Dutch and German verb clusters in Performance Grammar

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Within the psycholinguistically motivated syntactic framework of *Performance Grammar*, we develop a linearization model that we claim captures a broad range of linear order phenomena in Dutch and German clauses, including the verb clustering phenomena focused in this volume.

In Section 1, we lay out the essentials of Performance Grammar (PG hereafter). Sections 2 and 3 are devoted to the PG treatment of verb clusters in Dutch and German respectively. In Section 4, we draw some conclusions.

1. Essentials of Performance Grammar

Performance Grammar (Kempen & Harbusch, 2002; Harbusch & Kempen 2002)[1] consists of separate components generating, respectively, the hierarchical and the linear structure of sentences[2]. Hierarchical structures in PG are unordered trees ('mobiles') composed out of elementary building blocks called *lexical frames*. Every lexical entry (*lemma*) in the *Mental Lexicon* has associated with it a lexical frame encoding its information concerning word class (part of speech), subcategorization features, and morphological diacritics (person, gender, case, etc.). Lexical frames are retrieved from the Lexicon by a *lexicalizer* in response to a conceptual 'message' (during language production) or to a word string (during language perception). Associated with every lexical frame is a one-dimensional array called *topology*, which specifies a fixed number of positions (or *slots*, *landing sites*) where segments (branches, constituents) of lexical frames can be stored in left-to-right order. The segments stored in a topology may include constituents originating from a lexical frame lower in the hierarchy. As we will see below, this happens without affecting the frame hierarchy.

In this Section, we discuss the hierarchical and linear grammar components in turn. For the empirical psycholinguistic arguments in support of the separation between hierarchical and linear structure we refer to Kempen & Harbusch (2002).

1.1 Hierarchical structures in Performance Grammar

PG's hierarchical component generates unordered trees by combining 3-tiered 'mobiles' called lexical frames. Figure 1 shows the eight lexical frames expressing how each of the words in Dutch example (1) is used[3].

[1] For predecessors of PG, see Kempen & Hoenkamp (1987) and De Smedt & Kempen (1990a, b).

[2] Other grammar formalisms that assign hierarchical and linear computations to separate rule systems, are GPSG (Gazdar, Klein, Pullum & Sag, 1985) and HPSG (Pollard & Sag, 1994).

[3] For readers who are more familiar with German than with Dutch: the syntactic structure of the German translation of this example (*Denkst du, dass er das Auto repariert hat*) is identical in all currently relevant aspects.

(1) Denk je, dat hij de auto gerepareerd heeft?

Think you that he the car repaired has

'Do you think that he has repaired the car?'

The top layer of a frame consists of a single *phrasal node* (the 'root'; e.g. S, NP, DP, CP), which is connected to one or more *functional nodes* in the second layer (e.g., SUBJect, HeaD, Direct OBJect, CoMPlement, PREDicate, MODifier). At most one exemplar of a functional node is allowed in the same frame, except for MOD nodes, which may occur zero or more times. Every functional node dominates exactly one phrasal node ('foot') in the third layer, except for H(ea)D which immediately dominates a lexical (part of speech) node. Each lexical frame is 'anchored' to exactly one lexical item, which is printed below the categorial node serving as the frame's HeaD.

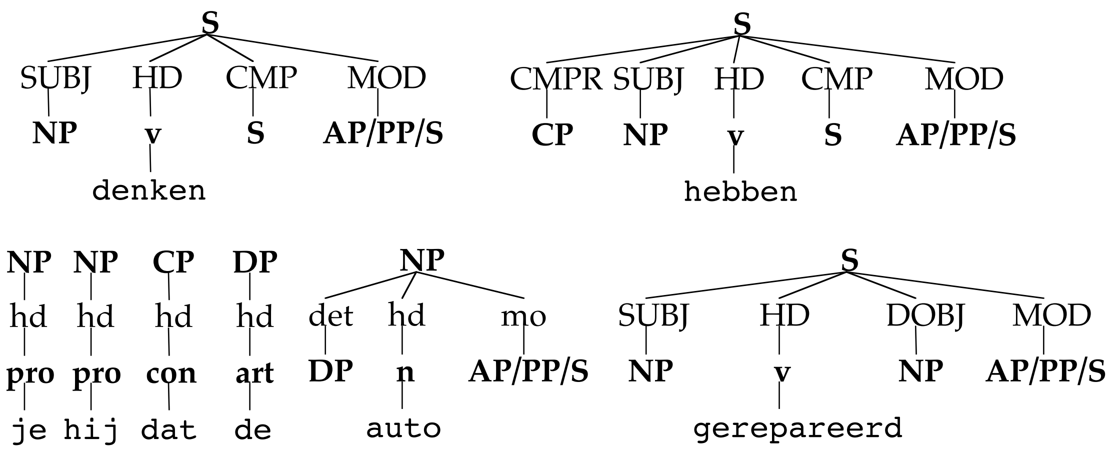


Figure 1. Simplified lexical frames underlying the eight words of sentence (1). Left-to-right order of branches is arbitrary. The basic shape of lexical frames is retrievable from the Mental Lexicon in response to contents of the to-be-expressed conceptual message; however, certain branches (e.g. CMPR) are added as a consequence of local syntactic constraints (CMPR = CoMPlementizeR; CP = Complementizer Phrase).

Lexical frames are combined to form larger mobiles by a *substitution* operation which replaces phrasal foot nodes by lexical frames. More precisely, substitution involves a simple, non-recursive form of unification called *feature unification,* and merges the root of one frame with one phrasal foot of another frame (Figure 2). Unification of two feature matrices proceeds as follows:

(A) For each attribute shared by the two matrices, take the value sets, compute their intersection, and delete the members that do not belong to the intersection. (Attributes occurring in one matrix only will not be affected.)

(B) If at least one of the intersections is the empty set, unification fails.

(C) Otherwise, unification succeeds, and a feature matrix containing one token of each of the shared or non-shared attribute-value pairs is returned.

