

PRINCIPLES OF PHRASAL ARCHITECTURE:
CATEGORY ASSIGNMENT IN COORDINATE STRUCTURES*

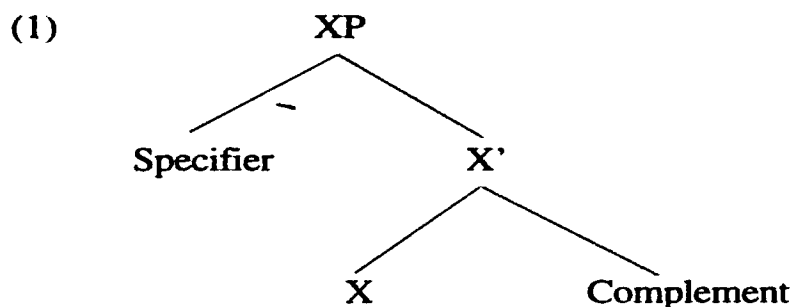
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This paper considers the possibility that the architectural properties of phrase structure can be derived from general principles rather than merely stated as stipulations. After proposing and illustrating a set of independently motivated principles, I focus my discussion on a series of puzzles associated with the syntax of coordination. The approach adopted here is shown to make two surprising predictions about coordinate structure, the apparent validity of which provides support for the proposed principles and for the general approach to phrase structure that they represent.

1. INTRODUCTION

Within the past two decades or so, the formal analysis of natural language has increasingly focused on the search for principles of sufficient depth and generality to explain rather than simply describe the facts of language. Indeed, it is perhaps not an exaggeration to say that this has become a unifying theme within the field, providing a common goal for otherwise quite different approaches to syntactic analysis. The purpose of this paper is to extend this type of thinking to a feature of language whose analysis within mainstream syntactic theory has been largely stipulative –the architecture of phrase structure.

The classic treatment of this question draws on the familiar 'X-bar schema' that originated in the work of Jackendoff (1977) and has evolved over the years to take the form depicted in (1) (following Larson 1988).

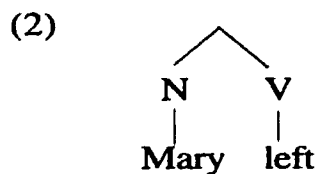


Among the stipulations inherent in this schema are the requirement that hierarchical structure exhibit binary branching and the requirement that the phrase (XP) be of the same category type as its head (X). Thus, a phrase with N as its head will be an NP, a phrase with V as its head will be a VP, and so on.

I will begin by outlining a quite different approach to phrase structure that I have been developing over the past several years. As I will explain in the next section, the key feature of this approach is that both the architectural and categorial properties of phrase structure can be predicted from principles more general than the X-bar schema. I will then illustrate some possible advantages of this approach to phrase structure by considering a number of intriguing phenomena and puzzles that arise in the study of coordinate structure in English.

2. PREDICTING PHRASAL PROPERTIES

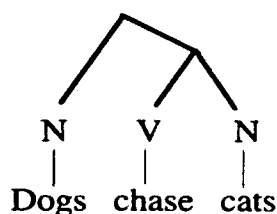
I take as my starting point the computational system for structure-building put forward in O'Grady (1991). The core of this system consists of a simple combinatorial operation that combines an argument-taking category (called a functor) with an argument of the appropriate type. The effects of this operation can be seen in the following example, where an intransitive verb combines with a nominal argument to form a sentence.



Somehow, this combinatorial operation must be constrained so that in more complex sentences –such as those built around transitive verbs, for example– the resulting syntactic representation exhibits the appropriate

architectural properties, including (I assume) binary branching and the familiar subject–object asymmetry.

(3)



How can these properties be instantiated without stipulation? As a first approximation, I believe that four principles are involved, each of which is independently motivated and none of which is specific to the syntax of natural language.

First, I assume that the computational system used for structure-building in natural language is subject to the Binariness Principle.

(4) The Binariness Principle

Combinatorial operations apply to pairs of elements.

