Specifying Syntactic Structures

edited by
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Dutch Verb Clustering without Verb Clusters

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ABSTRACT. We propose an analysis of Dutch cross-serial dependencies and related constructions based on minimal assumptions about phrase structure. We argue that there is no need to assume the existence of a constituent containing a "verb cluster" or "verbal complex". Furthermore, in clauses with normal (non-extraposed and non-topicalized) word order there are no (full or partial) VP's. Instead, all elements of a cross-serial dependency construction are directly dominated by S. The analysis is formulated in terms of Head-driven Phrase Structure Grammar (Pollard and Sag 1987, Pollard and Sag 1994), and makes crucial use of argument inheritance (Hinrichs and Nakazawa 1994). We demonstrate that our analysis not only accounts for the basic word order in cross-serial dependency constructions, but also for instances of partial extraposition and partial topicalization of VP's. We also show that a recent version of the HPSG binding theory is fully compatible with our analysis. Finally, we demonstrate how verb sequences in which the strictly cross-serial word order is not obeyed can be accounted for.

1 Introduction

1.1 The cross-serial dependency construction

Dutch subordinate clauses are verb-final. Furthermore, if the clause is headed by a modal, an auxiliary, or a verb such as *horen* (*to hear*), *proberen* (*to try*), *helpen* (to help) or *laten* (*to let*) (these are the so-called "verb-raising" verbs), the head of its non-finite VP-complement must occur right of the head of the main clause. This is illustrated in (1a,b). As the head of the non-finite VP can be a verb-raising verb itself, the construction can (in principle) lead to an arbitrary number of crossing dependencies between pre-verbal complements and verbs subcategorizing for these complements.

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This is illustrated in (1c), where subscripts are used to make the dependencies explicit.

(1) a. dat Jan het boek *wil* lezen
that John the book wants read
that John wants to read the book

b. dat Jan Marie het boek *laat* lezen
that John Mary the book lets read
that John lets Mary read the book

c. dat Jan_1 Marie_2 het boek_3 $\textit{wil}_1$ $\textit{laten}_2$ lezen_3
that John Mary the book wants let read
that John wants to let Mary read the book

In the remainder of this introduction, we review previous non-transformational accounts of the cross-serial dependency construction. In particular, we argue that in categorial and HPSG accounts, characterizing what counts as a verb-cluster is problematic. Next, we argue that there is little evidence for the existence of partial VP's in clauses with normal (i.e., non-topicalized and non-extraposed) word order. We conclude that our analysis, in which the verb cluster is not a constituent and partial VP's are not derivable in clauses with normal word order is an attractive alternative.

1.2 Problems with Verb-clusters

There are numerous non-transformational accounts of the cross-serial dependency construction.[1] All these accounts assume that the clause-final sequence of verbs is a constituent (the "verb cluster" or "verbal complex"). Furthermore, with the exception of Kroch and Santorini 1987, who argue for a left-branching verb cluster, it is assumed that this cluster has a right-branching structure, as illustrated in (2).

(2) dat Jan Marie het boek [wil [laten lezen]]

The assumption that the verb cluster is right-branching is problematic for categorial accounts as well as for HPSG accounts using argument inheritance.

Within Categorial Grammar, it has been proposed to derive verb clusters by means of (disharmonic versions of) composition or division. Composition can be used to combine a functor with its argument, even if this argument is "unsaturated". Division derives a category (A/C)/(B/C) (or (C\A)/(C\B) if used disharmonically) from a category A/B. The effect of such a rule is that a functor "inherits" the arguments of its argument. Us-

[1] See Bresnan et al. 1983 and Johnson 1988 for an account in terms of Lexical Functional grammar, Kroch and Santorini 1987 for an account in terms of Tree Adjoining Grammar, and Houtman 1984, Steedman 1985, Moortgat 1988, and Hoeksema 1991 for categorial accounts.

ing disharmonic division, one can for instance derive the verb cluster in (2) as follows:

(3)

$$\dfrac{\begin{array}{c} \textit{wil} \\ \mathrm{VP}/\mathrm{VP} \\ \Downarrow \\ (\mathrm{NP}\backslash \mathrm{VP})/(\mathrm{NP}\backslash \mathrm{VP}) \\ \Downarrow \\ (\mathrm{NP}\backslash(\mathrm{NP}\backslash \mathrm{VP}))/(\mathrm{NP}\backslash(\mathrm{NP}\backslash \mathrm{VP})) \end{array} \qquad \dfrac{\begin{array}{c} \textit{laten} \\ (\mathrm{NP}\backslash \mathrm{VP})/\mathrm{VP} \\ \Downarrow \\ (\mathrm{NP}\backslash(\mathrm{NP}\backslash \mathrm{VP}))/(\mathrm{NP}\backslash \mathrm{VP}) \end{array} \qquad \begin{array}{c} \textit{lezen} \\ \mathrm{NP}\backslash \mathrm{VP} \end{array}}{\mathrm{NP}\backslash(\mathrm{NP}\backslash \mathrm{VP})}}{\mathrm{NP}\backslash \mathrm{NP}\backslash \mathrm{VP}}$$

A problem for categorial accounts has been the fact that cross-serial word order is obligatory, that is, if the governing verb is a verb-raising verb, it must be followed by the governed verb and may not be followed by any of the non-verbal arguments of the governed VP. Sequences in which the governed verb is followed by a full or partial VP including non-verbal complements are ungrammatical:

(4)	a. *	dat	Jan	*wil*	het boek	lezen	
		that	John	wants	the book	read	
	b. *	dat	Jan	Marie	*laat*	het boek	lezen
		that	John	Mary	lets	the book	read

In a categorial grammar, such word orders are derived quite easily, however, using application instead of division or composition:

(5)

$$\ldots \quad \begin{array}{c} \textit{Jan} \\ \mathrm{NP} \end{array} \quad \dfrac{\begin{array}{c} \textit{wil} \\ \mathrm{VP}/\mathrm{VP} \end{array} \quad \dfrac{\begin{array}{c} \textit{het boek} \\ \mathrm{NP} \end{array} \quad \begin{array}{c} \textit{lezen} \\ \mathrm{NP}\backslash \mathrm{VP} \end{array}}{\mathrm{VP}}}{\mathrm{VP}}$$

To eliminate these ungrammatical derivations, it has been proposed that the verbal argument of a verb-raising verb must be "lexical". However, example (2) illustrates that under the assumption that verb clusters are right-branching, the proper requirement cannot be that the verbal argument must be a single verb. Rather, complex phrases consisting of a sequence of verbs must be allowed as arguments, whereas phrases containing one or more non-verbal complements must be excluded. As such information cannot be read off the categories of the constituents involved, this implies that the categorial formalism needs to be extended with a feature distinguishing "verbal complexes" from other verbal constituents and a method for assigning this feature to derived constituents. Although such a system can be designed (see Bouma and van Noord 1994, for instance), the result remains unsatisfactory as it requires an ad-hoc system of feature passing, which cannot be subsumed by general methods such as head-feature passing.

The problem is not restricted to CG, but surfaces in HPSG accounts as well. Hinrichs and Nakazawa 1994, for instance, use an argument-inheritance mechanism, which lets the SUBCAT-list of a modal or auxiliary be determined in part by the SUBCAT-list of its verbal complement. Essentially, this is a restatement of the categorial rule of division as a constraint on SUBCAT-lists. They account for "auxiliary-flip" in German by assuming that an auxiliary may either follow or precede a verbal complex. The latter case gives rise to "flipped" word order (note that this order is the standard situation in Dutch). To avoid spurious ambiguity and ungrammatical word orders, they must introduce a feature NPCOMP, distinguishing phrases containing NP-complements from phrases not containing such complements. That is, as in categorial accounts, NPCOMP must distinguish between verb clusters and other verbal constituents. The percolation of NPCOMP does not follow from general principles of feature-percolation, but instead is stipulated in the relevant rule schemata.[2]

In this paper, we argue that the problem of characterizing verb clusters can be avoided if one assumes that clause-final verb sequences do not constitute a constituent.

1.3 Problems with Partial VPs

While early transformational accounts of the Dutch cross-serial dependency construction assumed that the clause-initial complements of the verbs present in the verb-cluster are sisters (after a "pruning" transformation had eliminated VP-nodes whose head had been V-raised to a clause-final position (Evers 1975)), non-transformational accounts have assumed that the initial part of the clause, preceding the verb cluster, has considerable internal structure. However, there is little theory-independent motivation for postulating the existence of several verbal projections dominating the non-verbal arguments in the clause.

