West-Germanic Verb Clusters in LFG

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1. Introduction

In a previous paper (Zaenen and Kaplan, 1995; henceforth ZK) we developed a general LFG account of West Germanic sentence structure, concentrating on the order of nominal arguments in the forefield and the middlefield. The account was based on the interactions between functional uncertainty equations, functional precedence constraints, and phrase structure rules. It proposed general rules for non-extraposed, extraposed and third-construction infinitival complements. In this paper we start from that account and refine the proposed rule set to account for the order and form variation found in Dutch and German verb clusters.

2. West Germanic Infinitival Complements as described in ZK: Dutch

Ignoring adjunct material, embedded extraposed and non-extraposed clauses in Dutch can be represented by the annotated phrase structure rules in (1) and lexical entries of the type illustrated in (2). Rules (1a) and (1b) correspond to ZK (27) and ZK (13) respectively, and the lexical entries correspond to ZK (3).

(1) a. $\quad$ VP $\rightarrow \qquad$ NP* $\qquad$ V' $\qquad$ (VP)
$\qquad\qquad$ $(\uparrow \{\text{XCOMP}|\text{COMP}\}^* \text{ NGF}) = \downarrow$ $\qquad$ $(\uparrow \text{XCOMP}^* \text{ COMP}) = \downarrow$

$\quad$ b. $\quad$ V' $\rightarrow \quad$ V $\qquad\qquad$ (V')
$\qquad\qquad\qquad\qquad$ $(\uparrow \text{XCOMP}) = \downarrow$
$\qquad\qquad$ $(\uparrow \text{XCOMP}^+ \text{ NGF}) \neg <_f (\uparrow \text{NGF})$

(2) a. $\quad$ willen $\qquad$ $(\uparrow \text{PRED}) = \text{'want}<(\uparrow \text{SUBJ}) (\uparrow \text{XCOMP})>'$
$\qquad\qquad\qquad$ $(\uparrow \text{SUBJ}) = (\uparrow \text{XCOMP SUBJ})$

$\quad$ b. $\quad$ laten $\qquad$ $(\uparrow \text{PRED}) = \text{'let}<(\uparrow \text{SUBJ}) (\uparrow \text{XCOMP})>(\uparrow \text{OBJ})'$
$\qquad\qquad\qquad$ $(\uparrow \text{OBJ}) = (\uparrow \text{XCOMP SUBJ})$

c.   studeren $(\uparrow$ PRED$) =$ 'study$<(\uparrow$ SUBJ$)$ $(\uparrow$ OBJ$)>$'

As motivated by ZK, rule (1a) provides a flat constituent structure for zero or more NP's in the middlefield and relies on the functional uncertainty equation $(\uparrow$ {XCOMP|COMP}$*$ NGF$) = \downarrow$ to assign each NP to some nominal grammatical function (drawn from the set SUBJ, OBJ, … denoted by NGF) in an f-structure that can be reached on a path consisting of an indeterminate number of XCOMPs and/or COMPs. This specification by itself does not correlate the linear position of a particular NP with the depth of embedding of the verb that it can relate to. The (somewhat loose) correlation between NP position and level of embedding is provided by the verb-cluster rule (1b). This rule provides a right-branching structure for the verbs in a V' cluster, and the next lower verb becomes the head of the XCOMP assigned at each level (by virtue of the equation $(\uparrow$ XCOMP$) = \downarrow$). The f-precedence requirement $(\uparrow$ XCOMP^{+} NGF$) \neg <_f (\uparrow$ NGF$)$ imposes a simple constraint on the relation between the NP's and the verbs. Of all the ways that rule (1a) allows particular NP's to be linked to particular verbs, those possibilities in which an NP linked to a lower verb via XCOMP+ NGF comes before an NP linked to a higher predicate are unacceptable. The negative statement of the precedence condition, as ZK explain, gives the desired result in the vacuous cases when particular nominal functions are not present in a given sentence.

The lexical entries in (2) classify both *willen* and *laten* as verbs that take functionally-controlled open complements. The functional control equation $(\uparrow$ OBJ$) = (\uparrow$ XCOMP SUBJ$)$ marks the fact that *laten's* object serves as the understood subject of its complement, while the SUBJ of *willen* plays that complement role.   *Laten* is also a raising verb, since the $(\uparrow$ OBJ$)$ appears outside the angle brackets that enclose the thematic arguments in its semantic-form. *Willen* is marked as an equi verb since its subject is included within the thematic argument list.

These rules and lexical entries will analyze sentences like the following:

```
(3)  …dat  Jan  Marie geneeskunde wil    laten studeren.
     …that John Marie medicine     wants let   study.

     …that John wants to let Marie study medicine.
```

The sentence in (3) will be associated with the c-structure and corresponding f-structure in (4).[1] This diagram shows in addition the structural correspondence mapping between the nodes of the phrase structure and the units of the f-structure; this correspondence plays a crucial role in the formal definition of f-precedence that we give below.

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[1] We are agnostic about the difference between S and VP nodes in Dutch. Here they are collapsed, in other places we have distinguished them, but this c-structure distinction plays no role in our analysis.

(4)

S'

dat   S/VP

NP   NP   NP   V'

Jan   Marie   geneeskunde   V   V'

wil   V   V'

laten   V

studeren

$$\begin{bmatrix} \text{PRED} & \text{'want'} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'Jan'} \end{bmatrix} \\ \text{XCOMP} & \begin{bmatrix} \text{PRED} & \text{'let'} \\ \text{SUBJ} & [\ ] \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'Marie'} \end{bmatrix} \\ \text{XCOMP} & \begin{bmatrix} \text{PRED} & \text{'study'} \\ \text{SUBJ} & [\ ] \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'medicine'} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

ZK note that the optional VP at the end of rule (1a) also provides for extraposed complements, as in (5a), and the COMP alternative in the NP functional uncertainty equation offers a simple account of the Third Construction (5b). We briefly discuss these sentence patterns later on in this paper, after we have examined the range of verb-cluster variations.

(5)   a.   …dat   Jan heeft getracht Marie te helpen.
         …that Jan has   tried   Marie to help.
      b.   …dat   Jan Marie heeft getracht te helpen.
         …that John Marie has   tried   to help.