The Binariness Principle ensures that syntactic representations will have a binary architecture with each phrase consisting of just two constituents. As I have noted elsewhere (e.g. O'Grady 1997), this principle is apparently not specific to natural language, since arithmetical computations seem also to be constrained in this way.¹

Second, I assume that in cases where a functor has more than one argument, the combinatorial order is determined by a thematic hierarchy that stipulates the relative prominence of arguments of various types (e.g. Jackendoff 1972, Carrier-Duncan 1985, Larson 1988, Baker 1988, Speas 1990).

(5) The thematic hierarchy

agent > ... > theme > ...

In recent work (e.g. Jackendoff 1990), the effects of the hierarchy have been derived from a more general mapping principle that governs the relationship between syntactic structure and lexical-conceptual structure (the representation of lexical meaning). I believe that this is a desirable result, but I will not pursue this matter further here.

Third, I assume that in cases where any of a functor's argument dependencies remain unsatisfied after a particular combinatorial operation,

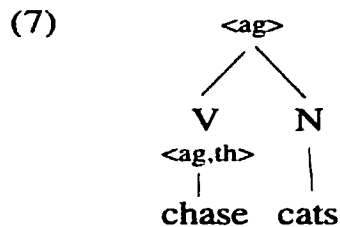
they are inherited upward for satisfaction by a subsequent combinatorial operation.

(6) The Inheritance Principle

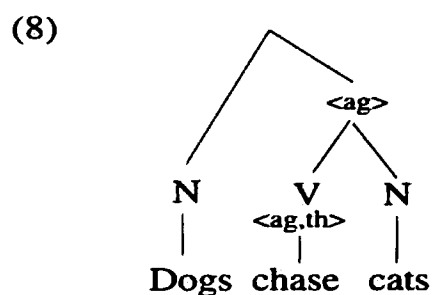
Unsatisfied dependencies are inherited upward.

Comparable proposals have been put forward under the name of feature-passing and percolation, both in morphology and in syntax (e.g. Lieber 1983, Roeper 1987).²

Taken together, these three principles ensure that even complex sentences will be assigned syntactic representations with the appropriate architectural properties. As a simple illustration, let us reconsider the sentence *Dogs chase cats*, whose structure is built in two steps. In the first step, the transitive verb combines with its theme argument, in accordance with the Binarity Principle and the thematic hierarchy. The still unsatisfied dependency on an agent argument is passed upward in accordance with the Inheritance Principle, yielding the representation in (7).



In the second step, the agent argument dependency is satisfied by combination with the nominal *dogs*.



This yields a syntactic structure of a relatively conventional sort, with binary branching and a subject-object asymmetry, but one thing is missing –there is no information about the syntactic category of the phrases *chase cats* and *dogs chase cats*.

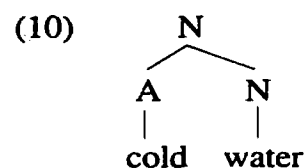
A phrase's category can be inferred from information about the notional type and semantic function of its component parts, in accordance with the following pragmatic principle. (A similar proposal was put forward independently by Ninio 1988.)

(9) The Transparency Principle

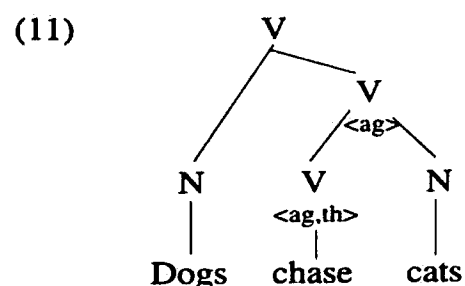
Specifying X's properties or participants still leaves an X.

To see how this works, let us assume as a first approximation that verbs have the notional type 'event', that adjectives are associated with the notion 'property', and that nouns are the category of 'entities' (Hale & Keyser 1993:68-72, O'Grady 1997:313ff).

Now consider what happens when an adjective combines with a noun, as in the phrase *cold water*. Given that the adjective denotes a property that is attributed to the entity denoted by the noun, it follows that the resulting phrase must be of the same notional type as *water* –that is, it must be an entity-denoting element and therefore must be an instance of the N category.