For German, it has been argued that the phenomenon of "partial fronting" (6) requires the existence of partial (or "contoured") VP's in the "Mittelfeld".

(6) a. *Das Buch* *lesen* wird er schon können
the book read will he already can
He'll surely be able to read the book
b. *lesen können* wird er das Buch schon
c. er wird das Buch schon lesen können

Given the un-controversial assumption that the fronted material in (6a,b) is a constituent, it seems at first sight that at least two different ways of

[2]In Rentier 1994, the analysis of Hinrichs and Nakazawa 1994 is used to account for Dutch cross-serial dependencies. The feature NPCOMP is replaced by LEX, whose distribution is again governed by the same rule-specific stipulations.

analyzing (6c) must exist, even-though it is semantically unambiguous. Accounts of partial VP-fronting using contoured VP's (Nerbonne 1986, Johnson 1986) have indeed made this assumption. The disadvantage of such an analysis is not only that it introduces spurious ambiguity, but also that it makes crucial use of this fact to account for the data.

An interesting alternative is provided in Nerbonne 1994, who argues that the fact that partial VP's can be fronted not necessarily implies that such constituents exist within the "Mittelfeld". His analysis assumes that the normal clause structure contains a "flat" VP and that partial VP's can only be derived in fronted position. This eliminates the spurious ambiguity problem and furthermore has the advantage that one does not have to motivate the existence of partial VP's in the Mittelfeld.

1.4 An alternative analysis

Postulating a verb-complex requires ad-hoc methods for characterizing what distinguishes a verb-complex from other verbal projections. Postulating partial VP's to account for partial fronting of VP's introduces the spurious ambiguity problem. The alternative we propose below assumes that the constituent structure for the cross-serial dependency construction does not contain a verb-cluster and does not contain partial VP's. Instead, all verbs and all non-verbal complements are directly dominated by S. We demonstrate that this not only accounts for cross-serial word order, but also that it is compatible with the analysis of a number of constructions that appear to be problematic for a flat analysis.

Note that the "flat" analysis that we propose is different from analyses based on sequence union (Reape 1990, Reape 1994) or similar non-concatenative operations (Kathol 1995). In those analyses only the derived structure is flat. In contrast, our analysis assumes that both the derived structure and the derivation structure is flat.

After briefly introducing our version of HPSG in the next section, we present the basic rule of the grammar in section 3 and demonstrate how it accounts for cross-serial word order. In section 4 we discuss two constructions in Dutch involving partial VP's. In section 5, we give an account of anaphoric binding that is largely independent of clause structure. In section 6, we demonstrate how verb-sequences with inverted word order and verb-sequences containing particles can be accounted for.

2 Preliminaries

The version of HPSG that will be used throughout this paper is introduced in this section.

2.1 Features and types

For expository purposes the feature declarations that we will assume will be somewhat simpler than for example found in the HPSG book (Pollard and Sag 1994). Signs will generally contain the following attributes, given here with their types:

$$(7)\quad {}_{sign}\begin{bmatrix} \text{HEAD} & \mathit{noun} \vee \mathit{verb} \vee \ldots \\ \text{SUBCAT} & \mathit{list\_of\_sign} \\ \text{ARG-S} & \mathit{list\_of\_sign} \\ \text{DIR} & \mathit{left} \vee \mathit{right} \\ \text{SLASH\_INHER} & \mathit{list\_of\_sign} \\ \text{SLASH\_TOBIND} & \mathit{list\_of\_sign} \\ \text{PFX} & \mathit{boolean} \end{bmatrix}$$

The type *sign* has two subtypes, *word* and *phrase*. The type of the feature HEAD encodes the syntactic category of the sign. For type *verb*, the feature VFORM (which can have values such *inf, fin* or *prt*) is appropriate. For type *noun*, the feature CASE (with values such as *nom* or *acc*) is appropriate. The feature SUBCAT encodes the syntactic valence information of the sign. Following recent work in HPSG we assume that the feature ARG-S encodes the argument structure. This is the level at which e.g. binding theory applies, and where control relations are established. This feature will be motivated in section 5. The feature DIR encodes the direction in which a head selects its argument (cf. section 3.3). The features SLASH_INHER, SLASH_TOBIND are used in the analysis of non-local dependencies. The type *sign* itself has two subtypes, *word* and *phrase*. In section 6 we introduce the features VR (which is appropriate for verbs) and PFX (which is appropriate for signs).

We use the following abbreviations. NP will be used for a nominal sign with an empty subcat list. S stands for a finite verbal sign with an empty SUBCAT list. VP will be used for a verbal sign with an empty subcat list. V will be used for lexical verbal signs. Finally PVP (partial VP) will be used for anything that is verbal.

2.2 Rules

The rule schemata that will be defined in this paper are instantiations of the following general schema:

(8) $M \rightarrow L^{*}\quad H\quad R^{*}$ COMBINATION-SCHEMA

This rule states that a mother node dominates a head daughter H, with an arbitrary number of daughters to the left of H and an arbitrary number of daughters to the right of H.[3]

The following constraints are attached to this rule schema:

(9) **Head-feature principle:** The HEAD and ARG-S features of the mother node M and the head daughter H are identical.

Subcat principle: The subcategorization list of the mother node consists of the elements of the subcategorization list of the head node, minus the signs left and right of the head.

Nonlocal feature principle: The nonlocal features (SLASH_INHERITED and SLASH_TOBIND) are propagated as usual (Pollard and Sag 1994).

Directionality principle: All elements left of the head have the value *left* for the DIR feature, whereas the elements right of the head have *right*.

Note that the first three constraints are standard in HPSG. The fourth constraint will be motivated in section 3.3.

We consider the rules that will be defined in the remainder of this article as (more specific) sub-types of (8) and (9).

3 Dutch verb-raisers in HPSG

3.1 Lexical entries

We assume that Dutch modals, auxiliaries and certain raising and equi-verbs select for a list of complements that consists of a verb and the complements selected by that verb. Perception verbs, as well as the causative *laten* and the verb *helpen* (to help) select for a verb, the complements of that verb, and an object NP. Sample lexical entries are given below.

(10) a. willen (*to want*)
$$\mapsto \begin{bmatrix} \textsc{head} & verb[\mathit{inf}] \\ \textsc{subcat} & \boxed{1} \oplus \left\langle {}_{word}\begin{bmatrix} \textsc{head} & verb[\mathit{inf}] \\ \textsc{subcat} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix}$$

b. hebben (*to have*)
$$\mapsto \begin{bmatrix} \textsc{head} & verb[\mathit{inf}] \\ \textsc{subcat} & \boxed{1} \oplus \left\langle {}_{word}\begin{bmatrix} \textsc{head} & verb[\mathit{prt}] \\ \textsc{subcat} & \boxed{1} \end{bmatrix} \right\rangle \end{bmatrix}$$

[3] We disallow the use of this rule if both L and R are both instantiated as the empty list. Thus, there is no place for unary rules in our grammar.

$$\text{c.}\quad \begin{matrix}\text{laten}\\ (\textit{to let})\end{matrix} \mapsto \begin{bmatrix}\text{HEAD} & verb[\mathit{inf}] \\ \text{SUBCAT} & \left\langle \text{NP}[acc] \right\rangle \oplus \boxed{1} \oplus \left\langle {}_{wd}\begin{bmatrix}\text{HEAD} & v[\mathit{inf}] \\ \text{SUBCAT} & \boxed{1}\end{bmatrix} \right\rangle\end{bmatrix}$$

We assume that finite forms are derived from a non-inflected root form by means of a lexical rule, which, among other things, prefixes a subject to the SUBCAT-list, and requires that this subject has nominative case. Thus, the finite (singular present tense) form of *willen* is:

$$\text{(11)}\quad \text{wil} \mapsto \begin{bmatrix}\text{HEAD} & verb[\mathit{fin}] \\ \text{SUBCAT} & \left\langle \text{NP}[nom] \right\rangle \oplus \boxed{1} \oplus \left\langle {}_{word}\begin{bmatrix}\text{HEAD} & verb[\mathit{inf}] \\ \text{SUBCAT} & \boxed{1}\end{bmatrix} \right\rangle\end{bmatrix}$$

3.2 The Head-complement schema

The most important innovation of our analysis is the fact that we assume that only one rule is needed to derive subordinate clauses. The rule is an instance of the head-complement-schema given in (12).