         …that John has tried to help Marie.

We begin by reviewing the formal properties of functional uncertainty and f-precedence, the key elements of our verb-cluster analysis. Functional uncertainty is the standard formal device in LFG for characterizing dependencies that relate functional units expressed by constituents that do not stand in a locally specifiable phrase-structure configuration. Kaplan and Zaenen (1989) introduced this device originally to give a natural, functional account of the long-distance dependencies that appear in topicalization, questions, and relative clauses, but it has found many other uses (see e.g. Dalrymple, 1993, Nordlinger, 1998). Functional uncertainty is a straightforward extension to the basic mechanism for describing simple functional relationships in LFG. A basic equation such as ($\uparrow$ XCOMP) = $\downarrow$ appearing in a phrase-structure rule is satisfied just in case the f-structure corresponding to the mother node of the c-structure expansion (the f-structure denoted by $\uparrow$) has an XCOMP attribute whose value is the f-structure corresponding to the daughter node of the expansion (the $\downarrow$ f-structure).

The problem with long distance dependencies is that the relationship between two f-structures is not determined uniquely by the positions of the phrasal constituents to which they correspond. Consider the topicalized sentences in (6):

(6) Mary John likes.
    Mary John says that Bill likes.
    Mary John says that Bill believes that Henry likes.
    Mary John says that …

In the first one *Mary* is understood both as the TOPIC of the sentence and also as the OBJ of *likes*. The equation ($\uparrow$ OBJ) = $\downarrow$ associated with the fronted *Mary* NP would properly characterize this within-clause relationship. In the second one *Mary* is still understood as the object of *likes*, but *likes* is now the predicate of a complement of the higher verb *says*, and the appropriate annotation for defining *Mary*'s within-clause function would be ($\uparrow$ COMP OBJ) = $\downarrow$. For the third sentence the equation would be ($\uparrow$ COMP COMP OBJ) = $\downarrow$, and in general for every additional level of embedding that might happen to be in the main clause, the path of functions appropriate for *Mary* would be lengthened with an additional COMP. The uncertainty in how to annotate the fronted NP comes from the fact that there is no information available at its surface position to determine exactly which of these possible equations correctly captures its functional relationship to the embedded clause.

Functional uncertainty provides a simple way of defining a family of equations while still leaving open the choice of exactly which member of the family will turn out to be consistent with an embedded f-structure. For this particular construction, the equations in the family all have functional paths that belong to the regular language COMP* OBJ, and the infinite family of appropriate equations can be specified in the single constraint ($\uparrow$ COMP* OBJ) = $\downarrow$. In the general case, suppose that f and g are f-structures and that α is an expression denoting a regular language of functional paths. Then we assert that

(7)   (f α) = g holds if and only if (f x) = g holds for some string x in the language α.

Kaplan and Zaenen (1989) give a somewhat more precise definition and discuss an initial set of linguistic applications for this device; Kaplan and Maxwell (1988a) show that it has attractive mathematical and computational properties.

Functional uncertainty is a general descriptive mechanism that need not be restricted to the binding of fronted phrases. As we have seen, it is used in rule (1a) to characterize the functional relation between a constituent in a flat c-structure middlefield and a governing verb that can be embedded in the c-structure indefinitely far away in the verb-cluster. A nice result is that the functional uncertainty in (1a) interacts with LFG's formal account of constituent coordination (Kaplan and Maxwell, 1988b) to allow for sentences such as (8) (originally due to M. Moortgat,

p.c.) where *een liedje* is the OBJ of *schreef* and of *verkopen* in spite of the fact that these verbs are at different levels of embedding.

(8) …dat Jan een liedje schreef en trachtte te verkopen.
     …that John a song wrote and tried to sell.

     …that John wrote and tried to sell a song.

Rule (1a) uses functional uncertainty to associate the NP's in a flat middlefield with argument positions in the predicate hierarchy. But because there is no c-structure hierarchy to mirror the f-structure dependencies, the linear ordering constraints that are naturally imposed by phrase-structure rules cannot be used to relate the c-structure order of the NP's to their positions in the functional hierarchy. Linear order constraints under these circumstances must be stated in terms of a combination of c-structure and f-structure properties. In rule (1b) we have used the functional precedence relation (f-precedence, notated as $<_f$) as a natural way of picking out the right configurations.

Left-to-right precedence is a native relation among the words and phrases of a c-structure tree, but it is not a native relation among the parts of an f-structure. But as illustrated in (4), LFG establishes a correspondence between nodes in the c-structure and units of the f-structure, and the image of c-structure precedence under the mapping from c-structure to f-structure induces an ordering relation on the f-structure. Its formal definition is given in (9).

(9)   For any f-structures f and g, f f-precedes g ($f <_f g$) if and only if all the c-structure nodes that map to f precede all the c-structure nodes that map to g.

F-precedence was exploited originally in the analysis of null-anaphora and weak crossover (Bresnan, 1995; Kameyama, 1989; Dalrymple et al., 2001). In ZK and here we use it to impose the proper ordering constraints on the elements in the middlefield, as this order depends on the level of f-structure embedding of the governing verb[2]. We observed that the constraint ($\uparrow$ XCOMP$^+$ NGF) $\neg <_f$ ($\uparrow$ NGF) is satisfied by the c-structure/f-structure configuration in (4). If we switch the order of the NP's as in (10), the string is still grammatical but the f-structure in (4) is no longer assigned to it. The only possible interpretation has *Marie*, not *Jan*, serving as the subject of the highest (left-most) predicate.

(10)   …dat Marie Jan geneeskunde wil   laten studeren.
       …that Marie Jan medicine   wants let   study.

     * …that John wants to let Marie study medicine.

---

[2] The annotations in (1b) do not specify the order of the grammatical functions of a single verb. They can be ordered by adding other f-precedence requirements to the V' rule, for instance ($\uparrow$ OBJ) $\prec$ ($\uparrow$ OBJ2) for Dutch,. In German such requirements are most likely better associated with the lexical item as there are different orders depending on different lexical classes.

```
…that Marie wants to let John study medicine.
```

The analysis in ZK also uses f-precedence to account for the order of the nominal complements in Swiss German. Their account of Swiss German assigns a flat as opposed to a right-branching structure for the sequence of NP's and verbs. ZK observe that certain topicalization facts argue against such a flat structure for the verb cluster in Dutch.

