

A Framework for Parsing Coordination

All languages, seemingly without exception, possess strategies which permit various types of co-ordination to occur at the phrasal as well as the sentential level, thereby forming complex phrases of various grammatical categories. Payne (1985: 3)

(...) coordination is a highly unrestricted phenomenon, that must be blocked in only a few exceptional cases (...) Houtman (1987: 140)

1. Coordination as repetition

In the spirit of the quotations at the onset, this chapter takes a rather liberal view on coordination. The basic assumption is that coordination is essentially a process of repetition of nonterminal strings, i.e., strings of types. Such a conjecture is supported by the following observation in Dutch and other languages (cf. Dik 1968: ch. 7). If you take a sentence, put a coordinator somewhere between two elements and insert to its right some re-lexicalization of some part of the sentence immediately preceding the coordinator, there is a great chance that the resulting phrase is grammatical. Here are some examples of coordination, 'generated' this way from sentence (1) by inserting a coordinator and repeating a string of types at the positions marked (&). The scope of the coordination is indicated by upper-case.

- (1) De voorzitter (&) wil (&) morgen niet (&) (&) vergaderen (&)
the president wants tomorrow not assemble
 omdat (&) sommigen tegen (&) het voorstel schijnen te gaan
because some against the proposal seem to go
 vote
stemmen
'The president does not want to call a meeting for tomorrow because some people seem to be going to vote against the proposal.'

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- (2) DE VOORZITTER of DE SEKRETARIS wil morgen niet
the president or the secretary wants tomorrow not
 vergaderen ...
assemble
- (3) DE VOORZITTER KAN en DE SEKRETARIS WIL
the president can and the secretary wants
 morgen niet vergaderen
tomorrow not assemble
- (4) De voorzitter kan MORGEN NIET maar VANDAAG WEL
the president can tomorrow not but today (yes)
 vergaderen
assemble
- (5) De voorzitter KAN MORGEN NIET maar WIL
the president can tomorrow not but wants
 VANDAAG WEL vergaderen
 today (yes) assemble
- (6) De voorzitter KAN MORGEN NIET VERGADEREN en
the president can tomorrow not assemble and
 WIL VANDAAG NIET WEGGAAN
wants today not leave
- (7) De voorzitter KAN MORGEN NIET VERGADEREN
the president can today not assemble
 OMDAT en WIL VANDAAG NIET WEGGAAN
because and wants today not leave
 OFSCHOON sommigen tegen het voorstel schijnen te
although some against the proposal seem to
 gaan stemmen
go vote
- (8) De voorzitter kan MORGEN NIET VERGADEREN
the president can tomorrow not assemble
 OMDAT SOMMIGEN VOOR en VANDAAG NIET
because some for and today not
 WEGGAAN OMDAT ANDEREN TEGEN het voorstel
leave because others against the proposal
 schijnen te gaan stemmen
seem to go vote

Some of the sentences resulting from simple repetition of types may be hard to grasp, due to the fact that topic/comment patterns vary with the scope of the coordinator and to other pragmatical circumstances. Coordination entails semantic and informational contrasts (cf. Dik 1968: ch. 12), realized as stress and

referential opposition. One could even try to restrict coordination in terms of focus and presupposition, as Dirksen (1990) does with respect to ellipsis. But we should be open to the fact that each and everyone of the structures underlying sentences (1)–(8) is grammatical: we can always construct presuppositional conditions, focus assignments, stress contours, referential stipulations and the like that license some or other lexicalization of the structural patterns involved. Hence, these sentences illustrate the almost unbounded productivity of so called Conjunction Reduction and Right Node Raising (sometimes also referred to as Backward Conjunction Reduction). Globally, Conjunction Reduction is held responsible for the double function (with respect to both coordinates) of the substring to the left of the left coordinate, and Right Node Raising for the double function of the substring to the right of the right coordinate. If in (9) Y_1 and Y_2 are the conjoined strings, any relation between X and Y_2 is traditionally said to arise from Conjunction Reduction, whereas any relation between Z and Y_1 is ascribed to Right Node Raising or Backward Conjunction Reduction.

(9) $X Y_1$ and $Y_2 Z$

According to this bisection, the reader may verify that in the examples (4) - (8) both phenomena can be observed.

The assumption that coordination involves the repetition of a string of types, can be formulated as:

- (10) *String Repetition Assumption*
 There is a type **COORD** such that
 1. $s \text{ COORD } s \rightarrow s$ holds for every designated type s , and
 2. if $c_1 \dots c_n \rightarrow s$ can be proved
 then for every i and j , $1 \leq i \leq j \leq n$
 $c_1 \dots c_i \dots c_j \text{ COORD } c_i \dots c_j c_{j+1} \dots c_n \rightarrow s$ holds

From now on, I will refer to this assumption as **SR**. The main objective of SR is to provide an anchor for answering a parsing problem: given a string with a coordination in it, how can mechanically, efficiently and truthfully be determined which elements belong to a coordinate and which don't? This question is neither trivial nor is the answer transparent at first sight, as can be seen from the rich variety of possible coordinations within the body of a sentence. Moortgat (1988) carefully distinguishes the question how to parse coordination efficiently, from what he calls the logical problem of coordination: how to account for the fact that coordination tends to be 'coordination of the likes'. He presents a solution to the latter but not to the former problem.

Obviously, questioning the nature of coordination precedes any trustworthy attempt to resolve the parsing problem. This chapter is meant to explore the usefulness of SR in finding answers to both the parsing problem and questions

concerning the nature of coordination. Among the latter, the following are prominent:

To which extent is coordination to be analyzed as a sentential and/or propositional process?

What, if any, is the relation between boolean and non-boolean types of coordination?

To which extent can we generalize over elliptical and non-elliptical forms of coordination?

Before turning to these and related matters, I will first discuss some idiosyncrasies of the formulation of SR and some necessary amendments to the power of SR.

Formulation (10) of SR uses a rather rigid notion of type. In particular, it does not extend to complex symbols. As a consequence, SR is not intended to cover feature clashes of any kind. Types in (10) just stand for the basic combinatory potential of categories, given a set of primitive types and some rules for constructing derived types. On any other interpretation of types, SR is bound to come up — at least on the sentential level — against a canonical set of counterexamples, the nature of which is explained in Zwarts (1986) and Hoeksema (1983, 1988), and which will be discussed briefly below.

SR (10) introduces the type for conjunctions syncategorematically, without reference to its combinatory nature and in the same vein as conjunctions were treated in e.g., Chomsky (1957) and Montague (1973). Yet, the first clause of (10) gives, embedded in a Lambekian approach to type change, rise to propositions like **COORD** \rightarrow $s \backslash s / s$ for every designated type s by calling the rule of right slash introduction (cf. chapter 1). Because the second clause specifies a crucially infinite class of environments for **COORD**, we cannot arrive, proceeding this way, at a finite lexical assignment of types for **COORD**. Therefore, SR implies that no functional type is assigned (lexically or otherwise) to coordinators.

At first sight, (10) does not appear to discriminate between possible values for the designated type s . Its value might be **np**, **vp** or **pp**, as well as the sentential type it seems to aim at. But SR is designed for parsing an unlimited variety of structures, i.e., for finding out what objects are coordinated if anything. It would be highly unproductive to charge the operation mode with a wide range of possible outcomes to check, if it is clear that only one is valid in a given situation: the scope of a coordination, in terms of types coordinated, is hardly ambiguous. Even when coordination appears to be semantically ambiguous, as in

- (11) Hij heeft alleen mooie mannen en vrouwen in dienst
 he has only beautiful men and women into service
 genomen
 taken
 'He has hired only beautiful men and women.'

the coordination is rigid from a typological point of view: in (11) the type **n** is coordinated under both interpretations of the scope of *mooie* 'beautiful'. To find out which types are coordinated, we had better start from the assumption that the result must be a sentence. So, the designated type mentioned in (10) is to be the sentential type, for practical reasons. Of course, this invokes the more fundamental question whether propositional reconstruction of coordinated structures is analytically valid. This question will be answered positively in section 2.

The logic of (10) is rather cautious. The antecedent of the *if... then* part assumes a typologically reducible simple sentence, and the consequent plugs in a coordination under simultaneous repetition of a string of types. Thus, the reducibility to **s** of the coordinated string is taken as a necessary condition on the reducibility of the simple string. If there is no way of reducing the complex string containing **COORD** there is no way of ensuring reducibility of the simple string. In yet other terms: if the reduction of a coordination is intractable, no 'generators' for the reduction are available. Looked upon this way, SR is quite harmless, and reminiscent of the approach Van Oirsouw (1987: 198) credits Chomsky (1957) for. Van Oirsouw points out that syntactic and semantic problems for (Backward) Conjunction Reduction only arise in case grammatical full coordinates, i.e., simple strings, are taken to be a necessary condition for the reduced coordination. There is, indeed, no transparent way of deriving (12b) from (12a).

- (12) (a) John hates Mary and Mary hates John
 (b) John and Mary hate each other

The logic of such a derivation is represented in (13b), as opposed to the structure of SR, rephrased in (13a).

- (13) (a) if $X Y_1 Z$ then, for some Y_2 , $X Y_1 \text{COORD } Y_2 Z$
 (b) if $X Y_1 \text{COORD } Y_2 Z$ then $(X Y_1 Z \text{ and } X Y_2 Z)$

Van Oirsouw suggests that the deletional accounts of coordination tend to reverse the conditions and run into problems for that very reason; he discusses these problems in some detail. Although SR seems to be immune to these problems, then, it is clear that the spirit of SR is sentential. In the words of Dik (1968) — who traces the 'reduction postulate' back to Aristotle and Port Royal — SR interpretes reduction not only in a logical sense, but also in a grammatical sense: "...the grammatical structure of the complex sentence should be described in terms of the grammatical structure of the simple sentences to which it can be reduced" (*op. cit.*: 129). SR maintains an implicative relation between coordination of phrases and (coordination of) simple sentences. Therefore, it is only fair to reflect on the field of phrasal coordinations that cause problems for sentential reconstruction.

2. Coordination as coordination of sentences

2.1. The hypothesis

The idea that every coordination can be traced back to a coordination of full sentences, springs from the deletion-under-identity approaches that developed in the spirit of transformational grammar in the late sixties and early seventies. Van Oirsouw (1987) offers an impressive overview of these (and other) treatments. The natural domain of transformations was taken to be sentential; since the coordination of two sentences surely is a sentence, it qualifies as a basis for a generalized rule of Conjunction Reduction. Both the generality of this type of rule and the sentential origin of coordination have been challenged, partly on observational grounds, partly because of an ongoing theoretical shift in Chomskian grammar and beyond. Again, Van Oirsouw (1987) describes the battleground at length, up to 1985, and enters the lists himself. Yet, as far as I can see, the case is far from being settled — which does, unfortunately, not discriminate between coordination and any other interesting topic in grammar. Some clear and important results concerning the behaviour of NPs in the coordination complex, however, are reported in Zwarts (1986) en Hoeksema (1983) on exploring the impact of generalized quantification.

As I indicated in the first section of this chapter, the sentential hypothesis may be useful for purely instrumental reasons, apart from its merits at a higher level of reflection on the nature of grammar. Therefore, the remainder of this section is dedicated to a justification of this hypothesis out of the theoretical winds. For this purpose, I take the sentential hypothesis initially to have the following, low profile.

- (14) Given two sentences of the form (a) **X Y COORD Y' Z** and (b) **X Y Z COORD X Y' Z** — where the single capitals stand for lexical strings — the relation between (a) and (b) is not trivial.

This doesn't mean a lot, yet, but an example may clarify some of its content. The relation between two sets is trivial if neither is contained in the other and neither is the other's complement. If the sentences of (14) can be constructed as sets (for example, if each denotes a set of worlds) the hypothesis would claim that either one is a subset of the other or it is the other's complement. And of course: deriving one sentence transformationally from the other, yields a non-trivial relation in an other logic.

As a first illustration of the effect of the hypothesis, we may consider some of the coordination types discussed and analyzed at some depth by Oehrle (1987). He points out that sentences with adverbs, modals or negation outside the scope of coordination are, in general, not equivalent to their sentential counterparts with

the adverbs, modals or negation distributed over the coordinated sentences. Here are some of his examples.

- (15) (a) Often, Kim goes to the Beach or Valery goes to the city
 (b) Often, Kim goes to the beach or often, Valery goes to the city
- (16) (a) Mrs. J can't live in Boston and Mr. J in LA
 (b) Mrs. J can't live in Boston and Mr. J can't live in LA

Clearly, the meanings of the sentences vary with the scope relations between the adverb and the disjunction in (15) and the the negated modal and the conjunction in (16). But it is also clear that (15b) entails (15a) and that (16b) entails (16a). Consequently, although it may require some intricate grammar to relate the sentences explicitly, each pair complies with hypothesis (14).

2.2. The problems for reduction

The counterexamples to a propositional or sentential reconstruction of coordination appear to fall into two classes: structures in which sentential reconstruction of coordination provokes all kinds of agreement clashes and structures in which semantic properties of quantifiers and other operators oppose naive reconstruction strategies. The sentences (17), like (12), exemplify a pure case of the first class; sentences (18) and (18b) are representative of the second kind.

- (17) (a) Jan en Marie keken elkaar aan in de spiegel
Jan and Marie looked(PL) each other at in the mirror
'Jan and Marie looked at each other in the mirror.'
- (b) *Jan keken elkaar aan in de spiegel en Marie keken
Jan looked(PL) each other at in the mirror en Marie looked(PL)
elkaar aan in de spiegel
each other at in the mirror
- (18) (a) Twee mannen slenterden naar binnen maar werden naar
two men slanted to inside but were to
buiten geduwd
outside pushed
'Two men slanted in but got pushed out.'
- (b) Twee mannen slenterden naar binnen maar twee mannen
two men slanted to inside but two men
werden naar buiten geduwd
were to outside pushed

The agreement cases may induce ungrammaticality in naive reconstruction. The quantifier cases undergo a semantic shift, preserving wellformedness. A closer inspection of (17), however, enables us to distinguish between two kinds of

agreement problems: number disagreement and anaphoric disagreement. The sentences (17) involve a mixture of these, and it may be useful to consider simple cases. (19a) and (19b) illustrate the pure agreement problem, whereas (20a) and (20b) focus on a problem of the anaphoric type.

- (19) (a) Jan en Marie gaan per vliegtuig naar Madras
Jan and Marie go by plane to Madras
- (b) *Jan gaan per vliegtuig naar Madras en Marie gaan per
Jan go by plane to Madras and Marie go by
vliegtuig naar Madras
plane to Madras
- (20) (a) De jongens en de meisjes stonden tegenover elkaar
the boys and the girls stood opposite-to each other
- (b) De jongens stonden tegenover elkaar en de meisjes
the boys stood opposite-to each other and the girls
stonden tegenover elkaar
stood opposite-to each other

The ungrammaticality of the sentential reconstruction in (19) seems fairly superficial from a parsing point of view, and solvable within the realm of unification of complex symbols. Moreover, Hoeksema (1983, 1988) convincingly argues that the number feature on predicates is determined by intrinsic properties of the (generalized) quantifiers in subject position. Given an extended use of unification procedures, this type of agreement clash does not seem to be a real objection to a sentential reconstruction strategy. The coordination of sentences (19b), when adjusted for agreement, represents a proposition that is in all respects equivalent to the coordination of NPs; this equivalence can be seen as a way of matching the sentential hypothesis (14).