(12) HEAD-COMPLEMENT-SCHEMA

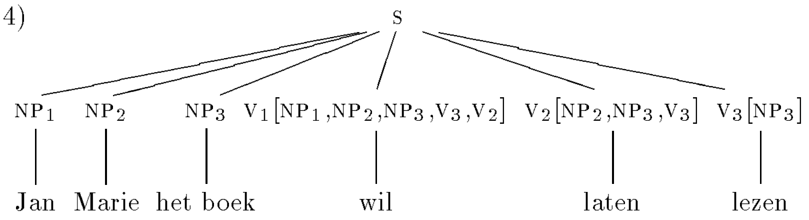
$${}_{phrase}\begin{bmatrix}\text{SUBCAT} & \boxed{1}\end{bmatrix} \rightarrow L^* \quad {}_{word}\begin{bmatrix}\text{SUBCAT} & \boxed{1} \oplus \left\langle \ldots \right\rangle\end{bmatrix} \quad R^*$$

This schema inherits from the rule schema given in (8). Therefore, the head-feature principle, subcategorization principle, nonlocal feature principle, and the directionality principle hold for this rule. The subcategorization principle together with the information in (12) implies that the non-head daughters that are selected by the head in this rule form a suffix of the SUBCAT list of the head. The remaining SUBCAT elements of the head form the subcategorization requirements of the mother node. Thus, this schema can be used to form both partial and saturated verb-phrases. In the first case only a subset of the SUBCAT elements are selected (and hence the SUBCAT list of the mother is non-empty). In the latter case all SUBCAT elements are selected (and hence the SUBCAT list of the mother is empty).

The HEAD-COMPLEMENT schema assigns a "flat" clausal structure to phrases containing a clause-final verb sequence. As an example we give a derivation for (13) in (14).

(13) (dat) Jan Marie het boek wil laten lezen
(that) Jan Marie the book wants to let to read
that Jan wants to let Marie read the book

(14)



This example can best be understood by looking at the verb *lezen* first. This ordinary transitive verb subcategorizes for an (accusative) noun phrase NP_3. The verb *laten* is a typical verb-raiser. It selects a verb, all subcat elements of this verb (in this case NP_3) and an accusative noun phrase of its own, NP_2. This verb in turn is selected by the finite modal *wil*. This modal subcategorizes for *laten*, all subcat elements of *laten* and a nominative subject NP_1. Because *wil* is the head of the rule it is the subcat list of *wil* that will effectively be used by the rule.

The HEAD-COMPLEMENT schema does not require that all complements must be selected. No "spurious ambiguity" results from this liberal formulation, as (12) requires that its head must be lexical (i.e., of type *word*), whereas the mother is non-lexical (i.e., of type *phrase*). This prevents a complex phrase licensed by (12) to be the head of another phrase licensed by (12), and thus "contoured" VP's cannot be derived.

This should be compared with analyses in which a verb cluster is assumed, such as the analysis of Hinrichs and Nakazawa 1994. As explained in the introduction, in such analyses it is difficult to account for the fact that raising is obligatory; those accounts need ad-hoc feature-passing mechanisms.

By not imposing any constraint on the length of SUBCAT of the mother in (12), we do allow unsaturated, partial, VP's. Such phrases do play a role in the discussion below.

Since we assume that subjects are part of the SUBCAT list of finite verbs, there is no need for a separate schema to combine a head with a subject.

3.3 Word-order

The directionality feature Remember that the directionality principle makes sure that arguments that are marked [DIR *left*] are selected to the left of the head, and that arguments that are marked [DIR *right*] are selected to the right of the verb. This is similar to the order feature of UCG (Zeevat et al. 1987).

Encoding word order by making reference to a separate feature has the advantage that it is possible to formulate word order constraints, while at the same time lexical entries can specify an exceptional word order. As will be explained in section 6, such exceptions do exist.

Word-order in verb raising constructions The unmarked word order in verb raising constructions is one in which the "governing" verb precedes the "governed" verb. Furthermore, (NP-) complements of a "governing" verb precede those of the "governed" verb. This gives rise to so-called "cross-serial" dependencies. These ordering constraints are implemented as follows.

The default values for DIR (for verbal heads) are *right* for verbal complements and *left* for all other complements. That is, verbal complements normally occur right of the head, whereas NP's and other non-verbal complements occur left of the head.

The value of SUBCAT is an ordered list, and thus, the order of complements on SUBCAT is significant. We assume that complements are ordered in terms of "obliqueness", with the least oblique elements occurring first on the list, and with the most oblique elements occurring last. This notion of obliqueness is important for our account of word order, since we assume that word order in Dutch is determined by the obliqueness ordering. In particular, we require that more oblique complements appear closer to the head.

In order to implement this observation we assume the following rule, which is an instantiation of the HEAD-COMPLEMENT schema (12).

(15) Rule 1

Rule 1 is an instance of the head-complement-schema such that for all left daughters l_1, l_2: l_1 precedes l_2 iff l_1 precedes l_2 on the SUBCAT list of the head. And similarly, for all right daughters of the rule r_1, r_2: r_1 precedes r_2 iff r_1 occurs after r_2 on the SUBCAT list of the head.

Note that the word-order in (14) is the only possible word-order that can be derived by this rule.

Thus, the obligatory cross-serial dependency word-order is obtained by assigning a flat structure (by the requirement that the verbal argument of a verb-raiser is *lexical*); furthermore all arguments of a head are ordered in terms of obliqueness: the more oblique elements occur closer to the head.

In section 6 we discuss a number of exceptions to the word-order generalizations given above, and we show how the analysis can be extended to treat these exceptions. In Bouma and van Noord 1996. our analysis of word-order in verb-clustering constructions is extended and applied to German as well.

4 Partial VPs

Even though our analysis is based on a flat structure for verb phrases, partial verb-phrases can be formed without any problem. In the grammar of Dutch such partial verb-phrases are only allowed in a few environments, in particular in the partial extraposition construction (also known as "the third construction"), and in topicalization.

4.1 Extraposition and partial extraposition

4.1.1 Extraposition

Some verbs subcategorize for a saturated verbal complement (sometimes marked with the infinitival complementizer *om*), as the following examples illustrate.

(16) a. dat Jan heeft geprobeerd [(om) het boek te lezen]
that Jan has tried [(COMPL) the book to read]
that Jan has tried to read the book

b. dat Jan Piet heeft gedwongen [(om) het boek te lezen]
that Jan Piet has forced [(COMPL) the book to read]
that Jan has forced Piet to read the book

It is not entirely clear whether we should analyse such examples as involving extraposition (the standard transformational point of view), or rather as straightforward selection to the right (Hoeksema 1991). Here we will assume that such verbal constituents to the right of the verb-cluster are simply analysed as arguments that need to be selected to the right, using the feature DIR introduced earlier.

Verbs that only allow extraposition of saturated verb-phrases (such as the verbs *beloven* (to promise) en *dreigen* (to threaten) in their non-modal reading) will not inherit the arguments of their verbal argument, but simply require that the verbal argument is saturated:

$$(17)\quad \text{beloven} \mapsto \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \left\langle \text{NP}[\textit{acc}], \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{te} \vee \textit{om}] \\ \text{SUBCAT} & \langle\rangle \\ \text{DIR} & \textit{right} \end{bmatrix} \right\rangle \end{bmatrix}$$

The word *om* is analysed as a verbal element (with VFORM *om*) that subcategorizes for a saturated verb-phrase with VFORM *te*:

$$(18)\quad \text{om} \mapsto \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{om}] \\ \text{SUBCAT} & \left\langle \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{te}] \\ \text{SUBCAT} & \langle\rangle \\ \text{DIR} & \textit{right} \end{bmatrix} \right\rangle \end{bmatrix}$$

The disjunctive specification of the VFORM feature of the verbal argument thus accounts for the optionality of *om*. Verbs which do subcategorize for a VP, but do not allow this complement to be headed by *om* (such as *menen* (*to believe/suppose*)), simply select a complement whose head is *verb*[*te*].