3. Variation in the order of verbal elements in Dutch

ZK do not discuss the difference between participles and infinitives nor the different orders that are possible within the verbal complex. In the following sections we give an overview of the facts and propose extensions to our rules to cover them.

3.1 Properties of verbs taking non-tensed verbal complements

It is useful to subdivide the Dutch verbs that take non-tensed verbal complements (henceforth NTV) according to distinctions on three dimensions that only partially coincide: the morphological dimension, the functional dimension, and the c-structure dimension. The morphological dimension specifies the morphological form of the verbal complement, the functional dimension specifies its syntactic function, COMP or XCOMP in the cases under discussion, and the c-structure dimension determines whether the verb is part of a verb cluster or not.

We describe these dimensions first and then discuss the constraints that account for the range of verb-cluster phenomena.

VERBAL COMPLEMENTS: MORPHOLOGICAL DISTINCTIONS

Morphologically, the verbal complements of an NTV can be participles, bare infinitives or *te-*infinitives. These morphological alternatives will be marked by the value of the VFORM feature in the f-structure that corresponds to the verb. We assume that *te* is a morphological element, just like the *ge-* of the participle, but which accidentally is not written as forming one word with the following infinitive. The four possible values of the VFORM feature are specified by the equations in (11); these are associated by a separate morphological component with the proper verb forms:

(11) a. $(\uparrow$ VFORM$) =$ PART   for participles
      b. $(\uparrow$ VFORM$) =$ INF   for bare infinitives
      c. $(\uparrow$ VFORM$) =$ TE-INF   for *te* infinitives
      d. $(\uparrow$ VFORM$) =$ TENSED   for all tensed forms

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The lexical entries for different classes of NTV verbs then select for the different morphological forms of their complements by virtue of the constraints in (11a):

(12)   a.   ($\uparrow$ XCOMP VFORM) $\in$ {PART, INF}   for auxiliaries
       b.   ($\uparrow$ XCOMP VFORM) = INF   for modals, causatives, perception verbs…
       c.   ($\uparrow$ XCOMP VFORM) = TE-INF   for other NTV verbs.

VERBAL COMPLEMENTS: FUNCTIONAL DISTINCTIONS

Verbal complements in LFG fall into two broad classes: XCOMPs and COMPs. XCOMP is an open function whose subject is functionally controlled by a function of the higher governing verb. With the COMP function there is no functional control, but we can have either an overt subject or a silent pro subject. In Dutch and German, COMPs with overt subjects are tensed embedded clauses, e.g. that-clauses, whereas the COMPs with silent pro subjects are the extraposed *te*-infinitives as illustrated in (13)

(13)   …omdat hij beloofd heeft een liedje te zingen.
      …because he promised has a song to sing.

      …because he promised to sing a song

Infinitival COMPs are always cases of equi-constructions. The relevant part of a lexical entry for a verb like *beloven* is given in (14)

(14)   ($\uparrow$ PRED) = 'beloven<($\uparrow$ SUBJ)($\uparrow$ COMP)>'
        ($\uparrow$ XCOMP SUBJ PRED) = 'PRO'

The various non-extraposed verbal complements are XCOMPs[3]. The difference between XCOMPs and COMPs is motivated by the possibility of an impersonal passive[4], as illustrated by the contrast in (15):

(15)   a.   Er   werd geprobeerd een liedje te zingen.
           There was   tried   a   song   to sing.
      b. * Er   werd een liedje proberen te zingen.

---

[3] It is possible to argue that in auxiliary and perhaps even in some modal constructions, the tensed verbs are in fact the head of the construction. See Butt, Niño and Segond (1996) and Frank and Zaenen(2002) for some discussion. This would complicate but not substantially change the analysis proposed here.

[4] Klaus Netter (p.c.) has argued that sentences like () are actually personal passives with an extraposed sentential subject. We could then assign the obj function to the active sentence, extending an analysis proposed for tensed German prepositional complements in Dalrymple and Lødrup (2000). Again, this analysis would not change the account substantially but it would require us to go further into a discussion about the typology of functions in LFG which we don't have space for here.

```
There was    a    song    try      to sing.

(Somebody) tried to sing a song.
```

Proberen is one of the verbs that can have a COMP or an XCOMP as illustrated in (16), but only the extraposed variant allows an impersonal passive.

```
(16) a.   …omdat   hij een liedje heeft proberen te zingen.
          …because he  a   song  has   try      to sing.
     b.   …omdat   hij geprobeerd heeft een liedje te zingen.
          …because he  tried      has   a   song   to sing.

     …because he has tried to sing a song.
```

This analysis was first proposed for Dutch by Schuurman (1987) and also adopted by Berman (2001) for German.

A different argument for the COMP/XCOMP distinction can be derived from the observation made in Evers (1975), that unstressed pronouns in the middlefield cannot be linked to argument positions in extraposed COMPs (extraposed infinitivals or tensed subordinate clauses).

```
(17) a. * …dat  zij 't heeft getracht te doen.
           …that she it has   tried    to do.
     b.   …dat  zij 't heeft trachten te doen.
          …that she it has   try      to do.

          …that she has tried to do it.
```

XCOMPs can appear in either equi or raising constructions. (16a) illustrates a subject equi case. The following examples illustrate object equi, subject raising, and object raising.

```
(18) …omdat    zij hem een liedje heeft helpen zingen.
     …because she him a   song   has   help   sing.

     …because she has helped him to sing a song.
```

```
(19) …omdat    hij een liedje scheen te willen zingen.
     …because he  a   song   seemed to want   sing.

     …because he seemed to want to sing a song.
```

```
(20) …omdat    Jan  de  kinderen een liedje hoorde zingen.
     …because John the children a   song   heard  sing.
```

```
…because John heard the children sing a song.
```

The relevant parts of the lexical entries are as given in (21)