Unfortunately, there is more to plurality than this. In so far as plurality of NPs is not dictated by plurality of the noun and/or the determiner (cf. the number opposition between *all* and *each/every*), we can extract from Hoeksema (1983, 1988) a neat analysis of plurality of NPs: an NP is plural if its associated quantifier has, in every model in which it is defined, a minimal element of cardinality greater than one, and is singular otherwise. This suffices to explain why the conjunctions *John and Mary* and *a man and a woman* are plural, whereas the conjunctions *each man and each woman* (the empty set may be the minimal element here) and *no student or no professor* and the disjunctions *John or Mary* and *a student or a professor* are invariantly singular. Informally, if conjunction of NPs is taken to be intersection of the associated quantifiers and disjunction is taken to be union, quantifiers that show up 'existential presuppositions' in the form of conditions on cardinality, induce plurality when intersected, whereas quantifiers that can be generated by the empty set, never contribute to plural characteristics of their NPs. Hoeksema (1988) describes the first class as atomic and referential, and the

second as quantificational. His approach explains why it is so difficult to have mixed conjunctions of atomic and quantificational NPs in subject position — in all languages that show overt subject/verb agreement:

- (21) (a) ??The Pope and every other catholic have a crucifix on the wall
 (b) ?The Pope and every other catholic has a crucifix on the wall

The problem of choice that we are confronted with here, is caused by a conflict of interests. The atomic NP *the Pope* has a unique minimal element of cardinality one that is lost under intersection; *every other catholic* has a minimal element that cannot survive intersection either, the cardinality of which, however, is contingent. Consequently, the minimal element of the intersection should be of cardinality greater than one, making the conjunction plural, but the intersection is also defined in a model where the Pope is the only catholic, *every other catholic* is consequently trivial and the intersection has the same minimal element as *the Pope* (of cardinality 1) after all, which would call for a singular NP. We cannot decide whether we should take the trail of necessity, leading to a singular NP, or the trail of contingency, leading to plurality. Singularity would imply that the intersection is not referential, although *the Pope* is, whereas plurality would imply that the intersection is referential, though *every other catholic* is not. Along the same lines one can imagine why conjunctions like *the Pope and no protestant* are weird, but singular when used. In fact, the existence of lexical number alternatives for real quantifiers (*no man* vs. *no men*, *all men* vs. *every man*) in many languages offers an 'administrative' way out of number agreement problems. As expected, no such problems arise when agreement is not relevant:

- (22) My grandmother despises the Pope and every other catholic

Problems of number agreement are not restricted to (coordination of) NPs. It is at least instructive to observe that conjoined VPs and Ss have no presettled relation to plurality, though singularity is clearly predominant. Compare:

- (23) (a) In de auto stappen en de radio aanzetten maakt mij
into the car step and the radio turn-on makes me
 altijd weer gelukkig
always again happy
 'Stepping into the car and turning on the radio never fails to make me happy.'
 (b) In de auto stappen en de radio aanzetten maken(PL) mij altijd weer
 gelukkig
 (c) Hem lastig vallen en hem om hulp vragen is iets wat ik
him (to) trouble and him for help ask is something that I
 altijd probeer te vermijden
always try to avoid
 'Troubling him and asking him for help is something that I always try to avoid.'
 (d) Hem lastig vallen en op zijn kamer werken kunnen(PL) je

- him (to) trouble and in his room work can your*
 ontslag betekenen
dismissal mean
 'Troubling him and working in his room can lead to your dismissal.'
- (e) Naar New York reizen en hem opbellen maken elkaar
to New York travel and him phone make each other
 overbodig
superfluous
 'Travelling to New York and phoning him make render each other redundant.'
- (24) (a) (2)... dat hij auto rijdt en dat hij tennist, maken deel uit
that he car drives and that he plays-tennis make part out
 van zijn levensstijl
of his lifestyle
 'That he drives a car and plays tennis is part of his life-style.'
- (b) ... dat hij auto rijdt en dat hij tennist, maakt deel uit
that he car drives and that he plays-tennis makes part out
 van zijn image
of his image
 'Driving a car and playing tennis is part of his image.'
- (c) *.. dat hij in Parijs heeft gewoond en dat hij zijn studie
that he in Paris has lived and that he his studies
 heeft afgemaakt, zijn onwaarschijnlijk
has finished are unlikely
- (d) ... dat hij in Parijs gewoond heeft en dat hij zijn studie
that he in Paris lived has and that he his studies
 heeft afgemaakt, zijn beide even onwaarschijnlijk
has finished are both equally unlikely
 'That he lived in Paris and that he finished his studies are equally unlikely.'
- (e) ... dat hij in Parijs heeft gewoond en dat hij zijn studie
 heeft afgemaakt, zijn feiten die ik niet kan betwisten
 ...
are facts that I not can dispute
- (f) *... dat hij in Parijs heeft gewoond en dat hij z'n studie
 heeft afgemaakt, is een feit dat ik niet kan betwisten

is a fact that I not can dispute
- (g) ... dat de kandidaat ongetrouwd is en dat hij veel om
that the candidate single is and that he much for
 kinderen geeft, wegen in de publieke opinie tegen elkaar op
children cares balance in the public opinion against each-other
 'That the candidate is single and that he cares a lot about children,
 counterbalance each other in the public opinion.'
- (h) ... dat hij overleden is en dat hij in Amsterdam woont, is
that he died has and that he in Amsterdam lives is

allebei erg onwaarschijnlijk
both very unlikely

In the confusing complex that seems to determine the number feature of these conjunctions, all kinds of patterns come together: nominalization tendencies and the nature of the predicate, intrinsic or contingent semantic connections between the conjoined constituents and the level of constituency at which coordination comes in. It is beyond my capacity to draw a complete picture, but some lines can be sketched. As to nominalization: if the conjoined subject is unlikely to be nominalized (if it is, e.g., the sentential or infinitival complement of a (passive) verb) plurality is weird. Compare:

- (25) (a) Haar te bezoeken en een flat te huren werd mij niet toegestaan
her to visit and an apartment to rent was me not allowed
 'I was not allowed to visit her and to rent an apartment.'
 (b) ??Haar te bezoeken en een flat te huren werden (PL) mij niet toegestaan
- (26) (a) Of het voorstel verworpen was en of de volgende vergadering is uitgesteld, is nooit gevraagd
whether the proposal rejected was and whether the next meeting has-been delayed has-been never asked
 'It was never asked whether the proposal had been rejected and whether the next meeting has been delayed.'
 (b) *Of het voorstel verworpen was en of de volgende vergadering is uitgesteld, zijn (PL) nooit gevraagd

But if 'floating quantification' arises the predicate, as in (24d), plurality of passivization subjects is again possible:

- (27) ... dat hij meermalen getrouwd is geweest en dat hij niet behoorde tot een kerkgenootschap, werden hem afzonderlijk door de pers verweten
that he more-than-once married has been and that he not belonged to a denomination were him separately by the press reproached
 'That he married more than once and that he did not belong to a religious denomination, were reproaches that the press hurled at him separately.'

If, however, the two conjoined constituents are understood as marking coherent events, plurality is almost out:

- (28) (a) ... daar aan te komen en niemand thuis te treffen lijkt mij een heel vervelende situatie
there at to arrive and nobody home to find seems me a very unpleasant situation

'Arriving there and finding nobody at home seems a very unpleasant situation to me.'

- (b) ??... daar aan te komen en niemand thuis te treffen lijken(PL) mij heel vervelende situaties(PL)

In this vein, the acceptable plurality of (23b) forces a reading in which it is not necessarily the car radio that is switched on. Note that this relation of shared reference is also reflected in agreement patterns for NPs: *my best friend and the mother of my children is on my side* suggests less support but more harmony than *my best friend and the mother of my children are on my side*.

Finally, if the category of the conjunction differs from the category of the subject as a whole because of contraction or because of operations on the top level, plurality is simply out:

- (29) (a) *Hem lastig vallen en om hulp vragen maken je niet geliefd
him (to) trouble and for help ask make you not popular
 (b) Hem lastig vallen en om hulp vragen maakt_{sg} je niet geliefd
- (30) (a) *... dat hij in Parijs woonde en zijn studie afmaakte,
that he in Paris lived and his studies finished
 hebben mij zeer verwonderd
have me highly amazed
'That he lived in Paris and finished his studies, highly amazed me.'
 (b) ... dat hij in Parijs woonde en hij zijn studie afmaakte,
 heeft_{sg} mij zeer verwonderd

As far as I can see, pragmatic coherence and structure of the conjoined elements are hardly independent of each other.

The considerations in this section favour the view that the instantiation of number agreement in languages like Dutch and English is determined by semantic as well as syntactic properties of the construction it is part of. In my understanding, however, they do not support the idea that agreement clashes in the reduction of phrasal coordination to sentential coordination are symptoms of general infeasibility of that relation. The effect of coordination on agreement phenomena apart from subject/verb interaction, like those of the anaphoric type illustrated in (20), is rather considered in combination with quantification and distribution: issues that are addressed in the sections to come.

2.3. Boolean coordination

2.3.1. The outline

The second class of possible disturbances of a reductionist program for coordination, besides (number)agreement, is related to the coordination of

quantifiers; this class was represented above by the sentences (18). In order to grasp their nature, it seems wise to reflect a bit on the notions of boolean and nonboolean conjunction. In general, conjunction and disjunction can be seen as algebraic operations on the category (taken as a set of expressions) that is assembled, in the sense that the junction of two members of the category yields another member of that category. Categories are therefore closed under junction, which makes them some algebra. The category of sentences is, moreover, a boolean algebra if we map each sentence to e.g., the set of models for that sentence, i.e., to propositions, or extensionally to a truth value. Then the category of sentences can be seen as a field **PROP** with a top element (1, the necessarily true proposition) and a bottom element (0, the necessarily false proposition), on which we can interpret conjunction as an associative commutative operation \cap 'meet' and disjunction as an associative commutative operation \cup 'join' such that for every **a** in **PROP**

$$(31) \quad \begin{aligned} \mathbf{a} \cap \mathbf{0} &= \mathbf{0} \\ \mathbf{a} \cup \mathbf{0} &= \mathbf{a} \\ \mathbf{a} \cap \mathbf{1} &= \mathbf{a} \\ \mathbf{a} \cup \mathbf{1} &= \mathbf{1}. \end{aligned}$$

Moreover, a boolean algebra is closed under the one-place operation \neg 'complement':

$$(32) \quad \begin{aligned} \neg(\mathbf{1}) &= \mathbf{0} \\ \neg(\mathbf{0}) &= \mathbf{1} \\ \mathbf{a} \cap \neg(\mathbf{a}) &= \mathbf{0} \\ \mathbf{a} \cup \neg(\mathbf{a}) &= \mathbf{1}. \end{aligned}$$

This gives rise to a partial ordering \leq on **PROP** such that for every **a**, **b**:

$$(33) \quad \begin{aligned} \mathbf{a} &\leq \mathbf{1} \\ \mathbf{0} &\leq \mathbf{a} \\ \mathbf{a} &\leq (\mathbf{a} \cup \mathbf{b}) \\ (\mathbf{a} \cap \mathbf{b}) &\leq \mathbf{a}. \end{aligned}$$

Along the same lines we may think of the category NP, for example, as being mapped on the set of generalized quantifiers, which is to be a field of subsets **QUANT** of some powerset **M**, with top **M** and bottom {}, the empty set, on which \cap , \cup , \neg and \leq are constructed as in (31) to (33). Under this mapping of NPs on generalized quantifiers, the conjunction of two NPs is the \cap of the related quantifiers, yielding another quantifier that happens to be the intersection of the first two, and the disjunction of two NPs is the \cup of their quantifiers, which is to be their union. Furthermore, any two boolean algebras are related homomorphically: we can always find a function **f** that preserves the structure of the domain algebra. For **PROP** and **QUANT**, now considered as boolean algebras $\langle \mathbf{P}, \cap_p, \cup_p, \mathbf{1}, \mathbf{0}, \leq_p \rangle$ and $\langle \mathbf{Q}, \cap_q, \cup_q, \mathbf{M}, \{\}, \leq_q \rangle$, respectively, there is

a family of homomorphisms \mathbf{f} that map **QUANT** into **PROP**. VPs can be considered to represent such homomorphisms. In general, a homomorphism has the following properties, where it should be noticed that an operator occurring in the scope of \mathbf{f} denotes an operation on **QUANT** and an operator outside the scope of \mathbf{f} denotes an operation on **PROP**:

$$(34) \quad \begin{aligned} \mathbf{f}(\mathbf{a} \cap_q \mathbf{b}) &= \mathbf{f}(\mathbf{a}) \cap_p \mathbf{f}(\mathbf{b}) \\ \mathbf{f}(\mathbf{a} \cup_q \mathbf{b}) &= \mathbf{f}(\mathbf{a}) \cup_p \mathbf{f}(\mathbf{b}) \\ \mathbf{f}(\mathbf{1}) &= \mathbf{M} \\ \mathbf{f}(\mathbf{0}) &= \{\}. \end{aligned}$$

From this it is easy to prove that

$$(35) \quad \mathbf{a} \leq_q \mathbf{b} \text{ iff } \mathbf{f}(\mathbf{a}) \leq_p \mathbf{f}(\mathbf{b}).$$

That is why \mathbf{f} is said to be order or structure preserving.

At this general background of boolean structures, we can test some types of coordination with respect to the question whether they do or do not support the general hypothesis (14).

Note that we may reformulate this hypothesis as the claim that for every 'linguistic' function \mathbf{f} from a boolean domain A to the algebra of propositions **PROP** and some operation \oplus , $\mathbf{f}(\mathbf{a} \oplus_a \mathbf{b})$ implies $\mathbf{f}(\mathbf{a}) \oplus_p \mathbf{f}(\mathbf{b})$ or the other way around, where *imply* reflects the ordering in the propositional algebra. To be more precise: in boolean terms hypothesis (14) adopts the format (36).

$$(36) \quad \begin{aligned} &\text{For every coordination } \mathbf{f}(\mathbf{a} \oplus_a \mathbf{b}), \text{ where } \mathbf{f} \text{ is a function with domain } A \\ &\text{and values in } P \\ &\mathbf{f}(\mathbf{a} \oplus_a \mathbf{b}) \leq_p (\mathbf{f}(\mathbf{a}) \oplus_p \mathbf{f}(\mathbf{b})) \text{ or } (\mathbf{f}(\mathbf{a}) \oplus_p \mathbf{f}(\mathbf{b})) \leq_p \mathbf{f}(\mathbf{a} \oplus_a \mathbf{b}). \end{aligned}$$

From this reformulation, one can read that the hypothesis does not require every context of coordination to behave as a homomorphism. In fact, the behaviour that is required, resembles the effect that the operation \neg has on the ordering of a single boolean structure. Boolean complementation is captured by De Morgan's laws:

$$(37) \quad \begin{aligned} (a) \quad &\neg(\mathbf{a} \cup \mathbf{b}) = \neg(\mathbf{a}) \cap \neg(\mathbf{b}) \\ (b) \quad &\neg(\mathbf{a} \cap \mathbf{b}) = \neg(\mathbf{a}) \cup \neg(\mathbf{b}). \end{aligned}$$

The relevance of these laws, that interrelate the meet and the join, for the analysis of natural language negation is demonstrated by Oehrle (1987) and Zwarts (1986). If we consider the properties of \neg when the two-place operations are kept constant, we get — by virtue of (37) and (33) — at the following theorems, holding for every \mathbf{a} and \mathbf{b} in a boolean set:

$$(38) \quad \begin{aligned} (a) \quad &\neg(\mathbf{a} \cup \mathbf{b}) \leq \neg(\mathbf{a}) \cup \neg(\mathbf{b}) \\ (b) \quad &\neg(\mathbf{a}) \cap \neg(\mathbf{b}) \leq \neg(\mathbf{a} \cap \mathbf{b}). \end{aligned}$$

Generalizing this scheme, some properties of downward monotone or minimally negative expressions **fd** show up (cf. Zwarts 1986):

- (39) (a) $\mathbf{fd}(a \cup b) \leq \mathbf{fd}(a) \cup \mathbf{fd}(b)$
 (b) $\mathbf{fd}(a) \cap \mathbf{fd}(b) \leq \mathbf{fd}(a \cap b)$.

