

Introduction

Coordination, general though it is within languages, is a quite obstinate phenomenon for theories of grammar. To see why, consider a terminal string (1) in some language with **&** as a coordinating element

(1) $\mathbf{a_1 \dots a_i \dots a_j \ \& \ b_1 \dots b_k \dots b_m}$

The coordinating element **&** is supposed to relate two substrings **A** = [$\mathbf{a_1 \dots a_j}$] and **B** = [$\mathbf{b_k \dots b_m}$]. What can we say about the status of each of the substrings and of the covering superstring **A+B** = [$\mathbf{a_1 \dots a_j \ \& \ b_1 \dots b_m}$]? For one thing, **A** and **B** should not be identical, i.e., if they are identical, the result is weird, in any language, except for the case that both **A** and **B** are sentences and **A+B** covers the whole of string (1). (2a) is unacceptable or a joke; (2b) is just a tautology.

- (2) (a) The general invited the commanding officers and the commanding officers.
(b) The general invited the commanding officers and the general invited the commanding officers.

It has been observed (Postal 1971) that coordination presupposes or induces at least some semantic difference between **A** and **B** and that in many cases accentuation is the proper way of expressing these differences. On the other hand, for a string like (1) to be grammatical, the 'coordinates' **A** and **B** must show some typological similarities relative to the non-coordinated environment:

- (3) (a) *John sang [beautifully] and [a coral] (Sag a.o. 1985)
(b) *John sang [the coral beautifully] and [Dylan's greatest hits in Amsterdam].

Coordinates are neither bound by constituency nor by functionality. There appear to be hardly any restrictions on the nature of **A** and **B**, except that they must be, in some sense, alike. Thus, the asterisks in (3) do not imply that any of the bracketed strings could not be a coordinate in an other coordinated string. In fact, each of them can occur as a coordinate in the same non-coordinated environment *John sang _*.

Contrasting with these subtleties, coordination is hardly ambiguous. In general, a string like (1) is only grammatical under one particular assignment of terminal elements to **A** and **B**. If some variation is possible, it is induced by modifiers and depends on what is occurring to the other side of the coordinator:

- (4) (a) I have seen old [men] and [women] being arrested.
 (b) I have seen [old men] and [women] being arrested.
 (c) *I have seen old [men] and [two children] being arrested.

What counts as a coordinate in a coordinated string, is not determined locally, but globally. For any a_i in (1), it depends on particular properties of some b_j , whether or not it is part of the left coordinate **A**. Essentially, this 'licenser' is not hierarchically ordered with respect to a_i . There is, furthermore, not necessarily a one-to-one correspondence in this respect between parts of **A** and parts of **B**. Many languages have forms of coordinative ellipsis where elements of **A** can only partially be related to elements of **B**; a typical example is the Gapping configuration:

- (5) John blamed Mary for spoiling the children and the children for everything else.

Not every infringement on the functional correspondence between **A** and **B** is admissible. In particular, long distance dependencies can not just affect one coordinate without affecting the other (Ross 1967):

- (6) (a) *What did John give a book to Mary and steal from Bill?
 (b) *To whom did John give a book and steal pictures from Bill?

So, the grammar of coordination has to deal with a type and function insensitive, lexically and structurally context sensitive but non-ambiguous and non-hierarchical phenomenon. Dik (1968) opens his study on coordination with a summary of the relevance of the construction:

For a variety of reasons the so-called 'coordinative construction' is of special importance to general linguistic theory. In the first place, this type of construction seems to be a universal feature of natural languages. Secondly, not only does its existence seem to be universal, but the way in which it is manifested in each particular language also shows a quite general, if not universal pattern. Thirdly, coordination is operative, to a greater or lesser extent, on many different levels of grammatical structure (...). Fourthly, this construction imposes some special requirements on the system of rules by which it is to be described, and is therefore directly relevant to the format or model on which grammatical description should be based. Finally, it constitutes one of the sources of the 'immanent productivity of natural languages', (...) by virtue of which a potentially infinite number of sentences can be constructed on the basis of a limited number of structural patterns.