For instance, the following matrices have two attributes in common:

$$\begin{bmatrix} \text{case} = \{\text{nominative, accusative}\} \\ \text{number} = \{\text{singular}\} \\ \text{person} = \{\text{3rd, 1st}\} \end{bmatrix} \qquad \begin{bmatrix} \text{person} = \{\text{1st, 2nd, 3rd}\} \\ \text{case} = \{\text{nominative}\} \end{bmatrix}$$

The intersections of these disjunctive value sets are {1st, 3rd} and {nominative} respectively. Since none of these sets is empty, unification succeeds and the following matrix is returned:

$$\begin{bmatrix} \text{case} = \{\text{nominative}\} \\ \text{number} = \{\text{singular}\} \\ \text{person} = \{\text{3rd, 1st}\} \end{bmatrix}$$

It follows that if a feature matrix contains at least one feature whose value set is empty, it cannot successfully unify with any other feature matrix. In Section 2 and 3 below we introduce order-related features and apply unification as a mechanism for assigning constituents to positions in a linear structure.

Unification uses the lexical frame as its domain of locality and serves, among other things, to select the value of agreement features (e.g. entailing second person singular *denk* of the verb *denken*; agreement features are not shown in the figure). Unification operates on features stored in the *feature matrix* that is associated with every categorial node (i.e., lexical or phrasal node). Such a matrix is a set of pairs, each consisting of an attribute and a finite set of values. Features are instantiated with a non-empty value set. An attribute is a character string (e.g., “gender”, “person”, “number”). A value set contains a non-zero finite number of character strings (e.g., {sing}, {1st, 2nd, 3rd}), each representing a possible value of the attribute (disjunctive value sets).

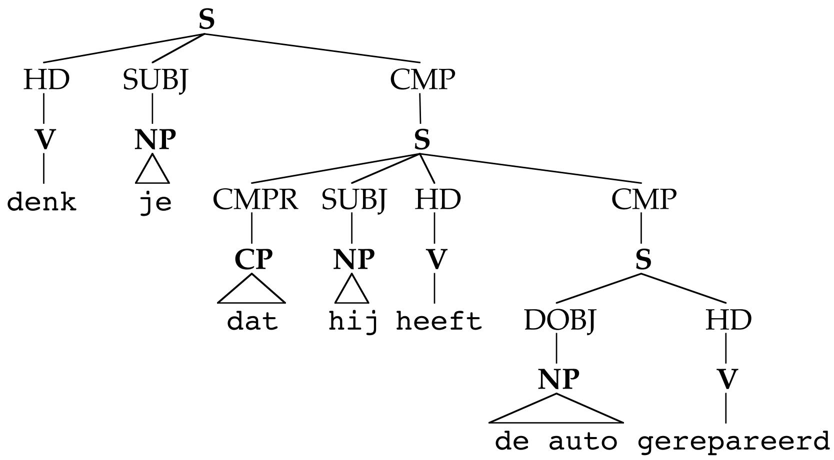


Figure 2. Verb frame hierarchy underlying example *(1)*. The root S-node of the verb frame associated with *heeft* and the CoMPlement S-node of *denk* have merged as a result of substitution, and so have the S-CMP of *heeft* and the root S-node dominating *gerepareerd*. Left-to-right order of branches is arbitrary.

1.2 Linear structure in PG

In order to assign a left-to-right position to the branches of lexical frames, we introduce an additional type of data structure. Associated with every lexical frame is a *topology*, a one-dimensional array specifying a fixed number of positions (or *slots*, *landing sites*) for its constituents. The topology of a verb frame (i.e., of a finite or non-finite clause) allocates storage space for each of various grammatical functions that can be fulfilled by its constituents, e.g., to the HeaD verb, to the SUBJect NP, the Direct OBJect NP, etc. The topology that we use for Dutch and German clauses specifies nine different slots, labeled as indicated in Figure 3.

Fore-field	Midfield						Endfield	
F1	M1	M2	M3	M4	M5	M6	E1	E2

Figure 3. Slot labels used in topologies for Dutch and German clauses.

Table 1 illustrates which clause constituents select which slots as their landing sites. Constituents may select different positions depending on their shape. For instance, if the Direct OBJect role is fulfilled by a Wh-phrase, it will end up in the Forefield of the clause rather than in the Midfield. A CoMPlement clause will land in slot E2 if it is finite; non-finite CoMPlements have several additional placement options.

We show linearization at work on sentence (2), an abbreviated version of (1). As we assume that every lexical item launches its own lexical frame and topology, a sentence containing more than one verb instantiates several clausal topologies. This applies to verbs of any type, whether main, auxiliary or copula. It follows that sentence (2) needs two topologies (Figure 4)

(2) *Denk je dat hij de auto repareert?*
think you that he the car repairs
'Do you think that he repairs the car?'

F1	M1	M2	M3	M4	M5	M6	E1	E2
	denk	je						•
								⇑
	dat	hij	de auto			repareert		

Figure 4. Linearization of example (2). The dashed slots of the embedded topology denotes 'topology sharing', to be discussed below.

Slot F1 of the interrogative main clause remains empty in the absence of a Wh-constituent. The pronominal Subject NPs of the main and the subordinate clause go to slot M2 of their respective topologies. The HeaD verb selects slot M1 in the main clause, and M6 in the CoMPlement. The CoMPlementizeR *dat* goes to M1 of the CoMPlement's topology. Finally, the root S-node dominating the finite CoMPlement clause lands in E2, as indicated by the bullet and upward double arrow.

Table 1. Examples of topology slot selection rules (Dutch and German clauses). Precedence between constituents landing in the same slot is marked by "<<".The details of the placement of HeaD verbs, CoMPlement clauses, and PaRTicles are explained in Sections 2 and 3.