The main difference between extraposition and raising constructions is that extraposition verbs require that their verbal argument is saturated. A verb raiser, on the other hand, requires that its verbal argument is lexical—and inherits the arguments of this verbal argument.

Another difference between the verb raising construction and the extraposition construction is the *infinitivus pro participio* (IPP) effect. The verb *hebben* ordinarily requires that its verbal argument is headed by a participle. However, if this verbal argument is a verb-raiser then an infinitive is required:

(19) a.	dat	Jan	de vrouwen	heeft	zien	slapen
	that	Jan	the women	has	see (INF)	sleep
	that Jan saw the women sleep					
b. *	dat	Jan	de vrouwen	heeft	gezien	slapen
	that	Jan	the women	has	seen (PRT)	sleep
	that Jan saw the women sleep					

The IPP effect can be used to distinguish between the verb-raising and the extraposition construction.

(20) a.	dat	Jan	Piet	heeft	zien	slapen
	that	Jan	Piet	has	see (INF)	sleep
	that Jan saw Piet sleep					
b.	dat	Jan	Piet	heeft	gedwongen	te slapen
	that	Jan	Piet	has	forced (PRT)	to sleep
	that Jan forced Piet to sleep					

4.1.2 Partial Extraposition

The interesting thing about extraposition in relation with verb clusters is the occurrence of partial verb-phrases that seem to mix the properties of ordinary extraposition on the one hand and verb-raising on the other hand (den Besten and Rutten 1989). Thus we get sentences such as:

(21) a.	dat	Jan	*de trainer van zijn gelijk*	heeft	gemeend	*te overtuigen*
	that	John	the trainer of his right	has	believed	to convince
	that John has believed to convince the trainer that he was right					

b. dat Jan heeft gemeend *de trainer van zijn gelijk te overtuigen*

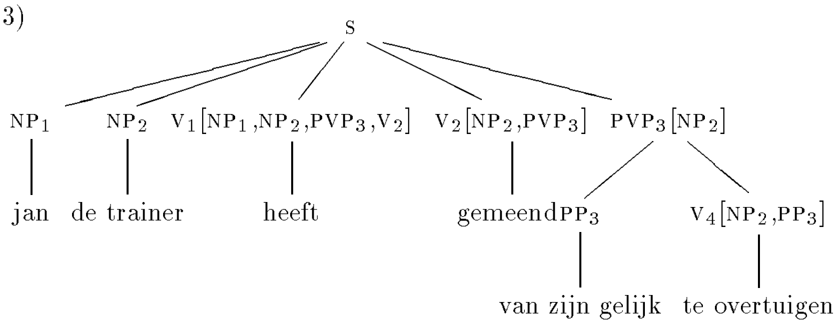
c. dat Jan *de trainer* heeft gemeend *van zijn gelijk te overtuigen*

Verbs that allow partial extraposition mix properties of ordinary extraposition verbs with the properties of raising verbs. On the one hand, partial extraposition verbs also inherit the remaining arguments on the SUBCAT list of a verbal argument that is selected to the right. But unlike raising verbs this argument need not be lexical. Furthermore the VFORM *om* (cf. below) is never allowed in case arguments are inherited. Finally the IPP effect does not occur in partial extraposition constructions.

In our analysis partial extraposition verbs do not specify a lexicality requirement on their verbal argument. Furthermore, unexpressed elements from the SUBCAT list are inherited by the head. Thus partial extraposition verbs are similar to verb-raising verbs in the sense that they inherit subcategorization information from their verbal argument. For example, the participle *gemeend* will have the lexical specification given in (22). The derivation for (21c) is given in (23).

(22) gemeend $\mapsto \begin{bmatrix} \text{HEAD} & verb[prt] \\ \text{SUBCAT} & \boxed{1} \oplus \left\langle {}_{sign}\begin{bmatrix} \text{HEAD} & verb[te] \\ \text{SUBCAT} & \boxed{1} \\ \text{DIR} & right \end{bmatrix} \right\rangle \end{bmatrix}$

(23)



Our analysis correctly predicts that *om* can never occur with partial extraposition. As indicated above, the complementizer *om* only combines with a saturated verb-phrase:

(24) a. dat Jan de vrouwen heeft geprobeerd te kussen
that Jan de vrouwen has try to kiss
that John has tried to kiss the women

b. * dat Jan de vrouwen heeft geprobeerd om te kussen

c. dat Jan heeft geprobeerd om de vrouwen te kussen

Note that the following sentence is ungrammatical:

(25) * dat Jan *van zijn gelijk* heeft gemeend *de trainer te overtuigen*

The contrast between this sentence and (21c) is explained by our assumption that only a suffix of the subcategorization elements can be selected by Rule 1 (12). Thus the VP *de trainer te overtuigen* cannot be built (with the relevant reading of *overtuigen*).

A difference between partial extraposition and verb-raising is the IPP effect: this effect only occurs with verb-raising constructions but not in (partial) extraposition constructions. There is a class of verbs (including *proberen* (to try)) that allow both verb-raising and (partial) extraposition. Our analysis predicts that these verbs can occur both in their infinitival form and in their participle form, when they are selected by the auxiliary *hebben*. This prediction is correct:

(26) a. dat Jan de vrouwen heeft proberen te kussen
that Jan the women has try (INF) to kiss
that John has tried to kiss the women

b. dat Jan de vrouwen heeft geprobeerd te kussen
that Jan the women has tried (PRT) to kiss
that John has tried to kiss the women

c. * dat Jan heeft proberen de vrouwen te kussen
that Jan has try (INF) the women to kiss
that John has tried to kiss the women

d. dat Jan heeft geprobeerd de vrouwen te kussen
that Jan has tried (PRT) the women to kiss
that Jan has tried to kiss the women

The first example is the verb-raising variant of *probeer*, the second example is the partial extraposition variant of *probeer* in which the extraposed argument happens to be lexical too. The third example shows that verb-raising is obligatory if the IPP effect is present. The subcategorization requirements of *hebben* are discussed in section 6.

4.2 Partial VP fronting

There is another set of examples in which partial VP's occur. Examples of Dutch partial VP topicalization are (sometimes only marginally) acceptable:

(27) a. [$_{pvp}$ bezocht] heeft Jan dat congres nog nooit
visited has Jan that conference not yet
Jan hasn't visited that conference yet

b. [$_{pvp}$ bezoeken] zou Jan dat congres niet willen
to visit would Jan that conference not want
Jan wouldn't want to visit that conference

c. [$_{pvp}$ willen bezoeken] heeft Jan dat congres nooit
want to visit has Jan that conference never
Jan has never wanted to visit that conference

Our analysis of such partial VP topicalizations is based on the analysis of Nerbonne 1994 for German, but improves upon that analysis because we do not need a special rule to build partial verb-phrases in topic position.

Following Nerbonne's analysis, we assume a lexical complement extraction rule for verbs, which moves a complement from SUBCAT to SLASH. The rule differs from the standard complement extraction rule in that the extracted complement and the element added on SLASH only structure-share the value of their features (HEAD and SUBCAT in particular):

(28)
$$\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \boxed{1} \oplus \left\langle {}_{\textit{sign}}\begin{bmatrix} \text{HEAD} & \boxed{3} \\ \text{SUBCAT} & \boxed{4} \end{bmatrix} \right\rangle \oplus \boxed{2} \\ \text{SLASH\_INHER} & \boxed{5} \end{bmatrix}$$
$$\Downarrow$$
$$\begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{SUBCAT} & \boxed{1} \oplus \boxed{2} \\ \text{SLASH\_INHER} & \left\langle {}_{\textit{sign}}\begin{bmatrix} \text{HEAD} & \boxed{3} \\ \text{SUBCAT} & \boxed{4} \end{bmatrix} \right\rangle \oplus \boxed{5} \end{bmatrix}$$

Thus, if a verb subcategorizes for a complement of type *word*, this requirement will not be present once the element has been moved to SLASH_INHER. Consequently, a verb-raiser which ordinarily requires that its argument is lexical (i.e., of type *word*) may allow for a non-lexical verbal projection (of type *phrase*) in topic position. Everything else remains the same: as before, unexpressed SUBCAT elements are inherited by the verb-raiser.