So, if an expression denotes a downward monotone function and a conjunction in its domain can be interpreted as the meet and a disjunction as the join, the relation between phrasal coordination and propositional coordination will be as proclaimed by hypothesis (36). This can be illustrated by an example involving the expression *nergens* 'nowhere'. This adverb is downward entailing, by the following reasoning. The set of models for (40a), $I(40a)$, is a subset of the set of models for (40b), $I(40b)$: if (40a) holds, (40b) will hold too, but not the other way around.

- (40) (a) Jan heeft aardappelen gegeten
Jan has potatoes eaten
 (b) Jan heeft iets gegeten
Jan has something eaten

In the algebra of propositions we thus have the ordering $\mathbf{I}(40a) \leq \mathbf{I}(40b)$. When we add *nergens* to both sentences, as in (41), we observe that (41b) implies (41a), and not the other way around.

- (41) (a) Jan heeft nergens aardappelen gegeten
Jan has nowhere potatoes eaten
 (b) Jan heeft nergens iets gegeten

Consequently, the effect of *nergens* 'nowhere' can be described as

- (42) if $\mathbf{a} \leq \mathbf{b}$ then $\mathbf{nergens}(\mathbf{b}) \leq \mathbf{nergens}(\mathbf{a})$

which identifies the referent of *nergens* as a downward monotone function on propositions. Next, consider the expression *Jan heeft nergens* 'Jan has nowhere'. It can be seen as a function taking properties to propositions, and because of the presence of *nergens* it is also monotone decreasing: we may safely assume that $\mathbf{aardappelen_eten} \leq \mathbf{eten}$ 'eat_potatoes \leq eat' holds in the VP algebra and $\mathbf{Jan_heeft_nergens}(\mathbf{aardappelen_eten}) \leq \mathbf{Jan_heeft_nergens}(\mathbf{eten})$ holds in **PROP**. According to (39), the implicative relations between coordinations of properties, interpreted in the algebra of VPs, that occur in the domain of *Jan heeft nergens* and coordinations of sentences (with that expression 'distributed' must be as is indicated below.

- (43) (a) Jan heeft nergens gegeten of gedronken
Jan has nowhere eaten or drunk
 (b) Jan heeft nergens gegeten of Jan heeft nergens gedronken
Jan has nowhere eaten or Jan has nowhere drunk
 (c) $\mathbf{I}(43a) \leq \mathbf{I}(43b)$; $\mathbf{fd}(a \cup b) \leq \mathbf{fd}(a) \cup \mathbf{fd}(b)$
 (d) (43a) implies (43b).

- (44) (a) Jan heeft nergens gegeten en gedronken
 (b) Jan heeft nergens gegeten en Jan heeft nergens gedronken
Jan has nowhere eaten and Jan has nowhere drunk
 (c) $\mathbf{I(44b)} \leq \mathbf{I(44a)}$; $\mathbf{fd(a)} \cap \mathbf{fd(b)} \leq \mathbf{fd(a \cap b)}$
 (d) (44b) implies (44a).

Since the statements in (43d) and (44d) are correct, we may conclude that conjunction and disjunction, when interpreted as, respectively, the boolean meet and the boolean join, in the scope of downward entailing expressions comply with hypothesis (36). Moreover, the direction of the implication between phrasal and propositional coordination is fully predictable from the nature of the junction.

For upward monotone functions **fu** we have the defining laws

- (45) (a) $\mathbf{fu(a \cap b)} \leq \mathbf{fu(a)} \cap \mathbf{fu(b)}$
 (b) $\mathbf{fu(a) \cup fu(b)} \leq \mathbf{fu(a \cup b)}$.

Since the expression *John has* is upward entailing, as one can easily verify, coordination in the scope of this expression accords with the reductional hypothesis if the implications with regard to the following sentences match the ordering of (45). Because (46c) and (47c) are correct, expressions denoting monotone increasing functions support the hypothesis.

- (46) (a) Jan heeft gegeten of gedronken
Jan has eaten or drunk
 (b) Jan heeft gegeten of Jan heeft gedronken
 (c) (46b) implies (46a).
 (47) (a) Jan heeft gegeten en (*and*) gedronken
 (b) Jan heeft gegeten en Jan heeft gedronken
 (c) (47a) implies (47b).

Thus, monotone contexts for phrasal coordination do not object the general hypothesis (14) and its restyling (36).

What about non-monotone environments? Among these, we find for example many 'qualifying' adverbs; consider:

- (48) (a) Jan zingt slecht
Jan sings badly
 (b) Jan zingt Dylans liederen slecht
Jan sings Dylan's songs badly

It seems reasonable to assume that in the algebra of VPs the element **zingen** is an upper bound of the element **Dylans'_liederen_zingen**: if VPs refer to sets, the latter set is at most a subset of the former. But none of the two sentences in (48) implies the other, which must be due to *slecht* 'badly': the set of bad singers is not

ordered with respect to the set of bad singers of Dylan's songs, as we all know. Thus, *slecht* is neither upward nor downward monotone.

In a certain sense, one can argue that nonmonotone expressions, to the extent that they show systematic behaviour with respect to coordination, necessarily act like downward entailing expressions. The argument runs like this. The schemata (39) and (45) are the only viable patterns for implicational relations between phrasal and propositional coordination under a boolean interpretation of coordination. Schema (45) defines upward monotony. If nonmonotone expressions fall into this pattern, they would qualify as monotone: contradiction. Schema (39) does not define downward monotony: it is only a set of weaker derivatives of downward monotony. By complying to this pattern, nonmonotone expressions are not subsumed under the downward entailing ones. Thus, (39) is the only frame of behaviour that nonmonotone expressions consistently may fit in. As a consequence, the general hypothesis is only consistent with non-monotone functions behaving negatively. For particular instances of non-monotone functions, some particular reasoning may be adequate as well, as is shown below.

As a special case illustrating the impact of the foregoing, there is the class of coordinations of type *NP VP COORD VP*, the logic of which is studied thoroughly in Zwarts (1986). Reversing functional structure, we may now consider the question whether in general an NP denotation, i.e., a quantifier on the universe, behaves like a homomorphism on the VP algebra, i.e., the algebra of first order sets. The answer is negative, which is convincingly explained in Zwarts' monograph; (49a) obviously does not imply (49b):

- (49) (a) Elke priester bad of offerde wijn
each priest prayed or sacrificed wine
 (b) Elke priester bad of elke priester offerde wijn

But homomorphic behaviour is far more than the general hypothesis (14) requires. So we can rephrase the question in the following way: is for any boolean operation \oplus , quantifier Q and sets A and B , the relation between $Q(A \oplus B)$ and $Q(A) \oplus Q(B)$ trivial? Clearly, from the preceding considerations in this sections it follows that if Q is upward or downward monotone, one of the two expressions implies the other. So we have, for upward monotone Q , that $Q(A \cap B)$ implies $Q(A) \cap Q(B)$ and $Q(A \cup B)$ implies $Q(A \cup B)$ while for downward monotone Q these implications are reversed. Consequently, the general hypothesis (14) holds with respect to VP coordination if the quantifier of which the coordination is predicated, is monotone.

Unfortunately, not every quantifier is monotone. The criterion is easy: unless the quantifier contains the universe or the empty set in every model, it is not monotone. There are infinitely many of these quantifiers, all of the form *at least n and at most m N*, for $n \leq m$, covering e.g., the specialized form *exactly n N (at least n and at most n N)* and generalized by *some but not all N* (cf. Zwarts 1986: p.220ff).

Let us then assume that they are all captured by the schema Det_1 and $Det_2 N$. A predication of a thus schematized NP, Det_1 and $Det_2 N VP$, is equivalent to the distribution of the VP, $Det_1 N VP$ and $Det_2 N VP$: the following sentences imply each other.

- (50) (a) At least five and at most seven boys were swimming
 (b) At least five boys were swimming and at most seven boys were swimming

When VP is VP_1 and VP_2 , this distribution of the predicate yields $Det_1 N VP_1$ and VP_2 and $Det_2 N VP_1$ and VP_2 , where one NP (the instance of *at least n N*) is upward monotone and the other downward monotone. From this point in the reduction, the two sentence internal VP coordinations therefore imply and are implied by, respectively, their upgradings to intersentential coordinations. Consider (51):

- (51) (a) At least five and at most seven boys were reading and smoking
 (b) [At least five boys were reading and smoking] and [at most seven boys were reading and smoking]
 (c) At least five boys were reading and at least five boys were smoking
 (d) At most seven boys were reading and at most seven boys were smoking

The first conjunct of (51b) implies (51c), while the second conjunct of (51b) is implied by (51d). Consequently, both *At least n N VP1 and VP2* and *At most m N VP1 and VP2* meet the general reduction hypothesis (14)/(36). Since these two sentences both are logical consequences of the complex phrasal coordination (51b) which itself is equivalent to (51a), I consider the composed nature of non-monotone NPs as consistent with the spirit of the hypothesis.

2.3.2. Some problems

Up to now, it was tacitly assumed that coordination can be interpreted in terms of boolean operations. This assumption is challenged successfully, however, in an increasing number of studies, e.g., Partee and Rooth (1983), Hoeksema (1983, 1988), Link (1987), Landman (1989) and Lasersohn (1992). Symptoms of nonbooleanness are manifold and hardly independent of each other. In general, it is the intersective reading of conjunction that cannot be maintained. Here are some examples.

- (52) (a) The man and the woman killed their neighbour
 (b) John and Mary did the tango
 (53) The house is painted yellow and blue
 (54) He opened the door and came in

(55) The air was alternately dry and humid (Lasersohn 1992)

If two people killed their neighbour, it is not implied that each of them did. A house painted yellow and blue is neither yellow nor blue, and it is not green either. Opening the door and coming in is not the same as coming in and opening the door. And when the air is alternately dry and humid, it is never dry and humid.

Scrutinizing these and other conjunctions, one could be tempted to deny the existence of any well behaved form of boolean coordination in natural languages. But then, there is the fact that most languages only use a very small set of coordinators to conjoin all kinds of expressions under all kinds of conditions. The boolean interpretation of coordination can be considered as an attempt to give an archetypical interpretation for this huge variety. Many domains appear to resist the particular structure that the boolean set up imposes on them. Lasersohn (1992) pleads for unifying the treatment of coordination beyond the boolean scenery, but gives no concrete hint as to a profile thereof. Unfortunately, I have nothing to offer in this respect but a consideration at the background of the reduction hypothesis (14).

All properties of boolean algebras are related deductively, and one can find several axiomatizations and proof networks in the literature on group theory and mathematical linguistics. At first sight, then, it does not seem very fruitful to try to discriminate between principal and peripheral properties of boolean interpretation, or to define degrees of booleanness. From a linguistic point of view, however, a coordination being not commutative is — intriguing though it may be — less troublesome than a coordination that gives rise to an object beyond the domain of the coordinates: *John* and *Mary* may denote individuals, but neither *John and Mary* nor *John or Mary* qualifies as such. Yet, every function mapping individuals to propositions, maps conjunctions and disjunctions of individuals to propositions. Several proposals that deal with this and other domains for coordination can be found in recent literature on group formation and event structure — some of them are discussed in the next section. Although they give rise to all kinds of alternative structures, one fundamental property of the boolean framework is preserved: conjunctions and disjunctions are asymmetrically ordered with respect to their components. Of course, this is not surprising. Apart from how the specific structure of a certain domain must be conceived, it seems beyond human capacity to handle sets of expressions $\{a, b, \dots\}$ for which **interpretation(a AND b) = interpretation(a OR b)** or **interpretation(a AND b) = interpretation(a)**. What, then, is the basis of the fundamental difference between conjunction and disjunction? It seems reasonable to think of conjunction as a restrictive and of disjunction as an extending operation in the following sense. Let \oplus and \otimes be two operations on a domain \mathbf{D} , interpreting *and* and *or*, respectively. Consider propositions $f(a \oplus b)$, $g(a)$ and $h(a \otimes b)$, and let f , g and h

be nontrivially related, i.e., for each \mathbf{t} the set of models for $\mathbf{f}(\mathbf{t})$, $\mathbf{g}(\mathbf{t})$ and $\mathbf{h}(\mathbf{t})$ are mutually ordered by the subset relation \subseteq . Now consider the following possible statements — which, under the present assumptions, happen to be boolean theorems.

$$(56) \quad (a) \quad \mathbf{f}(\mathbf{a} \oplus \mathbf{b}) \subseteq \mathbf{g}(\mathbf{a})$$

$$(b) \quad \mathbf{g}(\mathbf{a}) \subseteq \mathbf{f}(\mathbf{a} \oplus \mathbf{b})$$

$$(57) \quad (a) \quad \mathbf{g}(\mathbf{a}) \subseteq \mathbf{h}(\mathbf{a} \otimes \mathbf{b})$$

$$(b) \quad \mathbf{h}(\mathbf{a} \otimes \mathbf{b}) \subseteq \mathbf{g}(\mathbf{a})$$

$$(58) \quad (a) \quad \mathbf{f}(\mathbf{a} \oplus \mathbf{b}) \subseteq \mathbf{h}(\mathbf{a} \otimes \mathbf{b})$$

$$(b) \quad \mathbf{h}(\mathbf{a} \otimes \mathbf{b}) \subseteq \mathbf{f}(\mathbf{a} \oplus \mathbf{b})$$

Conjunction \oplus on \mathbf{D} is restrictive if (56a) holds for every \mathbf{f} and \mathbf{g} such that $\mathbf{f}(\mathbf{t}) \subseteq \mathbf{g}(\mathbf{t})$. Disjunction \otimes is extending if (57a) is valid for every \mathbf{g} and \mathbf{h} such that $\mathbf{g}(\mathbf{t}) \subseteq \mathbf{h}(\mathbf{t})$. If conjunction is restrictive and disjunction is extending, (58a) holds. To the extent that disjunction tends to behave in a boolean way, we may assume that \mathbf{g} and \mathbf{h} are equal.

In this set up, the order of \mathbf{D} with respect to \oplus and \otimes is not intrinsic but just a reflection of the order of the domain of propositions; the order on \mathbf{D} is second hand. It preserves, however, the spirit of the reduction hypothesis (14), since the propositional functions are required to be nontrivially ordered. In the next section, this generalization of coordination is embedded in a treatment of a characteristic case of phrasal coordination, the coordination of NPs. But first here is an application to the 'colour conjunction' in (53). Consider the propositional functions $\mathbf{f} = \text{the_house_is_painted_x}$ and $\mathbf{g} = \text{the_house_is_partially_painted_x}$, both ranging over colours. Clearly, for all colours \mathbf{t} , $\mathbf{f}(\mathbf{t}) \subseteq \mathbf{g}(\mathbf{t})$ in the propositional algebra: if a house has a certain colour, it also has that colour partially. Furthermore, if a house is painted yellow and blue, it is partially painted yellow and partially painted blue. Consequently, (56a) is valid for this particular \mathbf{f} and \mathbf{g} . So, coordination is restrictive here, no matter what order \oplus may impose on the domain of colours, and the use of the coordinator *and* in (53) is traceable.

2.4. Coordination and distribution

2.4.1. The nature of the problem

Let us now consider the complicated case of grammatical sentences of the form NP_1 and NP_2 VP — we can restrict ourselves to the \cap -like operation, since disjunction almost invariably behaves in a boolean, \cup -like way (cf. Hoeksema 1988) in extensional contexts (see below). Let NP_1 denote the quantifier \mathbf{Q}_1 , and NP_2 the quantifier \mathbf{Q}_2 . Take, again, a quantifier as a family of sets, i.e., a member of $\mathbf{Pow}(\mathbf{Pow}(\mathbf{U}))$ of some domain \mathbf{U} ; I will refer to the set of quantifiers over \mathbf{U}

as **QUANT**. Let VP be some function \mathbf{vp} from the set of quantifiers into the set of propositions. The conjunction NP_1 and NP_2 qualifies as boolean in the given context iff it denotes some quantifier \mathbf{Q}_3 and $(\mathbf{Q}_1 \cap \mathbf{Q}_2) = \mathbf{Q}_3$ and $\mathbf{vp}(\mathbf{Q}_1 \cap \mathbf{Q}_2) = \mathbf{vp}(\mathbf{Q}_1) \cap \mathbf{vp}(\mathbf{Q}_2)$. A nonboolean conjunction would fail to meet at least one of these conditions. It is unlikely that the coordination of two NPs denoting quantifiers creates something else than an NP denoting a quantifier (cf. Keenan and Faltz 1985). Thus we can concentrate on the latter two conditions: NP_1 and NP_2 VP involves a nonboolean conjunction iff $(\mathbf{Q}_1 \cap \mathbf{Q}_2) \neq \mathbf{Q}_3$ or $\mathbf{vp}(\mathbf{Q}_1 \cap \mathbf{Q}_2) \neq \mathbf{vp}(\mathbf{Q}_1) \cap \mathbf{vp}(\mathbf{Q}_2)$.