(21) a. object control: (↑ PRED) = 'predicate<(↑ SUBJ) (↑ OBJ)(↑ XCOMP)>'
                             (↑ OBJ) = (↑ XCOMP SUBJ)

      b. subject control: (↑ PRED) = 'predicate<(↑ SUBJ) (↑ XCOMP)>'
                             (↑ SUBJ) = (↑ XCOMP SUBJ)

      c. subject raising: (↑ PRED) = 'predicate<(↑ XCOMP)>(↑ SUBJ)'
                             (↑ SUBJ) = (↑ XCOMP SUBJ)

      d. object raising: (↑ PRED) = 'predicate<(↑ SUBJ) (↑ XCOMP)>(↑ OBJ)'
                             (↑ OBJ) = (↑ XCOMP SUBJ)

We will assume that the causatives and the perception verbs are object raising verbs. For some of these, however, other analyses have been proposed, especially complex predicate analyses. We follow Rambow (1997)'s conclusion for German that, at least under the LFG conception of complex predicates (see Butt, 1996, and Alsina, 1996), these do not fall into that category.

VERBAL COMPLEMENTS: C-STRUCTURE DISTINCTIONS

A third way verbs can be classified is whether they can combine with the head of their verbal complement to form a verbal cluster or whether they require it to be extraposed. We will call the first class *clustering* and the second *extraposing*. We assume that the clustering verbs have a feature CLUS, specified by an equation (↑ CLUS) = + in their lexical entries. Verbs that take participles or bare infinitives as their complements always have this feature but verbs that take *te*-infinitives can be either clustering or extraposing and may or may not have this feature. As we have seen above (16), a single verb can fall into both categories, but if it does, there will be a difference in its functional complement structure. The occurrence of extraposed or non-extraposed verbs is correlated with their functional complements by virtue of the phrase-structure rule (1a). As we will see in the next section, we cannot say that the clustering/extraposing distinction coincides with the distinction of taking an XCOMP or COMP.

3.2 Restrictions within the verbal cluster

MORPHOLOGICAL RESTRICTION: INFINITIVUS PRO PARTICIPIO

The most salient morphological phenomenon is the alternation between the participle and the infinitive for the complements of auxiliary verbs. The following examples illustrate this behavior:

(22) a. …dat Jan een liedje heeft gezongen.
         …that John a   song   has   sung.

                   …that John has sung a song.

     b. …dat Jan een liedje wil hebben gezongen.
          …that John a   song   wants to have sung.

                   …that John wants to have sung a song.

     c. …dat Jan een liedje heeft willen zingen.
         …that John a   song   has   want sing.

                   …that John has wanted to sing a song.

     d. …dat Jan heeft gehoopt een liedje te zingen.
         …that John has   hoped   a   song   to sing.

                   …that John has hoped to sing a song.

     e. …dat hij braaf moet zijn geweest.
         …that he good must be   been.

                   …that he must have been good.

We see here that the auxiliary *hebben* takes a participle complement when the complement consists of one verb (22a-b), but an infinitive when there is an embedded verb cluster (22c). When instead of a cluster there is an extraposed complement (22d) or a non-verbal complement (22e), the participle is again used. We can insure this behavior by attaching the following constraint to *hebben* and the other auxiliary verbs:

(23)   Auxiliaries: ($\uparrow$ XCOMP VFORM) = INF $\Leftrightarrow$ ($\uparrow$ XCOMP CLUS)

If the complement verb is an infinitive, then the constraint ($\uparrow$ XCOMP CLUS) must hold. This will be satisfied if the complement verb is marked with the CLUS feature and thus does not lie at the bottom of the verbal hierarchy. Otherwise, by virtue of (12a) the complement verb must be a participle and in that case it must be the lowest verb. Note that in the case of non-verbal XCOMPs the bottom verb behaves as non-clustering, as illustrated by the adjectival XCOMP complement in (22e). This is why the feature CLUS is not redundant with the XCOMP function.

ORDERING CONSTRAINTS IN THE VERB CLUSTER

Auxiliary, modal and modal-like constructions

Apart from the traditional modals there are a certain number of other verbs in Dutch that take bare infinitives, such as perception verbs (*zien*, *horen…*) and causatives (*laten*). As far as their ordering constraints and the morphology of their complement heads, they behave the same as the modals and they also only can occur in clusters.

All verb clusters allow a right-branching structure. We will call this the canonical order. We also find left-branching structures with auxiliaries (24) and modals (25).

```
(24) a.   …dat  Jan  een liedje heeft gezongen.
          …that John a   song   has   sung.
     b.   …dat  Jan  een liedje gezongen heeft.
          …that John a   song   sung     has.

        …that John has sung a song.

(25) a.   …dat  Jan  een liedje wilde  zingen.
          …that John a   song   wanted sing.
     b.   …dat  Jan  een liedje zingen wilde.
          …that John a   song   sing   wanted.

        …that John wanted to sing a song.
```

When a complement is headed by a cluster verb, however, not all the permutations that (24) and (25) might lead one to expect are grammatical. We find the following pattern for Standard Northern Dutch:

```
(26) a.    …dat  Jan  een liedje heeft willen zingen.
           …that John a   song   has   want   sing.
     b.  *…dat  Jan  een liedje willen zingen heeft.
           …that John a   song   want   sing   has.
     c.  *…dat  Jan  een liedje zingen willen heeft.
           …that John a   song   sing   want   has.
     d.  *…dat  Jan  een liedje heeft zingen willen.
           …that John a   song   has   sing   want.

         …that John has wanted to sing a song.
```

As shown in (26), a tensed auxiliary must come before a string of infinitives, and the complement infinitives themselves have to be in their canonical right-branching order. The same is true for tensed modals, as shown in (27):

```
(27) a.   …dat  Jan  een liedje wilde  mogen       zingen.
          …that John a   song   wanted be-allowed sing.
     b. * …dat  Jan  een liedje wilde  zingen mogen.
```

```
              …that John a    song   wanted sing    be-allowed.
      c. * …dat  Jan  een liedje mogen        zingen wilde.
              …that John a    song   be-allowed sing   wanted.
      d. * …dat  Jan  een liedje zingen mogen         wilde.
              …that John a    song   sing   be-allowed wanted.

          …that John wanted to be allowed to sing a song.
```