By similar reasoning, the phrase formed by combining a verbal category with any of its arguments must be of the verbal type. This is because the combinatorial operation in question has the effect of specifying a participant in the event denoted by the verb. By the Transparency Principle, the resulting phrase must still be of the event type and hence will be an instance of the V category. Thus, the more complete representation for the sentence in (8) above will include the information depicted in (11).



Two comments are in order before proceeding. First, the syntactic representation resulting from the interaction of the principles proposed here yields information about the category membership of a sentence's constituents, but not about their 'bar level'. Thus, N stands for both noun and noun phrase, V for both verb and verb phrase, and so on. This practice is common in categorial grammar (e.g. Dowty 1982), dependency grammar (Starosta 1988), some versions of government and binding theory (e.g. Speas 1990:44), and, more recently, the 'minimalist program' (Chomsky 1995:246).³

Second, sentences are treated as verbal projections. This view is shared by proponents of a wide variety of theoretical frameworks, including categorial grammar (Bar-Hillel 1953), generalized phrase structure grammar (Gazdar et al. 1985:61), dependency grammar (Starosta 1988), head-driven phrase structure grammar (Pollard 1988:398), and construction grammar (Fillmore 1988:43), among others. The most notable exception to this consensus, of course, is government and binding theory, in which the head of S is taken to be Agreement, Tense or Inflection, depending on the author. (See, however, Grimshaw 1997:376, who treats V as the head of S.)

As stated at the outset, the purpose of this paper is to explore the consequences of a principle-based approach to phrase structure for the study of coordination. As we will see directly, coordinate phrases have a number of unusual properties that present special challenges for theories of syntactic representation.

3. CATEGORY ASSIGNMENT IN COORDINATE STRUCTURES

A first fact to be captured is that the coordination of elements belonging to the same category yields a phrase of that category. Thus, if we coordinate two nominals (as in, *Harvey and Mary*), the result is a larger nominal category; if we coordinate two verbs (as in *go and eat*), the result is a larger verbal category; and so on. Since coordination does not involve the specification of properties or arguments, the Transparency Principle is of no help here. As a first approximation, I propose that the coordination operation is semantically additive and therefore has the consequences outlined in (12).

(12) The Cumulativity Principle⁴

Coordination of X and Y yields an output with the properties of X and Y.

In cases where X and Y are of the same notional type, the Cumulativity Principle ensures that the phrase produced by coordination will also be of that type. So, coordination of entity-denoting elements will yield an entity-denoting phrase (hence a nominal phrase, as in *Harvey and Mary*); coordination of event-denoting types will yield an event-denoting phrase (hence a verbal category, as in *go and eat*); and so on.

This is relatively straightforward and yields the more or less standard result. However, the Cumulativity Principle makes a very surprising prediction in the case of coordinate structures in which the conjuncts belong to different categories. The sentence in (13) exemplifies this coordination pattern.

(13) I asked [[_{NP} the time] and [_S whether I could wait there]].

Here coordination conjoins a nominal category and a sentential category (a type of verbal projection according to the view adopted here). The Cumulativity Principle therefore predicts that the resulting phrase should have the categorial properties of both conjuncts. That is, it should somehow be both nominal and sentential— it should have a dual category label of the type N|V (informally, NP|S).

The predicted result is unconventional, but there is good evidence that it is correct. Bayer (1996) has investigated the categorial status of 'mixed coordinate phrases' such as the one in (13) by examining their ability to occur in contexts where only a nominal or only a sentential category is permitted. The verb *wonder*, for instance, takes a sentential complement but not a nominal complement. (Here and in what follows, I use NP and S as convenient abbreviations for maximal projections of the N and V types, respectively.)

(14) (a) with a nominal complement:

*I wondered [_{NP} the time].

(b) with a sentential complement:

I wondered [_S whether I could wait there].

Interestingly, the sort of 'mixed' coordinate phrase that we are considering cannot occur as complement of *wonder*—which suggests that it is not sentential.