Slot	**Filler**
F1	*Declarative main clause*: SUBJect, Topic or Focus (one constituent only) *Interrogative clause*: Wh-constituent, including Du. *of* and Ger. *ob* 'whether' *Complement clause*: Wh-constituent
M1	*Main clause:* HeaD verb *Complement clause*: CoMPLementizeR *dat/om* (Du.) and *dass* (Ger.) 'that'
M2	Subject NP (iff non-Wh), Direct Object (iff personal pronoun)
M3	Indirect OBJect (iff non-Wh) << Direct OBJect (iff non-Wh and non-pers.pro.)
M4	PaRTicle (Du. only)
M5	Non-finite CoMPlement of Verb Raiser
M6	*Subordinate clause;* Du.: Pre-INFinitive *te* 'to' << HeaD verb Ger.: PaRTicle << Pre-INFinitive *zu* 'to' << HeaD
E1	Non-finite Complement of Verb Raiser (Du. only)
E2	Non-finite CoMP of VP Extraposition verb Finite Complement

In case of more than one verb, the topologies associated with them are allowed to *share* certain identically labeled slots, conditionally upon several restrictions. *After two slots have been shared, they are no longer distinguishable; in fact, they are the same object.* In example (2), the embedded topology shares its F1 and E2 slots with their namesakes in the matrix topology. This is indicated by the dashed border of the two bottom slots.

Now consider example (3), where the Direct OBJect of *repareert* is a Wh-phrase (*welke auto* ‘which car’). This constituent lands in the shared F1 slot: see Figure 5. As a consequence, the Wh-phrase gets ‘fronted’ and seems to have been ‘extracted’ from the complement. This behavior, caused by *lateral topology sharing* manifests itself as upward movement of constituents in shared slots. We will call this effect *promotion*. In the topology diagrams, promotion is indicated by an upward single arrow, and a bullet located at the landing site of the promoted constituent.

(3) *Welke auto denk je dat hij repareert?*
‘Which car do you think that he repairs?’

Figure 5. Linearization of example (3).

Example (1) embodies a more radical case of cross-clause topology sharing. The topologies associated with *heeft* and *gerepareerd* share the entire region extending from F1 through M4. The result is promotion of Direct OBJect *de auto*, as shown in Figure 6.

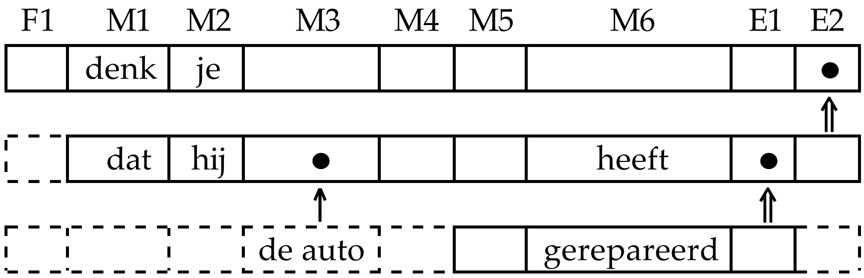


Figure 6. Linearization of example (1).

The overt constituent order of a sentence is determined by a *Read-out module* that traverses the hierarchy of topologies in depth-first, left-to-right manner, scanning shared slots only once. Any lexical item it 'sees' in a slot, is appended to the output string. E.g., *welke auto* in example (2) is seen while the Reader scans the matrix topology rather than during its traversal of the embedded topology. Consider the artificial example of lateral topology sharing in Figure 7. The uppermost clause shares lateral (peripheral) slots at, respectively, positions P1 and P5 of its topology with its downstairs neighbor. The lower topology has landed in slot P2 to the right of item *A*. The Read-out module first processes item *a* at P1 and *A* at P2, then proceeds to the non-shared region P2 through P4 of the lower topology, and outputs the sequence *bcd*. Having reached shared slot P5 it returns to slot P2 of the upper topology and processes there the remaining slots P3 through P5, which yields the sequence *Be*. The resulting string is *aAbcdBe* (cf. lower panel of Figure 7.)

We postulate that cross-clause lateral topology sharing in Dutch and German is subject to the restrictions in (4) below. The combination of constraints (4b) and (4c) implies that topology sharing may divide a clausal topology into three parts, as follows:

- a left-peripheral shared region up to but not including the position of the HeaD verb,
- a non-shared region including at least the position assigned to the HeaD verb, and
- a right-peripheral shared region.

The two shared peripheral regions will be called "lateral", the non-shared region "central". (Notice that the central region need not coincide with the Midfield; actually, in most cases they are different.)

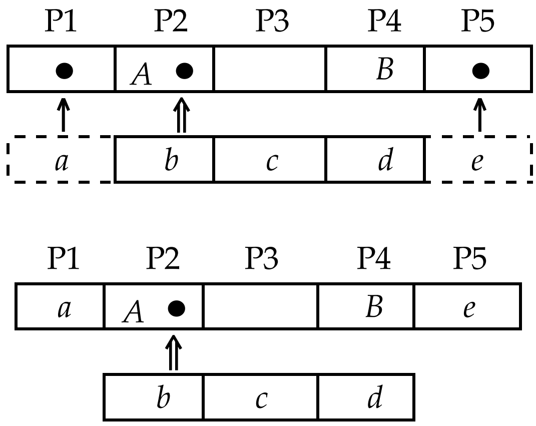


Figure 7. Read-out of topologies in case of lateral topology sharing. *Upper panel:* P1 through P5 are labels of the slots in both the upper and lower topology. Shared slots are indicated by dashed rectangles. Bullets above single arrows represent the position of items that have been 'promoted' into the upper topology. The double arrow points to the landing site of the non-shared region of the topology at its tail. *Lower panel:* The shared slots P1 and P5 of the embedded topology has not been drawn because they are the same objects as slots P1 and P5, respectively, of the governor's topology. Therefore, items *a* and *e* are 'seen' during read-out of the matrix topology. The output sequence reads *aAbcdBe*.

(4) *General Constraints on cross-clause lateral topology sharing in Dutch and German*

a. A verb frame can left-peripherally share part of its clausal topology with that of another verb frame only if they are located at adjacent levels of the verb frame hierarchy.

b. Only lateral (i.e., left- and right-peripheral) regions of a topology are sharable.

c. The HeaD of a lexical frame, i.e. the verb, does not participate in topology sharing: it cannot be promoted outside of its own topology, nor can the slot serving as its landing site be the promotion target of any constituent from a lower topology.