Failing the 'referential' requirement would imply that the conjunction NP and NP is not the boolean \cap (on quantifiers) as defined in (31). In fact, we have an example of such a category: the conjunction of nouns, referring to simple sets, is not the intersection of these sets; [_N *men and women*] is in no context understood as referring to the empty set, and for this reason (coordination in) N can be said to be nonboolean. But the interpretation of *and* as \cap cannot be the problem in the NP-algebra **QUANT**. It is perfectly sound to interpret the coordination of NPs as the intersection of their quantifiers. In all contexts *John and Pete* refers to the intersection of the ultrafiltering quantifier **John** generated by some singleton $\{\mathbf{j}\}$ and the ultrafiltering quantifier **Pete** generated by some singleton $\{\mathbf{p}\}$, i.e., to the family of sets that contain both the individual \mathbf{j} and the individual \mathbf{p} : $\mathbf{John} \cap \mathbf{Pete} = \{\mathbf{X} \subseteq \mathbf{U} \mid \{\mathbf{j}, \mathbf{p}\} \subseteq \mathbf{X}\}$. Similarly, *no woman and no man* is the idealizing quantifier that results from intersecting two ideals, linking all sets that contain neither women nor men.

So, though there are categories in which *and* is rather not interpreted as standard intersection, NP does not belong to these. It may be clear, however, that not every welldefined subset of **QUANT** is a boolean algebra (see Zwarts 1986 for analyses and explanations). In particular, the class of atomic or referential quantifiers, identified in Hoeksema (1983) as containing all quantifiers the smallest elements of which are singletons by definition, is not closed under intersection — though it is closed under union. To this class belong exactly the NPs that cause number agreement problems with respect to sentential reconstruction of their conjunction: the proper names, the singular pronouns, the singular definite descriptions and the singular indefinites. Hoeksema (1988) suggests that these NPs refer to individuals, which form a domain that lacks boolean structure according to Partee and Rooth (1983), and that conjunction in this domain is group-formation rather than \cap -like intersection. In this vein, the two conditions on nonbooleanness of conjunction of NPs mentioned before, come together: if some NPs do not show boolean structure, conjunction on that domain is freed from boolean properties and no VP could ever yield a structure preserving homomorphism from this domain into the boolean algebra of propositions.

Alternatively, we can stick with the quantifier interpretation of all NPs and a fully fledged boolean structure for this domain, in which case 'nonboolean behaviour' of conjoined NPs is attributed to the VP (cf. also Lønning 1987): it may fail to be a neat homomorphism between two proper boolean structures: **QUANT** and the propositional algebra. Keenan and Faltz (1985: 267ff.) mention four sources of VP contamination, without pretending to be complete or systematic in this respect: numerical elements in predicative position (*to be two students I don't like*), collectivity (*to be a happy couple, to collaborate*), reciprocity (*to love each other*) and intensionality (*seek, require, need* etc). This is indicated in the following informal statements in the format of (34):

- (59) (a) $\text{be_two_students_I_don't_like}(\text{john and mary}) \neq$
 $\text{be_two_students_I_don't_like}(\text{john}) \text{ and}$
 $\text{be_two_students_I_don't_like}(\text{mary})$
 (b) $\text{collaborate}(\text{john and mary}) \neq \text{collaborate}(\text{john}) \text{ and } \text{collaborate}(\text{mary})$
 (c) $\text{love_each_other}(\text{john and mary}) \neq \text{love_each_other}(\text{john}) \text{ and}$
 $\text{love_each_other}(\text{mary})$
 (d) $\text{she_is_looking_for}(\text{john or mary}) \neq \text{she_is_looking_for}(\text{john}) \text{ or}$
 $\text{she_is_looking_for}(\text{mary})$

Intensionality as a source of heteromorphism stands more or less apart, since intensional predicates do not preserve joins, whereas the other examples fail to preserve meets. The intensional predicates differ in yet another respect from the other nonhomomorphic predicates: notwithstanding the validity of (59d) there is at least some relation between the $\mathbf{f(a \cup b)}$ and the $\mathbf{f(a) \cup f(b)}$ statement, in that the second one implies the first:

- (60) $\text{she_is_looking_for}(\text{john}) \text{ or } \text{she_is_looking_for}(\text{mary}) \rightarrow$
 $\text{she_is_looking_for}(\text{john or mary}).$

Therefore, these VPs meet the hypothesis (14) and can be left out of consideration from now on.

As for the other predicates, one should not confuse weirdness or unwellformedness of the sentences corresponding to the $\mathbf{f(a) \cap f(b)}$ statement with the nature of the problem. Abstracting from plural/singular variations — which are quite harmless as such — VPs may fail to be homomorphic and yet be fully appropriate in both versions; accomplishments like *to build a house* may exemplify this:

- (61) $\text{build_a_house}(\text{john and mary}) \neq \text{build_a_house}(\text{john}) \text{ and } \text{build_a_house}(\text{mary})$

The two statements should not be identified since the building of a house by John and Mary does not imply, though it is implied by, the building of a house by John and the building of a house by Mary. The lack of homomorphic power of these predicates is to be attributed to nondistributivity of the predicate, which may or

may not be formally encoded in the predicate itself. It is encoded in predicates like *to be two students* and *to love each other*, it is not in *to build a house* and *to meet*, for example.

In order to formalize what it means for a predicate to be homomorphic or distributive, we may receive benefit from the construction of quantifiers in Keenan and Faltz (1985). There it is shown that all quantifiers, i.e., all NP denotations, can be constructed as boolean operation over individuals. Given some universe U , an individual on U is an ultrafilter on some u_i in U , i.e., the set $I(u_i) = \{X \subseteq U \mid u_i \in X\}$. A quantifier of the form *every N*, then, is the intersection of those individuals I such that the property denoted by N belongs to I . In the same vein, a quantifier of the form *(at least) two N* is the union of (at least) two individuals I to which the property denoted by N belongs (cf. Keenan and Faltz 1985: 81 ff). Obviously, an NP of the form NP_1 and NP_2 is the meet of the quantifiers denoted by NP_1 and NP_2 . Now we can represent each NP as a quantifier $\oplus(Q_1, \dots, Q_n)$ where \oplus is the generalized \cap or \cup over operands Q_1, \dots, Q_n . Obviously, $\oplus(I) = I$ for every individual I . Furthermore we can define the set of individuals from which a quantifier is constructed, recursively:

$$(62) \quad \begin{aligned} \text{iset}(I) &= \{I\} \text{ for every individual } I \\ \text{iset}(\oplus(Q_1, \dots, Q_n)) &= \cup(\text{iset}(Q_1), \dots, \text{iset}(Q_n)) \end{aligned}$$

Given this notions, a VP denoting a function f from quantifiers to propositions is said to be *distributive* over a quantifier $Q = \oplus(Q_1, \dots, Q_n)$ in case $f(Q)$ is equivalent to the generalized \oplus over $f(Q_1), \dots$, and $f(Q_n)$. A VP denoting f is distributive iff it distributes over every quantifier Q . In that case, f distributes over the *iset* of Q and is a complete homomorphism from the quantifier algebra into the propositional algebra. A VP denoting f is said to be *anti-distributive* if it distributes over no quantifier at all except individuals.

In this perspective, fully distributive (homomorphic) predicates form a limited class. As far as I can see, the only class of predicates that qualifies as such, is the class of predicates that instantiate in some way or another the format *to be (an) ADJ individual(s)*, for obvious reasons. In this class are for example *to be Dutch (individuals)* and *to be beautiful (individuals)*. Other predicates may or may not distribute under specific conditions and readings. The sentence *we are stupid* does not entail that any of us is stupid. My daughter is fully entitled to say *my daddy and I walked to Amsterdam* when she was on my shoulder part of the time, or even all the time. The class of anti-distributive predicates is restricted to predicates of the form *to be (form, constitute) a (Adj) collection*, e.g., *to be a team*, *to be a scouting group*, *to form an invincible army*, etc. This class can be seen as a generalization of the numerical predicates Keenan and Faltz (1985) mentioned as belonging to a nonhomomorphic type. As for the so called collective predicates like *meet*, *gather* and *be (get) around something* I agree with Landman (1989) that they may distribute in sentences like *The Security Council and the Dutch government met*, *The committees*

gathered, *The two armies surrounded the city* and thus cannot be 'collective' per se. Landman, however, concludes that the universe should be sorted into two kinds of entities, individuals and groups, and that predicates differ in the sort of entity they can be predicated of: *gather* can only be said of groups, whereas *to be a popstar* calls for individuals. This is the kind of approach that Scha (1981) prefers as well to explain anomalies like *The boy gathered* or *Colourless green ideas sleep furiously*. He suggests, furthermore, that there is a level of analysis at which these selectional differences can be neglected, but distributivity nevertheless can be traced. To see why and how, we may follow the lead of Scha (1981), Hoeksema (1983, 1988) and Dowty (1986) and concentrate again on the structure of NPs.

The important thing to note is that distributivity in the defined sense depends on the nature of the NP, rather than on the nature of the VP. Compare the following sentences.

- (63) (a) The boys built a cabin
 (b) All boys built a cabin
 (c) John, Bill and Pete built a cabin
 (d) Every boy built a cabin

All four sentences are compatible with the situation that each individual in the **iset** of the subject quantifier built a cabin on his own. This is the only model for (63d). At least (63a) and (63c) are also adequate in situations where the individuals mentioned cooperate in building one or more cabins but for no or not for every individual it is true that he built a cabin on his own. Dowty (1986) claims that (63b) may also hold in the latter situation. Yet, (63a) — (63c) differ in the implications for each of the individuals in the **iset** of the subjects. From (63a) we can infer virtually nothing about the building activities of any particular individual in the **iset** of *the boys*. (63b) and (63c) are true if and only if each of the individuals in the **iset** of the subject quantifier contributed in some way or another to the building of a cabin. This contribution is related to what Dowty (1986) calls 'subentailment' and to what is covered by the notion of involvement in Link (1984) and Landman (1989). Unfortunately, there does not seem to be any systematic way to specify what may count as a contribution of an individual to an event or the truth of some predication, but this is on a par with the fact that we don't have any systematic way to describe what it means for a predicate to hold of any object. Yet, in specified situations we may have very sharp intuitions about contributions. Consider (64):

- (64) Niels Bohr and Noam Chomsky developed foundational aspects of quantum theory

Note that this sentence does not claim that each of the scholars mentioned developed quantum theory separately. Nevertheless, it is false, since Noam Chomsky did not, in any way whatsoever, contribute to the development of the physical theory at stake. Now compare this to (65):

- (65) The physicists of the Kopenhagen Institute of Theoretical Physics developed foundational aspects of quantum theory

This sentence is bound to hold, even in case Noam Chomsky was, in another lifetime, a physicist at the Kopenhagen Institute in the relevant period, but did not contribute to the development of quantum theory, devoting himself to some other field of real science. But (66) is true only if each of the individuals in the **iset** of the subject was involved:

- (66) The two physicists developed quantum theory

These are simple semantic facts that should be accounted for, since they are part of the truth conditions for (at least) sentences with conjoined NPs. Landman (1989) seems to deny this, however, discussing the sentence in (67):

- (67) Groenendijk and Stokhof presented a paper at the conference

“Given the information that Groenendijk and Stokhof always operate as a team, (67) does not imply that, say, Stokhof was involved in the presentation, maybe he even did not come to the conference. Intuitively, in this context, we indeed take Groenendijk and Stokhof to be more than the sum of two individuals: a team.” (Landman 1989: 574). There is some circular traffic here. If operating as a team does not imply involvement of team members in team actions, what, then, does it mean for some individuals to operate as a team in some context? Obviously, Landman is right in claiming that (67) does not imply that Stokhof presented a paper at the conference or that he was present there. But if Stokhof would prove to have been not involved in any respect in the presentation of the paper at the conference (having been involved as little as Bob Dylan or I was), the sentence must be false (and, maybe, Groenendijk and Stokhof are not a team in this context after all). The notion of ‘team in a context’ does not contribute, in my view, to transparent metaphysics. Consider:

- (68) Groenendijk and Bob Dylan presented a paper at the conference

There is at least one reading of this sentence under which it can be true, even if Dylan had a studio session instead of attending at the conference, namely if Dylan was that much involved in the paper that he has to be credited for its presentation: this particular paper would not have been presented in this particular way at this particular conference if Dylan had not been involved in writing it, brainstorming on the subject, editing it, singing while it was conceived, or whatever may count as involvement in bringing about the presentation of a certain paper at a certain conference. And if so, are Groenendijk and Dylan a team? The answer does not matter, as it seems, since the truth conditions for (67) and (68) are equal: apart from Groenendijk an other well known individual is claimed to have been involved. I admit that involvement is hard to specify for a

predicate, but this is on a par with the fact that it is hard to specify under which conditions a certain event is truthfully subsumed under a predicate.

There is, then, a kind of hierarchy of NPs that contains at least three levels:

- (69) (a) LEVEL 1: definite noncardinal descriptions, pronouns, proper names
the boys, they, we, John
 (b) LEVEL 2: explicit conjunctions, cardinal descriptions
John and his colleagues, two boys, the two boys, some boys
 (c) LEVEL 3: universal descriptions
each boy, both boys

The account of the levels is not exhaustive, but just exemplary. Although it is far from accidental that these levels correspond, in the ontology of Link (1984), to groups, sums and individuals respectively, I won't pursue his system here. It may be true that this tripartition is just a way of naming distributional behaviour. I am convinced, however, and argue so later on, that this behaviour is determined by the structure of the NP and not by the sort of object that is quantified over. We do not have to make any commitment to a particular cascade of entities to describe what is going on. It is as sound to say that a language has that many different way of referring in order to express all these distributional possibilities as it is sound to say that language is about groups, groups of groups and other productions and that a group is a thing that has no proper parts. The explanatory power does not increase, in my view, by assigning ontologically loaded names to each of the distributional patterns. To some degree this may be a matter of taste but I am definitely not among those who think that "(...) language is the primary source for forming intuitions about our ontology" (Link 1986). Therefore, I stick with the structure of quantifying expressions in the most general sense, under minimal assumptions regarding the structure of the universe.

The first level in the hierarchy (69) has no distributional implications for particular individuals in the *iset*, though the predication requires some minimal number of involved individuals. The NPs in this class are anti-distributive. The third level is completely distributive. De Jong (1991) assigns a particular feature to determiners with respect to distributivity, and concludes that all partitive NPs, i.e., NPs with complex determiners, are distributive. In my view, however, it makes sense to discriminate between two kinds of distribution: just being involved in bringing about an event or state of the predicated type, or bringing about that state of affairs independently. At least for some partitives, those headed by a numeral, the second type of distribution is too strong. In (70a) there is no claim that three shareholders got half the profit each, while this is exactly the reading that makes (70b) surrealistic.