(28) illustrates that with an infinitival auxiliary taking an infinitival complement, only the canonical order is possible.

```
(28) a.   …dat  Jan  een liedje wou     hebben mogen        zingen.
              …that John a    song   wanted have   be-allowed sing
      b. * …dat  Jan  een liedje wou     mogen         zingen hebben.
              …that John a    song   wanted be-allowed sing   have.

          …that John wanted to have been allowed to sing a song.
```

However, when the lowest verb is a participle, it can be freely ordered with respect to the other verbs (28a-c)—this is the participle "creeping" effect. (29d,e) show that the infinitive has to stay in the canonical order relative its governing modal.

```
(29) a.   …dat  Jan  een liedje zal  hebben gezongen.
              …that John a    song   will have    sung
      b.   …dat  Jan  een liedje zal  gezongen hebben.
              …that John a    song   will sung     have
      c.   …dat  Jan  een liedje gezongen zal  hebben.
              …that John a    song   sung     will have.
      d. * …dat  Jan  een liedje gezongen hebben zal.
              …that John a    song   sung     have   will
      e. * …dat  Jan  een liedje hebben gezongen zal.
              …that John a    song   have   sung     will.

          …that John will have sung a song.
```

We can summarize the data in (24)-(29) about the relative ordering of the complements of modals and auxiliaries as follows:

(30)   a. A tensed modal or auxiliary must precede the head of its complement if this head is a cluster verb (24-26).

    b. A modal or auxiliary infinitive must precede the infinitival head of its complement (27-28).

c. A participle may follow or precede any other verb in the cluster (29).

Our account of these patterns starts from the ZK verb cluster rule in (1b), repeated here for convenience in (31). This rule allows only the canonical ordering, assigning the representation in (32) to (27a).

(31) V' →   V   (V')
                    (↑ XCOMP) = ↓
              (↑ XCOMP$^+$ NGF) ¬<$_f$ (↑ NGF)

(32)
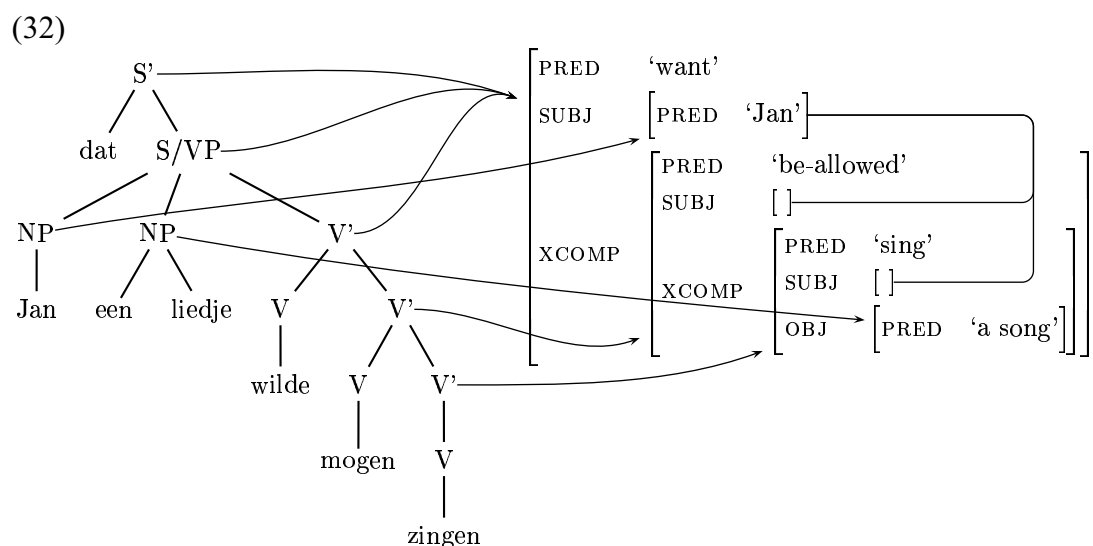
We could allow for the other ordering possibilities by elaborating the c-structure with another category to control order at the top of the cluster. Instead of doing that, we will relax the c-structure order throughout the cluster and then add functional-precedence constraints to the lexical entries of the various types of verbs. We adopt this strategy because it reflects our sense that these are idiosyncratic properties of lexical items that vary from dialect to dialect and language to language. Thus, we allow both orders in (24) and (25) by making the order in the right side of the rule in (30) optional as given in (32). Here we use a standard immediate-dominance notation; Kaplan (1989) shows that this notational extension adds nothing to the formal power of LFG.

(33) V' → [V ,   (V')   ]
                    (↑ XCOMP) = ↓
              (↑ XCOMP$^+$ NGF) ¬<$_f$ (↑ NGF)

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This rule will overgeneralize without further restrictions. It correctly prevents a higher verb (*heeft* in (34)) from appearing between two lower ones, but it incorrectly permits every governing verb to appear on either side of its complement.

```
(34)   a.  * …dat  Jan  een liedje willen heeft zingen.
              …that John a   song   want   has   sing.
       b.  * …dat  Jan  een liedje zingen heeft willen.
              …that John a   song   sing   has   want.

              …that John has wanted to sing a song.
```

The restrictions in (30a,b) are encoded by adding the following precedence constraints to the indicated lexical entries:

(35)   Tensed modals or auxiliaries: $(\uparrow \text{XCOMP CLUS}) \Rightarrow \uparrow <_f (\uparrow \text{XCOMP})$

(36)   Infinitival modals or auxiliaries: $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Rightarrow \uparrow <_f (\uparrow \text{XCOMP})$

The ordering constraint (36) on the modal and auxiliary infinitives insures that they always occur before their infinitival complements. In the case of the modals, an infinitival complement is the only possibility whereas auxiliaries can also take participles. For tensed modals and auxiliaries the canonical order is imposed by (35) only when the complement itself is a clustering XCOMP.

