Verb clusters and the scope of adjuncts in Dutch

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Abstract

In Dutch, an adjunct preceding a verb cluster can take both wide and narrow scope with respect to the matrix verb. Depending on word order, a further ambiguity arises from the fact that an adjunct may optionally take scope over quantified arguments. This paper presents a surface-oriented, lexicalist, analysis of the syntax and semantics of adjuncts which allows adjuncts to occur as sisters of complements and which uses underspecification as a means to express scopal ambiguities. The fact that the scope of adjuncts is highly sensitive to word order is accounted for by means of a semantic constraint on lexical dependency structures.

1 Introduction

The Dutch cross-serial dependency construction is characterized by the fact that complex clauses may be formed in which arguments precede verbal predicates in a non-nesting fashion. In the subordinate clause in (1), for instance, the NP *Anne* is the subject of the modal *mag*, and the NP *deze film* is the direct object of the verb *zien*.

(1) dat Anne *deze film* mag *zien*
that Anne this movie may see
that Anne is allowed to see this movie

The classic transformational analysis of this construction was given in Seuren (1972) and Evers (1975). An underlying structure was proposed in which *deze film zien* would be a VP left-adjacent to the modal *mag* and a *'Verb-raising'* transformation moved the main verb to the right of the modal. A further transformation, called *pruning*, removed spurious phrase structure nodes, and created a situation where *mag* governs *deze film*. Lexicalist analyses of this construction have either employed a syntactic operation called *'function composition'* which allows the syntactic valency of verbs to be combined, or a closely-related operation known as *'division'* or the *'Geach-rule'* in Categorial Grammar and as *'argument composition'* in Head-driven Phrase Structure Grammar. This mechanism allows the valency of a *Verb-raising* verb to depend on the valency of its (lexical) verbal argument.

The transformational as well as the lexicalist traditions face certain problems when trying to account for the distribution of adjuncts in the context of verb clusters. Adverbial phrases may either precede or follow complements:

(2) a. dat Kim **regelmatig** haar moeder bezoekt
that Kim regularly her mother visits

that Kim visits her mother regularly

b. dat Kim haar moeder **regelmatig** bezoekt

The same freedom can be found in clauses containing a verb cluster.

(3) a. dat Kim Anne **aandachtig** het scherm zag bestuderen
that Kim Anne attentively the screen saw study
that Kim saw Anne study the screen attentively

b. dat Kim Anne het scherm **aandachtig** zag bestuderen

The adverb *aandachtig* in (3) clearly modifies the main verb *bestuderen*, and thus it is to be expected that it may either precede or follow the direct object of *bestuderen*. In other cases, the adverbial phrase is most naturally interpreted as taking scope over the verb cluster as a whole:

(4) a. dat Kim Anne **niet** het huis hoorde verlaten
that Kim Anne not the house heard leave
that Kim did not hear Anne leave the house

b. dat Kim Anne het huis **niet** hoorde verlaten

What is striking about the word order in (4b) is that the complement of the main verb precedes an adjunct which takes scope over the verb cluster as a whole. Cases where the scope of the adjunct is actually ambiguous, can easily be constructed as well:

(5) a. dat Kim **regelmatig** haar moeder wil bezoeken
that Kim regularly her mother wants visit
that Kim regularly wants to visit her mother
that Kim wants to regularly visit her mother

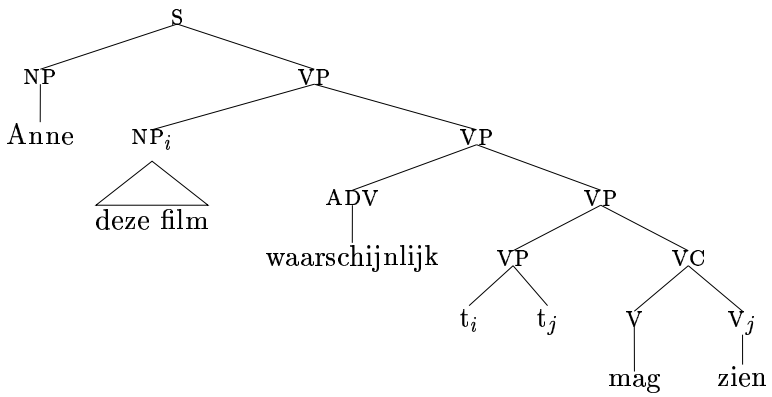
b. dat Kim haar moeder **regelmatig** wil bezoeken

In (5a) and (5b), the same ambiguity is present. The adverb *regelmatig* can be interpreted as taking scope over the verb *wil*, but also as taking scope over the main verb *bezoeken* only.

In transformational frameworks, examples such as (2a) and (4b) have been used as argument for a *scrambling* transformation, which moves an object, originally generated adjacent to the verb, to the left, and Chomsky-adjoins it to a VP-node (Webelhuth, 1992; de Hoop, 1992). The derivation of (6a), given in (6b) illustrates that scrambling must be able to move an object past adjuncts of a higher clause as well.

(6) a. dat Anne deze film **waarschijnlijk** mag zien
that Anne this movie probably may see
that Anne is probably allowed to see this movie

b.



Note that both elements of the VP *deze film zien* have been moved. The head has been adjoined to the right of the modal verb by *V-raising* and the object has been *scrambled* out of the complement VP to a position left of the adverb which modifies a projection of the modal verb *mag*. The ambiguity in examples like (5a) and (5b) can now be accounted for by assuming that the adverb was either adjoined to the embedded VP headed by (a trace of) *bezoeken*, or to the VP headed by *wil*. In both cases, the object-adverb order is obtained by scrambling.

In Head-driven Phrase Structure Grammar (HPSG, Pollard and Sag, 1994), *argument composition* has been widely used to account for the syntactic valency of verb clusters like *mag zien* in (6). It is assumed that the complements of the modal *mag* (defined by the COMPS-feature) consist of a (lexical) verbal complement *plus* all the elements on the COMPS list of that verbal complement. As *zien* is a simple transitive verb, the COMPS list of *mag* in (6) consists of a verbal complement and an accusative NP:

(7)
$$\begin{bmatrix} \text{PHON} & \langle mag \rangle \\ \text{HEAD} & v \\ \text{COMPS} & \left\langle \boxed{1}\text{NP}, \begin{bmatrix} \text{HEAD} & v \\ \text{COMPS} & \langle \boxed{1}\text{NP} \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

Specific grammar rules for combining a head with one or more complements are defined in HPSG as instantiations of a *head-complement-structure*: a structure consisting of mother, a head daughter and one or more complement daughters. The actual selection of complements follows from the *valence principle*: the value of the valence feature COMPS on the mother is equal to COMPS on the head daughter, minus all selected complements. A complement is selected if it occurs as a non-head daughter in a head-complement-structure, and its feature structure can be unified with an element on COMPS of the head daughter.

While there is a broad consensus about the lexical aspects of *verb clustering*, different analyses have been proposed for the syntactic structure of the construction. One approach is to assume that there is a rule, instantiating a head-complement-structure, which allows a lexical verbal head to combine with a lexical verbal complement to form a verb cluster, and another rule which accounts for the selection of non-verbal complements (the head of the rule is underlined):

(8) *head-complement-structure*: V[+LEX] → <u>V</u>[+LEX] V[+LEX]

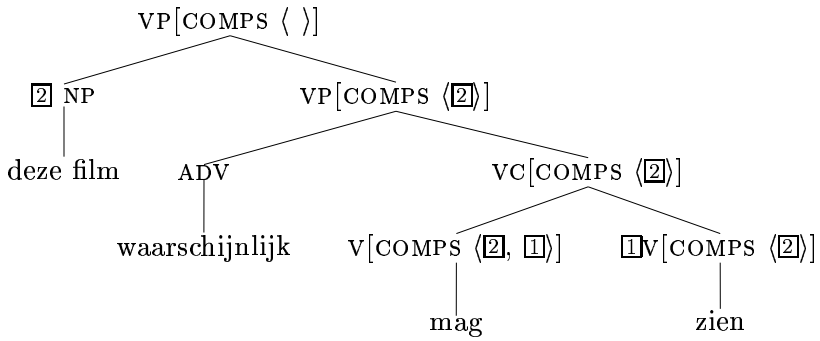
(9) *head-complement-structure*: V[-LEX] → XP <u>V</u>

A standard approach to adjunct word order in the VP simply allows adjuncts to be adjoined to arbitrary verbal projections (by means of a rule instantiating a *head-adjunct-structure*, which requires that the MOD value of the adjunct be unifiable with the feature structure of the head)), where the adjunct semantically takes scope over the constituent it is adjoined to:

(10) *head-adjunct-structure*: V → AdvP V

Thus, the derivation of the VP in (6) is as follows:[1]

(11)



The adverb-object word order is derived similarly, by assuming that the adverb modifies a saturated VP (i.e. V[COMPS ⟨ ⟩]).

In van Noord and Bouma (1994) it is observed that cases where an adverb modifies the governed verb, as in (12) and (3a) and (3b) above, are problematic for accounts based on argument inheritance. The manner adverb *hard* in (12) clearly modifies the event denoted by the embedded verb. However, in a non-transformational, surface oriented, framework, the adverb can only be analysed as a sister of a verbal projection headed by *laat*, and thus, as modifying the semantics of *laat* rather than *straffen*.

(12) dat de minister de misdadigers **hard** laat straffen
that the minister the criminals hard lets punish
that the minister makes the criminals be punished hard

A solution for this apparent mismatch between syntax and semantics can be found if adjuncts may be added lexically to the syntactic valency of a verb. By introducing adjuncts lexically on COMPS, they can be selected in syntax by the head-complement rule responsible for selection of non-verbal complements. In (12), the verb *straffen* is therefore now assigned an 'extended' COMPS-list including an adjunct. Furthermore, as adjuncts are present on COMPS, they participate in *argument composition*. The *argument composition* verb *laat* in (12) gets assigned the following COMPS-list:

(13)
$$\begin{bmatrix} \text{PHON} & \langle laat \rangle \\ \text{HEAD} & v \\ \text{COMPS} & \left\langle \boxed{1}\text{NP},\ \boxed{2}\text{ADV},\ \begin{bmatrix} \text{HEAD} & v \\ \text{COMPS} & \langle \boxed{1}\ \text{NP},\ \boxed{2}\ \text{ADV} \rangle \end{bmatrix} \right\rangle \end{bmatrix}$$

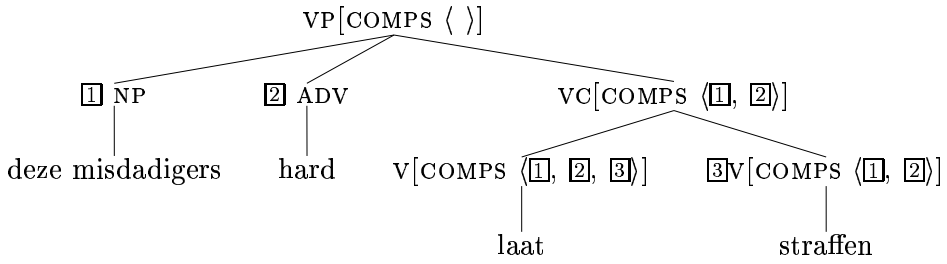
[1] The labels VC and VP are used for expository reasons only, where VC (*verbal complex*) is used for phrases consisting of a lexical verbal head and a lexical verbal complement, and VP is used for all other verbal phrases.