- (70) (a) Drie van de tweehonderd aandeelhouders krijgen de helft
three of the two-hundred shareholders get the half
 van de winst

- (b) *of the profit*
 Elk van de drie aandeelhouders krijgt de helft van de winst
each of the three shareholders gets the half of the profit

The second level requires involvement in the event of each particular individual in the **iset**, but not necessarily distribution of the predicate as such. I will refer to these NPs as *semi-distributive* — Dowty (1986) tends to consider the plural universal expressions of type *all N* also as belonging to this class. The involvement that is characteristic for semi-distributive NPs is part of the truth conditions of a predication over these quantifiers, as was shown with respect to example (64). We must therefore assume that each predicate P is associated with some derived property *Involv(P)* that is distributed over the individuals in the **iset** of a semi-distributive quantifier. To see why each predicate must have an *Involv(P)* instance, even when it may intuitively qualify as 'collective', it may suffice to look at typical examples from Landman (1989):

- (71) (a) The committees gathered
 (b) The Security Council and the EG Commission gathered
 (c) Each committee gathered

The first sentence is true iff enough committees gathered collectively or separately. The second sentence is true iff both the SC and the EGC were somehow involved in gathering and their combined action(s) qualify as (a) gather event(s). The third sentence is true iff each committee gathered separately; it is inadequate to express one single meeting of all committees. And, of course, no sentence claims anything at all about particular members of any council, committee or commission.

The sentence *Each boy gathered* is strange, since it is hard to imagine what a gathering of an individual boy is like. I tend to agree with Scha (1981) that this is in a par with *Each boy is easy to calculate*, where it is difficult to imagine what calculating a boy is like. Though it may appear attractive to enrich the universe of discourse with extensional or intentional entities that coincide with the uncommitment of anti-distributive NPs with respect to individuals in the **iset**, as proposed by Link (1984), Hoeksema (1983, 1988) and Landman (1989) in excitingly variant ways, such a sorting of the universe does not interfere with the distributional patterns that are at stake: whatever *N* refers to, *the Ns* is never distributed, *each N* always is, and *Det₁ N₁ and Det₂ N₂* always entails 'real' involvement of whatever *Det_i N_i* refers to, up to a degree that is equal to distribution. The conjunction case, moreover, shows that even the notions of individual and **iset** may be too ontological to describe the quintessence of distribution. The notions were derived from the way Keenan and Faltz (1985) construct quantifiers of the form *Det N*, as a boolean operation on ultrafilters. I represented these quantifiers above as $\oplus(Q_1, \dots, Q_n)$. For conjoined quantifiers we must assume that the operands Q_1 to Q_n can be complex quantifiers themselves,

belonging to one of the three levels of the hierarchy (69). Following this line, conjoined NPs are to be represented as the meet of two boolean operations over individuals: $\oplus(Q_1 \dots Q_n) \cap \oplus(Q_1' \dots Q_m')$. The distribution is recursive in the following sense. Let f be the function corresponding to some predicate P , and let fi correspond to $\text{Involv}(P)$, the property of being involved in bringing about an event of type P — this predicate is discussed extensively below. Then $f(\oplus Q_1 \cap \oplus Q_2) = f'(\oplus Q_1) \cap f'(\oplus Q_2)$, where f' is either f or fi . Whether $f' = fi$ or $f' = f$ and whether $f'(\oplus(Q_1, \dots, Q_n)) = \oplus(f'(Q_1), \dots, f'(Q_n))$ depends on the nature of the argument, according to the following pattern.

- (72) For every predication NP_1 and NP_2 VP , if VP denotes a function f with associate fi , and NP_i denotes a quantifier $Q_i = \oplus(Q_{i1}, \dots, Q_{in})$, $n \geq 1$, the interpretation of NP VP is $f(Q_1) \cap f(Q_2)$ if at least one NP_i is distributive, and $fi(Q_1) \cap fi(Q_2)$ otherwise, and $f'(\oplus(Q_{i1}, \dots, Q_{in})) = \oplus(f'(Q_{i1}), \dots, f'(Q_{in}))$ if NP_i is distributive and $f'(\oplus(Q_{i1}, \dots, Q_{in})) = \oplus(fi(Q_{i1}), \dots, fi(Q_{in}))$ if NP_i is semi-distributive.

For an example, consider

- (73) (a) The boys and the girls built a cabin
 (b) The boys were involved in building a cabin and the girls were involved in building a cabin
 (c) $fi(\cap(Q_{b1}, \dots, Q_{bn})) \cap fi(\cap(Q_{g1}, \dots, Q_{gm}))$
- (74) (a) Each boy and each girl built a cabin
 (b) Each boy built a cabin and each girl built a cabin
 (c) $\cap(f(Q_{b1}), \dots, f(Q_{bn})) \cap \cap(f(Q_{g1}), \dots, f(Q_{gm}))$
- (75) (a) Each boy and some girls built a cabin
 (b) Each boy built a cabin and some girls built a cabin
 (c) $\cap(f(Q_{b1}), \dots, f(Q_{bn})) \cap \cup(fi(Q_{g1}), \dots, fi(Q_{gm}))$

The sentence with conjoined NPs (73a) is true iff both the boys and the girls were involved in building a cabin. This is expressed in (73b). But this sentence has no consequences for individual contributions of any particular boy or girl, simply because both conjuncts have nondistributive subjects (cf. 73c). In (74) we might expect P to be the distributive. Here it is the full predicate that is distributed over the conjuncts, as indicated in (74b), and that percolates to the components of each of the conjoined distributive NPs, as in (74c). (75) shows a mixed case: the conjunction of a distributive and a semi-distributive NP. The full predicate is distributed over the conjuncts, but the associated predicate percolates into the second conjunct. As will be explained below, this does not exclude the possibility that each of the girls involved built a cabin.

Does this mean that we need different entities, e.g., individual entities and group entities, after all? I do not think so. We do need some notion of involvement to account for at least two kinds of facts: the fact that (plural) definite descriptions do not entail anything about individuals — which is the anchor of the group construction in the literature mentioned — and the fact that in NP conjunction each conjoined NP has some definite relation to what is predicated of the conjunction. I consider these facts to be symptoms of the same disease: the fuzziness of predication. One way to approach this fuzziness is assigning a richer (extensional) structure to predicates than simple sets. In my view, it is not unnatural to have VPs denote sets of sets, subsets of $\text{Power}(\text{Universe})$. They differ from generalized quantifiers in the way they are built and the laws to which they are submitted. The elements of the VPs can be seen as *ad hoc* groups, sets of entities that have some specified relation to the property they belong to, but do not have any ontological status apart from this property. The predication relation, then, is to be modelled after the relational view on determiners designed in Zwarts (1983a), where the genuine semantic configuration $\mathbf{NP}(\mathbf{VP})$ is traced back to a relation $\mathbf{Det}(\mathbf{N}, \mathbf{VP})$. If, however, the VP is internally complex, the \mathbf{Det} relation will be more complex too. This is, in short, a program that I will try to outline beneath and that should account for the various distributional options that have been stipulated thus far. The approach has no ambitions but to make clear that a notion of involvement can be formalized, and that such a notion can take care of what is going on between NPs and VPs. I must admit, however, that I am not certain to which extent this formalization observes the limits of Lønning's (1987) advise: “Our semantics should not be more specific than the language itself and not promote descriptions of what could have happened between the individuals as alternative interpretations of the sentence. Only when a disambiguation is needed should we make one, and then the distributional readings may be obtained from the collective interpretations of the NPs (...).”

2.4.2. An approach

To start with the most difficult part, the fuzziness, assume that for each VP there is a partial function \mathbf{f} that maps entities from the universe \mathbf{U} to the interval $[0 \ 1]$. VPs may differ both in the domain of their \mathbf{f} as in its codomain. For example, the VP *be four* can be associated with a function that assigns the value 0.25 to each entity; the VP *be a popstar* may have its \mathbf{f} only defined for some subset of the universe (the musicians) and assign either 1 or 0, but no value in between; the VP *build a cabin* has its \mathbf{f} assign any real value in $[0 \ 1]$. In short, per VP there is some assignment of involvement of entities in events or states that count as events or states of the VP type. If for some \mathbf{a} and some \mathbf{f} $\mathbf{f}(\mathbf{a}) = 1$, we take this to express that there is an event or state of the type of the VP associated with \mathbf{f} , that is brought about by \mathbf{a} alone. If $\mathbf{f}(\mathbf{a}) = 0$, \mathbf{a} has nothing to do whatsoever with that

type of event or state. One can even be more precise and assume that f assigns values relative to particular events, but for the sake of transparency I won't follow this track here.

To arrive at the denotation of a VP, we use two functions: πf and σf , for product and sum respectively. For every subset \mathbf{A} of \mathbf{U} , $\sigma f(\mathbf{A})$ is the sum of the f values for the members of \mathbf{A} , and $\pi f(\mathbf{A})$ is the product of the f values for the members of \mathbf{A} . It is clear, given f , that πf is able to select sets of entities involved in the predicate associated with f and σf suites to identify sets of entities that represent the predicate. If $\pi f(\mathbf{A}) > 0$, all a in \mathbf{A} are involved in VP. If $\sigma f(\mathbf{A}) \geq 1$, \mathbf{A} represents a state or event of the VP type. Now we can define a VP denotation as the union of all sets that meet certain πf or σf conditions. Obviously, as for the product operation, we are only interested in the nonnull cases. As for the σf condition, we may assume that some variation is possible; a VP may require its elements to have an σf value of exactly 1, or at least 1, and a VP may require its σf sets to be also πf sets, eliminating all individuals with f value zero from its elements. For generality's sake, I will take in both of the alternatives the liberal option: VP selects any superset of an \mathbf{A} such that $\sigma f(\mathbf{A}) = 1$.

Given the generalized options for σf and πf , the denotation $\Delta(\mathbf{VP})$ of a VP as a set of sets over \mathbf{U} with respect to an involvement function f is

$$(76) \quad \Delta(\mathbf{VP}) = \{\mathbf{X} \mid \sigma f(\mathbf{X}) \geq 1\} \cup \{\mathbf{X} \mid \pi f(\mathbf{X}) > 0\}$$

So, a VP denotation is constructed as the union of the sets that bring about at least one event or state of the VP type and the sets that consist of entities involved in these events. To the first family of sets I will refer as the σ -segment of $\Delta(\mathbf{VP})$ or $\mathbf{VP}\sigma$, to the second as the π -segment or $\mathbf{VP}\pi$. Note that the balance between the two segments is dependent on predicate specific closure conditions on the $\mathbf{VP}\sigma$. If, for example, this segment is restricted to sets \mathbf{X} for which $\sigma f(\mathbf{X}) = 1$, the segment is a subset of $\mathbf{VP}\pi$. Unless $\mathbf{VP}\sigma$ is empty, the intersection of the two segments is not empty. To avoid impureness of the model, it should be the case that $\mathbf{VP}\pi$ is empty iff $\mathbf{VP}\sigma$ is. Furthermore, under the chosen liberal generalization for $\mathbf{VP}\sigma$, $\Delta(\mathbf{VP})$ contains the 'maximal ad hoc group' \mathbf{U} (in its σ -segment) iff it is not empty. Independent of this provisos, the relation between $\mathbf{VP}\pi$ and $\mathbf{VP}\sigma$ is given by the formula: $\mathbf{X} \in \mathbf{VP}\pi$ iff for some $\mathbf{Y} \supset \mathbf{X}$, $\mathbf{Y} \in \mathbf{VP}\sigma$. This amounts to the restriction that there is no set of entities involved if there is no event or state of the wanted type.

Next, consider any structure of type $NP VP$ as denoting a relation $\mathbf{Det}(\mathbf{N}, \mathbf{VP})$ between an ordinary set \mathbf{N} (the set on which the quantifier \mathbf{Q}_{np} 'lives') and a \mathbf{VP} as constructed in (76). The main idea behind this construction is that each determiner induces specific conditions on the relation between \mathbf{N} and the π -segment of $\Delta(\mathbf{VP})$ and on the relation between \mathbf{N} and the σ -segment, which must be met for the det-relation to hold. I will refer to these conditions as the π -conditions and the σ -conditions (of the determiner) respectively. Now we can

formulate, for each determiner, the interaction between involvement of individuals and full events. Here are some examples:

(77)

<i>relation</i>	<i>σ-condition</i>	<i>π-condition</i>
the (N, VP)	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\sigma \neq \varphi$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$
every (N, VP)	$\{\{a\} \mid a \in \mathbf{N}\} \subseteq \mathbf{VP}\sigma$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \subseteq \mathbf{VP}\pi$
no (N, VP)	$\{\{a\} \mid a \in \mathbf{N}\} \cap \mathbf{VP}\sigma = \varphi$	(no condition)
some (N, VP)	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\sigma \neq \varphi$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$

Probably, these conditions can be refined, and I certainly do not claim that they are very sophisticated as to form or content. These conditions, however, do not exhaust the definition of the determiners; in particular, **some** and **the** may be distinguished by different distributive features (cf. 69a) and presuppositions (cf. De Jong 1991); in terms of Barwise and Cooper (1981), it may be useful to mark them as distinct with respect to evaluation procedures, in that the validation of **the**(N, VP) takes N as a witness set and **some**(N, VP) just a subset of N. (Alternatively, one can choose $\mathbf{N} \in \mathbf{VP}\pi$ as the π -condition on **the**(N, VP).) The overall idea of (77) may be clear from the following paraphrases.

- (78)
- The relation **the**(N, VP) holds if at least some N bring about an event of type VP and (thus) at least some N are involved in doing so.
 - The relation **every**(N, VP) holds if every nonempty subset of N (including the singletons) brings about an event of the VP type and (thus) every subset of N (including the singletons) is involved.
 - The relation **no**(N, VP) holds if no nonempty subset of N brings about any VP event, though some or all members of N may be involved in such an event.
 - The relation **some**(N, VP) holds under the same σ - and π -conditions as the relation **the**(N, VP).

In general, the π -condition is implied by the σ -condition. The absence of a π -condition on **no** is due to my intuition that the 'negative' distributivity of this determiner does not entail that no entity of the N kind can be involved in an event of the VP type (cf. 82). Judgements may vary, however.

The crux of this exercise is that it underlies a general account of the distribution phenomena. Two observations are relevant in this respect in a structure of type NP_1 and NP_2 VP the conjunction as such is to be associated with an event of the VP kind, but each NP has its own involvement pattern. The latter marks the essential difference between 'group' readings for ordinary plurals and for conjunctions (compare e.g., (73)). So, the π -condition for conjoined NPs is simple: it is the conjunction of the single π -conditions of each of the (determiners of the) NPs. Is the σ -condition on conjoined NPs also the conjunction of the single NP σ -conditions? The answer is negative. Let me try to demonstrate the

invalidity of hypothetical distribution pattern (79), tantamount to this conjunction of both π - and σ -conditions, with some examples.

(79) $NP_1 \& NP_2 VP$ is true iff $\mathbf{det}_1(\mathbf{N}_1, \mathbf{VP})$ holds and $\mathbf{det}_2(\mathbf{N}_2, \mathbf{VP})$ holds.

- (80) (a) The boys and the girls built a cabin
 (b) The boys and the girls hate each other
 (c) Every boy and some girls built a cabin
 (d) John and some girls hate each other

The first sentence is, under hypothesis (79) and definitions (77), bound to be true iff both some boys and some girls built a cabin. In that case the closure conditions chosen for $\mathbf{VP}\sigma$ would entail that there is also an event of building a cabin brought about by a mixed group of boys and girls. But this entailment is contra-intuitive: the boys and the girls may have built a cabin (together) if each sex built a cabin. (80a) does, however, not entail that both the boys and the girls built a cabin. The same unwanted implication arises with (80b). (80c) would be correctly modelled by (79), since the hypothesis entails that not only each boy built a cabin but some girls did too. In the fourth sentence we see again an incorrect consequence of the hypothesis: the normal reading of John hating some girls and some girls hating John, can only be derived from the closure conditions on $\mathbf{VP}\sigma$, i.e., full distribution of the σ requirements, if John 'hates each other' (or maybe himself) and some girls hate each other. So we see that under (79) we may come up with any reading, but only by twisted reasoning. Note, however, that in each of the sentences the 'distribution' of π -conditions is on the right track; for each of the conjuncts the particular involvement conditions of (77) must be warranted.