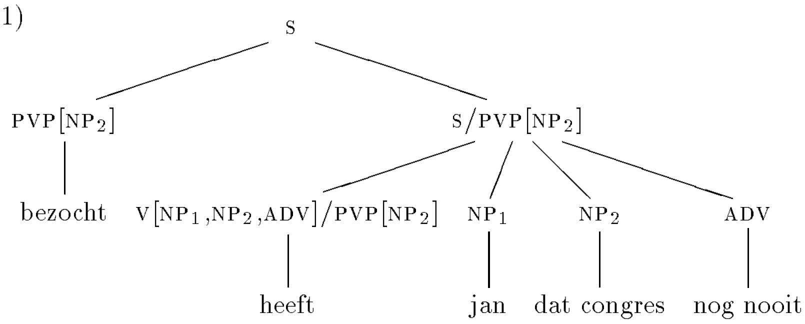
Apart from this lexical rule Nerbonne 1994 needs a special mechanism to construct partial VP's. In order to prevent spurious ambiguities (of the kind discussed in Pollard 1990) this rule is supposed to build such VP's only in topic position. For this reason the binary feature FOCUS is introduced. In the current analysis this gymnastics is not needed at all: our Rule 1 introduced in (12) also creates partial VP's. On the other hand, we do not get spurious ambiguities because of the lexicality specifications on the head and the mother of Rule 1. Consider for example the relevant lexical specification of the verb *heeft* in (27a) (leaving the adjunct out of the discussion — for an analysis of adjuncts that is compatible with the analysis given here, see van Noord and Bouma 1994). This specification (30) is output of the lexical rule given above and is produced on the basis of (29).

(29) heeft $\mapsto$
$$\begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{fin}] \\ \text{SUBCAT} & \left\langle \boxed{1}\ \text{NP}[\textit{nom}] \right\rangle \oplus \boxed{3} \oplus \left\langle {}_{\textit{word}}\begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{prt}] \\ \text{SUBCAT} & \boxed{3} \end{bmatrix} \right\rangle \\ \text{SLASH\_INHER} & \langle\rangle \end{bmatrix}$$

(30) heeft $\mapsto \begin{bmatrix} \text{HEAD} & verb[fin] \\ \text{SUBCAT} & \left\langle \boxed{1}\ \text{NP}[nom] \right\rangle \oplus \boxed{3} \\ \text{SLASH\_INHER} & \left\langle {}_{sign}\begin{bmatrix}\text{HEAD} & verb[prt] \\ \text{SUBCAT} & \boxed{3}\end{bmatrix} \right\rangle \end{bmatrix}$

The derivation of (27a) is illustrated in (31). It is assumed here that verb-fronting is analysed by a rule that is also an instance of the head-complement-schema (12), in which word-order is the same as in rule 1 except that the finite verb precedes everything else. Furthermore the topic is selected by a filler-gap rule of the kind that is standard in HPSG.

(31)



This section illustrated how the "flat" analysis is compatible with the occurrence of partial VP's. We have shown that the fact that partial VP's can be topicalized and extraposed need not imply that such partial VP's occur in the verb-cluster. Furthermore such partial VP's do not need to give rise to the spurious ambiguities of Pollard 1990, and neither require the *ad-hoc* rule of Nerbonne 1994.

5 Verb Clusters and Binding

The HPSG treatment of binding in Pollard and Sag 1994 uses the notion o-command. This notion is defined in terms of the SUBCAT list. In this section we show that the subcategorization lists that surface in inheritance-based accounts are not the appropriate structures for the binding theory. We present an alternative account of binding to account for Dutch binding phenomena in verb raising constructions, on the basis of the feature ARG-S introduced by Iida et al. 1994.

5.1 Binding Constraints

The binding constraints we assume are essentially those found in chapter 6.4 of Pollard and Sag 1994:

(32) **principle A.** A locally o-commanded anaphor must be locally o-bound.
principle B. A personal pronoun must be locally o-free.
principle C. A non-pronoun must be o-free.

In Pollard and Sag 1994 the notion o-command is defined in terms of the SUBCAT list: a referential sign X locally o-commands Y iff X precedes Y on SUBCAT. The general notion o-command then holds between X and Y iff X locally o-commands a Z, and Z dominates Y.

The fact that arguments can be shared in SUBCAT lists raises the question how we should interpret the principles of binding. For example, principle B can be understood at least in two ways:

- A personal pronoun must be locally o-free *in all* SUBCAT *lists it is a member of*
- A personal pronoun must be locally o-free *in at least one* SUBCAT *list it is a member of*

We show that if the binding constraints are defined with respect to SUBCAT lists then both interpretations give rise to problems. As an alternative we will then use the feature ARG-S introduced in Iida et al. 1994 to account for the binding data from Dutch.

5.2 Some linguistic data

It is typically assumed (Model 1991) that verb-cluster constructions do not witness clause-union effects as far as binding phenomena are concerned. This should imply that sentences of the kind *dat* NP NP NP *ziet wassen* witness the same binding facts as sentences of the kind *dat* NP *ziet dat* NP NP *wast*, where *ziet* (sees) is a verb-raiser and *wassen/wast* (to wash/washes) is an ordinary transitive verb. This is not true. Consider the following examples:[4]

(33) a. dat Jan Piet$_i$ zichzelf$_i$ ziet wassen
that Jan Piet$_i$ himself$_i$ sees wash
that Jan sees Piet$_i$ wash himself$_i$

b. * dat Jan Piet$_i$ hem$_i$ ziet wassen
that Jan Piet$_i$ him$_i$ sees wash
that Jan sees Piet$_i$ wash him$_i$

c. * dat Jan$_i$ Piet zichzelf$_i$ ziet wassen
that Jan$_i$ sees Piet wash himself$_i$

[4]Note that we will not discuss the Dutch reflexive *zich* which has some peculiar properties. The current analysis (Bredenkamp 1994, Koster 1986) of this reflexive assumes that it needs to be bound by the subject of the minimal finite domain. Given that verb-clusters at best introduce non-finite domains the distribution of *zich* does not shed any new light on the structure of verb-cluster constructions.

d. dat Jan$_i$ Piet hem$_i$ ziet wassen
that Jan$_i$ sees Piet wash him$_i$

e. * dat Jan zichzelf$_i$ Piet$_i$ ziet wassen
that Jan sees himself$_i$ wash Piet$_i$

f. * dat Jan hem$_i$ Piet$_i$ ziet wassen
that Jan sees him$_i$ wash Piet$_i$

g. dat Jan$_i$ zichzelf$_i$ Piet ziet wassen
that Jan$_i$ sees himself$_i$ wash Piet

h. * dat Jan$_i$ hem$_i$ Piet ziet wassen
that Jan$_i$ sees him$_i$ wash Piet

In these examples, the impossibility of (33h) illustrates a clause-union effect:

(34) dat Jan$_i$ ziet dat hij$_i$ Piet wast
that Jan$_i$ sees that he$_i$ Piet washes
that Jan$_i$ sees that he$_i$ washes Piet

Let us attempt to analyse the sentences above solely in terms of SUBCAT. Since we are assuming that non-finite verbs do not contain a subject on their SUBCAT list, such an account is utterly impossible. However, we will illustrate that problems remain, even if we tentatively assume that subjects are present on the subcat list of non-finite verbs.

In (33a-d) there are two relevant SUBCAT lists: the matrix one essentially is a list containing three noun phrases, the most oblique one being the anaphor: ⟨*Jan,Piet,pro*⟩; and the embedded one which is similar except that the (matrix) subject is not there: ⟨*Piet, pro*⟩.

(33a) is predicted to be grammatical: principle A is satisfied (in both lists). (33b) is ruled out, because principle B is violated (in both lists). In order to properly rule out (33c) we must assume that principle A holds universally because only in the embedded SUBCAT list principle A is violated. In (33d) we must assume that principle B applies in an existential way: in the embedded SUBCAT list the pronoun is locally free.

In (33e-h) the two SUBCAT lists are ⟨*Jan,pro,Piet*⟩ and ⟨*pro,Piet*⟩, respectively. (33e) and (33f) are ungrammatical (principle C violation). (33g) is allowed in both a universal and existential interpretation of the binding constraints. Finally (33h) can only be ruled out under a universal interpretation of principle B.

Thus we have constructed a paradox concerning principle B. (33d) requires an existential interpretation of principle B, but (33h) requires a universal interpretation. Note that principle A requires a universal interpretation.