As adjuncts are no longer distinct from complements at the level of syntax, it can be assumed that they are all selected in the Mittelfeld by means of a single head-complement rule:

(14) *head-complement-structure*: V[COMPS ⟨ ⟩] → XP^{+} $\underline{V}$

The example in (12) can now be analysed as follows:

(15)



In the *adjuncts-as-complements* analysis it is assumed that an adjunct modifies the semantics of the head which lexically introduces it. Thus, even though the adverb *hard* is selected in syntax by *laat*, semantically it modifies the main verb *straffen*. Similar examples where an adverb takes wide scope (such as (6)) are accounted for by assuming that in those cases the lexical argument structure of the modal verb has been extended with an adjunct.

In de Hoop (1992), de Hoop and van der Does (1998), and elsewhere, it has been argued that *object scrambling* interacts with semantics. In particular, they assume that scrambling of an indefinite NP forces a '*quantificational*" reading of that NP, and that the possibility of depends on focus and presuppositional structure. Another clear semantic difference between scrambled and non-scrambled word order is described in Ruys (2001): whereas (16a) is ambiguous between a *de re* and *de dicto* reading of the object, the scrambled (16b) only has a *de re* reading.

(16) a. dat Jan vaak een meisje zoekt
that John often a girl seeks
that John often seeks a girl
that there is a girl which John often seeks

b. dat Jan een meisje vaak zoekt
that there is a girl which John often seeks

The literature on scrambling does not provide a clear answer to the question how to account for this difference exactly, but at the very least examples like these suggest that the relative order of adjuncts and complements must be closely linked to a semantic account of scope. It should also be clear that the adjuncts-as-complements analysis as it stands does not provide such an account, as it allows adjuncts to be interspersed with complements freely on COMPS, and only stipulates that the inserted adjuncts must take scope over the lexical semantics of the verb on whose COMPS-list they originate.

In this paper, I extend the adjuncts-as-complements analysis with an explicit account of semantics which supports a detailed account of the interaction of word order and scope for adjuncts, complements, and *argument raising* verbs. In HPSG, quantifier scope can be accounted for by means of explicit storage and retrieval of NP-meanings, or by means of underspecification. The latter approach constructs underspecified meaning representations which can be resolved in one or more ways, depending on the constraints imposed on such structures.

One of the attractive features of underspecification semantics is that it suggests a framework in which word order may impose constraints on semantic representations. Below, I will develop an underspecified semantics for a fragment of HPSG with adjuncts-as-complements, and propose a scopal constraint which accounts for the word order phenomena observed above.

In the next section the HPSG analysis of Dutch verb clusters is reviewed in more detail. In section 3 I outline the essentials of Lexical Resource Semantics (Richter and Sailer, 2001b), the underspecified semantics formalism I will be using. In section 4, the treatment of adjuncts as complements along the lines of Bouma, Malouf, and Sag (2001) is shown to be compatible with the data above. Furthermore, an underspecification semantics for both scopal and non-scopal, intersective, modifiers is presented, and integrated with the adjuncts-as-complements analysis.

In the final three sections, several implications of the proposal are considered. One prediction is that adjuncts in general may take wide or narrow scope with respect to the matrix verb. It is argued that this is correct for a range of adjunct types. Furthermore, the analysis predicts that adjuncts modifying a matrix verb may appear between dependents of the lower verb. Evidence for this prediction is presented. Finally, I address the semantics of clauses containing an *argument inheritance* verb and more than one adjunct (potentially modifying two different predicates) or a combination of an adjunct and a quantified NP complement. In such cases, the scope of the adjuncts relative to the other dependents is completely determined by word order. To account for this restriction, a constraint on the dependency structure of verbal lexical entries is proposed.

2 Dutch cross-serial dependencies in HPSG

The syntax of the so-called verbal complex in Dutch and German with its notorious crossing dependencies has received ample attention in theoretical linguistics, at least since Seuren (1972) and Evers (1975). Within the framework of Head-driven Phrase Structure Grammar (Pollard and Sag, 1994), Hinrichs and Nakazawa (1994) have proposed a lexicalist analysis of this construction in terms of *argument inheritance*, thereby following earlier work in Categorial Grammar in terms of function composition (Steedman, 1984). Various aspects of their analysis have been elaborated in a number of publications (Kathol, 1998; Kiss, 1994; Nerbonne, 1994; Müller, 1996; Müller, 1999; Meurers, 1999; Bouma and van Noord, 1998; van Noord and Bouma, 1997).

The core observation of Hinrichs and Nakazawa (1994) is that argument inheritance allows complements of one verbal head to be inherited (lexically) by a governing verbal head, thus allowing the governing verbal head to select the complements of that head. This in turn opens up the possibility of complement word orders where *inherited* complements occur between *true* arguments and the verbal head itself.

Below, I present a grammar fragment for Dutch modal and *accusativus cum infinitivo* verbs. Crossing dependency word orders are accounted for by means of argument inheritance.

Following Bouma, Malouf, and Sag (2001), I assume that the valency of lexical items is determined by a mapping from *argument structure* to *dependency structure* and from *dependency structure* to (grammatical) valency. The list of dependents consists of the list of arguments, possibly extended with adjuncts. The valence features SUBJ and COMPS correspond to the head and the tail of the list of dependents, respectively.[2]

[2]In Bouma, Malouf, and Sag (2001), a unified account of subject, complement, and adjunct extraction

The lexical entry for the transitive verb *bestuderen* given in (17) has an argument structure consisting of a nominative and an accusative NP. The semantics of the verb is represented by the head-feature MAIN, whose function is explained in more detail in the next section. Its value is a three-place relation *study*, including a Davidsonian event variable. The other arguments of the relation are unified with the semantic index of the nominative and accusative NP, respectively.

(17)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{bestuderen} \rangle \\ \textsc{head} & \begin{bmatrix} \textit{verb} & \\ \textsc{main} & \text{study}(e,i,j) \end{bmatrix} \\ \textsc{arg-st} & \left\langle \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textit{noun} & \\ \textsc{case} & \textit{nom} \\ \textsc{index} & i \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textit{noun} & \\ \textsc{case} & \textit{acc} \\ \textsc{index} & j \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

The value of DEPS and the valence features SUBJ and COMPS is determined by general *mapping* constraints. A mapping constraint is expressed as an implication on (typed) feature structures. For now, I assume the constraint in (18), which requires that feature structures of type *word* must have identical values for DEPS and ARG-ST. The constraint in (19) states that, for verbal lexical entries, the single element of SUBJ corresponds to the first element on DEPS, whereas the tail of DEPS corresponds to COMPS:[3]

(18)
$$\textit{word} \rightarrow \begin{bmatrix} \textsc{deps} & \boxed{1} \\ \textsc{arg-st} & \boxed{1} \end{bmatrix}$$

(19)
$$\begin{bmatrix} \textit{word} & \\ \textsc{head} & v \end{bmatrix} \rightarrow \begin{bmatrix} \textsc{subj} & \langle \boxed{1} \rangle \\ \textsc{comps} & \boxed{2} \\ \textsc{deps} & \langle \boxed{1} \rangle \oplus \boxed{2} \end{bmatrix}$$

The constraints above imply that the lexical entry for *bestuderen* can therefore be as follows:

(20)
$$\begin{bmatrix} \textit{word} & \\ \textsc{phon} & \langle \textit{bestuderen} \rangle \\ \textsc{head} & \textit{verb} \\ \textsc{subj} & \langle \boxed{1}\ \textsc{np}[\textit{nom}] \rangle \\ \textsc{comps} & \langle \boxed{2}\ \textsc{np}[\textit{acc}] \rangle \\ \textsc{deps} & \langle \boxed{1}, \boxed{2} \rangle \\ \textsc{arg-st} & \langle \boxed{1}, \boxed{2} \rangle \end{bmatrix}$$

Heads may project *head-complement* and *head-subject* structures. A head-complement rule for building VPs was given in (14). Head-subject structures are similar to head-complement structures, except that in this case the non-head daughter is a subject, and therefore has to unify with an element on SUBJ. The fact that subjects are normally selected after all

is given by assuming that dependents may be realized on SLASH (the feature used to register non-local dependencies) instead of on one of the (local) valence features. This possibility is ignored in the presentation below.

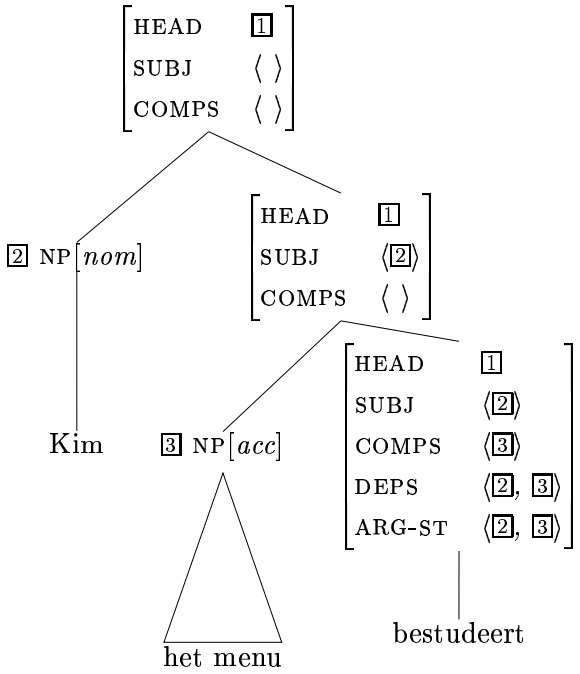
[3] In (19) $A \oplus B$ denotes the concatenation or 'append' of the two lists A and B.

complements, can be implemented by requiring that the COMPS value of the head must be the empty list:

(21) *head-subject-structure*: V → NP V[COMPS ⟨ ⟩]

As both head-complement and head-subject structures are *headed* structures, the value of the attribute HEAD is unified on the mother and head daughter. An example is given in (22).

(22)



Argument inheritance verbs differ from ordinary verbs in that their argument structure depends on the valence of the verbal complement they combine with. Formally, this can be represented by defining the argument structure of inheritance verbs as the *append* (⊕) of three lists: a list containing a subject argument, a direct object argument (for object control verbs), a list of inherited complements whose value is identical to the COMPS-list of the verbal complement, and a list containing the verbal complement itself:[4] [5]

[4] The representation of *argument inheritance* verbs in the architecture proposed by Bouma, Malouf, and Sag (2001) is also addressed in De Kuthy and Meurers (1999; 2001). In their proposal, *argument structure* does not include inherited arguments. Instead, arguments which must be inherited from a verbal complement are incorporated in DEPS by means of the constraint which defines the mapping between ARG-ST and DEPS. I believe their formulation is essentially correct, especially if binding phenomena (which must most likely be accounted for in terms of ARG-ST) and extraction are taken into account as well. As the formulation of mapping constraint which extends DEPS both with adjuncts and inherited arguments is complex, I will assume, for ease of exposition, that the effect of argument inheritance is encoded lexically in ARG-ST.