(15) *I wondered [[_{NP} the time] and [_S whether I could wait there]].

At the same time, though, the coordinate phrase appears not to be an NP either. The key test involves verbs such as *criticize*, which can take only a nominal complement.

- (16) (a) with a nominal complement:
 We criticized [_{NP} the idea].
 (b) with a sentential complement:
 *We criticized [_S that John was always late].

As shown in (17), a mixed coordinate phrase cannot occur as complement of this verb, which suggests that it is not an NP.

- (17) *We criticized [[_{NP} the idea] and [_S that John was always late]].

Why then can a mixed coordinate phrase occur as complement of *ask* in (13), repeated here?

- (13) I asked [[_{NP} the time] and [_S whether I could wait there]].

As Bayer observes, the key factor seems to be that *ask* allows EITHER a nominal complement OR a sentential complement.

- (18) (a) with a nominal complement:
 I asked [_{NP} the time].
 (b) with a sentential complement:
 I asked [_S whether I could wait there].

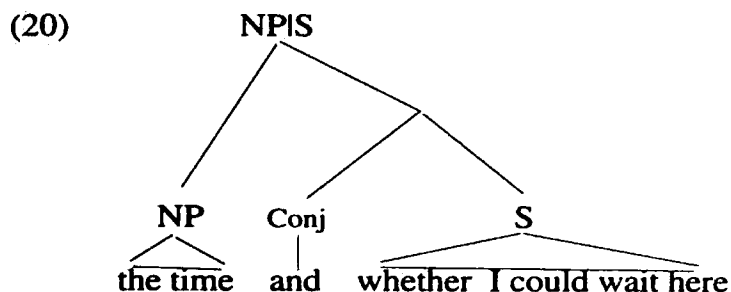
Bayer proposes that we can account for the distribution of mixed coordinate phrases if we make two assumptions. First, consistent with the facts presented above, we must assume that the verbs *wonder*, *criticize*, and *ask* have the selectional properties depicted in (19). (I continue to use NP and S as convenient abbreviations for maximal projections of the N and V types, respectively.)

- (19) (a) *wonder*: _ S
 (b) *criticize*: _ NP
 (c) *ask*: _ NP / S

The disjunction operator \vee in (18c) has exactly the same status as in mathematical logic –it indicates that *ask* selects an NP, an S, or both.

(Recall that for a logician, ‘John is here or Mary is here’ is true if John is here, if Mary is here, or if both are here.)

Bayer’s second assumption is that a mixed coordinate phrase has dual category membership: thus, the example under consideration is both an NP and an S –that is, it is an NP|S (more precisely, N|V), just as the Cumulativity Principle predicts.⁵

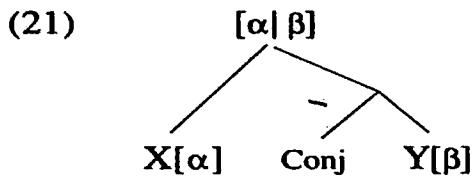


Given its categorial status, the coordinate phrase is eligible to serve as complement of *ask* –a verb whose selectional properties permit it to take a complement that is an NP or an S (or both, given the meaning of the disjunction operator). However, it cannot occur as complement of *wonder*, which permits only an S complement, or of *criticize*, which takes only an NP complement. This is exactly what the facts outlined above show and exactly what the Cumulativity Principle predicts.

4. AN EXTENSION TO NON-CATEGORIAL FEATURES

As we have just seen, a surprising (but apparently correct) consequence of the Cumulativity Principle is that the coordination of unlike categories yields a phrase with a dual set of categorial properties –such as the NP|S category in (20). This result provides striking independent support for the validity of the Cumulativity Principle and for the approach to category assignment that it represents.

Additional evidence in support of this approach comes from a further prediction made by the Cumulativity Principle, which is that the full range of grammatical features associated with conjuncts (and not just their category labels) should be carried up to the coordinate phrase. That is, coordination should work as follows, where α and β represent the set of grammatical properties associated with the respective conjuncts –including category labels, referential indices, and features such as [plural] and [negative].