There is, fortunately, an alternative to the rigid hypothesis (79) that exploits the boolean structure of the set of quantifiers. In the spirit of (77) we can try to state the σ -condition for the conjunction of NPs in terms of the set that the intersection of the two quantifiers, being a quantifier itself, lives on. A quantifier \mathbf{Q} interpreting *Det N* lives on the set \mathbf{N} , i.e., whether \mathbf{X} is in \mathbf{Q} , only depends on $\mathbf{X} \cap \mathbf{N}$. For intersections of quantifiers, such a set always exists too, which is obvious from the Keenan and Faltz (1985) construction of quantifiers as a boolean operation on ultrafilters. To give some examples: *every boy and/ but no woman* lives on the least member of the powerset of the complement of the set of women of which the set of boys is a subset; *John and some girls* lives on every least set that contains girls and the entity John; *the men and some girls* lives on every least set that contains all men and some girls. There may be, as can be seen from these examples, more than one set the quantifier lives on. Yet, it is obvious that the σ -condition on coordinated NPs can be stated in terms of these sets:

(81) NP_1 and $NP_2 VP$ is true, given that NP_1 denotes \mathbf{Q}_1 and NP_2 denotes \mathbf{Q}_2 and $\mathbf{Q}_1 \cap \mathbf{Q}_2 = \mathbf{Q}_\&$ and \mathbf{L} is some set $\mathbf{Q}_\&$ lives on, if $\mathbf{L} \varepsilon \mathbf{VP}\sigma$ and the π -conditions for NP_1 and NP_2 with respect to VP hold.

In order to let this condition do its task properly, the π -conditions for the normal NPs must be sharpened a bit. In particular, note that the π -condition for the relation **every** is somewhat underdetermined in (77). Since this condition is implied by the σ -condition, it is clear that for every $\mathbf{X} \in \{\mathbf{Pow}(\mathbf{N}) - \varphi\}$, $\pi_t(\mathbf{X}) = \mathbf{1}$, making $\{\mathbf{Pow}(\mathbf{N}) - \varphi\}$ a subset of a distinguished subset of $\mathbf{VP}\pi$, to wit $\{\mathbf{X} \mid \pi_t(\mathbf{X}) = \mathbf{1}\}$, the set of sets consisting of maximally involved entities, which I will refer to as $\mathbf{VP}\pi_{\max}$. In the same vein, we now have a π -condition for the determiner relation **no**, since $\mathbf{VP}\pi_{\max}$ must be excluded here. I will therefore evaluate the effect of (81) with respect to the following sample of conditions, replacing (77):

(82)			
<i>relation</i>	<i>σ-condition</i>	<i>π-condition</i>	
the (N, VP)	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\sigma \neq \varphi$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$	
every (N, VP)	$\{\{\mathbf{a}\} \mid \mathbf{a} \in \mathbf{N}\} \subseteq \mathbf{VP}\sigma$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \subseteq \mathbf{VP}\pi_{\max}$	
no (N, VP)	$\{\{\mathbf{a}\} \mid \mathbf{a} \in \mathbf{N}\} \cap \mathbf{VP}\sigma = \varphi$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\pi_{\max} = \varphi$	
some (N, VP)	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\sigma \neq \varphi$	$\{\mathbf{Pow}(\mathbf{N}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$	

Let us first reconsider the sentences (80), repeated below, under the hypothesis (81) and the sharpened conditions (82). Proper names are subsumed under the **the** relation, in so far as the distributional conditions are concerned. This yields the σ - and π -conditions for the conjunction phrases given in (84).

- (83) (a) The boys and the girls built a cabin
 (b) The boys and the girls hate each other
 (c) Every boy and some girls built a cabin
 (d) John and some girls hate each other
- (84) (a) σ -condition:
 $\{\{\mathbf{boys}\} \cup \{\mathbf{girls}\}\} \in \mathbf{VP}\sigma$
 π -condition:
 $\{\mathbf{Pow}(\{\mathbf{boys}\}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$ AND
 $\{\mathbf{Pow}(\{\mathbf{girls}\}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$
- (b) idem
- (c) σ -condition:
 $\{\mathbf{X} \mid \{\mathbf{man}\} \leq \mathbf{X} \text{ and } \text{card}(\{\mathbf{girls}\} \cap \mathbf{X}) > 1\} \cap \mathbf{VP}\sigma \neq \varphi$
 π -condition:
 $\{\mathbf{Pow}(\{\mathbf{boys}\}) - \varphi\} \leq \mathbf{VP}\pi_{\max}$ AND
 $\{\mathbf{Pow}(\{\mathbf{girls}\}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$
- (d) σ -condition:
 $\{\mathbf{X} \mid \{\mathbf{j}\} \leq \mathbf{X} \text{ and } \text{card}(\{\mathbf{girls}\} \cap \mathbf{X}) = 1\} \cap \mathbf{VP}\sigma \neq \varphi$
 π -condition:
 $\{\mathbf{j}\} \in \mathbf{VP}\pi$ AND $\{\mathbf{Pow}(\{\mathbf{girls}\}) - \varphi\} \cap \mathbf{VP}\pi \neq \varphi$.

The conditions for (83a) select those models in which at least the union of boys and girls brought about a *build_a_cabin* event and both some boys and some girls were involved in doing so. This set of models may include some in which each sex builded its own cabin: the σ -condition is compatible with a *state_of_affairs* in which $\{\mathbf{girls}\} \varepsilon \mathbf{VP}\sigma$ and $\{\mathbf{boys}\} \varepsilon \mathbf{VP}\sigma$, but neither relation is entailed. The same pattern emerges from the condition set for (83b): we cannot conclude that some boy hates another boy, though it must be true that some boys as well as some girls are hating or being hated and there is a full state of *hating_each_other* for the boys and the girls together. In both sentences, the condition set appears to filter models correctly.

Next, consider (83c) and its condition set (84c). Here we see that the σ -condition again does not claim there to be multiple events of *building_a_cabin*. The π -condition on **every**, however, guarantees that each boy has his own event and therefore built a cabin, since for every boy \mathbf{x} , $\{\mathbf{x}\} \varepsilon \{\mathbf{Pow}(\{\mathbf{boys}\}) - \varphi\}$ and $\pi\mathbf{f}(\{\mathbf{x}\}) = \mathbf{1}$, according to the definition of $\mathbf{VP}\pi\mathbf{max}$, a subset of $\mathbf{VP}\sigma$. As for the girls: no cabin is claimed for them in (84c) nor is it excluded that they built a cabin of their own, but involvement is required. I must admit that my judgements about the appropriateness of this low profile for the second NP are weak. If one is convinced that the conditions for *some girls* are too weak and that $\{\mathbf{girls}\} \varepsilon \mathbf{VP}\sigma$, one is also bound to assume that the partner of a fully distributive NP acts as a 'stand alone' in the conjunction, bringing in its own σ -condition. Or, somewhat more sophisticated: if the distribution rule (81) amounts to implying the σ -conditions of one NP, the σ -conditions of the other are called for too. This would mean that in the context of a fully distributive NP like *every N* the VP is fully distributed over every NP conjoined with that distributive NP, according to its own σ -conditions.

Sentence in (83d) seems to be treated correctly by (81). The resulting condition set (84d) requires the world to be such that there is some mutual hate between John and girls, with at least John and some girls hating or being hated. Since we may assume that for no entity \mathbf{x} the involvement function \mathbf{fi} associated with *hate_each_other* gives $\mathbf{fi}(\mathbf{x}) = \mathbf{1}$, the π -condition for the NP *John* cannot introduce the possibility that John takes care of an *hate_each_other* state on his own.

I take the following version of the distributive hypothesis (81) to be warranted by these considerations:

- (85) NP_1 and NP_2 VP is true,
 given that NP_1 denotes \mathbf{Q}_1 and NP_2 denotes \mathbf{Q}_2 and $\mathbf{Q}_1 \cap \mathbf{Q}_2 = \mathbf{Q}_\&$
 and \mathbf{L} is some set $\mathbf{Q}_\&$ lives on, IF
 (a) $\mathbf{L} \varepsilon \mathbf{VP}\sigma$ AND
 (b) the π -conditions for NP_1 and NP_2 with respect to VP hold AND
 (c) if (b) entails the σ -conditions of NP_1 , the σ -conditions of NP_2

hold.

2.4.3. Generalizing the approach

Recall that the main topic of this chapter is the question whether or not and, if so, to which extent we are entitled to derive coordinated propositions from proposition internal or phrasal coordinations. In order to justify this derivation for a particular opaque case — the conjunction of NPs — I adopted the following positions. First, we need a notion of being_involvement in a state or event named by a predicate to explain the different entailments of e.g., *the boys* and *John and Bill* with respect to contributions of individual entities referred to by these NPs to the bringing_about of events or states. Further, given some formalization of this notion, we can score NPs with respect to involvement patterns they impose on predicates (i.e., π -conditions) apart from the pattern of bringing_about events or states named by the predicate (σ -conditions). Finally, this enables a general formulation of the distribution of predicates over conjoined NPs: the VPs answer to π -conditions is always distributed, while the VPs answer to σ -conditions is distributed if these conditions are entailed by the π -conditions.

On the base of the reasoning thus far, I conclude that there is always some aspect of a predicate distributed over conjoined NPs. This is the part, $\mathbf{VP}\pi$, that is entailed by the predicate's event structure, $\mathbf{VP}\sigma$. Any sentence implies something about some predicate or, in terms of the present approach, any sentence implies something about the structure of $\mathbf{VP}\sigma$. $\mathbf{VP}\pi$ is completely determined by $\mathbf{VP}\sigma$. For a sentence to be true, $\mathbf{VP}\pi$ is to meet the full range of conditions that the various quantifiers in the sentence impose on it, boolean relations between these quantifiers taken into account. In many cases, the distribution of $\mathbf{VP}\pi$ induces the distribution of $\mathbf{VP}\sigma$. If we represent the predication relation as \mathbf{H} (of Holding of some conditions) between pairs of quantifiers and VP denotations, the partial distribution of predicates over conjoined NPs observes the following regime:

$$(86) \quad \mathbf{H}((Q_1 \cap Q_2), (\mathbf{VP}\sigma \cap \mathbf{VP}\pi)) \text{ iff} \\ \mathbf{H}((Q_1, \mathbf{VP}\pi)) \cap \mathbf{H}((Q_2, \mathbf{VP}\pi)) \cap \mathbf{H}((Q_1 \cap Q_2), \mathbf{VP}\sigma).$$

From this one can derive:

$$(87) \quad \text{if } \mathbf{H}((Q_1 \cap Q_2), (\mathbf{VP}\sigma \cap \mathbf{VP}\pi)) \text{ then } \mathbf{H}((Q_1, \mathbf{VP}\pi)) \cap \mathbf{H}((Q_2, \mathbf{VP}\pi)).$$

This implication clearly complies with the general hypothesis of non-triviality (14). One aspect of its background should be clarified. The general enterprise of this study is to determine the syntactic boundaries of coordinations efficiently. In that enterprise, I'm more concerned about categories of expressions than about the expressions themselves. Therefore, the fact that a $\mathbf{VP}\pi$ cannot be phrased in exactly the same terms as the VP it is a semantic component of — although prefixing *to be involved in* could account for the kinship — is less important than

the present approach's implication that $\mathbf{VP}\pi$ is an object of the same type as VP. In this respect and to the extent that the π/σ approach to predication is valid, (87) is a partial confirmation of the general hypothesis (14).

2.4.4. Distribution and non-constituent coordination

To conclude this rather involved treatment of distributivity phenomena, it is appropriate to reveal one more, highly intriguing aspect of distributivity, captured by the following claim:

(88) In non-constituent coordination the predicate is fully distributed.

Consider, for example, the following sentences.

- (89) (a) ... dat de jongens grimmig en de meisjes opgewekt
that the boys grimly and the girls cheerfully
 tegenover elkaar stonden
across each-other stood
- (b) ... dat het rode leger met artillerie en het blauwe leger met
that the red army with artillery and the blue army with
 cavalerie het vijandelijk kamp omsingelde(n?) SG/PL?
cavalery the enemy camp surrounded
- (c) ... dat ik Frits met tegenzin en Marie vol vreugde heb
that I Frits reluctantly and Marie joyfully have
 ingelicht
informed

In these sentences each NP that is involved in some coordination, is fully satisfied in its particular σ -condition: each of these NPs introduces its own event(s) of the predicated type, whereas the predicates as such are almost 'collective' in nature and the NPs don't resist to 'collectivity'. The first sentence implies that the boys were standing opposite of each other, and that the girls were too. The second sentence implies that the encampment was surrounded twice, which explains the numeral bias. In (89c) there must be two different events of me informing someone.

It is only natural to assume that this full distribution is due to the semantics of the 'added' constituent in the coordination, but I did not succeed in constructing convincing cases of nonconstituent coordination *_with_NPs* that did not imply $\mathbf{VP}\sigma$ distribution. I must admit, though, that I do not have firm judgements in case the shared predicate is explicitly forced to be 'cumulative'. I cannot compute, for example, how much money has been spent by Fred and Marie in:

- (90) ... omdat Fred vier kostuums en Marie vijf jurken heeft
because Fred four suits and Marie five dresses has
 gekocht voor in totaal 2.000 gulden
bought for a-total-amount-of 2.000 guilders

But this turbidity also can be observed in:

- (91) Elke student heeft bij mij boeken gekocht voor
each student has from me books bought for
 in totaal 200 gulden
a-total-amount-of 200 guilders

Here too I am inclined to consider the a cumulative interpretation of the adverbial PP to run contrary to the spirit of the construction.

If (88) is sound, no matter why exactly, the cases in which distributivity is to be handled with care, are restricted to pure coordinations of constituents XP: a class that is easily recognized in an automatic procedure (cf. chapter 3).

2.5. The scope of the hypothesis

The discussion thus far strongly suggests that the following statement, a specialization of the general hypothesis (14), is valid across all types of coordinations:

- (92) If a sentence S with a nonterminal cut typed $\mathbf{X C COORD C' Y}$ is grammatical, there are at least two sentences S' and S'' of types $\mathbf{X C Y}$ and $\mathbf{X C' Y}$ respectively, such that $S' COORD S''$ entails S or S entails $S' COORD S''$.

What matters here, is whether or not this logic of coordination at the level of types should be reflected in the parsing of coordination, as SR (10) implies. In the light of the foregoing, it is worth noting that the reference to types in SR does not interfere with semantic sincerity. As a matter of fact, SR does not require two parallel occurrences of the same type to be represented by categories having identical interpretations, no matter whether the types belong to the coordinates or to the shared parts of the sentence. Consequently, SR is not a rule of conjunction reduction. It does not claim that each and every phrasal coordination is derived, syntactically or semantically, from full sources by rules of grammar. SR does claim, however, that at some level of analysis (e.g., logical form) phrasal coordination has to be interpreted as a coordination of propositions, i.e., as some operation on semantic objects of a type natural languages refer to by, among others, sentences. The content of these derived propositions is non-trivially determined by the lexical material involved. Let us again consider two notorious cases of 'non-distributional' predicates:

- (93) Jan en Piet zijn even dom
Jan and Piet are equally stupid
 (94) Het blauwe leger en het rode leger omsingelen de stad
the blue army and the red army surrounded the city

In (93) it is predicated of Jan that he is as stupid as Piet. In (94) it is predicated of the blue army that it takes part in the surrounding of the city. If these predications are false, the corresponding sentence is also false. This is not accidental. (93) means that Jan is as stupid as Piet; (94) *means* that both the blue army and the red army took part in the surrounding of the city, and is incompatible with the situation that the red army did not contribute to the surrounding of the city. The individualized predications convey information that e.g., a system for automatic interpretation of languages should be able to deduce from the proper analysis of (93) and (94).