[5] The head feature TOP contains the semantics of a phrase, as explained in the next section.

(23)
$$\begin{bmatrix}
\textsc{phon} & \langle \textit{moeten} \rangle \\
\textsc{head} & \begin{bmatrix} \textit{verb} \\ \textsc{main} & \text{must}(e,i,\alpha) \end{bmatrix} \\
\textsc{arg-st} & \left\langle \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textit{noun} \\ \textsc{case} & \textit{nom} \\ \textsc{index} & i \end{bmatrix} \end{bmatrix} \right\rangle \oplus \boxed{1} \oplus \left\langle \begin{bmatrix} \textit{word} \\ \textsc{hd} & \begin{bmatrix} \textit{verb} \\ \textsc{vform} & \textit{inf} \\ \textsc{top} & \alpha \end{bmatrix} \\ \textsc{subj} & \langle \begin{bmatrix} \textsc{index} & i \end{bmatrix} \rangle \\ \textsc{comps} & \boxed{1} \end{bmatrix} \right\rangle
\end{bmatrix}$$

(24)
$$\begin{bmatrix}
\textsc{phon} & \langle \textit{zien} \rangle \\
\textsc{head} & \begin{bmatrix} \textit{verb} \\ \textsc{main} & \text{see}(e,i,\alpha) \end{bmatrix} \\
\textsc{arg-st} & \left\langle \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textit{noun} \\ \textsc{case} & \textit{nom} \\ \textsc{index} & i \end{bmatrix} \end{bmatrix}, \begin{bmatrix} \textsc{hd} & \begin{bmatrix} \textit{noun} \\ \textsc{case} & \textit{acc} \\ \textsc{index} & j \end{bmatrix} \end{bmatrix} \right\rangle \\
 & \oplus \boxed{1} \oplus \left\langle \begin{bmatrix} \textit{word} \\ \textsc{hd} & \begin{bmatrix} \textit{verb} \\ \textsc{vform} & \textit{inf} \\ \textsc{top} & \alpha \end{bmatrix} \\ \textsc{subj} & \langle \begin{bmatrix} \textsc{index} & j \end{bmatrix} \rangle \\ \textsc{comps} & \boxed{1} \end{bmatrix} \right\rangle
\end{bmatrix}$$

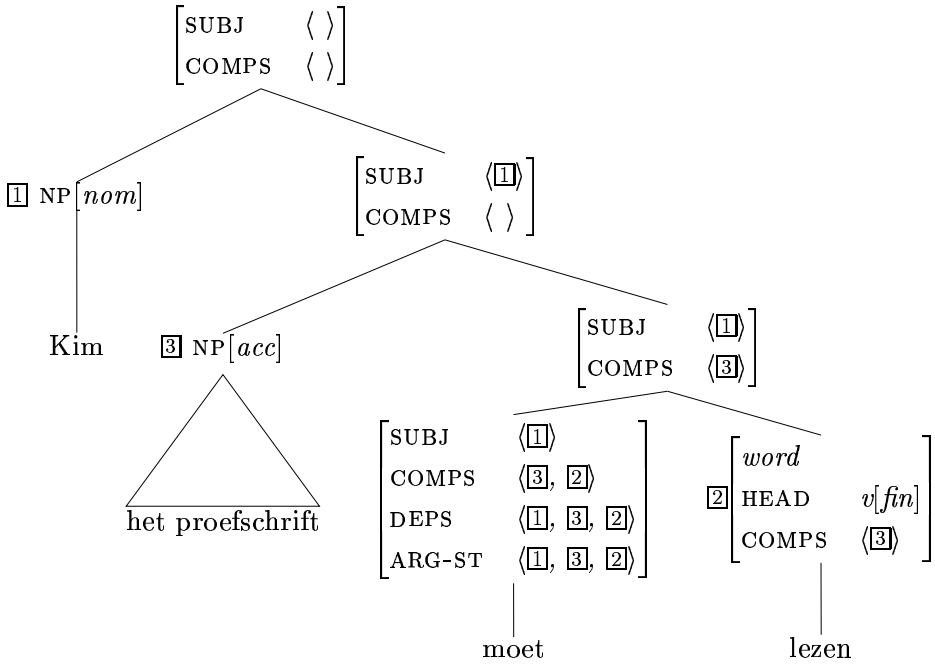
The argument structure of argument inheritance verbs is flexible, and depends in part on the syntactic valence of the verbal complement they combine with. Consequently, the value of DEPS and COMPS is also flexible. The examples below therefore represent only two possibilities for instantiating the flexible lexical entries in (23) and (24). In (25), it is assumed that the verbal complement of *moeten* is a transitive verb, having a single element on COMPS. In (26), *zien* takes an intransitive verb (whose COMPS list is empty) as verbal complement.

(25)
$$\begin{bmatrix}
\textsc{phon} & \langle \textit{moeten} \rangle \\
\textsc{subj} & \langle \boxed{1} \rangle \\
\textsc{comps} & \langle \boxed{3}, \boxed{2} \rangle \\
\textsc{deps} & \langle \boxed{1}, \boxed{3}, \boxed{2} \rangle \\
\textsc{arg-st} & \langle \boxed{1}\textsc{np}[\textit{nom}], \boxed{3}, \boxed{2}\ \textsc{v}[\textsc{comps}\ \langle \boxed{3} \rangle] \rangle
\end{bmatrix}$$

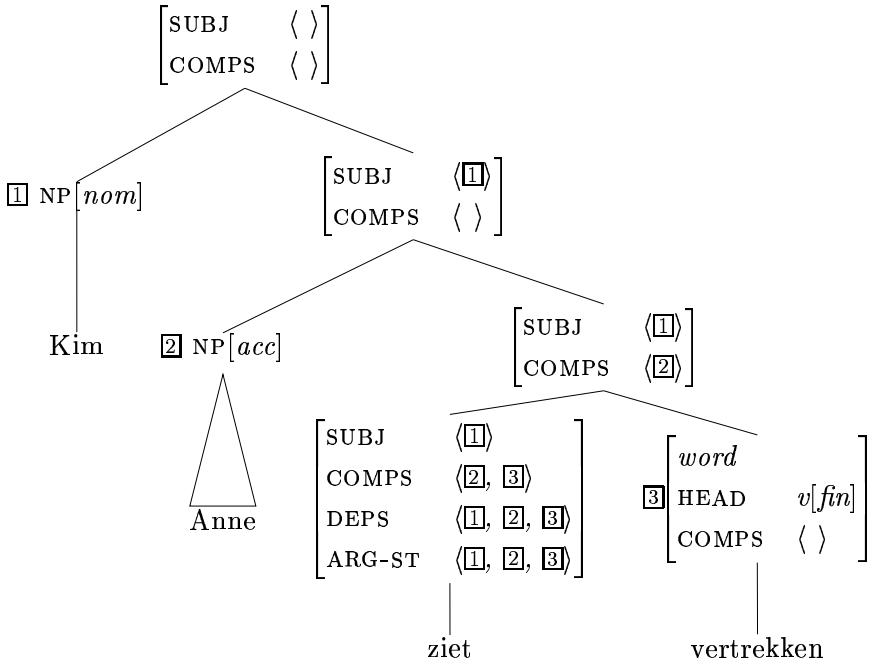
(26)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{zien} \rangle \\ \textsc{subj} & \langle \boxed{1} \rangle \\ \textsc{comps} & \left\langle \boxed{2}, \boxed{3} \right\rangle \\ \textsc{deps} & \langle \boxed{1}, \boxed{2}, \boxed{3} \rangle \\ \textsc{arg-st} & \langle \boxed{1}\textsc{np}[\textit{nom}], \boxed{2}\textsc{np}[\textit{acc}], \boxed{3}\ \textsc{v}[\textsc{comps}\ \langle\ \rangle] \rangle \end{bmatrix}$$

These lexical entries can be used to derive the following examples:

(27)



(28)



Word order is accounted for by means of *linear precedence* constraints, which may impose ordering constraints on sister nodes. For the purposes of this paper, it suffices to assume

that non-verbal complements are realized in the same order as they appear on COMPS of the head, and that they must precede the head. Verbal complements inside the verb cluster must normally follow the head. In Bouma and van Noord (1998), an analysis of word order in Dutch and German verbal complexes is presented, which accounts for the order of verb clusters consisting of more than two verbs, and for such phenomena as 'AUX-flip' and *'Oberfeldumstellung'* in German, and the distribution of separable verb-particles in Dutch.

3 LRS Semantics

Underspecification semantics accounts for the ambiguity of natural language expressions by assigning such expressions underspecified or quasi logical forms which correspond to one or more fully specified formulas. Ambiguity is expressed by a single (underspecified) formula and thus can be the result of a single grammatical derivation. Ambiguity resolution amounts to instantiating the underspecified representation into a fully resolved formula. Underspecification semantics is particularly popular in computational semantics (Alshawi and Crouch, 1992; Frank and Reyle, 1995; Bos, 1995; Copestake et al., 1999) as it supports architectures in which grammatical analysis only produces different analyses if there are genuine syntactic ambiguities. Reduction of syntactic ambiguity in general has a positive effect on parsing efficiency. Ambiguity resolution amounts to selecting the syntactically correct parse and instantiating its meaning. In many cases, only a partial resolution of the underspecified result is necessary. In an automatic translation system, for instance, it may be necessary to select the correct syntactic structure and to resolve underspecified lexical predicates, but resolving quantifier is not always required.

In this section, I introduce the basic concepts of Lexical Resource Semantics (LRS) (Richter and Sailer, 2001b; Richter and Sailer, 2001a), a recent member of the family of underspecified semantics formalisms. LRS allows (standard, fully specified) logical formulas to be described by means of underspecification. The constraints make use of the machinery of constraint-based grammar formalisms as much as possible. In particular, the theory is integrated in the grammar framework of HPSG. I will be mostly concerned with underspecified representations of the scope of quantifiers and scopal adverbs.

The semantics of words and phrases in LRS is encoded by means of the features TOP, PARTS, MAIN, and INDEX. The value of TOP and MAIN is a logical form. The value of PARTS is a list of terms. The value of INDEX is a logical variable. The TOP of a clause is its logical form. It has to consist of all and only the terms in its PARTS list. If PARTS can be assembled into a logical form in various ways, an ambiguity arises. MAIN is the element of PARTS which corresponds to the meaning of the lexical head of the phrase. In *headed structures*, the value of TOP, MAIN and INDEX is identical on mother and head daughter. For this reason, I assume that these features are present under HEAD.

Words typically introduce a single semantic term. The lexical entry for *lezen* (*read*) in (29) has a PARTS attribute containing a term consisting of the relation name *read* , and arguments e, i, and j.[6] The argument e stands for a Davidsonian event variable. The other two arguments are co-indexed with the the INDEX values of the two NP-arguments.

[6]The PARTS lists in (Richter and Sailer, 2001b) contain elements corresponding to relation names and individual arguments as well. Here, I refrain from including that level of decomposition.