Consistent with what was observed in the preceding section, we predict that a mixed coordinate phrase will have the categorial properties of both conjuncts. In addition, we predict that a coordinate phrase whose conjuncts differ with respect to other grammatical information will exhibit the properties associated with each constituent. A variety of considerations to which I now turn suggest that this too is correct.

4.1 PARTIAL AGREEMENT

As is well known, verbal agreement in English is triggered by the subject of the sentence.

(22) *Mary* works hard every day.

Consistent with this fact, an NP embedded inside the subject phrase is normally not able to trigger agreement even if it is adjacent to the verb.

(23) *[The friend of the two *boys*] *work* hard every day.

Crucially, however, there is at least one pattern in English where an NP embedded inside the subject NP can trigger agreement in the verb. This is the type of coordination pattern exemplified in (24) and (25), which illustrates the phenomenon of 'partial agreement' discussed by Fowler (1983:89), McCawley (1988:740ff), Johannessen (1996), and Sobin (1997), among others.

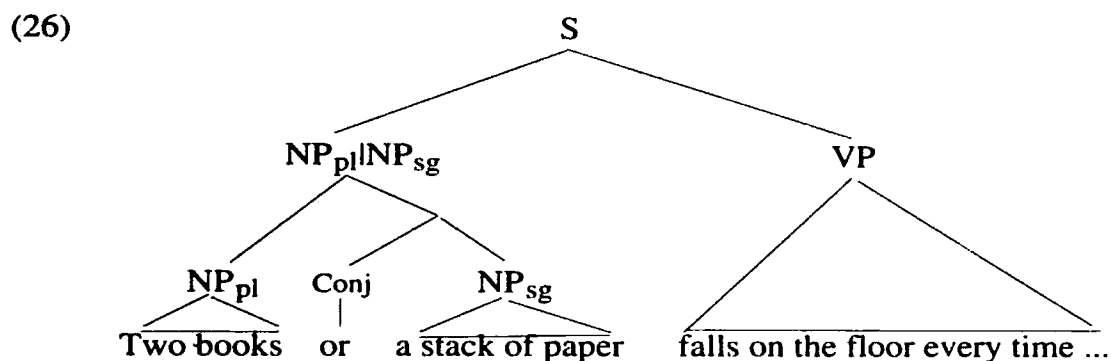
(24) [Two books or *a stack of paper*] *falls*/**fall* on the floor every time I open this cupboard.

(25) [A stack of paper or *two books*] *fall*/**falls* on the floor every time I open this cupboard.

As these examples show, verbal agreement can be triggered by the second component of a coordinate phrase in cases of disjunction.⁶ Hence,

the verb takes the singular form in (24) and the plural form in (25), matching the number features of the second disjunct.

The Cumulativity Principle allows constructions such as these to be assimilated to the more general pattern of subject-verb agreement in English by creating a syntactic structure in which the agreement trigger is the first sister of the V + complement complex (abbreviated here as VP) –just as it is in simple sentences such as *A man is at the door*.



In accordance with the Cumulativity Principle, the grammatical features (including number) of the disjunct *a stack of paper* are inherited by the coordinate phrase in this representation. This in turn ensures their availability for processes such as agreement that operate on elements that are in the subject position.

4.2 VARIABLE BINDING

As we have just seen, the Cumulativity Principle creates a 'raising effect', allowing an element that is embedded inside a larger phrase to behave as if it occupied the structural position associated with that phrase thanks to the inheritance of its grammatical features. This effect can be observed in a number of other phenomena that are sensitive to an NP's structural position.

One such phenomenon involves the assignment of a bound variable interpretation to pronouns, as happens in a sentence such as (27), where *he* can refer to each person in the set of boys.

(27) [Each of the boys]_i thinks that he_i should be a millionaire.