Following the concept of meaning brought forward by Higgenbotham (1985), then, we are licensed to conclude that (93) and (94) should have some representations — their logical forms — that account for these meanings. In order to get at those meanings, we must assume that predicates induce functions generating derived predicates, in accordance with their nature and as a part of their lexical meaning. The predicate in (93) is an equivalence relation, by force of the equality adverb, and therefore symmetric. The predicate in (94) is known to be collective. So, we must assume that somewhere in the trajectory from form to interpretation a function distributing symmetric predicates to yield predicates and a function distributing collective predicates to yield predicates are activated. This does not affect, however, the kinship between the original predicate and its derivative. They have to be of the same type, i.e., they must have the same combinatory potential at all levels of representation.

In chapter 3 it is argued that for determining the phrasal scope of coordination the assumption that phrasal coordination can be related systematically to sentential coordination, is imperative. The arguments in favour of hypothesis (14)/(36)/(92) support that assumption at the level of combinatory types. The hypothesis does not claim that the reconstruction preserves meaning, nor that the reconstruction is necessary from a syntactic point of view. To the extent that the hypothesis can be maintained, it confirms the way SR is made operational, in chapter 3, as a basis for a typological analysis of coordination.

3. The Roots of SR

It is worth mentioning that SR (10) defines a far from trivial form of coordination. As Maarten Hijzelendoorn pointed out to me, SR will be too permissive for any artificial language we use. Under SR no particular relation between the members of a coordinate — no matter how liberally constructed — is presumed or intended. Now let us suppose — anticipating the exposure of evidence — that SR makes sense for at least one language, Dutch, in stressing the repetition of nonterminal strings and parallelism. Then there are two ways out for the classical approach that defines coordination as a junction of equally typed constituents. The first strategy is flexibilization of the notions of category and constituent, as argued for in e.g., Zwarts (1986). This line is developed predominantly by Steedman (1985, 1990) and Moortgat (1988) and hinges on the completeness property of flexible categorial grammar pointed out by Moortgat (1988) and others (cf. chapter 1). We might consider this strategy, in a certain sense, as an adaption of the one-category requirement of Chomky's (1957) original formulation: expand a nonterminal **X** as **X and/or X**. The other strategy is to stick with immediate non-flexible constituency and to reanalyse every infringement on it by coordination as some form of ellipsis. Specimens of the latter approach can be found in almost all transformational work on coordination; a new branch in this enterprise and a thorough criticism of foregoing attempts in the same vein are offered by Van Oirsouw (1987).

SR is indebted to the ideas in Goodall (1987), Williams (1978) and to those that De Vries (1987) credits Rini Huybrechts for, according to which coordination involves the linearization or union of sets of partial phrase markers. In Goodall (1987) the sentence (95) is represented as (96):

(95) Elaine took Mary to the airport and Jane to the beach

(96) Elaine took [NP Mary] [PP to the airport]
 [NP Jane] [PP to the beach]

The representation may not look overly sophisticated but the column of strings of labelled bracketings in (96) is to be considered as *one* wellformed labelled bracketing according to Williams' (1978) extension of the original notion by Peters and Ritchie (1973). The derivational relation between (95) and (96) is given with a rule of linearization, again suggested in Williams (1978). Both Goodall (1987) and De Vries (1987) refer to the theory of Reduced Phrase Markers designed in Lasnik and Kupin (1977) as underlying their approaches, but De Vries considers linearization in the spirit of Williams and Goodall to be too simpleminded. She pleads additional restrictiveness of the syntactic relation between coordinated and non-coordinated elements, in order to avoid the wellknown problems of sentences like

(97) *John leaves at six and Pete seven

(98) *He greets every woman and kisses man

In the presentation of the procedure operationalizing SR, in chapter 3, I will try to show that exactly this type of failure can be remedied by generalizing the locality conditions on Gapping in Neijt (1979) to principles of the reconstruction of phrasal coordination at type level (chapter 3, section 5).

The kind of approach to coordination that Goodall (1987) and Williams (1978) opt for, is adopted in chapter 3 on the base of a rigid categorial framework, again reflecting the viewpoint that coordination is a highly marked but not very restrictive species of linguistic structure. To a large extent, the idea behind SR is developed in Van Oirsouw (1987). In particular, he stresses the role of sequences of categories, rather than structures, in the syntax of coordination. He connects his linear approach, however, essentially to a deletion grammar, and this is exactly where the present way of 'doing' coordination and Van Oirsouw's diverge.

4. Parallelism

SR (10), by simple coindexation, underlines a feature of coordination that was referred to above as parallelism. The coordinates in a wellformed string are supposed not only to share a certain functionality but also to express the same linearity. Sentence (99) is simply unwellformed.

- (99) *Haar gaf hij en ik gaf Kees een zoen
her gave he and I gave Kees a kiss

Note that *een zoen* can be distributed felicitously over both coordinates: *Haar gaf hij een zoen* 'her he kissed' and *Ik gaf Kees een zoen* 'I kissed Kees' are both correct, expressing events of the same class. Moreover, the two coordinates have the same combinatory valencies: *een zoen* 'a kiss' is an object to *geven* 'give' in each of the propositions induced by (99). A neo-classical treatment of coordination as the one developed in Steedman (1985, 1990), must therefore categorize the two coordinates alike, as a consequence of completeness, and accept the coordination. SR is designed to rule out this kind of accidental co-typing. It requires explicitly that the order of types in the coordinates is the same. It does not allow for any local permutation of types in one coordinate. It must be noted, however, that the parallelism requirement of SR does not extend to the ordering within a coordinated constituent, i.e., a constituent belonging to a coordinate. Interesting examples of embedded coordinations with different word order are given by Van Zonneveld (1992); for example:

- (100) Als je gepakt wordt en je bent al eens
if you caught are and you have-been already once
 veroordeeld, dan hang je
convicted then hang you
 'If you are caught and you were convicted once before, you are in for it.'

The left conjunct under *als* 'if' has verb-final word order, the other verb-second word order. For SR, this is not relevant, however, since the coordination is of type **s COORD s**, and parallelism is not challenged in constituent coordination.

Now, parallelism is rejected by Van Oirsouw (1987: 261ff) as an universal restriction on coordination. This rejection extends to parallelism of ordering as well as to structural parallelism, which can be considered as co-functionality of the coordinates with respect to the non-coordinated (and shared) parts of a string. Van Oirsouw's counterexamples to linear parallelism exclusively involve Gapping, as in the German sentence

- (101) Den grossen nehme ich und du den kleinen
the big-one take I and you the small-one

He disqualifies structural parallelism by referring to sentences like German

- (102) Käse mag ich nicht und ist auch nicht gut für mich
cheese like I not and is also not good for me

Both types of sentences are marked — the (102) case is a notorious stylistic howler but that is no reason to neglect them. It might seem remarkable that in each case the linear ordering of types — as opposed to that of categories or complex symbols — is upheld. In (101) we find the relative ordering **np np** at each side of *und*, whereas in (102) each coordinate will be of category **s \ np**, and thus equally ordered as well. This seems to be of little importance, however. The Gapping example can be doubled by sentences of an equal degree of acceptability in which the order of types is reversed:

- (103) Heute fährt Karl, und Heinz morgen
today drives Karl and Heinz tomorrow

- (104) The freshmen take this week exam and next week the freshmen (Schoppe 1991)

I will follow Van Oirsouw in claiming that structural parallelism is neither a sufficient nor a necessary wellformedness condition on coordination, adding that fixed order languages will only rarely be capable to embed structurally diverging coordinates in given left and right environments. Sentences (101), (103) and (104) are specimens of a type of coordination — elliptical coordination — that trespasses simple SR almost by definition and deserves special attention (cf. below and chapter 3) from a computational point of view. Van Oirsouw subsumes all ellipses under the syntax of coordination. This should not imply, however, that the computation of coordination is monolithic. To my knowledge, the linear exceptions to parallelism have no counterparts in the field of ordinary non-constituent coordination, as can be seen from the weirdness of (99); this is also argued by Hendriks (1991a). So, we have here another feature of coordinative ellipsis, apart from its being not completely repetitive, that calls for special treatment. Computationally, it constitutes an amendment to Van Oirsouw's project of rigorous unification of coordination and elliptical phenomena.

5. Coordination and Ellipsis

5.1. Singular and multiple events

Coordinative ellipsis, and in particular Gapping, is that form of coordination in which the right coordinate does not contain all the types predicted by SR. Yet, one important feature of SR is preserved: the left-hand side of the coordination can be factorized in such a way that every category in the elliptic coordinate finds a proper counterpart. As indicated in the preceding section, we may relax the nature of this mapping to allow for slight permutations. A certain class of exceptions to this requirement on the right-to-left mapping will be dealt with later on. In general, then, we can tell where the alleged repetition starts — with the leftmost category to the left of the coordinate that is matched by the leftmost (or just: some) category to the right of the coordinate — and, *a fortiori*, where it ends — at the coordinator. Phenomenologically, coordinative ellipsis implies that replacing the left coordinate by the right one, does not yield a grammatical and/or a fully interpretable sentence. Consider the following triple where — as will be the case in the remainder of this section — the coordinates are in capital.

(105) Elke maatregel heeft de rijken hier waarschijnlijk rijker gemaakt
each measure has the rich here probably richer made
 'Each measure probably has enriched the rich here.'

(106) Elke maatregel heeft DE RIJKEN HIER WAARSCHIJNLIJK
 RIJKER GEMAAKT en DE ARMEN DAAR
 ... *and the poor there*
 WAARSCHIJNLIJK ARMER
probably poorer
 'Each measure has probably enriched the rich here and impoverished the poor there.'

(107) *Elke maatregel heeft de armen daar waarschijnlijk armer

(106) is a fine example of Gapping, and we cannot replace the left coordinate by the right one, as (107) shows. It is easy to check that in full complex coordination such a replacement produces a grammatical sentence. This motivates the **ellipsis criterion**:

(108) A coordination
[X C(1) ... C(n) COORD C(1') ... C(m) Y]
 is a coordinative ellipsis iff
[X C(1') ... C(m) Y] is ungrammatical and
[X C(1) ... C(n) Y] is grammatical.

This criterion digs deeper than it may appear at first sight. It implies, for example, that (106) involves ellipsis, while the seemingly equivalent (109) does not, as can be seen from the grammaticality of (110), the replacement test

- (109) Elke maatregel heeft DE RIJKEN HIER
each measure has the rich here
 WAARSCHIJNLIJK RIJKER en DE ARMEN DAAR
probably richer and the poor there
 WAARSCHIJNLIJK ARMER gemaakt
probably poorer made
- (110) Elke maatregel heeft de armen daar waarschijnlijk armer gemaakt
'Each measure probably impoverished the poor there.'

The same discrimination holds for the following couple of coordinations:
 according to the ellipsis criterion, (111) is ellipsis but (112) is not.

- (111) Wij hebben toen JAN OPGEBELD en PIET
we have then Jan phoned and Piet
- (112) Wij hebben toen JAN en PIET opgebeld
we have then Jan and Piet phoned
'Then we phoned Jan and Piet.'

Pairs like (106)/(109) and (111)/(112) may be typical for SOV languages like Dutch, but it does make sense to bisect them in the way the ellipsis criterion does. Sentence (111), for example, lacks one interpretation that is prominent in the possibly ambiguous (112): the first sentence does not report on one single event of calling somebody but on two, whereas the second unifies the calling of Jan and Piet in one event by preference, though not necessarily. The same pattern emerges in the following pair, where a 'collective' predicate occurs: the elliptic sentence (113a) — where *de poolse divisie* 'the Polish division' is meant to be a subject — has no reading implying that there is one single event of surrounding the city.

- (113) (a) Daarna heeft HET RUSSISCHE BATALJON
afterwards has the Russian battalion
 DESTAD OMSINGELD en DE POOLSE DIVISIE
the city surrounded and the Polish division
'Afterwards, the Russian battalion surrounded the city, and the Polish division.'
- (b) Daarna hebben HET RUSSISCHE BATALJON en DE POOLSE
 DIVISIE de stad omsingeld
'Afterwards, the Russian battalion and the Polish division surrounded the city.'

Moreover, it seems unlikely that (113a) can be analyzed as an extraposition of a right conjunct, as Van Zonneveld (1992) argues for in the case of coordinated objects. Taking (113b) as the source for the extraposition, we end up with a serious agreement problem.

- (114) *Daarna hebben HET RUSSISCHE BATALJON
afterwards have the Russian battalion

de stad omsingeld en DEPOOLSE DIVISIE
the city surrounded and the Polish division

With some effort, a comparable diversification of events can be noticed in (106) and (109). Sentence (106), marked elliptic by criterion (108), leaves open the possibility that the effects by which the measurements enrich the rich, are disjoint from their effects on the poor. (109), on the other hand, can only mean that each effect of a measurement was such that the rich got richer and the poor more poor. Although I am not able to offer a grammar of events to formalize these subtleties, the semantic intuitions about (111) and (112) appear to underpin the impact of the ellipsis criterion: ellipsis entails multiplication of events.

Now recall that in section 2.4.4 it was noticed that none of the problems with respect to distributivity versus collectivity discussed there, arises in the context of non-constituent coordination. Indeed, it is fairly easy to demonstrate that in non-constituent coordination the same tendency towards multiplication of events is resident as in configurations that are marked elliptic by the ellipsis criterion. Compare, for example, the constituent coordinations (112) and (113b) to (115a) and (115b), respectively.

- (115) (a) Wij hebben toen JAN MET VREUGDE en PIET
we have then Jan joyfully and Piet
 MET TEGENZIN opgebeld
reluctantly phoned
- (b) Daarna heeft*hebben HET RUSSISCHE BATALJON
afterwards has/have the Russian battalion
 IN PANIEK en DE POOLSE DIVISIE IN WANORDE
in a-panic and the Polish division in disarray
 de stad omsingeld
the city surrounded

Even when trying to abstract from the number problem in the second sentence, we are forced to infer from these sentences two single events of calling somebody with some emotion and two single events of surrounding the city with some tactics. Apparently, it is as hard to construct one event of calling two people under pairwise contrastive emotions as it is to construct one event of surrounding the city by different formations one-to-one linked to different modalities of operation.

An effect similar to the individualization of events can be observed in the semantic opposition between (116) and (117):

- (116) Ik heb DE JONGEN en HET MEISJE een boek gegeven
I have the boy and the girl a book given
 'I gave the boy and the girl a book.'
- (117) Ik heb DE JONGEN EEN BOEK en HET MEISJE EEN

I have the boy a book and the girl a
 BOEK gegeven
book given
 'I gave the boy a book and the girl a book.'

Whereas (116) permits a reading amounting to the distribution of (copies of) a particular book among boys and girls — say: a wide scope reading for *een boek* — (117), of course, does not permit such an interpretation. The latter sentence may not be straight (due to insufficient semantic opposition inside one couple of coordinated elements and a resulting prosodic bias) but it is grammatical, and it does not give us any reason to deduce a single event of book distribution. Of course, in the real world behind the proposition the boys book(s) and the girls book(s) may be the same, but at the level of propositional interpretation and event structure (117) confronts us with distinct events of giving books, without hints as to the identity of the books distributed in the two events.

5.2. Ellipsis as discontinuity

In the preceding section it was argued that non-constituent coordination and elliptical coordination (identified by the ellipsis criterion (108)) have an important semantic feature in common: the induction of multiple events. Yet, predominant is a difference between them, be it at the level of strings. Compare the sentences of (118).