(29)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{lezen} \rangle \\ \textsc{head} & \begin{bmatrix} \textsc{top} & \textit{lf} \\ \textsc{index} & e \\ \textsc{main} & \boxed{1} \end{bmatrix} \\ \textsc{arg-st} & \left\langle \begin{bmatrix} \textit{np} \\ \textsc{index} \quad i \end{bmatrix}, \begin{bmatrix} \textit{np} \\ \textsc{index} \quad j \end{bmatrix} \right\rangle \\ \textsc{parts} & \langle\ \boxed{1}\ \mathrm{read}(e,i,j)\ \rangle \end{bmatrix}$$

I will assume, following the MAIN principle of (Richter and Sailer, 2001b), that in every lexical entry and every phrase, MAIN is required to be a component of TOP.

Scope-taking elements, such as quantifiers, and certain verbs and adverbs, are associated in the lexicon with underspecified terms, containing one or more arguments whose value is required to be a semantic term again. Such arguments are indicated with letters $\alpha, \beta, ...$

(30)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{een, boek} \rangle \\ \textsc{head} & \begin{bmatrix} \textit{noun} \\ \textsc{top} & \textit{lf} \\ \textsc{main} & \boxed{1} \\ \textsc{index} & x \end{bmatrix} \\ \textsc{parts} & \langle\ \exists x(\alpha \wedge \beta), \boxed{1}\ \mathrm{book}(x) \rangle \\ \& \ \boxed{1} \lhd \alpha \end{bmatrix}$$

In quantified noun phrases, the semantic head of the noun is required to be a component of the restriction of the quantifier. The constraint $T \lhd U$ is used to express that a term T must be a component of a larger term U. Complex constraints of this type, which cannot be expressed as feature values or reentrancies, are added to a feature structure with the prefix &.

The PARTS value of a phrase is simply the concatenation of the PARTS attributes of the daughters. Therefore, a standard derivation of (31) will give rise to the PARTS in (32a).

(31) alle studenten lezen een boek
all students read a book

(32) a.
$$\begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{index} & e \\ \textsc{main} & \boxed{4} \end{bmatrix} \\ \textsc{parts} & \left\langle \forall x(\alpha \rightarrow \beta),\ \boxed{2}\ \mathrm{student}(x),\ \exists y(\gamma \wedge \delta),\ \boxed{3}\ \mathrm{book}(y),\ \boxed{4}\ \mathrm{read}(e,x,y)\ \right\rangle \\ \& \ \boxed{2} \lhd \alpha\ \&\ \boxed{3} \lhd \gamma \end{bmatrix}$$

b. $\boxed{1}\ \forall x(\mathrm{student}(x) \rightarrow \exists y(\mathrm{book}(y) \wedge \mathrm{read}(e,x,y)))$

c. $\boxed{1}\ \exists y(\mathrm{book}(y) \wedge \forall x(\mathrm{student}(x) \rightarrow \mathrm{read}(e,x,y)))$

The semantics of an utterance is the value of its TOP. This value is constrained to consist of all and only the terms in PARTS. Furthermore, all scopal constraints must be satisfied. The

logical forms in (32b) and (32c) are the result of two ways to instantiate the value of TOP in (32a), compatible with the principles and constraints.[7]

As the scope of quantifiers is not subject to restrictions, the analysis also accounts for the fact that quantified NPs may in general take wide or narrow scope with respect to a modal verb. Modal verbs, such as *wil* in (33), are assumed to be control verbs, i.e. they express a relation between an entity and a VP meaning, where the subject argument of lexical head of the VP is required to be identical to the index of the subject of the modal verb.

(33)
$$\begin{bmatrix} \textsc{phon} & \langle wil \rangle \\ \textsc{head} & \begin{bmatrix} verb & \\ \textsc{top} & \boxed{1} \\ \textsc{index} & e \\ \textsc{main} & \boxed{2} \end{bmatrix} \\ \textsc{arg-st} & \left\langle \begin{bmatrix} \textsc{hd} & \begin{bmatrix} noun & \\ \textsc{index} & i \end{bmatrix} \end{bmatrix} \right\rangle \oplus \boxed{3} \oplus \left\langle \begin{bmatrix} \textsc{hd} & \begin{bmatrix} verb & \\ \textsc{top} & \alpha \end{bmatrix} \\ \textsc{subj} & \langle \begin{bmatrix} \textsc{index} & i \end{bmatrix} \rangle \\ \textsc{comps} & \boxed{3} \end{bmatrix} \right\rangle \\ \textsc{parts} & \left\langle \boxed{2}\ \mathrm{want}(e, i, \alpha) \right\rangle \end{bmatrix}$$

In examples like (34) the direct object argument of the embedded verb *vervangen* may take either wide or narrow scope with respect to the modal verb *wil*. Given the lexical entry for *wil* in (33), a derivation of (34) gives rise to the semantic representation in (35a). The value of TOP in this representation can be either (35b) or (35c).

(34) dat Kim een computer wil vervangen
that Kim a computer wants replace
that Kim wants to replace a computer
that there is a computer that Kim wants to replace

(35) a.
$$\begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{index} & e \\ \textsc{main} & \boxed{2} \end{bmatrix} \\ \textsc{parts} & \langle\ \boxed{2}\ \mathrm{want}(e, k, \alpha),\ \boxed{3}\ \mathrm{replace}(e', k, x),\ \boxed{4}\ \mathrm{computer}(x),\ \exists x(\beta \wedge \gamma)\ \rangle \\ \multicolumn{2}{l}{\ \&\ \boxed{4} \trianglelefteq \beta} \end{bmatrix}$$

b. $\boxed{1}\ \mathrm{want}(e, k, \exists x(\mathrm{computer}(x) \wedge \mathrm{replace}(e', k, x)))$

c. $\boxed{1}\ \exists x(\mathrm{computer}(x) \wedge \mathrm{want}(e, k, \mathrm{replace}(e', k, x)))$

Note also that semantic construction does not need to take into account the fact that the embedded VP *een computer vervangen* is discontinuous and that the direct object is inherited on the argument structure of *wil*. The meaning of a phrase is determined by the PARTS

[7] Note that the event variable of the verbal predicate remains unbound. I will assume that its proper interpretation can be arrived at by replacing it by a Skolem constant dependent on the (non-existential) quantifiers which take scope over it.

list, which is simply the concatenation of the PARTS of the daughter phrases, and the lexical semantics of the words involved. This schema is general enough to support the syntactic analysis of argument inheritance verbs without extra stipulations.

4 Adjuncts as Complements

In this section, Argument Structure Extension as defined in Bouma, Malouf, and Sag (2001) is introduced. I demonstrate that this operation, which allows adjuncts to be selected as complements, enables an account of the fact that adjuncts may appear left of a verb cluster and still take scope over only a part of that cluster. Furthermore, I show that the underspecified semantics introduced in the previous section allows the adjuncts as complements analysis to be combined with an explicit semantics.

4.1 Syntax

The adjuncts-as-complements hypothesis makes the selection of adjuncts a lexical property of the verbs involved, and allows adjuncts to be selected by the same rule mechanism responsible for selection of complements. Arguments for selecting adjuncts as complements in HPSG have been presented for French (Miller, 1992; Abeillé and Godard, 1994), Japanese (Manning, Sag, and Iida, 1999), Polish, Finnish (Przepiórkowski, 1999a; Przepiórkowski, 1999b) and English (Bouma, Malouf, and Sag, 2001). In van Noord and Bouma (1994) it is argued, on the basis of examples like those presented in the introduction, that the distribution and scope of adjuncts in the context of Dutch verb clusters also provide evidence for lexical selection of adjuncts as complements. By treating adjuncts as complements, selected lexically by the heads which they modify, adjuncts become visible for argument inheritance. This basically allows adjuncts in the Mittelfeld to act as adjuncts of an embedded verb.

In van Noord and Bouma (1994) the valency of verbs is extended by means of a (recursive) lexical rule which adds adjuncts to COMPS. In Bouma, Malouf, and Sag (2001) an alternative is proposed, in which adjuncts are introduced in the mapping from argument structure to dependency structure (DEPS). The *Argument Structure Extension* principle defines this mapping:

(36) **Argument Structure Extension:**

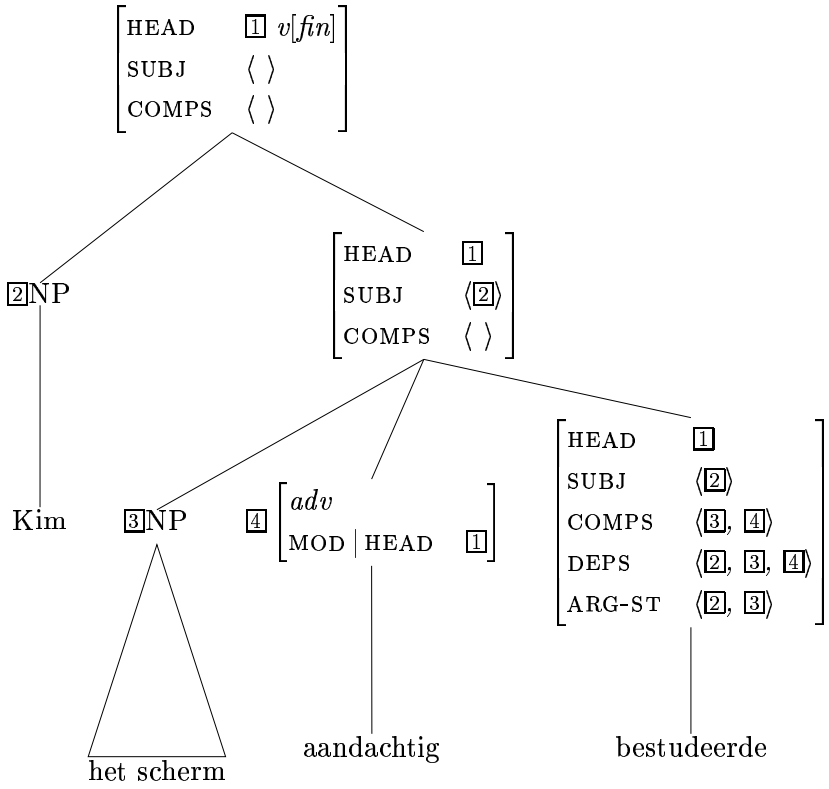
$$word \rightarrow \begin{bmatrix} \text{HEAD} & \boxed{2} \\ \text{DEPS} & \boxed{1} \bigcirc \mathit{list}\left(\begin{bmatrix} \text{MOD} & \begin{bmatrix} \text{HEAD} & \boxed{2} \end{bmatrix} \end{bmatrix}\right) \\ \text{ARG-ST} & \boxed{1} \end{bmatrix}$$

Note that Argument Structure Extension is defined as an implicational constraint: each feature structure of type *word* must satisfy the feature structure in the implication. The value of DEPS is defined as the *sequence union* (or *shuffle*) of two lists: ARG-ST and an arbitrary list of adjuncts. This essentially allows any number of adjuncts to be interspersed with arguments on DEPS, while leaving the relative order of ARG-ST unchanged.[8] The mapping of dependents to SUBJ and COMPS remains as before. A transitive verb like *bestuderen* can

[8]The sequence union or shuffle of two lists A and B consists of a list containing all and only the elements of A and B. Furthermore, if A_1 precedes A_2 on A, it must also precede A_2 in the result. Similarly for list B. The operation resembles shuffling two decks of cards.

now be instantiated with a two element DEPS-list as before, but also with a three element list, as shown in the examples below.