Whether or not two clausal topologies share some lateral region(s), and which slots will be affected, depends on a *language-specific cross-clause lateral topology sharing rule*. The topology sharing rules for Dutch and German are shown in Table 2. The variables *LS* and *RS* stand for, respectively, the number of left- and right-peripheral slots that the complement clause shares with the topology of its governor. For instance, the first row of the Table indicates that if a Dutch or German complement clause is interrogative, it shares no slots with its upstairs neighbor. The last row deals with declarative non-finite complements of Verb Raisers (auxiliaries in particular; see beginning of Section 2): In both Dutch and German, the right-peripherally shared area includes one slot only, i.e.

E2. The left-peripherally shared areas in the two languages differ: In German it covers five slots (F1 through M4); in Dutch it varies optionally between four (F1 through M3) and six (F1 through M5). Figure 4 and Figure 5 above illustrate sharing of the F1 slot of a finite declarative complement clause[4]. Figure 6 shows sharing of the entire left-peripheral region F1 through M4, due to the fact that *de auto gerepareerd* is the declarative non-finite complement of the auxiliary *heeft* 'has'.

Table 2. Size of the left- and right-peripheral shared topology areas (*LS* and *RS*) in diverse complement constructions.Numbers separated by a colons denote the minimum and the maximum size of a shared region.

Type of CoMPlement clause	**Dutch**	**German**
Interrogative	*LS*=0 *RS*=0	*LS*=0 *RS*=0
Declarative & Finite	*LS*=1 *RS*=0	*LS*=1 *RS*=0
Declarative & Non-Finite, VP Extraposition	*LS*=1 *RS*=0:1	*LS*=1 *RS*=0:1
Declarative & Non-Finite, Third Construction	*LS*=1:6 *RS*=0:1	*LS*=1:6 *RS*=0:1
Declarative & Non-Finite, Verb Raising	*LS*=4:6 *RS*=1	*LS*=5 *RS*=1

The final ingredient of PG's linearization system utilizes the non-recursive feature unification mechanism introduced in Section 1.2. We allow lexical frames to carry not only agreement features but also positional features. While their values are determined as part of the unification process. A simplified example is provided in Figure 8 by the placement of the past participle *gerepareerd* of example (1). The "CMPtype" feature on the CoMPlement S-node in the lexical frame of the Dutch auxiliary *heeft* 'has' specifies the disjunctive value "{M5, E1 }". This means that the complement of *heeft* is free to land either in slot M5 or in slot E1. Because the root S-node of *gerepareerd* happens to have a CMPtype feature with one of these values, its unification with *heeft*'s complement S-node succeeds. This licenses the CoMPlement clause headed by *gerepareerd* to land in slot E1 of *heeft*'s topology (see Figure 6). As will become clear shortly, unification of positional features offers a simple but effective method to control verb order in Dutch and German clause-final verb clusters.

[4] The complement clause in Figure 5 is declarative notwithstanding the fact that it includes a Wh-phrase. Compare sentence (3) with the following English paraphrase, which brings out the scope of the Wh-phrase: 'For which car *x* is it the case that he repairs *x*?'.

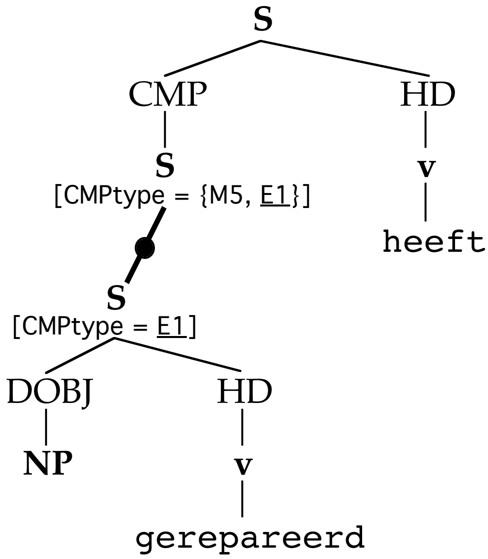


Figure 8. Positional features for two verbs of sentence (1). The underlined slot label in the CMPtype features refers to the value of CMPtype *after* unification of the two S-nodes.

Now that the essentials of PG's linear ordering component are in place, we can proceed to the verb clustering phenomena in the target languages.

2. Verb clustering in Dutch

The rule for cross-clause topology sharing in Dutch is shown in Table 2. It contains provisions for three different types of non-finite CoMPlement clause constructions traditionally called 'Verb Raising', 'VP Extraposition', and 'Third Construction'[5] (Den Besten & Rutten, 1989). We now discuss some examples that illustrate the joint effect of slot selection (Table 1) and topology sharing.

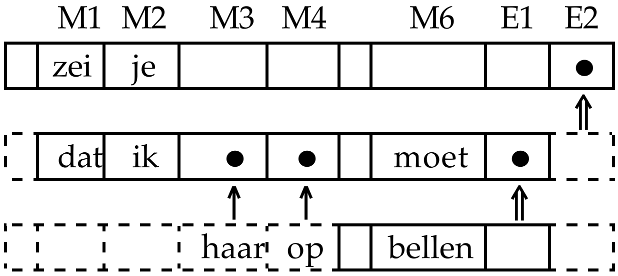
In sentence (5), the finite middle clause lands in slot E2 of the matrix. The lower clause is governed by the verb *moeten* 'must, have to', a Verb Raiser. Therefore, it shares the entire left-peripheral region from F1 through M3 (*LS*=4; cf. Table 2), and possibly even M4+M5 (*LS*=4:6), with its upstairs neighbor. This causes promotion of the Direct OBJect and the PaRTicle of the lower clause. If slot M4 of the lower topology were not shared, PaRTicle *op* would end up after *moet*.

[5] Verbs that allow their non-finite complements to be introduced by CoMPlementizeR *om* will be treated as Extraposition Verbs.