These constraints do not affect participles, but the phrase structure rule (33) does not allow the participle to creep leftward in the verb cluster as illustrated in (29). We remedy this with the following extension:

$$(37) \quad V' \rightarrow \quad (V) \qquad [\quad V \, , \qquad (V') \qquad \qquad]$$
$$(\downarrow \text{VFORM}) = \text{PART} \qquad (\uparrow \text{XCOMP}) = \downarrow$$
$$(\uparrow \text{XCOMP}^+) = \downarrow \qquad (\uparrow \text{XCOMP}^+ \text{NGF}) \neg <_f (\uparrow \text{NGF})$$

This rule allows a participle to appear at any position in the verbal complex; by virtue of the uncertainty it functions as an XCOMP at the current level or at some lower level in the functional hierarchy. By the restrictions discussed above, the uncertainty will always resolve to the lowest level in the cluster.

The same creeping phenomenon is found with particles:

```
(38) a. …dat  Jan  een liedje moet willen meezingen.
         …that John a   song   must want   with-sing.
     b. …dat  Jan  een liedje moet mee  willen zingen.
         …that John a   song   must with want   sing.
```

```
c. …dat   Jan   een liedje mee   moet willen zingen
   …that John  a     song    with must want    sing.

   …that John must want to sing along a song.
```

If participles and particles appear together in the same cluster, they can both creep but they do not have to be adjacent as long as the particle precedes participle, as shown in (39).

```
(39) a. …dat   Jan   een liedje meegezongen moet willen hebben
        …that John  a     song    with-sung    must want    have.
     b. …dat   Jan   een liedje mee   moet gezongen willen hebben
        …that John  a     song    with must sung     want    have.
     c. …dat   Jan   een liedje moet mee   willen gezongen hebben
        …that John  a     song    must with want    sung     have.
     d. …dat   Jan   een liedje moet willen mee   hebben gezongen
        …that John  a     song    must want    with have    sung.

        …that John must want to have sung along a song.
```

In LFG, Dutch particles belong to the post-position morphological category PostP and they contribute the feature PRT to the f-structure of their head. We add this category to the beginning of our phrase structure rule with an uncertainty that allows for the leftward creep:

$$
\text{(40)} \quad \text{V'} \rightarrow \quad \text{(PostP)} \qquad\qquad \text{(V)} \qquad\quad [\ \text{V} \quad , \qquad \text{(V')} \qquad\quad]
$$

$$
(\uparrow \text{XCOMP}^+ \text{PRT}) = \downarrow \quad (\downarrow \text{VFORM}) = \text{PART} \qquad\qquad (\uparrow \text{XCOMP}) = \downarrow
$$

$$
(\uparrow \text{XCOMP}^+) = \downarrow \qquad\qquad (\uparrow \text{XCOMP}^+ \text{NGF}) \neg <_f (\uparrow \text{NGF})
$$

$$
\downarrow \neg <_f (\downarrow \text{PRT})
$$

The precedence constraint now attached to the participle verb asserts that the participle verb cannot come before its particle.[5] In this case the constraint is stated in the negative to cover the vacuous case where there is no particle to associate with the verb.

Equi verbs and raising verbs with te in verb cluster constructions

With clustering equi verbs and raising verbs whose complement head is a *te* infinitive , the situation is rather simple: the equi or raising verb only allows right branching[6], modulo the behavior of the participle already described in the previous section. This is illustrated in the

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[5] We do not discuss here the separate issue of exactly how particle and its head mutually select each other.

[6] The grammatical pattern illustrated in (i) involves the derde constructie

```
(i)      …dat Jan een liedje heeft geprobeerd te zingen
       * …dat Jan een liedje geprobeerd te zingen heeft
       * …dat Jan een liedje geprobeerd heeft te zingen
```

following examples. The pattern for subject-raising verbs is shown in (41) and (42) and (43) illustrates the behavior of subject equi verbs.

(41) a.   …dat Jan   een liedje schijnt te zingen.
         …that John a   song   seems   to sing.
   b. * …dat Jan   een liedje te zingen schijnt.
         …that John a   song   to sing   seems.
   c.   …dat Jan   een liedje schijnt te willen zingen.
         …that John a   song   seems   to want   sing.
   d. * …dat Jan   een liedje schijnt te zingen willen.
         …that John a   song   seems   to sing   want.

         …that John seems to want to sing a song.

(42) a.   …dat Jan   een liedje schijnt te hebben gezongen.
         …that John a   song   seems   to have sung.
   b.   …dat Jan   een liedje schijnt gezongen te hebben.
         …that John a   song   seems   sung   to have.
   c.   …dat Jan   een liedje gezongen schijnt te hebben.
         …that John a   song   sung   seems   to have.

         …that John seems to have sung a song.

(43) a.   …dat Jan   een liedje probeert te zingen.
         …that John a   song   tries   to sing.
   b. * …dat Jan   een liedje te zingen probeert.
         …that John a   song   to sing   tries.

         …that John tries to sing a song.

   c.   …dat Jan   een liedje probeert te mogen   zingen.
         …that John a   song   tries   to be-allowed sing.
   d. * …dat Jan   een liedje probeert te zingen mogen.
         …that John a   song   tries   to sing   be-allowed.

         …that John tries to be allowed to sing a song.

The *te*-taking verbs have the lexical constraint (↑ XCOMP VFORM) = TE-INF , and in all their forms they also have the precedence condition ↑ <$_f$ (↑ XCOMP). Their ordering properties follow from these lexical specifications and the phrase structure rules above.

Extraposed verbal complements and the third construction

As indicated above, we analyze extraposed infinitivals as COMPs just like obligatorily extraposed *dat*-clauses. They are handled by the optional VP expansion in the ZK phrase structure rule (1a),

but here we propose a slightly restricted version that more accurately reflects the fact that an NP can link to a COMP only at the bottom of the hierarchy.[7]

(44) VP →   NP*   V'   (VP)
            (↑ XCOMP* (COMP) NGF) = ↓   (↑ XCOMP* COMP) = ↓

Within the extraposed VP, we can of course get all the non-tensed verb cluster orders describe above as illustrated with a couple of examples in (45), but nothing special needs to be said about this.