(37)

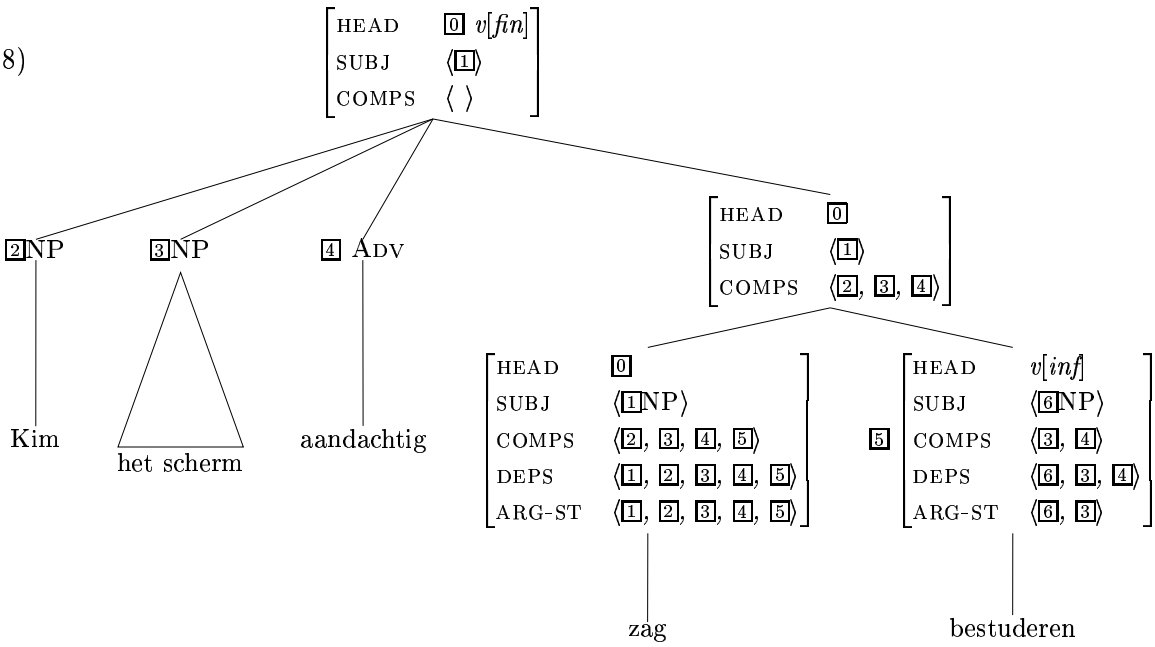


Note that argument structure extension requires the MOD|HEAD value of the adjunct to unify with the head features of the head which is being modified. The fact that adverbs typically modify verbs, but not nouns or prepositions, is accounted for by restricting MOD|HEAD of adverbs to the type *verb*.

The formulation of Argument Structure Extension in (36) does not impose any restrictions on the ordering of adjuncts with respect to arguments, and thus in general allows adjuncts to precede subjects (the initial element of ARG-ST) as well. In Dutch, adjuncts may precede subjects (in subordinate clauses) only if certain conditions are met. It seems possible to formulate the relevant constraints on adjunct-subject word order in terms of the framework presented here, but this falls outside the scope of the present paper.

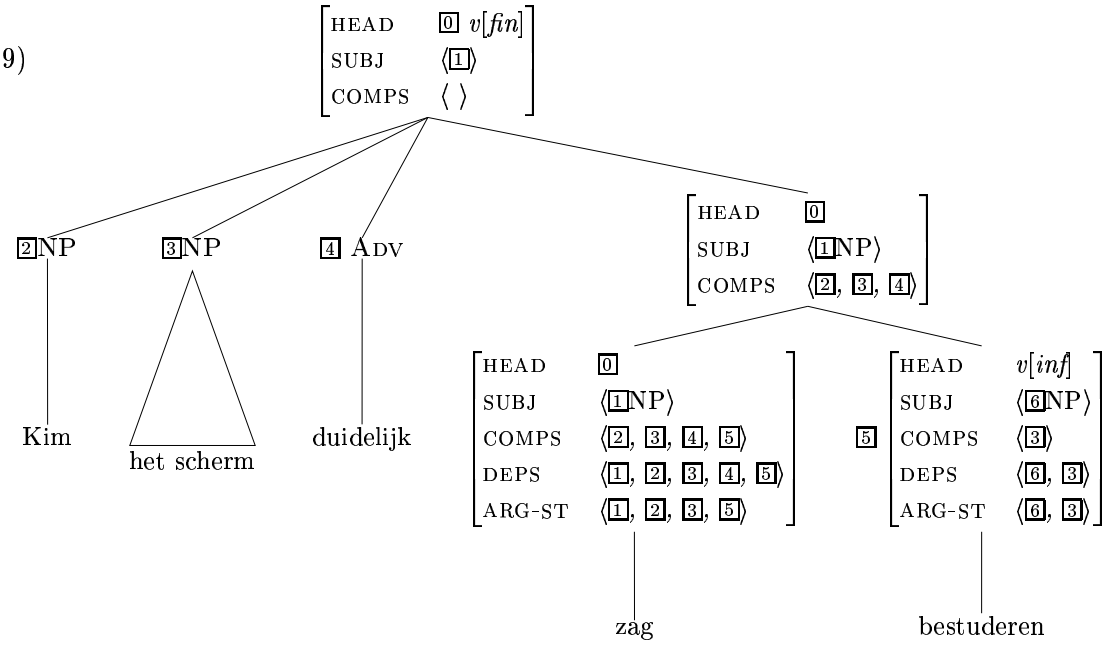
As selection of adjuncts is subsumed by the same mechanism responsible for the selection of complements, inheritance of COMPS-lists consisting of both arguments and adjuncts is predicted. This is illustrated in the example below.

(38)



In those cases where the adverb clearly modifies the matrix verb, it is assumed to be introduced on the DEPS list of the matrix verb, and it is not inherited from the COMPS list of the governed verb.

(39)



Finally, it should be noted that in general an ambiguity is predicted in those cases where an adverb can semantically function both as a modifier of the main verb and as a modifier of the matrix verb.

4.2 Semantics

In this section the adjunct-as-complements analysis is supplemented with a semantics in terms of LRS. I will analyze both scope-taking and intersective adjuncts.

Scope-taking adverbials, such as negation, modal adverbs (*mogelijk, possibly*), and frequency adverbs (*vaak* (*often*), *nooit* (*never*)), must take scope over the predicate introduced by the verb they modify. Furthermore, unlike quantified NP's, which in general can take arbitrary wide scope, adjuncts must take scope within the clausal or verbal projection of the verb of which they are a dependent:

(40) Kim gelooft dat de trein naar Amsterdam **vaak** te laat is
Kim believes that the train to Amsterdam often late is
Kim believes that the train to Amsterdam often is late
**Kim often believes that the train to Amsterdam is late*

These two constraints on adjunct scope can be implemented in LRS by assuming that adverbials must take scope over the MAIN of the head they modify, and must take scope within the TOP of the head they modify. This is exemplified in (41), which gives the semantics of the lexical entry for *regelmatig* (*regularly*), which is assumed to introduce a unary operator.

(41)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{regelmatig} \rangle \\ \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{main} & \boxed{3} \end{bmatrix} \\ \textsc{mod} & \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textit{verb} & \\ \textsc{top} & \boxed{1} \\ \textsc{main} & \boxed{2} \end{bmatrix} \end{bmatrix} \\ \textsc{parts} & \langle \boxed{3}\text{regularly}(\alpha) \rangle \\ \& \ \boxed{2} \lhd \alpha & \end{bmatrix}$$

The fact that the scope of an adverb is limited to the TOP of the verb it modifies is a consequence of the fact that the TOP values of both are unified. Thus, the MAIN term introduced by the adverb must be within the semantic domain of the verb. Note also that if *geloven* (*believe*) selects for a clausal argument whose TOP is unified with one of the arguments of the *believe* relation (i.e. *believe* functions like a modal operator much like *must* in (34)), the adverb *vaak* (*often*) in (40) can take scope over *te laat zijn* (*be late*) but not over *gelooft*.

Example (42) contains a scopal adverb preceding a quantified NP. In such cases, the NP may take either wide or narrow scope with respect to the adverb.

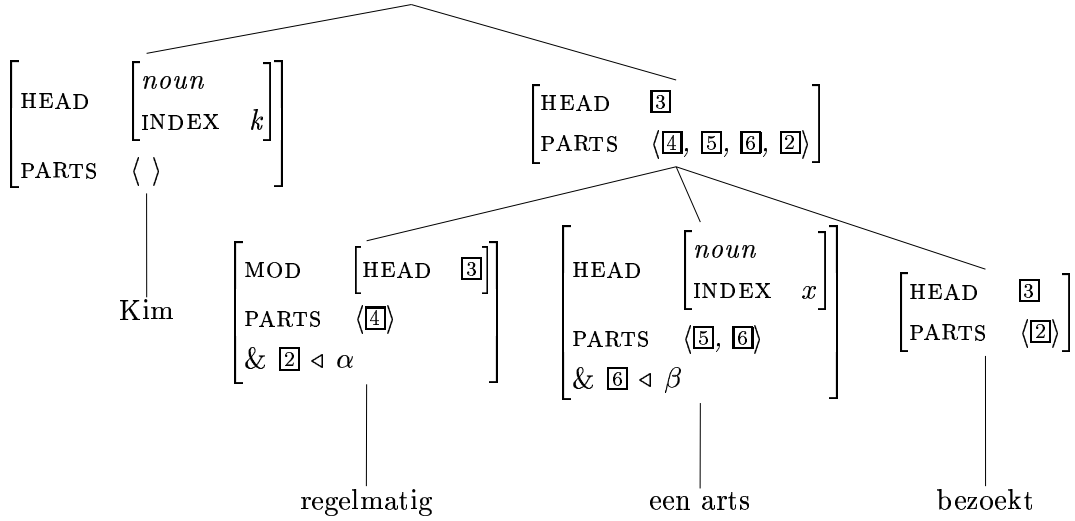
(42) dat Kim regelmatig een arts bezoekt
that Kim regularly a doctor visits
that Kim regularly visits a doctor
that there is a doctor which Kim regularly visits

In the adjuncts-as-complements analysis, the DEPS-list of the verbal head, *bezoekt*, needs to be instantiated to a list containing one modifier, as shown in (43). This gives rise to the derivation shown in (44). The TOP-value can be resolved to a well-formed logical formula in two ways

(45a,b). Note that in both cases the scopal constraints on various parts of the structure are respected. In particular, as long as *regularly* scopes over the main verbal predicate *visit*, the quantifier may take either wide or narrow scope with respect to the adverbial operator.