(5) a. *Zei je dat ik haar op moet bellen?*

said you that I her up have-to call

'Did you say that I have to call her up?'

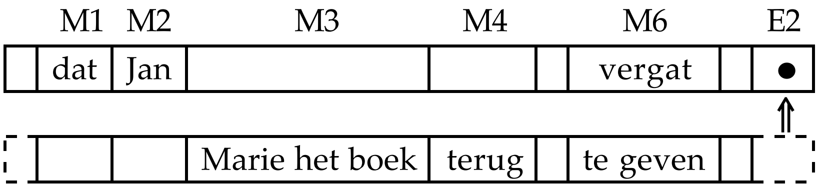


The examples in (6) exemplify the Third Construction, with *vergeten* 'forget' as governing verb. The topology-sharing rule now licenses varying amounts of topology sharing in the left periphery, and thereby several alternative output strings. Sentences (6a) and (6b) represent the extremes: no promotion of any constituent in (6a) vs. all constituents dependent on the infinitival verb promoted in (6b). Intermediate amounts of topology sharing yield acceptable sentences *provided that sharing is indeed left-peripheral*: see the grammaticality contrast between items (6b/c) on the one hand and (6d/e) on the other. The grammaticality contrast between examples (6f/g) illustrates VP Extraposition: *vragen* 'ask' governs a VP Extraposition construction, like *dwingen* 'force'. This rules out promotion of Direct OBJect *de fiets* into the same slot as *vragen*'s Indirect OBJect *Jan*.

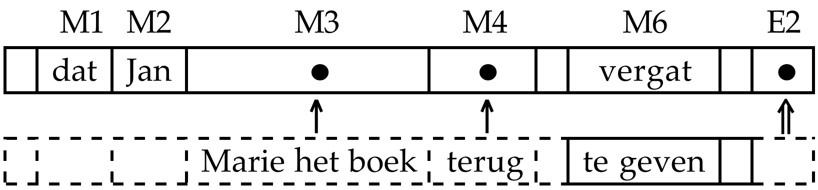
(6) a. ... *dat Jan vergat Marie het boek terug te geven*

that John forgot Mary the book back to give

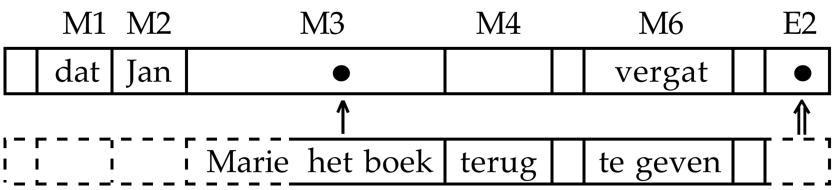
'... that John forgot to give Mary the book back'



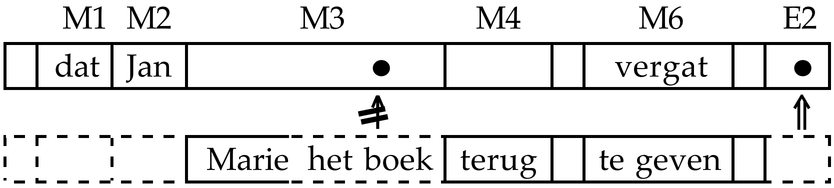
b. ... *dat Jan Marie het boek terug vergat te geven*



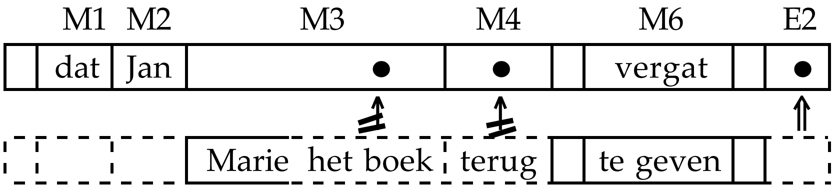
c. ... *dat Jan Marie vergat het boek terug te geven*



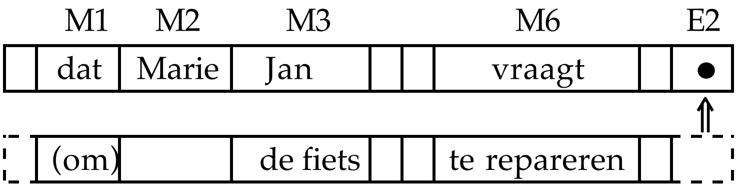
d. *... *dat Jan het boek vergat Marie terug te geven*



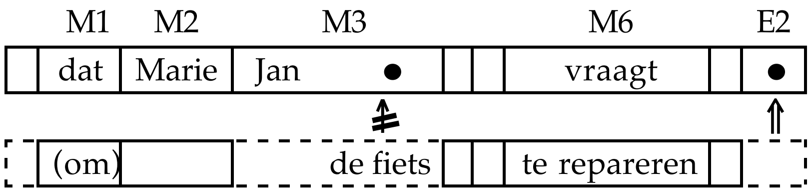
e. *... *dat Jan het boek terug vergat Marie te geven*



f. ... *dat Marie Jan vraagt (om) de fiets te repareren*
that Marie Jan asks (CMPR) the bike to repair
'that Marie asks Jan to repair the bike



g. *... *dat Marie Jan de fiets vraagt te repareren*



The rules discussed so far may cause a congestion of verbs at the end of a finite clause. Such a *verb cluster* contains one finite verb, one or more non-finite dependent verbs (infinitive or past participle), possibly with one PaRTicle and/or one or more Pre-INFinitives *te* 'to'. Some representative examples are given in (7). They include three Verb Raisers (the auxiliaries *hebben* 'have', *zullen* 'will/shall' and *kunnen* 'can', to be able to'), one main verb that cannot take a non-finite complement clause (*zingen* 'to sing'), and a Third Construction verb (*hopen* 'to hope'). The sentences also exemplify the 'infinitivus pro participio' (IPP) phenomenon. If the perfective auxiliary *hebben* takes another Verb Raiser (VR) as its complement, this verb surfaces as an infinitive rather than as a past participle. In (7m), for instance, the infinitival form *kunnen* substitutes for the past participle *gekund* as complement of *hebben*. The subscripts in the examples denote levels in the verb frame hierarchy.