As is well known, this sort of interpretation is generally possible only if the quantified NP c-commands⁷ the pronoun, as it does in (27). For this reason, a bound variable interpretation is generally not available

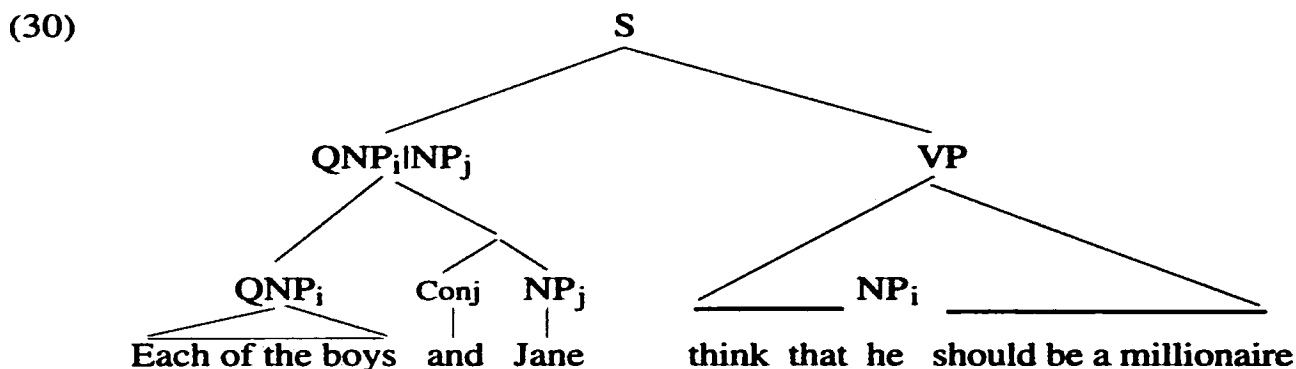
when the quantified antecedent is embedded inside a larger phrase and therefore does not c-command the pronoun. In (28), for instance, the pronoun can have only a deictic interpretation, referring to someone not mentioned in the sentence.

(28) **[The woman who likes [each of the boys]_i] thinks that he_i should be a millionaire.*

Crucially, however, a bound variable interpretation is possible if the quantified antecedent is part of a coordinate phrase.

(29) *[[Each of the boys]_i and Jane] think that he_i should be a millionaire.*

Why should this be so? As illustrated in (30), inheritance has the effect of placing the quantified NP (QNP) in a position where it c-commands the pronoun.



By virtue of inheritance, the grammatical features of the QNP, including its index, are part of the dual category associated with the coordinate phrase. This in turn establishes the c-command relation that commonly licenses the bound variable interpretation of a pronoun.

4.3 NEGATIVE POLARITY

As is well known, the polarity item *anyX* can be licensed by a structurally more prominent negative element.

(31) *None of the children saw anything.*

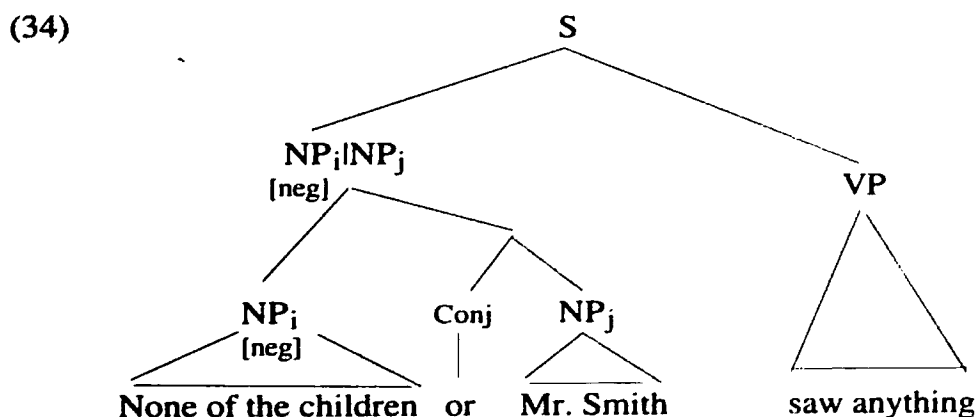
As expected, the negative element in (32) cannot license *anything*, since it is embedded in the subject phrase and therefore does not c-command the polarity item.