5.3 Binding constraints on ARG-S

The previous examples indicate that binding constraints cannot be expressed in terms of SUBCAT, if the grammar makes use of argument inheritance. As an alternative account we use the feature ARG-S ("argument-structure") Iida et al. 1994, Manning and Sag 1995.

The feature ARG-S will be the focus of control and binding. Typically the value of ARG-S is a list of syntactic dependents, ordered with the least oblique element (often the subject) left.

Note that in our analysis only finite verbs contain a subject on the SUBCAT list. This is in line with our assumption that control relations are established on the value of ARG-S. In (35) the verb *kussen* has a SUBCAT list only containing its accusative object. The verb *probeert* has a SUBCAT list containing a VP and its nominative subject. Hence control cannot be established on SUBCAT.

(35)	dat	Jan	probeert	om	Marie	te kussen
	that	Jan	tries	COMPL	Marie	to kiss
	that Jan tries to kiss Marie					

The value of ARG-S can be used, as can be seen from the lexical specifications of the two verbs:

(36) a. kussen $\mapsto \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{inf}] \\ \text{SUBCAT} & \left\langle \boxed{1} \right\rangle \\ \text{ARG-S} & \left\langle \text{NP}, \boxed{1}\ \text{NP} \right\rangle \end{bmatrix}$

b. probeert $\mapsto \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{fin}] \\ \text{SUBCAT} & \left\langle \boxed{1}\ \text{NP}[\textit{nom}],\ \boxed{2}\ \text{VP}[\textit{om}] \right\rangle \\ \text{ARG-S} & \left\langle \boxed{1}, \boxed{2} \right\rangle \end{bmatrix}$

Control theory should establish that the index of the nominative subject of *proberen* is structure-shared with the first element on the ARG-S list of its VP-complement.

Note that the value of ARG-S of verbs generally must contain a subject. Even subject-raising verbs have to contain a subject on ARG-S because otherwise control relations cannot be established in examples such as:

(37)	dat	Jan	belooft	om	Marie	te zullen	kussen
	that	Jan	promises	COMPL	Marie	to will	to kiss
	that Jan promises that he will kiss Marie						

Here the subject-raiser *zullen* has a subject on its ARG-S even though it does not assign a semantic role to that noun-phrase.

We can then define o-command in terms of the structure of ARG-S; i.e., a referential sign X locally o-commands Y iff X precedes Y on ARG-S. The general notion o-command then holds between X and Y iff X locally o-commands a Z, and Z dominates Y.[5]

Let us now return to the examples (33). As we will explain below it is necessary to assume a subject-to-object raising analysis for the ARG-S value of verbs such as *zien*. The value of ARG-S of the verb *ziet* is therefore as follows for the first four examples of (33).

$$(38)\quad \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{ARG-S} & \left\langle \text{NP}_{jan}\ ,\ \boxed{1}\ \text{NP}_{piet}\ ,\ \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{ARG-S} & \left\langle \boxed{1}\ ,\ \text{NP}_{pro} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

The embedded ARG-S value is in these cases the relevant binding domain both for principle A as for principle B. (33a) is well-formed because the reflexive is locally bound. (33b) is ruled-out because the pronominal is not locally free. In (33c) the reflexive is locally o-commanded but not locally bound, hence (33c) is ruled out. (33d) is fine because the pronominal is not locally bound.

If the anaphor is the raised object (33e-h) then the ARG-S of the verb *ziet* will be:

$$(39)\quad \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{ARG-S} & \left\langle \text{NP}_{jan}\ ,\ \boxed{1}\ \text{NP}_{pro}\ ,\ \begin{bmatrix} \text{HEAD} & \textit{verb} \\ \text{ARG-S} & \left\langle \boxed{1}\ ,\ \text{NP}_{piet} \right\rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

(33e-f) are ruled out because the nonpronoun *Piet* is not o-free. The remaining two examples are more interesting, and form the motivation for the raising-to-object structure of the value of ARG-S. Given such an analysis, the reflexive in (33g) is not o-commanded in the embedded ARG-S structure, hence it need not be o-bound there. It is locally o-commanded in the topmost ARG-S structure, and it indeed is o-bound there. In (33h) the pronominal is not locally free in the topmost ARG-S structure. Note that the structure of ARG-S is similar to the functional structures advocated in LFG for English raising-to-object verbs, cf. for example Dalrymple 1993.

However, note that we now still have to face the question whether the binding constraints are interpreted existentially or universally, because on ARG-S we also have (a limited form of) structure-sharing. We argue (against Iida et al. 1994) for the universal interpretation. The universal interpretation seems to be the formally most attractive assumption because it allows for a "local" check (binding constraints can be implemented as constraints

[5]For the moment we will assume that "dominates" is defined in terms of the ARG-S feature rather than the DTRS feature.

on argument structures). In the existential interpretation this can only be done in relation with global information of all other argument structures that a pronoun might appear in.

The universal interpretation is also forced by sentence (33h). This sentence should be ruled out. Note though that the pronominal occurs both in the argument structure of the matrix verb and in the argument structure of the embedded verb. The sentence is ruled out in the universal interpretation, because the pronoun is not free in the argument structure of the matrix verb. The existential interpretation, on the other hand, predicts that the sentence is well-formed, because the pronoun is free in the argument structure of the embedded verb.

The universal interpretation is also neccessary in order to rule out anaphors in the subject-to-object-raising position that don't find an antencedent:

(40) * dat Jan$_i$ zichzelf$_j$ Piet$_k$ ziet wassen
that Jan$_i$ himself$_j$ Piet$_k$ sees to wash
that Jan$_i$ sees himself$_j$ wash Piet$_k$

In an existential interpretation this sentence would be accepted because the anaphor is not o-commanded in the embedded ARG-S hence principle A is satisfied in the embedded ARG-S.

If we follow the suggestion in Pollard and Sag 1994, chapter 6.8.3 that local o-command should include subjects of embedded (infinite) VP's then we could adopt an analysis for raising-to-object verbs in which there is no structure-sharing on ARG-S. This would complicate the definition of (local) o-command, but it would avoid the choice between the existential and universal interpretation of binding constraints.

It is interesting to compare the current analysis to the LFG analysis of Dalrymple 1993. As indicated above the functional structures she assumes are similar to our ARG-S. Anaphors and pronouns lexically constrain the (functional) environment in which they are allowed to occur. In such an approach it is quite natural to assume that constraints that are expressed in a positive way ("my environment should contain ...") need only be satisfied once. On the other hand, constraints that are expressed in a negative way ("my environment should not contain ...") will get a kind of universal interpretation. Dalrymple's analysis predicts the set of facts given above. However, in order to be able to give such a lexical account of binding she needs a special type of functional uncertainty ("inside-out functional uncertainty"). Even if functional uncertainty were added to the formal machinery of HPSG it would be unclear how the "inside-out" type of functional uncertainty could be expressed in HPSG (Bredenkamp 1994).

6 Word Order Variation in the Verb Sequence

The standard word order for clauses containing one or more verb-raising verbs is the one that gives rise to a pattern of strictly cross-serial dependencies. There are at least two important exceptions to this pattern, however. With a governing modal or auxiliary, word orders in which the governed verb precedes the governor are possible. Second, verbs selecting a "separable verb prefix" give rise to word orders in which the prefix may occur in a number of positions within the clause-final verb sequence. An account of these constructions is given below.

6.1 Inversion

Modals do allow the head of their infinitival complement to occur either right or left of the head:

(41) a. dat Jan het boek *wil* lezen
that John the book wants read
that John wants to read the book

b. dat Jan het boek lezen *wil*

Example (41a) illustrates normal word order, while (41b) illustrates the construction in which the governed infinitive occurs right of the head. Word orders in which the head of a verbal complement precedes its governor are usually referred to as instances of "inversion".

At first blush, we can account for inversions by simply allowing a modal verb to select for its verbal complement either to the right or to the left (that is, the DIR feature is left uninstantiated). We need to impose additional constraints on the [DIR *left*] option, however, as the possibility of inversion is not always available.