(43)
$$\begin{bmatrix}
\textsc{phon} & \langle \textit{bezoekt} \rangle \\
\textsc{head} & \boxed{3}\begin{bmatrix} \textit{verb} \\ \textsc{top} \quad \boxed{1} \\ \textsc{main} \quad \boxed{2} \end{bmatrix} \\
\textsc{subj} & \langle\, \boxed{4}\begin{bmatrix} \textit{noun} \\ \textsc{index} \quad i \end{bmatrix} \rangle \\
\textsc{comps} & \langle\, \boxed{5}\begin{bmatrix} \textit{adv} \\ \textsc{mod} \mid \textsc{head} \quad \boxed{3} \end{bmatrix}, \boxed{6}\begin{bmatrix} \textit{noun} \\ \textsc{index} \quad j \end{bmatrix} \rangle \\
\textsc{deps} & \langle \boxed{4}, \boxed{5}, \boxed{6} \rangle \\
\textsc{arg-st} & \langle \boxed{4}, \boxed{6} \rangle \\
\textsc{parts} & \langle \boxed{2}\ \mathrm{visit}(e,i,j) \rangle
\end{bmatrix}$$

(44)
$$\begin{bmatrix}
\textsc{head} & \boxed{3}\begin{bmatrix} \textsc{top} \quad \boxed{1} \\ \textsc{main} \quad \boxed{2} \end{bmatrix} \\
\textsc{parts} & \langle \boxed{4}\ \mathrm{regularly}(\alpha),\ \boxed{5}\ \exists x(\beta \wedge \gamma), \boxed{6}\ \mathrm{doctor}(x),\ \boxed{2}\ \mathrm{visit}(e,k,x) \rangle
\end{bmatrix}$$



(45) a. $\boxed{1}\ \mathrm{regularly}(\ \exists x(\mathrm{doctor}(x) \wedge \mathrm{visit}(e,k,x)))$

b. $\boxed{1}\ \exists x(\mathrm{doctor}(x) \wedge \mathrm{regularly}(\mathrm{visit}(e,k,x)))$

Intersective modifiers are characterized by the fact that they introduce a predicate which takes the event introduced by the verbal predicate as argument. Intersective modifiers do not seem to give rise to ambiguities with respect to quantified NP arguments (46a). Furthermore, if an intersective adverb co-occurs with a quantifier, it seems the event predicated over by the adverb cannot be bound by an existential quantifier scoping over the quantified NP (46b).

(46) a. dat Kim vandaag een arts bezoekt
that Kim today a doctor visits

that Kim visits a doctor today

b. dat Kim vandaag geen arts bezoekt
that Kim today no doctor visits
that Kim does not visit a doctor today
**that there is a moment today where Kim does not visit a doctor*

These observations motivate the analysis of intersective adverbials exemplified in (47) below. The relation symbol $\trianglelefteq$ is defined as follows: $f \trianglelefteq g$ holds if $f = g$ or if $g = g' \wedge g''$ and $f \trianglelefteq g'$ or $f \trianglelefteq g''$. In other words, the adverbial predicate must be conjoined with the MAIN predicate introduced by the verb, possibly in conjunction with other predicates.

(47)
$$\begin{bmatrix} \textsc{phon} & \langle \textit{vandaag} \rangle \\ \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{main} & \text{today}(e) \end{bmatrix} \\ \textsc{mod} & \begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{index} & e \\ \textsc{main} & \boxed{2} \end{bmatrix} \end{bmatrix} \\ \textsc{parts} & \langle \text{today}(e) \wedge \alpha \rangle \\ \& \ \boxed{2} \trianglelefteq \alpha & \end{bmatrix}$$

The effect of this constraint is to effectively force narrow scope for the adverb in those cases where an ambiguity would otherwise be conceivable. The example in (46b) gives rise to the semantic structure in (48a), whose TOP can only be resolved as shown in (48b).

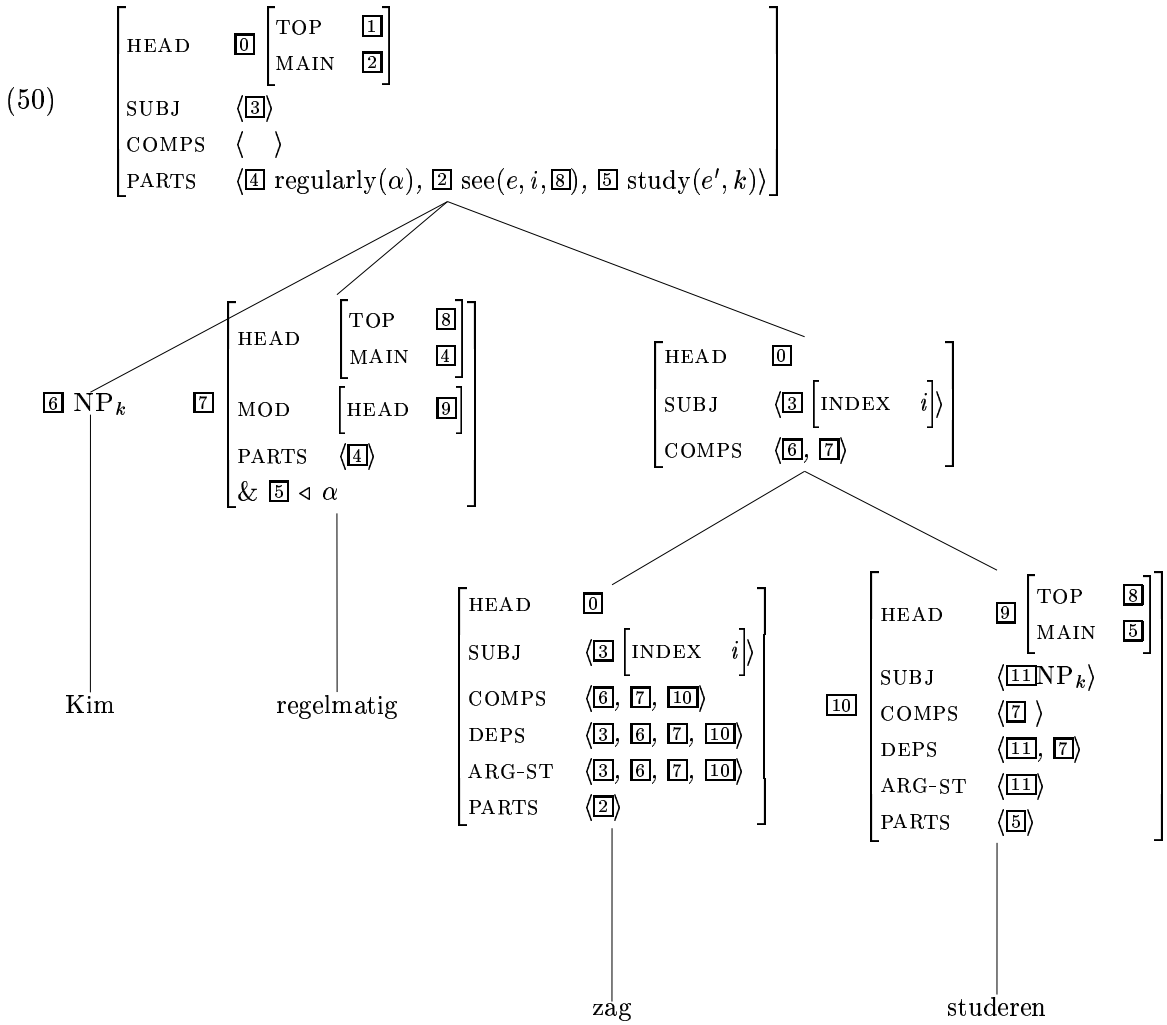
(48) a.
$$\begin{bmatrix} \textsc{head} & \begin{bmatrix} \textsc{top} & \boxed{1} \\ \textsc{main} & \boxed{2} \end{bmatrix} \\ \textsc{parts} & \langle \neg\exists x(\alpha \ \wedge \ \beta), \boxed{3} \ \textit{doctor}(x) \ , \ \textit{today}(e) \ \wedge \ \gamma, \boxed{2} \ \textit{visit}(e,k,x) \rangle \\ \& \ \boxed{3} \lhd \alpha \ \& \ \boxed{2} \trianglelefteq \gamma & \end{bmatrix}$$

b. $\boxed{1} \ \neg\exists x(\text{doctor}(x) \ \wedge \ \text{today}(e) \ \wedge \ \text{visit}(e,k,x))$

The ambiguity of adverbial phrases in the context of argument inheritance verbs can now be described precisely. If a scopal adjunct is introduced on the lower verb, it must take scope over the predicate introduced by that verb and within the semantic domain defined by that predicate (i.e. TOP). The derivation with the narrow scope reading for *regelmatig* in (49) is given in (50).

(49) dat ik Kim regelmatig zag studeren
that I Kim regularly saw study
that I saw Kim study regularly

(50)



An adjunct is introduced by Argument Structure Extension on the DEPS list of the verb *bestuderen*. Argument Structure Extension unifies the MOD|HEAD value of the adjunct with the HEAD of the verb. The adjunct is inherited by the verb *zag*. When this verb combines with its complements, the feature structure of the adverb *regelmatig* is unified with the adjunct on COMPS of *zag*, which is the same as the adjunct introduced originally on the DEPS list of *studeren*. As the MOD|HEAD value of the adverb *regelmatig* is unified with the HEAD value of *studeren*, constraints on the relative scope of *regelmatig* are interpreted relative to *studeren*. As the TOP value of *studeren* is an argument of the matrix predicate *see*, the adverb must have narrow scope with respect to *see*. Thus, the only way to resolve the TOP value of the VP is as shown in (51).

(51) $\boxed{1}$ see(e, i,regularly(study(e', k)))

The wide scope reading differs from the structure given in (50) only in that Argument Structure Extension introduces an adjunct on DEPS of *zag* in that case. The semantic constraints on the scope of *regelmatig* would apply relative to *see*, and therefore only the wide scope reading would be available (as *regelmatig* has to outscope the MAIN predicate of *zag* in that case).

In this section, it has been demonstrated tht Argument Structure Extension allows adjuncts to be added to the syntactic valence of verbal heads. LRS provides the tools to provide a semantics for adjuncts selected as complements as well. The relative order of adjuncts and arguments, as well as the interaction between scope and word order, has been left almost completely unconstrained, however. In the remainder of this paper, I will be concerned with the question to what extent additional constraints on the word order and scope of adjuncts need to be imposed.

5 The scope of adjuncts with respect to the matrix verb

The theory outlined in the previous sections makes a number of predictions about word order and scope of adjuncts in the Mittelfeld preceding a verb cluster consisting of an argument inheritance verb and a main verb. Adjuncts are introduced lexically, and are freely added to DEPS of either the matrix or the governed verb. Argument inheritance accounts for the inheritance of arguments as well as adjuncts. The analysis therefore predicts that adjuncts in the Mittelfeld may take either wide or narrow scope with respect to the matrix verb. In this section, I argue that this prediction is correct for various types of adjuncts.

Adverbials to the left of a verb cluster may in general take wide or narrow scope with respect to the matrix verb. This is not to say that all examples involving adverbials and verb clusters are ambiguous. In some cases the relative scope of an adverbial is hard to determine, and does not seem to have an impact on semantics. In other cases, there is a clear preference for interpreting an adverbial as taking either wide or narrow scope. However, genuinely ambiguous cases exist as well.