(7) a. ... *dat ze deze liedjes zullen*$_1$ *zingen*$_2$
that they these songs will sing
'... that they will sing these songs'
b. ... *dat ze deze liedjes zingen*$_2$ *zullen*$_1$
c. ... *hebben*$_1$ *gezongen*$_2$ *('… have sung')*
d. ... *gezongen*$_2$ *hebben*$_1$
e. ... *zullen*$_1$ *hebben*$_2$ *gezongen*$_3$ ('… will have sung')
f. ... *zullen*$_1$ *gezongen*$_3$ *hebben*$_2$
g. ... *gezongen*$_3$ *zullen*$_1$ *hebben*$_2$
h. *... *hebben*$_2$ *zullen*$_1$ *gezongen*$_3$
i. *... *hebben*$_2$ *gezongen*$_3$ *zullen*$_1$
j. *... *gezongen*$_3$ *hebben*$_2$ *zullen*$_1$
k. ... *zullen*$_1$ *kunnen*$_2$ *zingen*$_3$ ('… will be able to sing')
l. *... *zullen*$_1$ *zingen*$_3$ *kunnen*$_2$ (all other permutations unacceptable)
m. ... *hebben*$_1$ *kunnen*$_2$ *zingen*$_3$ ('have been able to sing')
n. *... *hebben*$_1$ *zingen*$_3$ *kunnen*$_2$ (all other permutations unacceptable)
o. … *hadden*$_1$ *zullen*$_2$ *zingen*$_3$ (all other permutations unacceptable)
would-have will sing
'… would have intended/promised/planned to sing'
p. ... *zullen*$_1$ *hebben*$_2$ *kunnen*$_3$ *zingen*$_4$ ('will have been able to sing')
q. *... *zingen*$_4$ *zullen*$_1$ *hebben*$_2$ *kunnen*$_3$ (all other permutations bad)
r. … *dat ze deze liedjes hopen*$_1$ *te zingen*$_2$
that they these songs hope to sing
… 'that they hope to sing these songs'
s. *… *dat ze deze liedjes te zingen*$_2$ *hopen*$_1$
t. … *dat ze deze liedjes hopen*$_1$ *te kunnen*$_2$ *zingen*$_3$ (all other permutations unacceptable)
'… that they hope to be able to sing these songs'
u. ... *zouden*$_1$ *kunnen*$_2$ *hebben*$_3$ *gezongen*$_4$
'it might be possible that they have sung (these songs)'
v. ... *zouden*$_1$ *kunnen*$_2$ *gezongen*$_4$ *hebben*$_3$
w. ... *zouden*$_1$ *gezongen*$_4$ *kunnen*$_2$ *hebben*$_3$
x. … *gezongen*$_4$ *zouden*$_1$ *kunnen*$_2$ *hebben*$_3$
y. *... *hebben*$_3$ *gezongen*$_4$ *zouden*$_1$ *kunnen*$_2$ (all other permutations unacceptable)

Our approach to controlling word order in verb clusters deploys the unification mechanism for positional features introduced at the end of Section 1.1 (cf. Figure 8). We postulate that whenever a verb frame is instantiated as a finite or non-finite complement, its root S-node contains the *CoMPlement type* feature. The values of the "CMPtype" feature simultaneously represents three aspects of the complement:

(A) verb status[6]: the HeaD verb is a bare infinitive (coded as "Infin"), an infinitive preceded by a Pre-INFinitive[7] ("PInfin"), a past participle ("PastP") or a finite verb ("Fin")

(B) landing site (slots M5, E1 or E2), and

(C) pattern of left-peripheral topology sharing allowed by the HeaD verb (cf. Table 2): VP Extraposition (VE), Verb Raising (VR) Third Construction (VT), or finite complementation (VF). Verbs that take no complement at all will be designated as 'simple verbs' (VS). In order to abbreviate notation we propose to let the symbol "V" in a CMPtype feature cover any of the verb types distinguished here: V={VE, VF, VR, VS, VT}.

For instance, the feature "CMPtype = {M5-VR-Infin}" represents the option "non-finite complement clause that is headed by an infinitival Verb Raiser without Pre-INFinitive and lands in slot M5". The feature "CMPtype = E2-V(E,T)-PInfin" indicates that the clause carrying it will be realized as a non-finite clause in slot E2 of its governer, that the HeaD verb of this clause takes a VP Extraposition or a Third Construction complement, and that the HeaD verb will be preceded by Pre-INFinitive *te*. Notice that characters between parentheses denote optional elements. E.g. "V(E, S)"is matched by an Extraposition verb or by a simple verb without a complement; the code "(P)Infin" stands for an infinitive with or without a PINF. "(M5, E1)" indicates that M5 or E1 can be chosen as landing sites. Importantly, the symbol "V" is an abbreviation of "V(E,F,R,S,T)" and matches any verb type from the set {VE, VF, VR, VS, VT}.

We assume that every root S-node of a complement clause is instantiated with a CMPtype feature whose value set includes one or more such tripartite options. Furthermore, the CMP-S foot node in the lexical frame of verbs that take finite or non-finite complements, also includes a CMPtype feature. Unification of such a foot S-node with the root S-node of another verb frame succeeds only if this operation yields a non-empty CMPtype value set (cf. the definition of feature unification in Section 1.1).

Figure 9 shows the CMPtype features for the verbs in (7). The modal auxiliaries have two entries each[8]. Sentence (7a) involves unification of the CMP-S node in the lexical

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[6]We borrow this term from Bech (1955).

[7]The PINF is realized as *to* in English, as *te* in Dutch, and as *zu* in German.

frame for *zullen2* with the root node of the *zingen* frame. The one remaining option "E1-V-Infin" directs the infinitive *zingen* to slot E1 in the topology of *zullen2*. The inverse order in (7b) ensues in the case of selection of verb frame *zullen1*, with the main verb in slot M5 (*zingen zullen*). The past participle *gezongen* that complements the perfect auxiliary *hebben* in (7c/d), has two landing site options: M5 and E1.