(32) *[Someone who none of the children know] saw anything.

Crucially, though, a negative element inside a coordinate structure can license a polarity item.

(33) [None of the children or Mr. Smith] saw anything.

How can this be? The answer lies in the syntactic representation that our proposal assigns to sentences such as (33).



As depicted here, the Cumulativity Principle ensures that the properties of the two conjuncts –including the negative feature on *none of the children*– are passed up to the coordinate phrase. This has the effect of placing an NP bearing the [+negative] feature in a position where it c-commands the direct object, thereby licensing the polarity item.

4.4 PRINCIPLE B EFFECTS

Like many languages, English does not permit a pronoun to have an antecedent that is too ‘close’.

(35) *John_i praised him_i.

As a first approximation, we can capture this fact with the help of the version of Principle B stated in (36).

(36) A pronoun cannot have a c-commanding antecedent in the same clause.

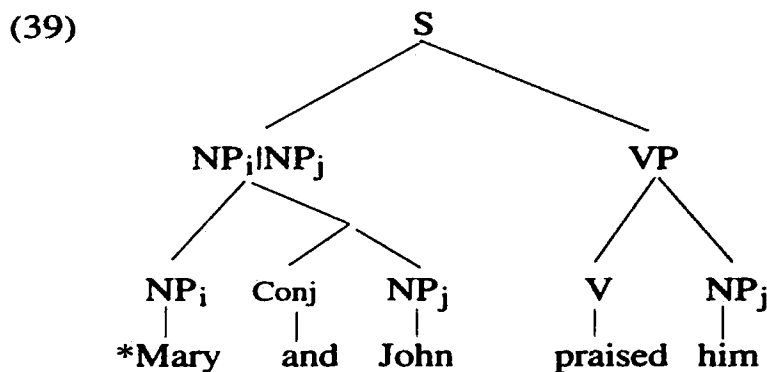
Principle B correctly rules out (35) while at the same time permitting patterns such as (37), in which the pronoun has a non-c-commanding antecedent in the same minimal clause.

(37) [A friend of John_i] praised him_i.

Interestingly, however, the pronoun in (38) cannot have an antecedent within the coordinate phrase.

(38) *[Mary and John_i] praised him_i.

This too is expected if (38) has the syntactic structure depicted in (39).



Here, the Cumulativity Principle creates a coordinate phrase that includes the grammatical properties of the NP *John* –the intended antecedent for the pronoun. Since this in turn creates a c-command relation between that NP and the pronoun, coreference is ruled out by Principle B.

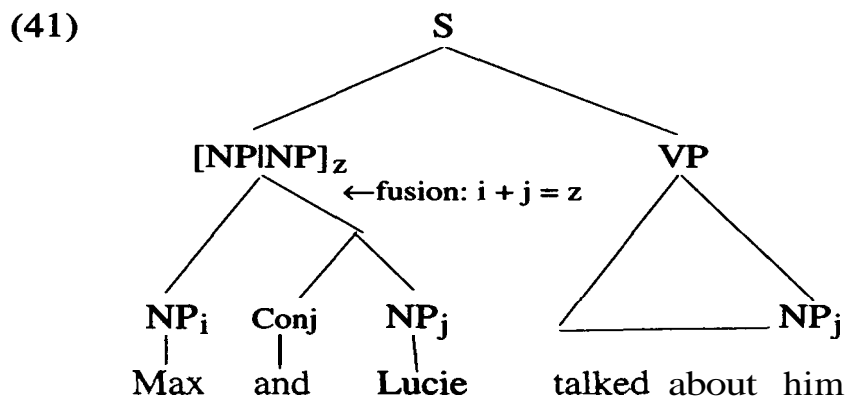
An intriguing challenge for this proposal comes from Reinhart & Reuland's (1993:677) observation that not all coordinate structures exhibit a Principle B effect. They note, for example, that (40) is acceptable on a 'collective' interpretation in which Max and Lucie jointly talk about Max.