First of all, it is restricted to *finite* modal governors:

(42) a. dat Jan het boek zou *moeten* lezen
that John the book would(FIN) must(INF) read
that John should read the book

b. * dat Jan het boek zou lezen *moeten*

c. * dat Jan het boek lezen zou *moeten*

Second, inversion is possible only if the governed verb is not itself a verb-raiser. This is illustrated for modals, perception verbs, and auxiliaries, in the examples below. Note the difference between (42b,c), in which the most deeply embedded verb occurs left of its (infinitival) governor, and (43a,b), in which governed modal occurs left of its (finite) governor.

(43) a. * dat Jan het boek moeten lezen *zou*

b. * dat Jan het boek moeten *zou* lezen

c. dat Jan Marie *kan* horen zingen
that John Mary can(FIN) hear sing
that John can hear Mary sing

d. * dat Jan Marie horen zingen *kan*
e. * dat Jan Marie horen *kan* zingen
f. dat Jan dit boek *moet* hebben gelezen
that John this book must have read
that John must have read this book
g. * dat Jan dit boek hebben gelezen *moet*
h. * dat Jan dit boek hebben *moet* gelezen

The second constraint on inversion implies that somehow a distinction between "verb raisers" and other verbs must be made. To this end, we introduce the (boolean) feature VR (comparable to the feature AUX in the grammar of English), which has a positive value only if a verb is a "verb raiser".

We can now account for modal inversion by adding the following type of lexical entry for finite modals:

$$\text{(44)}\quad \text{wil} \mapsto \begin{bmatrix} \text{HEAD} & verb[fin] \\ \text{SUBCAT} & \left\langle \boxed{1}\ \text{NP}[nom] \right\rangle \oplus \boxed{2} \oplus \left\langle \boxed{3} {}_{word}\begin{bmatrix} \text{HEAD} & verb[inf,\text{-}vr] \\ \text{SUBCAT} & \boxed{2} \\ \text{DIR} & left \end{bmatrix} \right\rangle \\ \text{ARG-S} & \left\langle \boxed{1}\ ,\ \boxed{3} \right\rangle \end{bmatrix}$$

One can either consider the lexical entry in (44) as stipulated, or else, if these finite forms are derived by means of a lexical rule from an un-inflected root (as are the regular finite forms), one can attach a constraint to the lexical entries of modal roots. The constraint is a disjunction, saying that the last element on SUBCAT is [DIR *right*], or else the last element is [DIR *left*,-VR] and the sign itself is [VFORM *fin*].

Auxiliaries allow for the same type of inversion as modals, that is, the participle of an auxiliary may often occur either to the right or to the left of the auxiliary.

(45) a. dat Jan het boek heeft gelezen
that John the book has read
that John has read the book
b. dat Jan het boek gelezen heeft

Auxiliaries differ from modals, however, in that the possibility of inversion exists with non-finite auxiliaries as well:

(46) a. dat Jan het boek moet hebben gelezen
that John the book must have read
that John must have read the book
b. dat Jan het boek gelezen moet hebben

c. ?* dat Jan het boek moet gelezen hebben

Note that in these complex inversion cases, the participle has to occur as the first element of the verb sequence, and (normally) cannot occur left-adjacent to the governing auxiliary, as in (46c).[6]

Auxiliaries are like modals, in that inversion is excluded if the governed verb is a verb-raiser:

(47) a. dat Jan Marie heeft horen zingen
that John Mary has(FIN) hear(INF) sing
that John has heard Mary sing

b. * dat Jan Marie horen zingen heeft

c. * dat Jan Marie horen heeft zingen

d. dat Jan dit boek heeft moeten lezen
that John this book has(FIN) must(INF) read
that John has had to read this book

e. * dat Jan dit boek moeten lezen heeft

f. * dat Jan dit boek moeten heeft lezen

Note that the (47) illustrates IPP (*infinitivus pro participio*, see also section 4), i.e., the governed verb-raiser appears not as a participle but in its infinitival form.

We can account for inversion with a governing auxiliary as follows. First of all, we account for the IPP-effect by simply stipulating two different entries for *hebben*, one selecting -VR participles, and one selecting +VR infinitives. As inversion is possible for governed participles, but not for governed infinitives, the DIR-value of the last argument can remain unspecified in the first entry, but must be *right* for the second:

(48) a. $$\text{hebben}_1 \mapsto \begin{bmatrix} \text{HEAD} & verb[inf] \\ \text{SUBCAT} & \boxed{1} \oplus \left\langle \boxed{2}\,{}_{word}\!\begin{bmatrix} \text{HEAD} & verb[prt,\ \text{-}vr] \\ \text{SUBCAT} & \boxed{1} \end{bmatrix} \right\rangle \\ \text{ARG-S} & \langle \text{NP}, \boxed{2} \rangle \end{bmatrix}$$

b. $$\text{hebben}_2 \mapsto \begin{bmatrix} \text{HEAD} & verb[inf] \\ \text{SUBCAT} & \boxed{1} \oplus \left\langle \boxed{2}\,{}_{word}\!\begin{bmatrix} \text{HEAD} & verb[inf,\ +vr] \\ \text{SUBCAT} & \boxed{1} \\ \text{DIR} & \text{RIGHT} \end{bmatrix} \right\rangle \\ \text{ARG-S} & \langle \text{NP}, \boxed{2} \rangle \end{bmatrix}$$

[6] Some speakers accept the word order in (46c) . We come back to this issue at the end of section 6.2.

The possibility of inversion with participles now follows if we instantiate DIR as *left* in (48a). Note that there is no need to restrict this option to finite forms only. As with modals, one might consider the possibility of merging both lexical entries into one entry, subject to a disjunctive constraint.

The interesting aspect of this analysis is that it immediately accounts for the dubious status of (46c). As, under a flat analysis, the participle (including an unspecified value for DIR) is an inherited argument of the finite verb (*moet* in (46)), the participle must occur either to the right of *moet* (in which case it must also be right of the auxiliary because of the obliqueness constraint on word order) or to its left. The possibility that *gelezen* occurs right of the modal but left of the auxiliary is ruled out. Under a binary-branching analysis of the verb-cluster, this fact appears to be much harder to account for. One might pursue the possibility of using the feature FLIP (used by Hinrichs and Nakazawa 1994 to account for German AUX-flip) to allow participles to occur left instead of right of the head. Note however, that a binary rule which allows a participle to combine with a following verbal head will also produce the dubious (46c).[7]

6.2 Separable Verb Prefixes

Certain verbs in Dutch subcategorize for a so-called "separable prefix". These particle-like elements appear as part of the verb in subordinate clauses, but appear in clause-final position if their governor heads a main clause:

(49) a. dat Jan Marie *aan*spreekt
that John Mary PRT speaks
that John speaks to Mary
b. Jan spreekt Marie aan

In complex verb-sequences, the prefix can appear not only as part of its governor, but also in positions further to the left:

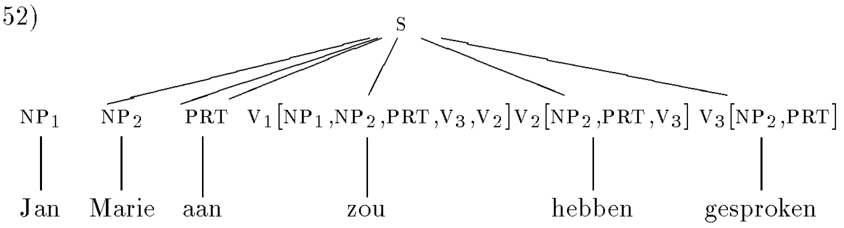
(50) a. dat Jan Marie zou hebben *aan*gesproken
that John Mary would have PRT spoken
that John would have spoken to Mary
b. dat Jan Marie zou *aan* hebben gesproken
c. dat Jan Marie *aan* zou hebben gesproken

In the analysis below, we assume that separable prefixes are selected as complements, and thus appear on the SUBCAT-list of the verbs introducing them (51). Such an analysis immediately accounts for example (50c). The phrase structure for this example is given in (52).

[7] A way out for the binary-branching analysis would be the ensure somehow that combinations of a "flipped" participle and a verbal head are not marked as verb-clusters (see Bouma and van Noord 1994).