The six examples in (7e-j) include all permutations of *zullen*, *gezongen*, and *hebben*. They are acceptable only if *zullen* precedes *hebben*; the position of *gezongen* seems irrelevant. *Zullen2*'s CoMPlement unifies successfully with *hebben*, forcing the latter to land in E1 and to trail behind its governor. Past participle *gezongen* is offered two possible landing sites: M5 and E1. Figure 10 portrays the latter option. If *gezongen* selects M5, the verb cluster surfaces as *zullen gezongen hebben*. This presupposes, in agreement with the middle option in the topology sharing rule in Table 2, that *zullen2* does NOT share its M5 slot with that of its complement *hebben*. If *zullen2* chooses the other option and does share its M5 slot with that of its complement, *gezongen* will end up as the first member of the verb cluster.

The IPP effect exemplified in (7m-q) is due to the interaction between *hebben* and *kunnen/zullen* at unification. (*Hadden* is the past tense plural of *hebben*.) *Hebben* and *kunnen2/zullen2* are successful unification partners, given that *hebben* is the governor and a verb raiser its complement. We assume that the IPP effect is restricted to VR complements of *hebben*. However, the effect also occurs — optionally — when *hebben* takes a complement clause headed by a Third Construction verb with all non-verbal constituents promoted. Sentence (8) is an example.

(8) a. … *dat zij dit lied hebben proberen/geprobeerd te zingen*
that they this song have try/tried to sing
'… that they have tried to sing this song'
b. … *dat zij hebben *proberen/geprobeerd dit lied te zingen*

We can handle this by granting verbs like *proberen* the double status of Third Construction verb *and* Verb Raiser:

(9) [CMPtype={(M5, E1)-VT-Infin, E2-VT-(Fin, PInfin), E1-VR-PInfin}]

If the latter option is chosen, the infinitive *proberen* (heading the complement clause landed in E1 of *hebben*'s topology) is obligatory, and the topology sharing rule forces

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[8] In order to distinguish different verb frames that belong to the same verb, we use numerical *suffixes*, e.g. *zullen1* and *zullen2*. They should not be confused with numerical *subscripts* that in sample sentences refer to verb hierarchy level (e.g. *zullen*$_1$ and *zullen*$_2$). The numerical suffixes serve to differentiate between lexical frames; they do not imply that the meanings associated with these frames are also different.

promotion of all non-verbal constituents: see (8b). The grammatical alternative in (8b) with *geprobeerd* is analyzable as a Third Construction without promotion of its dependents.

The verb *hopen* in (7r-t) takes a Third Construction complement at slot E2. All other placements are illegal. E2 is also the only possible landing site for complements of VP Extraposition verbs (VE; not illustrated here).