Category Assignment in Coordinate Structures

(40) Max_i and Lucie talked about him_i .

However, (40) is unacceptable on a 'distributive' interpretation, where there are two separate acts of talking. (As Reinhart & Reuland note, the distributive interpretation is strongly preferred in (38), which is why this sentence sounds so unacceptable.)

Why should this be? One possibility is that the distributive interpretation of (40) comes from a syntactic structure parallel to (39), in which the indices of the two NPs are passed up to the coordinate phrase without change, ultimately leading to a violation of Principle B. In the case of the collective interpretation, in contrast, the indices may undergo a fusion operation, yielding the result depicted in (41).



In addition to capturing the collective interpretation associated with the subject NP, fusion leaves an index on the coordinate phrase that is distinct from the one on the pronoun. The pronoun can therefore corefer with the conjunct *Max* without bringing about a Principle B violation since there is no c-command relation between the co-indexed NPs.⁸

5. CONCLUSION

As noted at the outset, the analysis of the architectural properties of phrase structure within mainstream syntactic theory has been largely stipulative. This paper has explored a possible remedy to this state of affairs by exploring the possibility that these properties can be derived from general principles. After outlining and illustrating the basic proposal, our discussion focused on the consequences of this approach for the study of coordination. As explained above, the interest of this particular topic lies in the fact that the principle needed to derive the categorial status of coordinate phrases –the Cumulativity Principle– makes two surprising predictions.

The first of these predictions is that there should be 'mixed' coordinate phrases that belong simultaneously to different category types (e.g. NP | S). As we saw, following the work of Bayer, this turns out to be correct. The second prediction involves the status of non-categorial grammatical information. As explained in section 4, the Cumulativity Principle predicts that coordinate phrases will inherit the full set of grammatical properties associated with their constituents, including indices and formal features such as [plural] and [negative]. As we have seen, evidence from a variety of phenomena (partial agreement, variable binding, negative polarity, and Principle B effects) suggests that this prediction too is correct.

The overall picture that emerges from this discussion, then, is a relatively positive one. In particular, there do seem to be general principles that can predict the architectural properties of phrase structure without the need for the usual stipulations. Moreover, these principles have the advantage of shedding new light on a series of puzzles that arise in the syntax of coordination, creating promising prospects for additional research along these lines.

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NOTES

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This operation is called application in categorial grammar (e.g. Bar-Hillel 1953, Bach 1979, Dowty 1982) and Merge in the recent minimalist program (Chomsky 1995).

¹ In adding three numbers, for instance, we always proceed in a pair-wise fashion. The sum of $7 + 9 + 5$ is determined by first adding a pair of numbers (say, 7 and 9) and then adding the third to that sum.

² Inheritance is also found in arithmetical computation. Given binarity, for instance, the cube of 5 (5^3) is determined by first multiplying 5 by 5 and then carrying out the remaining operation on the product (25).

³ Nothing much turns on this, though, and there is a simple algorithm that will assign XP labels if some need for them arises; see O'Grady (1991:14) and Chomsky (1995:242).

⁴This contrasts what has been proposed in Generalized Phrase Structure Grammar, where the grammatical features on a coordinate phrase correspond to the intersection of the features on the conjuncts (Gazdar et al. 1985:175). For a critique of this idea, see Bayer (1996:580ff).

⁵I assume that coordination is also constrained by the Binarity Principle. I take no position here on which category type (if any) the intermediate *and XP* phrase should belong to.

⁶The agreement trigger is usually the disjunct that is closer to the verb, but this is not always the case, as Sobin (1996:320) notes. In English, partial agreement is only possible with disjunction. In some languages, however, it is found with conjunction as well (Johannessen 1996).

⁷X c-commands Y if the first phrasal category above X also contains Y.

⁸This raises the question of why a reflexive pronoun cannot be bound by a conjunct in a coordinate phrase that has a distributive interpretation.

(i) *Mary and John_i praised himself_i.

It is possible that the unacceptability of this sentence pertains to semantic factors involving the nature of reflexivity, but I will leave this matter unresolved for now.

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