INTRODUCTION

One may compare grammars for natural language in terms of their ability to incorporate this peculiar configuration in a consistent way. Gazdar a.o. (1985: 186fn.) read Williams (1978) and Goodall (1983) a lecture for proposing coordinative structures that are not or not completely embedded in the grammatical framework they — Williams and Goodall — adhere to. This criticism applies, I believe, to most of the attempts by generative grammarians to cope with coordination. Throughout the history of generative grammar, the treatments of coordination never made it to the core of the theory. Chomsky's (1957) production rule $X \rightarrow X \text{ and } X$ hardly matches the X-bar format. The Coordinate Structure Constraint of Ross (1967), designed to rule out (6), is the only one of his constraints that is neither explained away nor absorbed by more abstract principles in the actual aggregation of the generative theory. Williams's (1978) factorization — appreciated for its adequacy (cf. Zwarts 1986) — as well as Goodall's (1983, 1988) linearization have not been extended to other areas of generative analysis. Neijt (1979) is an heroic effort to bring the intrinsicalities of coordinative ellipsis under the regime of sentence grammar; Den Besten (1982), however, argues with some force that such an enterprise is doomed to fail. Chomsky (1982: 15) suggests that more-dimensional approaches to coordination might be adequate, adding that “(...) incompatibility of such proposals with the theory of phrase structure grammar stands as no barrier to them”. Several attacks on coordination along these lines, among which in recent time those of Muadz (1992) and Grootveld (1992), have been made; their common claim is that more and richer structure is needed, in order to account for coordination properly, than is provided by the standard inventory of generative grammar. Nevertheless, in generative textbooks current in the Netherlands like Bennis and Hoekstra (1989) and Model (1991), coordination is near to absent in the gamut of phenomena presented to the eager student.

Coordination, thus, looks like an encounter of the third kind to generative grammar. It is, however, not an alien object to other frameworks. Sag a.o. (1985) demonstrate that the liberal understanding of what a category is in Generalized Phrase Structure Grammar, smoothly covers some of the more obstinate instances of coordination. Steedman (1985) and Zwarts (1986) argue that the polymorphism of coordination demonstrates the need for a thorough revision of the notion of constituent, and that the alternative notion of constituent is on a par with the flexibility, in this respect, of categorial grammar. In this spirit, Moortgat (1988) and Wittenburgh (1986) appear to claim that Categorial Grammar holds a solution to — in Moortgat's words — “(...) the *logical* problem of solving Boolean polymorphism” (one should take into account here that Boolean algebra was meant to deal with coordination in natural language). In the approach of these authors, coordinates are values of some essential variable, introduced by the coordinating element. Although the range of possible values for this variable is finite in each coordinated string (Moortgat 1988; Van Benthem 1991), the valuation procedure is far from efficient: it necessarily involves many guesses that

are bound to fail, whereas in each sentence very few valuations are correct, and mostly only one.

This study deals with coordination in a procedural perspective. Its main objective is to establish a method of computing coordination, i.e., a method of determining which are the coordinated substrings in a coordinative construction. In this sense, the study takes an engineer's point of view: its emphasis is on the *why* of the *how*, i.e., on the motivation for a particular method of resolving coordination.

There are two major questions. First, is it appropriate to consider coordination as a phenomenon that the structural component of a grammar should deal with? And second, is it possible, in a configuration of type (1), for the strings **A**, **B** and **A+B** to be determined effectively and efficiently? The study suggests that the first question must be answered negatively: the properties of coordination are such that their account should be separated from the account of hierarchical relations in a sentence. The second question, I argue, has a qualified positive answer: it is possible to fix the coordinates effectively and efficiently if the procedure can operate on rigid partial representations of the constituent structure of a sentence. The study confirms, in this respect, the exceptional status that coordination has in generative grammar, for procedural reasons. It assumes, however, that the partial representations feeding the procedure that resolves coordination, must be identified in the realm of (combinatory) categorial grammar, and that they are not flexible but rigid.

The study is divided into three chapters, which can be read separately.

In the first chapter, the nature of a categorial grammar that provides rigid partial structures, is discussed. It introduces the notion of minimal categorial grammar (of a certain language) with respect to the space of categorial systems generated by the Lambek calculus. Finally, the chapter gives an outline of a minimal categorial grammar of Dutch, in particular of its verb cluster.

Chapter 2 analyses coordination as linear repetition of categories, providing the format in which the particular properties of coordination can be stipulated. It is recognized that this analysis is basically reductional, as it relates all coordination to coordination of sentences. This implication of the repetitive analysis is defended, both in its syntactic and in its semantic aspects. Moreover, it is shown that coordinative ellipsis, especially Gapping, can be seen as a form of discontinuous repetition.

Chapter 3 presents a detailed argument that the positions defended in the previous chapters yield an explicit and effective procedure for determining coordination. The existence and the structure of this procedure are derived stepwise from a formalized version of a minimal categorial grammar and a formal definition of coordination as repetition. The procedure is modelled as parasitic on the grammar. The procedure's contribution to overall conditions on coordination

INTRODUCTION

and its relation to the approach of Moortgat (1988) are evaluated. An algorithm implementing the procedure is given in the appendix to the chapter.