In cases involving a simple temporal or locative adjunct, it may be hard to determine whether an adjunct restricts the event introduced by the matrix verb, or only the event introduced by the embedded verb:

(52) dat Sanne Kim **gisteren** een artikel zag schrijven
that Sanne Kim yesterday a paper saw write
that Sanne saw Kim write a paper yesterday

It is almost impossible to think of situations where the temporal adverb applies strictly to either the matrix verb or the embedded verb. In other cases, the adverb is most naturally interpreted as restricting the event introduced by the embedded verb:

(53) dat Kim het artikel **morgen** af wil hebben
that Kim the paper tomorrow PRT wants finish
that Kim wants the paper finished tomorrow

Ambiguous examples can be found as well:

(54) dat Kim Sanne **in de tuin** hoorde zingen
that Kim Sanne in the garden heard sing
Kim heard Sanne sing in the garden
In the garden, Kim heard Sanne sing

Here, the adjunct may restrict either the location of the event introduced by the perception verb *horen* or the event introduced by the main verb *zingen*.

Operator adverbs, like negation, modal adverbs, and adverbs quantifying over events, tend to take scope over the matrix verb, although narrow scope readings are not excluded.

(55) Ik heb Johan **nooit** horen klagen over geld
I have Johan never heard complain about money
I have never heard Johan complain about money

(56) dat Kim Sanne de opdracht **niet** zag inleveren.
that Kim Sanne the assignment not saw hand in
that Kim didn't see Sanne hand in the assignment

(57) dat Sanne deze film **waarschijnlijk** mag zien
that Sanne this movie probably may see
that Sanne probably is allowed to see this movie

(58) Zuid-Afrika is een staat die zich **niet** laat intimideren door dreigementen
South Africa is a state which self not lets intimidated by threats
South Africa, is a state which doesn't let itself be intimidated by threats

The examples above illustrate that operator adverbs tend to take scope over perception, modal, and causative verbs. However, in some cases an operator adverb can take either wide or narrow scope:

(59) dat Kim de boeken **nooit** wil controleren
that Kim the books never wants check
that Kim never wants to check the books
that Kim wants to never check the books

(60) dat Kim het verslag **wekelijks** wil ontvangen
that Kim the report weekly wants to receive
that Kim weekly wants to receive the report
that Kim wants to receive the report weekly

Manner adverbs tend to impose strong restrictions on the kind of verbs they can modify. The adverb *wild*, for instance, can modify *zwaaien*, but not the *accusativus-cum-infinitivo*-usage of *zien*. Therefore, (61) only has a reading where the manner adverb takes narrow scope with respect to the matrix verb.

(61) dat Cathy hen **wild** zag zwaaien.
that Cathy them wild saw wave
that Cathy saw them waving wildly

More examples are presented below:[9]

(62) Ik heb de minister **schouderophalend** horen zeggen dat er een grens is.
I have the minister shruggingly hear say that there a border is
I heard the minister say shruggingly that there is a limit

[9]The examples were extracted from a Dutch newspaper corpus (*de Volkscrant op cd-rom, 1997*) using the Gsearch corpus tool (Corley et al., 2001).

(63) de beestjes die ze **dartel** naderbij zien fladderen
the small creatures which they playfully closer see fly
the small creatures which they see fly towards them playfully

(64) Het is vreemd dat Stegemann Schubert **uitvoerig** laat praten
It is strange that Stegemann Schubert extensively allow talk
It is strange that Stegemann allows Schubert to talk extensively

While verbs of saying combine frequently with the adverb *schouderophalend* (*shruggingly*), this adverb cannot normally co-occur with *horen* (*hear*). Similarly, the adverbs *dartel* (*playfully*) and *uitvoerig* (*extensively*) can be used in conjunction with *fladderen* and *praten*, but not with *zien* and *laten*. Thus, only the narrow scope readings are possible.

The dependency between the embedded verb and some manner adverbs can also be demonstrated by examples like (65) and (66) below. The adverb *hard* can mean both *fast* and *strongly, fiercefully, severely*. Only the first reading is available in (65), whereas only the second reading is available in (66). As the matrix verb is identical in both cases, this difference in interpretation must be due to differences in meaning of the embedded verb, thus providing evidence for the fact that the manner adverb modifies the embedded verb.

(65) Kim heeft Anne **hard** zien weglopen
Kim has Anne fast see run-away
Kim has seen Anne run away fast

(66) Kim heeft de politie de demonstranten **hard** zien aanpakken
Kim has the police the demonstrators severly see deal-with
Kim has seen the police deal with the demonstrators severly

The conclusion to be drawn from the examples above is that adjuncts in the Mittelfeld in general may take wide or narrow scope over a matrix verb. If either a wide scope or narrow scope reading is excluded, this is due to the lexical semantics of either the verb or adjunct involved. It is not the case that scopal ambiguity is restricted to particular classes of adjuncts.

6 Scrambling of adjuncts and arguments

The analysis outlined above introduces adjuncts lexically, by adding adjuncts freely to DEPS. Thus, it is predicted that adjuncts and arguments in principle can occur in both orders. As arguments are inherited on ARG-ST by argument-inheritance verbs, it is predicted that matrix adjuncts may follow arguments of the embedded verb. The examples below provide evidence that this is correct.

Adjuncts of the matrix verb may clearly appear in a position immediately preceding the verb cluster, and possibly following inherited arguments:

(67) dat Kim de kinderen het boek **niet** zag lezen
that Kim the children the book not saw read
that Kim didn't see the children read the book

Here, an operator adverb follows the direct object of the embedded verb *lezen*.

As adjuncts are mixed freely with non-adjunct dependents of a verb (i.e. both arguments and inherited arguments), the analysis also predicts that matrix adjuncts may occur between arguments of the lower verb. The following example shows that this is indeed possible:

(68) dat Kim de spelers de bal **niet eerder** zo hard zag raken
that Kim the players the ball not before so hard saw hit
that Kim never before saw the players hit the ball so hard

Adjuncts which take narrow scope, on the other hand, cannot precede arguments of the matrix verb. This is illustrated in the example below:

(69) *dat Anne **hard** Piet zag weglopen
that Anne fast Piet saw run away
that Anne saw Piet run away fast

In (69), the adverb *hard* precedes *Piet*, the direct object of *zag*. The argument structure of a perception verb like *zien* consists of a subject, an object, inherited arguments, and a verbal complement, in that order. Inherited adjunct complements can therefore never the object. The adverb *hard* in (69) can therefore only be interpreted as modifying the matrix verb *zien*, a reading which is semantically anomalous.

Finally, note that this analysis of adjunct word order differs from scrambling in that it does not involve movement of arguments in the Mittelfeld. This appears to be a welcome result in light of the discussion in Neeleman (1994), who criticizes scrambling analyses of adjunct placement. In particular, he notes several data that argue against the fact that scrambling involves movement of argument NP's. For instance, the order of arguments in Dutch, compared to a language like German, is relatively fixed. In general it is not possible to reorder arguments with respect to each other. However, the examples in (68) and below show that an adjunct may follow one or more arguments:

(70) a. dat Kim **niet eerder** de spelers de bal zo hard zag raken
b. dat Kim de spelers **niet eerder** de bal zo hard zag raken

If all orders are derived by means of scrambling of one or more argument NPs, one would expect the following examples to be grammatical as well:

(71) a. *dat Kim de bal **niet eerder** de spelers zo hard zag raken
b. *dat Kim de bal de spelers **niet eerder** zo hard zag raken

The ungrammaticality of the examples in (71) (under the reading given in (68), i.e. with *de bal* as object of *raken*) shows that scrambling overgenerates in this respect.

The adjuncts-as-complements analysis, does not have this problem, as it does not presuppose that arguments can be reordered freely. Instead, it assumes a lexical mechanism that allows adjuncts to be added to DEPS. Neeleman (1994) proposes a transformational analysis where adjuncts may be added to verbal projections at D-structure, and where selection of arguments, by means of θ-role assignment, is formulated so as to allow adjuncts to intervene between predicates and arguments at D-structure. This seems to be a transformational analogue of the analysis proposed here.

7 A constraint on word order and scope

A number of authors have observed that, while the position of adjuncts in the Mittelfield appears to be relatively free, there is a strong relation between the position of an adjunct and its potential to take scope over other adjuncts and arguments. In this section, I review the data and point out that constraints on scope can be observed both in simple clauses and in clauses containing a verb cluster, where adjuncts and arguments may be licenced by different verbal predicates.

A constraint on the scope of elements on DEPS is proposed, which has the effect that adjuncts may only take scope over other dependents to their right. The constraint generalizes over clauses with a single predicate and verb clusters. It rules out the apparent cases of overgeneration of the account so far.

7.1 Multiple adjuncts

If a clause contains two adjuncts in the Mittelfeld, reordering of the adjuncts has an effect on scope:

(72) a. dat Jan **met tegenzin vaak** pizza eet
that John unwillingly often pizza eats
that John unwillingly often eats pizza

b. dat Jan **vaak met tegenzin** pizza eet
that John often unwillingly eats pizza

Ackema and Neeleman (to appear) present the following example:

(73) dat we **in die dagen volgens Marleens plan** op vakantie gingen
that we in those days according to Marleen's plan on holiday went
that we used to go on holiday in accordance with Marleen's plan in those days

(74) dat we volgens Marleens plan in die dagen op vakantie gingen
that, in accordance with Marleen's plan, we went on holiday in that period

They conclude that, in the Mittelfeld, the relative scope of adjuncts is strictly determined by word order, with the leftmost adjunct always taking scope over any following adjuncts. Ackema and Neeleman (to appear) also present the following example:

(75) dat ik Jan het project **regelmatig gedurende een tijdje** zag hinderen
that I Jan the project regularly for some time saw hamper

They observe that in this example, the adverb *regelmatig* has to take scope over the phrase *gedurende een tijdje* (76a). Note, however, that the example actually contains a verb cluster. The adjuncts can therefore in principle take scope over either the matrix verb *zien* or the embedded verb *hinderen*. The narrow scope reading for both adjuncts seems possible (76b), as well as the reading where *regelmatig* takes wide scope over the matrix verb and *gedurende een tijdje* takes narrow scope (76c). The reading where both take wide scope seems semantically odd, but not impossible in principle (76d). Readings where the adjunct *gedurence een tijdje* takes wider scope than *regelmatig* are completely excluded, however (76e-g).

(76) a. *that I regularly saw Jan hamper the project for some time*

b. *that I saw Jan regularly for some time hamper the project*

c. *that I regularly saw Jan for some time hamper the project*

d. ? *that I regularly for some time saw Jan hamper the project*

e. **that, for some time, I regularly saw Jan hamper the project*

f. **that I saw Jan for some time regularly hamper the project*

g. **that I for some time saw Jan regularly hamper the project*

The example shows that the observation that adjunct scope follows word order applies both to adjuncts modifying the same predicate and to adjuncts in the Mittelfeld modifying different predicates.

The following examples also demonstrate the similarity of simple clauses and clauses containing a verb cluster in this respect.