(45) a.   …dat Jan hoopt een liedje goed gezongen te hebben.
          …that John hopes a   song well sung   to have.
     b.   …dat Jan hoopt een liedje goed te hebben gezongen.
          …that John hopes a   song well to have sung.

       …that John hopes to have well sung a song.

We assume that the third construction arises from the combination of extraposition and focused elements in the middlefield.[8] That this is a kind of focus construction would also explain the facts illustrated earlier in (17). In this construction, just like in topicalization, we cannot link an unstressed pronoun to an NGF of the extraposed COMP. Again this construction has been described in ZK and is covered by the COMP annotation on the NP in rule (44).

SUMMARY: AN LFG ANALYSIS OF DUTCH VERB CLUSTERS

Our account of Dutch verb clusters involves two phrase structure rules and several lexical/morphological specifications. The VP rule (44), repeated in the summary below, is the one given in ZK, modulo the small restriction for the COMP in the NP uncertainty path. The V' rule (40) has been expanded to allow for particles and participles, and it relaxes the ordering of the V' and the V.

(44)   VP →   NP*   V'   (VP)
            (↑ XCOMP* (COMP) NGF) = ↓   (↑ XCOMP* COMP) = ↓

---

[7] The ZK account in (1a) would allow ungrammatical strings such as
        * …omdat Jan het liedje geprobeerd heeft te beloven te zingen.
[8] This does not account for the fact that the third construction is not possible when the extraposed element is introduced by *om*,
(i)   …dat Jan een liedje heeft geprobeerd om te zingen
We assume that *om* is a complementizer and that it blocks topicalization but we have not formalized this.

(40) V' → (PostP) (V) [V , (V')]
$(\uparrow \text{XCOMP}^{+} \text{PRT}) = \downarrow$ $(\downarrow \text{VFORM}) = \text{PART}$ $(\uparrow \text{XCOMP}) = \downarrow$
$(\uparrow \text{XCOMP}^{+}) = \downarrow$ $(\uparrow \text{XCOMP}^{+} \text{NGF}) \neg <_f (\uparrow \text{NGF})$
$\downarrow \neg <_f (\downarrow \text{PRT})$

Our lexical/morphological specifications make explicit which features and constraints are needed to account for the ordering in the verb cluster. We make use of a quite standard feature inventory augmented only by the CLUS feature that we introduce to mark verbs that occur in the specific, not universally available, cluster construction. The features assigned to particular morphological forms are described by (11), also repeated here, (12) and (23) indicate how those morphological features of complements are selected by governing verbs, and (35) and (36) relate morphological features to the right-branching precedence constraints that restrict the relaxed c-structure order.

(11) a. $(\uparrow \text{VFORM}) = \text{PART}$ for participles
      b. $(\uparrow \text{VFORM}) = \text{INF}$ for bare infinitives
      c. $(\uparrow \text{VFORM}) = \text{TE-INF}$ for *te* infinitives
      d. $(\uparrow \text{VFORM}) = \text{TENSED}$ for all tensed forms

(12) a. $(\uparrow \text{XCOMP VFORM}) \in \{\text{PART, INF}\}$ for auxiliaries
      b. $(\uparrow \text{XCOMP VFORM}) = \text{INF}$ for modals, causatives, perception verbs…
      c. $(\uparrow \text{XCOMP VFORM}) = \text{TE-INF}$ for other NTV verbs.

(23)   Auxiliaries: $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Leftrightarrow (\uparrow \text{XCOMP CLUS})$

(35)   Tensed modals or auxiliaries: $(\uparrow \text{XCOMP CLUS}) \Rightarrow \uparrow <_f (\uparrow \text{XCOMP})$

(36)   Infinitival modals or auxiliaries: $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Rightarrow \uparrow <_f (\uparrow \text{XCOMP})$

The following lexical entries are examples of how these constraints are realized.

(46) a. hebben: $(\uparrow \text{PRED}) = \text{'perfect}<(\uparrow \text{XCOMP})>(\uparrow \text{SUBJ})\text{'}$
                  $(\uparrow \text{SUBJ}) = (\uparrow \text{XCOMP SUBJ})$
                  $(\uparrow \text{CLUS}) = +$
                  $(\uparrow \text{XCOMP VFORM}) \in \{\text{PART, INF}\}$
                  $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Leftrightarrow (\uparrow \text{XCOMP CLUS})$
                  $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Rightarrow \uparrow <_f (\uparrow \text{XCOMP})$
                  $(\uparrow \text{VFORM}) = \text{INF}$

      b. heeft: $(\uparrow \text{PRED}) = \text{'perfect}<(\uparrow \text{XCOMP})>(\uparrow \text{SUBJ})\text{'}$

$(\uparrow$ SUBJ$) = (\uparrow$ XCOMP SUBJ$)$

$(\uparrow$ CLUS$) = +$

$(\uparrow$ XCOMP VFORM$) \in \{$PART, INF$\}$

$(\uparrow$ XCOMP VFORM$) =$ INF $\Leftrightarrow (\uparrow$ XCOMP CLUS$)$

$(\uparrow$ XCOMP CLUS$) \Rightarrow \uparrow <_f (\uparrow$ XCOMP $)$

$(\uparrow$ VFORM$) =$ TENSED

c. willen: $(\uparrow$ PRED$) = $ 'want<$(\uparrow$ SUBJ$) (\uparrow$ XCOMP$)$>'

$(\uparrow$ SUBJ$) = (\uparrow$ XCOMP SUBJ$)$

$(\uparrow$ CLUS$) = +$

$(\uparrow$ XCOMP VFORM$) =$ INF

$\uparrow <_f (\uparrow$ XCOMP $)$

$(\uparrow$ VFORM$) =$ INF

d. wil: $(\uparrow$ PRED$) = $ 'want<$(\uparrow$ SUBJ$) (\uparrow$ XCOMP$)$>'

$(\uparrow$ SUBJ$) = (\uparrow$ XCOMP SUBJ$)$

$(\uparrow$ CLUS$) = +$

$(\uparrow$ XCOMP VFORM$) =$ INF

$(\uparrow$ XCOMP CLUS$) \Rightarrow \uparrow <_f (\uparrow$ XCOMP $)$

$(\uparrow$ VFORM$) =$ TENSED

e. proberen (cluster entry):