- (118) (a) Jan heeft van harte en Piet heeft met tegenzin ingestemd
Jan has warmly and Piet has reluctantly agreed
 (b) Jan heeft van harte ingestemd en Piet met tegenzin
Jan has warmly agreed and Piet reluctantly
 'Jan agreed warmly and Piet reluctantly.'
 (119) (a) *Piet met tegenzin ingestemd
 (b) *Jan heeft van harte ingestemd en Piet heeft met tegenzin

(118a) is ordinary string conjunction according to SR (10). (118b) is an ellipsis according to the ellipsis criterion, since (119a) is ungrammatical. SR and the ellipsis criterion together seem to define the same bipartition that is constructed by Dirksen and Kerstens (1987) and Dirksen (1990) as the distinction between surface and deep ellipsis. They define this distinction in terms of focus, presupposition and peripherality, assuming more sophisticated means of representation than are available here. In their approach, (118a) is to be qualified as an instance of surface ellipsis and (118b) is to be considered deep ellipsis. Dirksen (1990) suggests, moreover, that the bipartition correlates to different parsing strategies. Although the present frame is not suited to incorporate the defining characteristics of deep versus surface ellipsis, the parsing effect is easy to

trace. SR presupposes the righthand coordinate to be a typological *substring* of the string of types to the left of the coordinator; the ellipsis criterion selects those righthand coordinates that are *discontinuous* with respect to the leftside string.

In order to establish a proper definition of *(dis)continuous substring* and to understand the parsing effect of ellipsis, recall that the coordination rule SR is defined at the level of nonterminal strings, i.e., in terms of cross-cuts of the structural graphs. Therefore we can handle relevant notions of continuity in terms of identity of parts of strings. The first move, then, is to observe that the left coordinate starts with a category identical to the onset of the right coordinate. This implies that the left coordinate always can be found, be it non-deterministically, since it starts with a particular constituent and does not extend beyond the coordinator itself. Moreover, the left string is continuous by definition. Consequently, discontinuity in the right coordinate has to be located to the right of its onset: the two coordinates start identically at type level.

The notion of *(typological) substring* is defined as follows:

- (120) Given a string $\langle \mathbf{a}_1, \dots, \mathbf{a}_n \rangle$ of nonterminal symbols, a string $\langle \mathbf{b}_1, \dots, \mathbf{b}_m \rangle$ is a typological substring of it iff
 $m \leq n$, and
 for every i there is an i' such that $\mathbf{b}_i = \mathbf{a}_{i'}$ and
 $\mathbf{b}_1 = \mathbf{a}_1$, and
 for every i, j, i' and j' , if $i \neq j$ and $\mathbf{b}_i = \mathbf{a}_{i'}$ and $\mathbf{b}_j = \mathbf{a}_{j'}$ then $i < j$ iff $i' < j'$.

The main feature of this notion is the preservation of order in the substring relative to the matrix, introduced by the last clause.

Now continuity of substrings can be stipulated by adding a new clause to the definition above:

- (121) Let $\mathbf{B} = \langle \mathbf{b}_1, \dots, \mathbf{b}_m \rangle$ be a substring of $\mathbf{A} = \langle \mathbf{a}_1, \dots, \mathbf{a}_n \rangle$.
 \mathbf{B} is continuous relative to \mathbf{A} if
 for all i , $1 < i \leq m$, $\mathbf{b}_i = \mathbf{a}_i$,
 and discontinuous otherwise.

According to these definitions, a left coordinate $\langle \mathbf{c}_1, \dots, \mathbf{c}_n \rangle$ has exactly n continuous substrings and $\sum_{i=2}^n n! / (i!(n-i)!)$ discontinuous substrings with onset \mathbf{c}_i . Combining the ellipsis criterion and the substring definitions, coordinative ellipsis can be defined as involving a discontinuous right coordinate:

- (122) A coordinated structure $\mathbf{X} \text{ COORD } \mathbf{Y} \mathbf{Z}$, where \mathbf{X} and \mathbf{Y} are non-empty strings of types and \mathbf{Z} is a string of types, is a coordinative ellipsis iff \mathbf{Y} is a discontinuous substring of \mathbf{X} in the sense of the definitions (120) and (121).

Defining ellipsis is one thing, recognizing it is another. Since this is more or less what linguistic computation is about, I will next address the question how ellipsis may be recognized. Fortunately, there is some indirect evidence that wellformed coordinative ellipsis is constructed best as an extension of a full sentence (cf. section 5.3). If this can be warranted, the additional computational effort of checking a string for discontinuity can be restricted to environments where to the left of the coordinator a sentential type occurs. For definition (122) this would imply, first, that the component **Z** reduces to zero and, second, that **X** → **s** is deducible.

As for Dutch, two classes of counterexamples to the claim that coordinative ellipsis is a discontinuous substring of a full sentence to its left, are brought forward. The first class contains specimen of N-Gapping; an illustrative example is (123), from Dirksen (1990).

- (123) Ik heb MOOIE BOEKEN en INTERESSANTE gekocht
I have beautiful books and interesting bought

Although I strongly prefer a marked, parenthetical intonation, one may consider it as an example of sentence internal ellipsis. Alternatively, however, the gapped noun can be seen as a free null anaphor of the kind that is dubbed 'deep anaphora' by Hankammer and Sag (1976). In contrast to 'surface anaphora' they can be triggered by nonverbal context. Indeed, each of the following sentences, showing a noun gap, is wellformed and interpretable in the context given.

- (124) [Your best friend shows you, silently but expectantly, some of his latest paintings; your reaction:]
 (a) Ik heb wel eens mooiere gezien
I have once more-beautiful seen
'I have seen more beautiful ones.'
 (b) Heb je ook abstracte?
have you also abstract
'Do you also have abstract ones?'
 (c) Ik wist niet dat je de allereerste nog bewaard had
I knew not that you the very-first still retained had
'I did not know that you retained the very first ones.'

Standard Gapping requires a verbal context. The fact that noun gaps don't, disqualifies them as products of sentence internal coordinative ellipsis. The second class of counterexamples is far more serious. Here a restricted form of Gapping only affects the finite verb:

- (125) (a) DE JONGENS HEBBEN VALS en DE MEISJES
the boys have out-of-tune and the girls
 ZUIVER gezongen
in-tune sung

- (b) ZIJ ZULLEN MIJ, IK HEN beklagen
they will me I them pity
 'They will pity me, I them.'

(from: Multatuli, *Liefdesbrieven*)

Clearly, in these cases, the discontinuous substring is not preceded by, but properly embedded in a full sentence. Notably, however, the finite verb is the only constituent that can be gapped here. In (126) the right coordinates are also discontinuous in an NP position, marked with #, and the sentences are ungrammatical or dubious. Their respective counterparts in (127) occur in standard Gapping format, with a full sentence preceding the coordinator, and they are grammatical.

- (126) (a) *JIJ HEBT OMA EEN VAAS en/maar IK OPA # gegeven
you have grandma a vase and/ but I grandpa given
 (b) ?JIJ HEBT OMA EEN VAAS en/maar IK #
you have granny a vase and/ but I
 BLOEMEN gegeven
flowers given
 (c) *ZIJ VROEG MIJ VRIENDELIJK en/maar JIJ #
she asked me kindly and/ but you(NOM)
 BARS om te vertrekken
gruffly to leave
- (127) (a) Jij hebt oma een vaas gegeven, en/maar ik opa
you have grandma a vase given and/ but I grandpa
 (b) Jij hebt oma een vaas gegeven, en/maar ik bloemen
you have grandma a vase given and/ but I flowers
 (c) Zij vroeg mij vriendelijk om te vertrekken, maar jij bars
she asked me kindly to leave but you^{NOM} gruffly

In the context of a non-sentence, gapping non-finite verbs fails too, but here it is difficult to construct a solid alternative — for independent reasons, I presume:

- (128) (a) *Zij heeft MIJ PROBEREN OVER TE HALEN en/maar
she has me tried to-persuade and/ but
 JOU TE DWINGEN niet te komen
you^{NOM} to force not to come
 (b) ?Zij heeft mij proberen over te halen niet te komen
she has me tried to-persuade not to come
 en/maar jou te dwingen
and/ but you to force

If the possibility of sentence internal discontinuity is limited to finite verb gaps, as it seems, we still have a major restriction on contexts in which discontinuity can occur.

- (129) In a structure **X A COORD B Y**, the right coordinate **B** can only be discontinuous with respect to **A** if **A** → **s** or the difference between **B** and **A** is a finite verb.

In the next section it will be argued that, notwithstanding this slight relaxation of the contextual preconditions on discontinuity, the nature of coordinative ellipsis is sentential.

5.3. The interpretation of ellipsis

Cremers (1983b) argues for an interpretive resolution of elliptic structures by means of higher order functions, abstracted from the immediate context of the elliptic configuration. Recently, Dalrymple, Shieber and Pereira (1991) have demonstrated the impact of this kind of approach on a great number of semantic issues. The main part of their examples concerns VP ellipsis — for which there is no analogue in Dutch — but they suggest that the advantages of higher order unification extend to a wide range of elliptic configurations. A characteristic (though not surprising) analysis under this approach is given in (130) where the VP ellipsis *Bill does not* is in one reading (the sloppy one) interpreted by application of the function (130b), that is derived from the interpretation of the lefthand side of the coordination by abstraction, to the denotation of *Bill*, yielding the interpretation (130c) for the whole sentence.

- (130) (a) John realizes that he is a fool, but Bill does not
 (b) $\lambda x. \text{realize}(x, \text{fool}(x))$
 (c) $\text{realize}(j, \text{fool}(j)) \text{ BUT not}(\text{realize}(b, \text{fool}(b)))$

If this approach is on the right track, as is claimed by Dalrymple *et al.* (1991), we have an immediate explanation for the fact that ellipsis cannot occur in arguments: since the functions needed to provide an interpretation for the elliptical substring are derived from propositions, we cannot arrive at autonomous functions if the substring itself is a necessary part of the proposition that is to yield such a function. This gives a straightforward explanation for the absurdity of:

- (131) *John asked me whether Bill did too

It is obvious, however, that a deletion approach to VP ellipsis would give us the same result. If the constituent to be deleted must be a VP, this target VP cannot be contained in the VP that must license the deletion under identity, for physical and logical reasons. Gapping cannot occur in arguments either:

- (132) *John told Mary that Bill Sue that he loved here

But there is no deletional explanation for this, since the deleted constituent, the verb in the first embedded sentence, is not part of its alleged counterpart *told*. The interpretive approach of Cremers (1983b) and Dalrymple *et al.* (1991) explains the ungrammaticality of (132): the string that is in need of interpretation, is part of the proposition that must provide the additional semantics and therefore no consistent and finite interpretation is available. There is an easy parsing parallel to this: at the moment an interpretation must be available, there is no propositional context established that could provide it. Pursuing this track, we can even explain why ellipsis is not blocked in adjuncts (cf. the VP ellipsis in 133), and in comparatives (like 134), which Hendriks (1991) convincingly argues to have all characteristics of Gapping, i.e., coordinative ellipsis.

- (133) (a) The gangsters found him before the police did
 (b) Mary dated every guy that Sue did

- (134) Hij heeft meer harten gebroken dan ik glazen
he has more hearts broken than I glasses
'He has broken more hearts than I have broken glasses.'

In each of these sentences, there is a typological full sentence, and thus a proposition on some level of representation, outside the embedded sentence in which the ellipsis shows up. This is evident in (133a), but maybe less so in the other two sentences. Nevertheless, in (133b) as well as in (134) a typological substring $NP V_{trans} NP$ to the left of the ellipsis can be distinguished. Herewith, we also have a logical form containing elementary propositions that may yield, by abstraction, the functions appropriate to provide interpretative 'fillers' for the (gaps in the) elliptical phrase. This is not the place to go into details of the exact representations of these sentences, but the assumption that at the moment of interpretation of these ellipses a propositional frame has been activated in their left contexts, discriminates between the grammatical examples above and the almost uninterpretable and unwellformed sentences of (135).

- (135) (a) *Every guy that Sue did, Mary dated too
 (b) *Meer boeken dan bij mij platen stonden bij hem
more books than at-my-place records were at-his-place
 rond het bed
around the bed

The interpretative approach to ellipsis thus gives an explanation for the ungrammaticality of (132) and (131). The nature of this explanation, the absence of a proposition to the left of the ellipsis, consolidates hypothesis (129).

5.4. Generalizing conditions on ellipsis

The kernel of the reasoning thus far is that coordinative ellipsis and sentence internal coordination are branches of the same tree, the oak of nonterminal string

repetition. Now we have to face an important restriction on discontinuous coordination: Neijt's (1979) rule that discontinuous strings tend to select major constituents and that all the elements of a discontinuous coordinated substring belong to one specific grammatical domain. The 'Major Constituent Condition' is originally suggested by Hankamer (1973) and is paraphrased in (136); the grammatical domain is given by Neijt in terms of a subjacency condition (Neijt 1979: 185), that is reformulated in (137) with respect to Gapping.

- (136) (a) A *major constituent* is immediately dominated by S or VP.
 (b) The remnants of Gapping are major constituents.
- (137) X and Y cannot be remnants in one single gapped string if X is dominated by an NP or an S with a lexical specifier that does not dominate Y.

It is not by accident, I suppose, that these conditions converge in many cases. Yet, (138a) is excluded by (136) but not by (137), whereas (138b) is blocked by (137) but not by (136).

- (138) (a) *John goes to Amsterdam and Pete Groningen
 (b) *John said that Bill won and Mary Sue

They converge, e.g., at excluding

- (139) *John called every looser and Bill winner

Quite informally, it seems possible to unify the two conditions:

- (140) For X and Y to be remnants in one single gapped string, X and Y must be major parts of one and the same constituent

The idea behind this is simple: (137) puts a limit to the differences in degrees of embedding of remnants and (136) wants the remnants to be of equal valence with respect to the category that is to be constructed on top of them. Seen this way, it is at least attractive to subsume all restrictions on (dis)continuity around coordinators under this umbrella. The following ungrammaticalities, where no canonical Gapping is operative, are likely to suffer from the same shortcomings as those in (138).

- (141) (a) *Ik heb DE MEISJES IN DE TUIN en JONGENS
I have the girls in the garden and boys
 KEUKEN laten spelen
kitchen let play
- (b) *... dat hij IN ENKELE KEUKENS VAAK maar ALLE
that he in some kitchens often but all
 GRAAG kookte
readily cooked
- (c) *Wie heeft BOEKEN MET PLAATJES of TEKENINGEN

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who has books with pictures or drawings
TEKST te koop?
text for sale

In the first of these sentences, *jongens* 'boys' en *keuken* 'kitchen' match *meisjes* 'girls' and *tuin* 'garden', respectively, but these figure under different constituents: they are not 'constituent-mates', where Neijt's (137) requires remnants to be 'cycle-mates'. The same can be said of the counterparts of *alle* 'all' en *graag* 'readily' in (141b). In the third sentence, *tekeningen* 'drawings' en *tekst* 'text' may be grasped within one constituent, but they are not at the same level 'major part' in that constituent. So, it seems as if the informal generalization (140, 264) of the Neijt/Hankamer complex extends the observations behind it to the level of string repetition in general, under relativization of categorial parameters. This connection is also suggested in Kempen (1991), where coordination is conditioned on the basis of Levelt's (1983) approach to speech corrections. In section 5 of chapter 3 I will argue that such a generalization is the summit of an algorithmic approach in which Steedman's (1990) notion of decomposing structures selects, more or less automatically, the relevant categorial parameter to 'mateness' and 'majorness'.

6. Summary

In this chapter the hypothesis has been forwarded that coordination can be analyzed as the continuous or discontinuous repetition of nonterminal strings (SR). In order to motivate the operationalization of SR for parsing purposes in a limited categorial framework, some inherent relation between phrasal and sentential coordination must be established. It is argued that in all kinds of coordination entailment relations between phrasal and sentential forms arise. Whereas these relations are rather unproblematic in the cases of nonconstituent coordination and discontinuous coordinative ellipsis, quite involved reasoning is needed to elaborate the entailments in the case of constituent coordination.

The computational efficiency of SR is endangered by discontinuous repetition. This form of coordination is generalized as coordinative ellipsis. Coordinative ellipsis turns out to be restricted to specific contexts and/or specific types.