(51) gesproken $\mapsto \begin{bmatrix} \text{HEAD} & \textit{verb}[\textit{prt}] \\ \text{SUBCAT} & \left\langle \boxed{1}\ \text{NP}, \begin{bmatrix} \text{HEAD} & \textit{particle} \\ \text{DIR} & \textit{left} \end{bmatrix} \right\rangle \\ \text{ARG-S} & \left\langle \text{NP}, \boxed{1} \right\rangle \end{bmatrix}$

(52)



Cases in which the prefix is adjacent to its governor, or placed in some intermediate position, require a different analysis. When the prefix is adjacent to its governor, it is often assumed that the prefix has been incorporated by its governor. If we believe that this suggestion is on the right track, we could introduce a new rule schema to deal with this kind of "incorporation": [8]

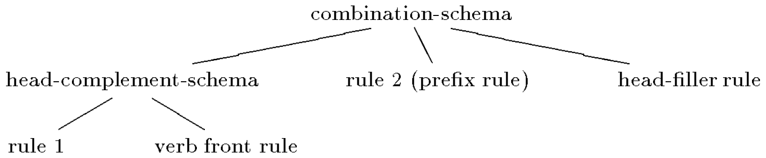
(53) Rule 2: $_{\textit{word}}\begin{bmatrix} \end{bmatrix} \rightarrow \begin{bmatrix} \text{PFX} & + \end{bmatrix}, \; _{\textit{head} \wedge \textit{word}}\begin{bmatrix} \text{HEAD} & \textit{verb}[\neg \textit{fin}] \end{bmatrix}$

Rule 2 instantiates the general rule schema presented in section 2, and thus the Head-feature, Subcategorization, Nonlocal feature, and Directionality principle apply.[9]

The rule can be used to combine a non-finite head with a prefix, and gives rise to a complex constituent that is lexical instead of phrasal. The distinction between complements that can be prefixed and other comple-

[8] For a different analysis of separable prefixes refer to Bouma and van Noord 1996.

[9] Let us take a moment to summarize the rules and rule schemata used in this paper:



The combination-schema is defined in (8) and (9). The head-complement-schema is defined in (12). Rule 1 is an instantiation of that schema, with the ordering constraint (15) added.

ments is implemented using the boolean feature PFX. The default will be that elements of SUBCAT are -PFX, but that separable prefixes are +PFX.

Rule 2 is restricted to non-finite verbs for two reasons. First of all, this restriction prevents a spurious derivation of cases such as (50c), where the prefix can be considered to be an ordinary complement. Second, we must prevent the rule from applying in main clauses (49). If Rule 2 could apply on finite verbs (which may head main clauses) the ungrammatical (54) would be derivable.

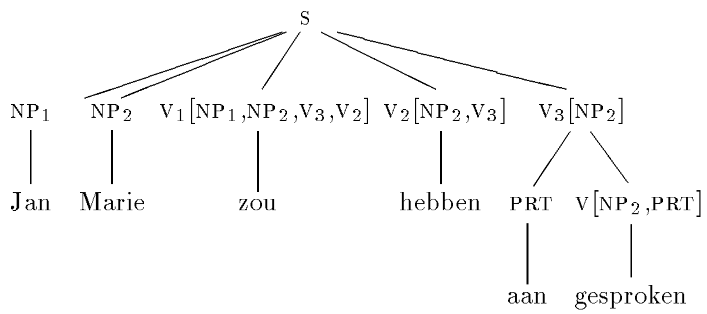
(54) *Jan *aan*spreekt Marie
John PRT speaks Mary
John speaks to Mary

The following word order constraint holds for Rule 2:

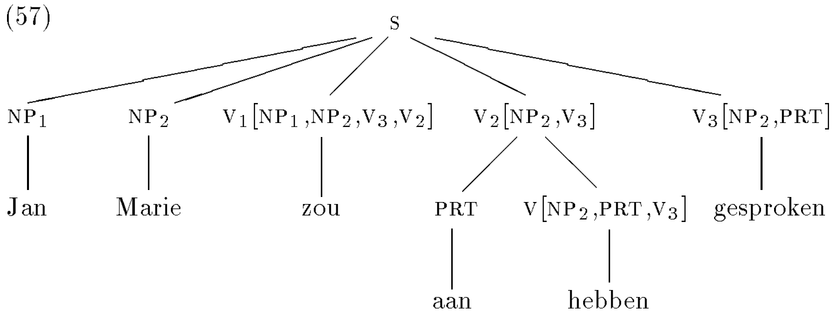
(55) The non-head daughter must be the most oblique element marked [DIR *left*] on the SUBCAT-list of the head.

This constraint not only orders prefixes left of the head, but also introduces a limited amount of ordering freedom. In particular, prefixes are not only allowed to precede the verbs that introduce them (see (56)), but are also allowed to precede governors which "inherit" the prefix as argument (57).

(56)



(57)



While the word order constraint imposed on Rule 2 allows a prefix to appear in a number of positions within the verb cluster, at the same time, an important restriction on the position of "inherited" prefixes is obeyed. The restriction is illustrated in the examples below, in which inversion applies to participles selecting a prefix:

(58) a. dat Jan Marie *aan*gesproken zou hebben
that John Mary PRT spoken would have
that John would have spoken to Mary
b. * dat Jan Marie gesproken zou aan hebben
c. * dat Jan Marie gesproken aan zou hebben

The derivation of the ungrammatical (58b) is excluded, as the prefix is not the most oblique [DIR *left*] element on SUBCAT of *hebben* (59), and thus Rule 2 cannot licence *aan hebben* as a complex lexical element. For the same reason, Rule 2 does not licence *aan zou* as a lexical element in (58c). Note also that a derivation of the latter example by means of Rule 1 is excluded, as this would imply a violation of the word order constraint for Rule 1, which says that if two complements occur left of the head, the most oblique complement should be closest to the head.

(59) hebben $\mapsto$

$$\begin{bmatrix} \text{HEAD} & verb[inf] \\ \text{SUBCAT} & \boxed{1}\left\langle \text{NP}, \begin{bmatrix}\text{HEAD} & particle \\ \text{DIR} & left\end{bmatrix}\right\rangle \oplus \left\langle \boxed{2}\,{}_{word}\!\begin{bmatrix}\text{HEAD} & verb[prt,\ \text{-}vr] \\ \text{SUBCAT} & \boxed{1} \\ \text{DIR} & left\end{bmatrix}\right\rangle \\ \text{ARG-S} & \left\langle \text{NP}, \boxed{2}\right\rangle \end{bmatrix}$$

The word order constraint on Rule 2 has deliberately been formulated to allow prefixes to precede verbs which only "inherit" this prefix. Some speakers of Dutch, however, are reluctant to accept sentences in which a prefix appears in intermediate positions in the verb cluster. Such speakers do accept examples in which the prefix is adjacent to the verb introducing it, and also examples in which the prefix appears left of the finite verb, but they do not accept the word order in(60b)

(60) a. dat Jan Marie zou hebben *aan*gesproken
that John Mary would have PRT spoken
that John would have spoken to Mary
b. ?* dat Jan Marie zou *aan* hebben gesproken
c. dat Jan Marie *aan* zou hebben gesproken

This dialect can be described by imposing a more restrictive word order constraint on Rule 2. As it stands, the word order constraint requires that the selected prefix must be the most oblique [DIR *left*] element on SUBCAT.

If the prefix is simply required to be the most oblique (i.e., the last) element on SUBCAT, Rule 2 can only apply to verbs which introduce the prefix. Remember that if a verb subcategorizes for a prefix via inheritance, the prefix can never be the last element on SUBCAT, and thus the ungrammaticality (in the restrictive dialect) of (60b) would be accounted for.

Finally, we come back to inversion with auxiliaries. Some speakers of Dutch accept not only instances of inversion with a governing auxiliary in which the governed participle occurs as the first element of the verb sequence, but also instances in which the participle occurs in intermediate positions left of the auxiliary. That is, such speakers also accept the word order in (61c).

(61) a. dat Jan het boek moet hebben gelezen
that John the book must have read
that John must have read the book
b. dat Jan het boek gelezen moet hebben
c. ?* dat Jan het boek moet gelezen hebben

As we pointed out above, a flat analysis of the verb cluster makes it easy to account for the dialect in which only (61a) and (61b) are grammatical.

In dialects in which (61c) is grammatical as well, the position of participles in inverted word orders is highly similar to that of prefixes (in the standard dialect that accepts these in intermediate positions). Our suggestion is therefore that for dialects that accept the word order in (61c), participles are marked +PFX as well.

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