$(\uparrow$ PRED$) = $ 'try<$(\uparrow$ SUBJ$) (\uparrow$ XCOMP$)$>'

$(\uparrow$ SUBJ$) = (\uparrow$ XCOMP SUBJ$)$

$(\uparrow$ CLUS$) = +$

$(\uparrow$ XCOMP VFORM$) =$ TE-INF

$\uparrow <_f (\uparrow$ XCOMP $)$

$(\uparrow$ VFORM$) =$ INF

f. proberen (extraposition entry):

$(\uparrow$ PRED$) = $ 'try<$(\uparrow$ SUBJ$) (\uparrow$ COMP$)$>'

$(\uparrow$ COMP SUBJ$) = $ 'pro'

$(\uparrow$ COMP VFORM$) =$ TE-INF

$(\uparrow$ VFORM$) =$ INF

Given that most of the constraints are linked to (classes of) lexical items, accounting for dialect variation consist in many cases simply in removing or adding a constraint. For instance in the dialect of the second author of this paper sentences like the following are grammatical (cf. 26):

(47) …dat Jan een liedje willen zingen heeft.
　　 …that John a   song   want   sing   has.

```
…that John has wanted to sing a song
```

(48) …dat Jan   een liedje moet willen zingen hebben.
     …that John   a   song   must want   sing   have.

     …that John must have wanted to sing a song.

For this dialect we can simply say that the constraints (↑ XCOMP CLUS) ⇒ ↑ <f (↑ XCOMP) in (35) and (↑ XCOMP VFORM) = INF ⇒ ↑ <f (↑ XCOMP) in (36) are included for modals but not for auxiliaries.

4. Prolegomena to a treatment of German verb clusters

In this section we sketch how the Dutch system can be adapted to account for some of the phenomena found in German. We do not attempt to describe a real variant of German here; we just choose some salient aspects of the German verbal cluster ordering and give rules to handle them. A full treatment of any variant of German would need further specifications.

German allows for extraposition and for the third construction, so the Dutch VP rule (44) can be taken over to German without modification. German differs from Dutch in not permitting the creeping of participles or particles. This means that the PostP and participle expansions for Dutch are not needed in the German V' rule, and that we can revert to the basic unordered c-structure arrangement in (33). We also want to account for the following observations about the order of verbs in German clusters:

(49) a.   …daß sie ausgehen wollte.
          …that she outgo   wanted.

          …that she wanted to go out.

     b.   …daß sie mich ausgehen gesehen hat.
          …that she me   outgo   seen   has.

          …that she has seen me go out.

     c.   …daß sie hat ausgehen wollen.
          …that she has outgo   want.

          …that she has wanted to go out.

     d.   …daß sie wird ausgehen wollen.
          …that she will outgo   want.

          …that she will want to go out.

e. * …daß   sie hat ausgehen gewollt.
     …that she has outgo   wanted.

     …that she has wanted to go out.

f. * …daß   sie wollte ausgehen.
     …that she wanted outgo.

     …that she wanted to go out.

g. * …daß   sie ist ausgegangen.
     …that she is outgone.

     …that she has gone out.

h. * …daß   sie das haben tun können   muß.
     …that she that have   do be-able must.

     …that she must have been able to do that.

i.   …daß   sie das muß haben tun können.
     …that she that must have   do   be-able.

     …that she must have been able to do that.

The patterns in (49) exemplify the following generalizations:

(50) In German verb clusters the canonical order is left branching, with complements preceding
      their governors (49a, b).

(51) Some German verbs optionally govern right-branching complement structures, subject to
      the following conditions:

      a. All verbs below a left branching verb also branch to the left (49h,i).

      b. Right branching can start at a tensed verb (i.e. the highest verb of a cluster) (49c, d, h).

      c. The head of a right-branch complement is always in the infinitive, even when the
          governing verb is an auxiliary (Ersatzinfinitiv) (49e).

The canonical left-branching order is possible for all German cluster verbs (50), and
complements below a left-branch are also left-branching (51a). The following two precedence
constraints enforce these conditions:

(52)   a. $\uparrow <_f (\uparrow \text{XCOMP})$
       b. $(\uparrow \text{XCOMP CLUS}) \Rightarrow (\uparrow \text{XCOMP}) <_f (\uparrow \text{XCOMP XCOMP})$

The small number of cluster verbs (including *haben*, *werden*, and *wollen*) that optionally allow right-branching complements have as a disjunctive alternative to (52) the simple right-branching constraint (53):

(53) $\uparrow <_f (\uparrow \text{XCOMP})$

One consequence of constraint (52b) is that right branching can begin only at the top of an XCOMP hierarchy.   The top verb of a cluster can either be a tensed form as specified in (51b), or it can be the *zu*-infinitive head of an extraposed COMP. Extraposition verb entries include the variant of (52b) shown in (54) and thus exclude the possibility of right-branching anywhere below the extraposed infinitive.

(54) $(\uparrow \text{COMP VFORM}) = zu\text{-INF}$
        $(\uparrow \text{COMP CLUS}) \Rightarrow (\uparrow \text{COMP}) <_f (\uparrow \text{COMP XCOMP})$

Finally, the constraint (55) implements the generalization (51c) that right-branching complements of auxiliaries have infnitival heads.

(55)   Auxiliaries: $(\uparrow \text{XCOMP VFORM}) = \text{INF} \Leftrightarrow (\uparrow \text{XCOMP}) <_f \uparrow$

5. Conclusion

In this paper we have sketched an LFG treatment of verb clusters in West Germanic languages with a particular emphasis on Dutch. Our treatment reflects what we take to be the idiosyncratic nature of the phenomena: we do not see broad, universal generalizations here. However, these phenomena are interesting because they involve several kinds of interactions. There are mutual constraints among local morphological/lexical features and quasi-local ones (for example,the features of the XCOMP of an XCOMP or COMP), and these then correlate with how functional precedence relations and long-distance uncertainties can be resolved.   Our account made use only of descriptive devices that are independently motivated and already available in the LFG formalism. Germanic verb-cluster phenomena thus provide further support for the architectural principles of the LFG framework.

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