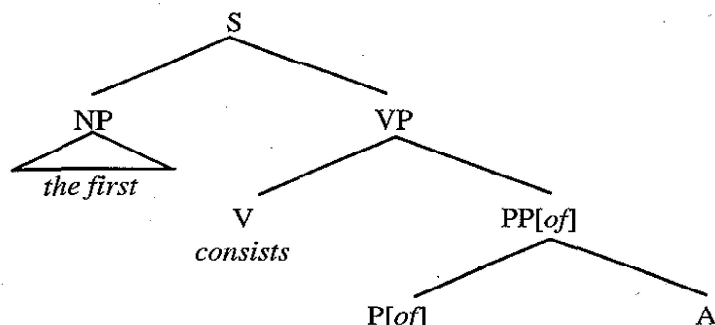


Fig. 7. Phrase structure tree for *The first consists of A*.

If a coordination part is inserted following *A*, theoretically, the following possibilities for coordination exist:

- The coordination part relates to the *current* active level, that is, the prepositional complement. An example of such a coordination would be: *The group consists of students and teachers*.
- The coordination part relates to the previous active level, that is, the verb complement realized by a PP with head *of*. In that case, the preposition is obligatory (it is the head, and subcategorized by the verb), and therefore, cannot be omitted from the coordination part. Its lexical realization is dependent on/determined by the verb *consist*.
- The coordination part relates to the second preceding active level, that is, the level of VP. Since for the coordination part the rule describing the verb phrase may be accessed independently of its prior instantiation, the verb phrase need not have the same realization as before. Therefore, we can have a verb phrase containing a prepositional verb coordinated with one that does not, as in *The group consisted of students and contained twenty people*.
- The coordination part relates to the next higher active level, which is the level of the sentence. At this level, there may be either coordination of full clauses, or gapping, as in example (14'). This can be accounted for if the rule defining the coordination part has access to information regarding the verb (which is the head of the VP and, ultimately, may be regarded as the head of the sentence). Note that this information has implicitly been accessed through involvement of the active levels VP and S. This means that information on the verb complementation may indeed be available to the rule defining the coordination part. This complementation must necessarily be compatible with the verb *consists*. Repetition of the preposition follows from the fact that it is obligatory in the verb complement that accompanies *consists*. The verb may be absent from the coordination part provided that the complementation is related to the verb that, ultimately, creates the sentence level at which coordination takes place.

The informal discussion of examples in this section showed that in principle, a rule defining the coordination part on the basis of the rules involved in the description of the substring preceding it, may have access to all relevant details needed to provide an accurate description of conjuncts. The crucial factor that makes this analysis possible is the different grouping of the substrings making up the surface structure of the sentence, as shown in Fig. 3. It is important to see that this description defines conjuncts strictly in terms of their surface structure, without making use of deletion rules or underlying levels of analysis. 'Incomplete' conjuncts may be defined on the basis of information regarding subcategorization patterns and saturatedness of the previous context. Such information could be encoded in terms of features, and feed into the definition of the coordination part by means of a general rule. The coordination part itself may be treated as an optional linear interruption of regular phrase structure patterns. This generalization can be expressed in a way similar to the use of metarules in GPSG. The rule describing coordination would take as input the set of phrase structure rules that describe the regular patterns of the grammar, and would yield the set of rules that include the coordination part.

### 3. SUMMARY AND CONCLUSIONS

In this paper I have discussed the surface structure of coordination. I have argued that in a surface structure account, the description of coordination in terms of identical conjuncts (the 'X and X'-view) leaves a number of cases unresolved. The question arises how far coverage of 'X' should be expanded in order to account for all possible conjuncts, and whether expanding the coverage of conjuncts in this manner fails to capture a generalization about coordination as such. In an alternative analysis, I have argued that a more successful account of coordination can be given when a different grouping of the substrings making up the surface structure is defined. This alternative defines a coordination part, consisting of coordinator and right conjunct, on the basis of structural information regarding its preceding context (consisting of left context and left conjunct).

While the discussion seems to show clear potential of the linear approach, there are still many interesting questions to be explored. These relate, among others, to the role of the coordinator (e.g. *or*, *but*, *and*); to agreement relations between coordination part and right context (e.g. *in this and later plays* vs. *\*in this and later play*), and to details of semantic interpretation (e.g. distributive vs. collective reading of coordinated nouns). Also the domain of application of the coordination rule needs to be investigated. In particular, this relates to the question how much of the left context is relevant (e.g. in the case of embedding). Finally, the relationship between coordination and other phenomena that cause linear interruption of regular hierarchical structure is worth investigating. Examples include comparison and subordination. The occurrence of gapping and reduction in the context of such phenomena suggests that the role of linear structure might be more important in linguistic analysis than is generally assumed.

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