(77) a. dat de speler de bal **waarschijnlijk snel** afspeelt
that the player the ball probably quickly passes
that the player probably passes the ball quickly

b. dat de speler **waarschijnlijk snel** de bal afspeelt

c. dat de speler **waarschijnlijk** de bal **snel** afspeelt

d. *dat de speler de bal **snel waarschijnlijk** afspeelt

e. *dat de speler **snel waarschijnlijk** de bal afspeelt

f. *dat de speler **snel** de bal **waarschijnlijk** afspeelt

Examples (77a-c) illustrate that adverb combinations may precede or follow the direct object. Examples (77d-f) show that manner adverbs cannot precede an operator adverb. This is probably due to the lexical semantics of manner adverbs. Manner adverbs tend to co-occur only with specific verbal predicates. If a modal adverb intervenes, and if adjunct scope follows word order, the manner adverb would modify the semantics of the adverb rather than the verbal predicate. This leads to semantic anomaly.

Example (78) shows that exactly the same orders are possible in clauses with a verb cluster.

(78) a. dat de speler de bal **waarschijnlijk snel** leert afspelen
that the player the ball probably quickly learns pass
that the player probably learns to quickly pass the ball
that the player probably quickly learns to pass the ball

b. dat de speler **waarschijnlijk snel** de bal leert afspelen

c. dat de speler **waarschijnlijk** de bal **snel** leert afspelen

d. *dat de speler de bal **snel waarschijnlijk** leert afspelen

e. *dat de speler **snel waarschijnlijk** de bal leert afspelen

f. *dat de speler **snel** de bal **waarschijnlijk** leert afspelen

In this case, the manner adverb may either modify the matrix verb or the embedded verb.[10] Under a reading where the modal adverb modifies the matrix verb *leert*, and the manner adverb *snel* modifies *afspelen*, one can only explain the ungrammaticality of (78d-f) if constraints on the scope of adjuncts apply to adjuncts licenced by different verbal predicates as well.

The conclusion of this section is that, although adjuncts of a matrix predicate may freely mix with arguments of a lower clause in Dutch verb raising constructions, they may not follow adjuncts of the lower clause. A potential explanation for this fact requires that the constraint which accounts for the fact that adjunct scope follows word order, applies to adjuncts of a single predicate as well as to adjuncts which are licenced by different members of a verb cluster.

7.2 Scope of adjuncts and arguments

Although adjuncts can mix with arguments rather freely in Dutch, the various word order possibilities do have an effect on semantics. Much of the literature on object scrambling is concerned with the question how to characterize the semantic effects of scrambling exactly. Here, I will focus on scope effects only.

The following example illustrates that the scope of an adjunct in the Mittelfeld depends on its position with respect to other arguments:

(79) a. dat Kim **regelmatig** twee computers verplaatst
that Kim regularly two computers moves
that Kim regularly moves two computers
that there are two computers which Kim moves regularly

b. dat Kim twee computers **regelmatig** verplaatst
that there are two computers which Kim moves regularly

The adverb may only take scope over the indefinite argument NP if it precedes the argument. Ruys (2001) notes that a similar effect can be observed in the context of intensional predicates:

(80) a. dat Jan **met een verrekijker** een eenhoorn zoekt
that Jan with binoculars a unicorn seeks
that, with binoculars, Jan searches for a unicorn

b. dat Jan een eenhoorn **met een verrekijker** zoekt
that there is a unicorn which John seeks with binoculars

The first example is ambiguous between a *de dicto* and *de re* reading for the existential, whereas the second only has a *de re* reading.

In those cases where a subject can be non-initial, the interaction of word order and scope can also be demonstrated for subjects.

(81) dat er **regelmatig** een dokter bij Kim op bezoek komt
that there regularly a doctor at Kim on visit comes

[10] A narrow scope reading of the modal adverb is again excluded for lexical semantic reasons, i.e. the object of learning can be an verbal predicate, but is unlikely to be a modal predicate.

that regularly, a doctor visits Kim

that there is a doctor which regularly visits Kim

(82) dat een dokter **regelmatig** bij Kim op bezoek komt
that a doctor regularly at Kim on visit comes

that there is a doctor which regularly visits Kim

The first example, involving an existential *there* construction, is ambiguous, whereas in the second example only the wide scope reading for the subject is possible.

The observations concerning adjunct and argument scope apply to verb clusters as well.

(83) a. dat Kim **regelmatig** minstens twee computers moet repareren
that Kim regularly at least two computers must repair

that Kim regularly has to repair at least two computers

that there are at least two computers which Kim has to repair regularly

b. dat Kim minstens twee computers **regelmatig** moet repareren

that there are at least two computers which Kim has to repair regularly

(84) a. dat Jan **waarschijnlijk** een pizza wil bestellen
that Jan probably a pizza wants order

that Jan probably wants to order a pizza

that there is a pizza which Jan probably wants to order

b. dat Jan een pizza **waarschijnlijk** wil bestellen

that there is a pizza which Jan probably wants to order

(85) a. dat ik Kim **regelmatig** minstens twee computers zie verplaatsen
that I Kim regularly at least three computers see move

that I regularly see Kim move at least two computers

that I see Kim move regularly at least two computers

that there are at least two computers, which I regularly see Kim move

that there are at least two computers, which I see Kim regularly move

b. dat ik Kim minstens twee computers **regelmatig** zie verplaatsen

that there are at least two computers, which I regularly see Kim move

that there are at least two computers, which I see Kim regularly move

The examples illustrate that the interaction between adjunct and argument scope applies equally to cases where an adjunct and an inherited argument co-occur in the Middlefield. Example (85b) is ambiguous where the scope of the adverb with respect to the matrix predicate is concerned. Under both readings, however, the adverb may not take scope over a preceding argument.

7.3 A semantic constraint on dependency structure

The observations in the two preceding paragraphs suggest that adjunct scope needs to be constrained in such a way that adjuncts may not take scope over preceding adjuncts and

arguments. Furthermore, the constraint should generalize over both simple clauses and clauses with verb clusters.

The adjuncts-as-complements analysis treats adjuncts and arguments as lexically selected dependents of a verbal predicate. Furthermore, I have assumed that the order of elements on DEPS directly reflects word order in the Mittelfeld. Scope ambiguities are accounted for in underspecified semantics by assuming that the constraints on the logical form of a phrase leave room for different hierarchical orderings of the semantic elements which give rise to the ambiguity. Constraining the scope of adjuncts so that they may not take scope over preceding dependents (arguments or adjuncts) can therefore be achieved by imposing additional constraints on the scope of adjuncts, relative to their position on DEPS.

The following constraint on verbal lexical entries implements this:

(86) $$\left[\begin{array}{ll} \textit{word} & \\ \textsc{deps} & \left\langle \ldots, \boxed{1}\left[\textsc{head} \mid \textsc{main}\ \boxed{2}\right], \ldots, \boxed{3}\left[\textsc{head} \mid \textsc{main}\ \boxed{4}\right], \ldots \right\rangle \\ \textsc{arg-st} & \boxed{5} \\ \& & \boxed{2} \lhd \boxed{4} \end{array}\right] \rightarrow \boxed{3} \in \boxed{5}$$

The idea is that for each pair A, B, of elements on DEPS: if B follows A and outscopes A, B must be an argument (i.e. a member of ARG-ST). This basically ensures that adjuncts can only scope over depedents which follow them on DEPS, while it does not impose such a constraint on arguments. Note that the constraint prevents adjuncts from taking scope over preceding adjuncts as well as over preceding arguments. Arguments, on the other hand, can still take arbitrary scope.

Consider the lexical entry for the verb *eet* in (87), for example. It will contain a DEPS list containing two adjuncts (eventually instantiated with the MAIN values given) and a direct object (88). The constraint in (86) prevents the adjunct *met tegenzin* to take scope over *vaak*.

(87) dat Jan **vaak met tegenzin** pizza eet
that John often unwillingly eats pizza

(88) $$\left[\begin{array}{ll} \textsc{deps} & \langle \boxed{1}, \left[\textsc{hd}\ \left[\textsc{main}\ \ \text{often}(e)\right]\right], \left[\textsc{hd}\ \left[\textsc{main}\ \ \text{unwillingly}(e)\right]\right], \boxed{2} \rangle \\ \textsc{arg-st} & \langle \boxed{1}\text{NP}, \boxed{2}\text{NP} \rangle \end{array}\right]$$

An example involving a verb cluster is given in (89). If both adjuncts are introduced on either the matrix verb or the embedded verb, the scope constraint clearly prevents a reading where *waarschijnlijk* takes scope over *snel*. The situation where *waarschijnlijk* is introduced on the matrix verb, and *snel* is inherited is sketched in (90).

(89) *dat de speler de bal **snel** **waarschijnlijk** leert afspelen
that the player the ball quickly probably learns pass

(90) $$\left[\begin{array}{ll} \textsc{deps} & \langle \boxed{1}, \boxed{2}, \boxed{3}, \left[\textsc{hd}\ \left[\textsc{main}\ \ \text{probably}(e)\right]\right], \boxed{4} \rangle \\ \textsc{arg-st} & \langle \boxed{1}\text{NP}, \boxed{2}\text{NP}, \boxed{3}\left[\textsc{hd}\ \left[\textsc{main}\ \ \text{quickly}(e)\right]\right], \boxed{4}\left[\textsc{comps}\ \ \langle \boxed{2}, \boxed{3} \rangle\right] \rangle \end{array}\right]$$

Here, *waarschijnlijk* cannot take scope over *snel*, as *waarschijnlijk* is not an argument.

The fact that argument inheritance is implemented using ARG-ST instead of DEPS may suggest that inherited adjuncts are mistakenly treated as arguments in (86). While this is true in principle, no overgeneration results, as the scope of inherited adjuncts is always restricted to the TOP of the verb which introduces them. Thus, an inherited adjunct can never scope over a matrix verb (or any of its arguments) to begin with.[11]

The constraint proposed above only restricts the scope of adjuncts. It is compatible, however, with a proposal for German in Kiss (2001). Kiss argues that in clauses with a canonical word order, i.e. SUBJ < I-OBJ < D-OBJ, scope follows linear order. The scope of an adverb, which can intervene between any of the arguments, is also strictly determined by linear order. Ambiguity arises only in cases where there is a mismatch between obliqueness and linear order. If a subject follows the direct object, scope may either follow linear order or respect obliqueness. Steedman (2002) speculates that a similar situation might hold for certain Dutch constructions as well.

8 Conclusions

In this paper, a lexicalist, surface-oriented, account of adjunct word order and scope in the Mittelfeld has been proposed. It differs from most of the transformational literature by not assuming a *scrambling* transformation, or alternative mechanism, for reordering arguments. Instead, it has been assumed that adjuncts may be freely inserted in the lexical dependency structure of verbal predicates. While most of the literature on scrambling has focussed on simplex clauses, I have argued that constraints on the relative scope of adjuncts and arguments generalize to clauses involving verb clusters as well. Adjunct scope in the Mittelfeld strictly follows word order. In the analysis proposed here, which combines a lexical treatment of adjunct selection with underspecification semantics, this constraint can be expressed as a general constraint on the dependency structure of lexical entries.

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[11] A more elegant account can perhaps be obtained by following the suggestions in de Kuthy and Meurers (2001) (see also footnote 4). Another option is to introduce a binary feature to distinguish between arguments and adjuncts.

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