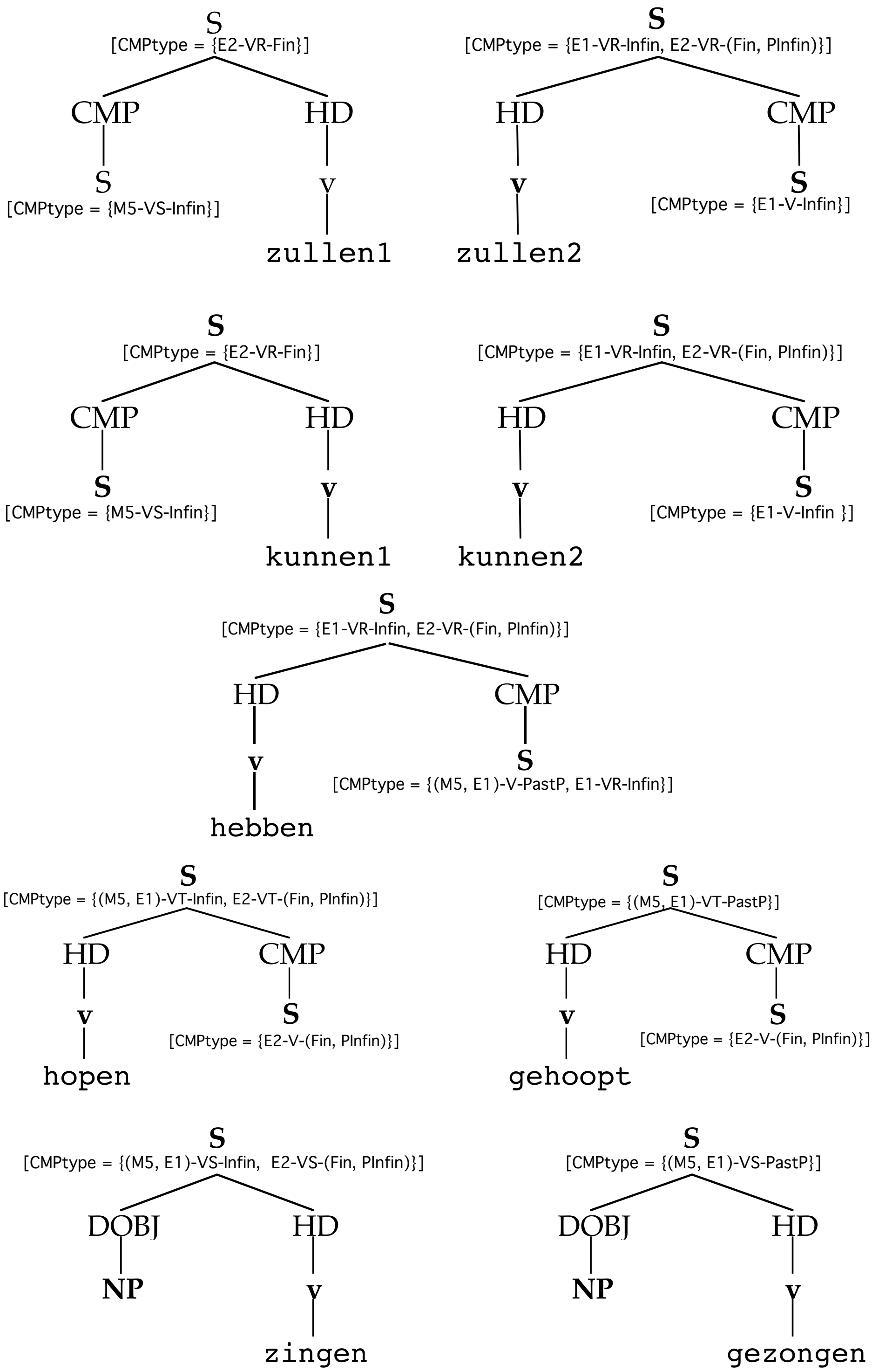


Figure 9. Partial lexical frames for the verbs in (7). The CMPtype features, which control the placement of finite and non-finite clauses, have been printed between square brackets below the S-nodes.

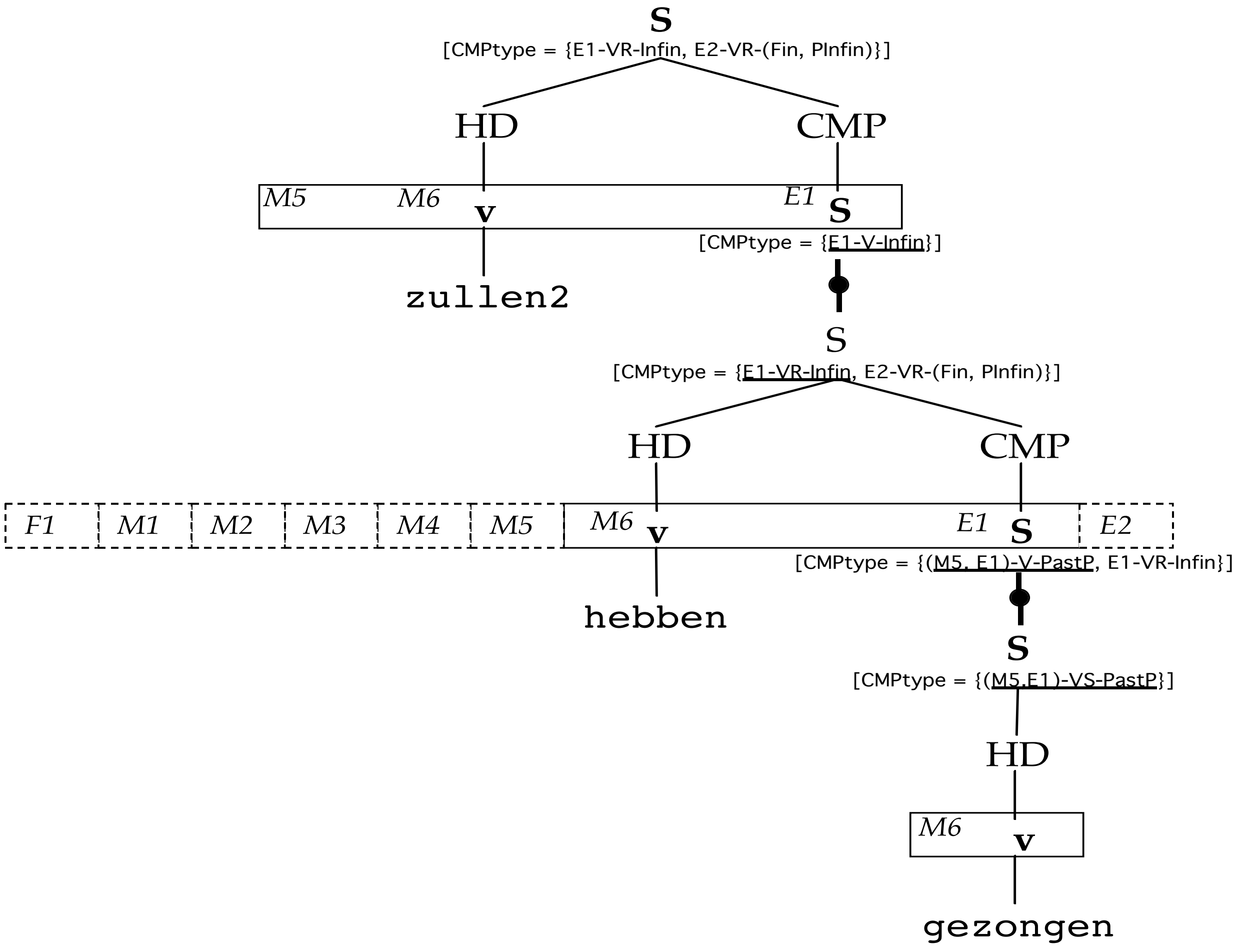
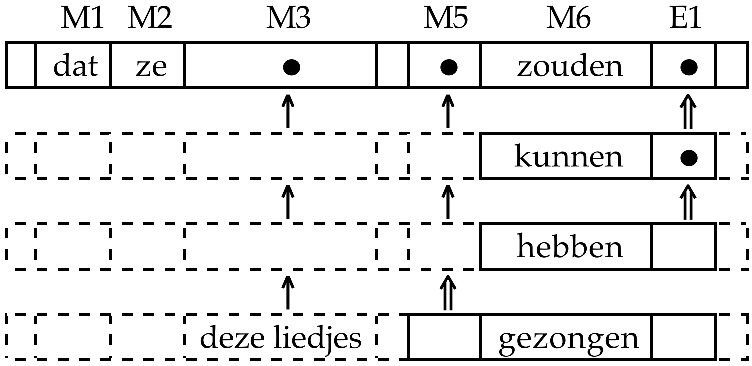


Figure 10. Analysis of sentences (7e-j). The complement headed by *gezongen* selects position E1 from the two alternatives licensed by the unification of its root S with the CMP-S of *hebben*. (The legal M5 option, yielding *gezongen hebben*, is not depicted here.) Sharing of slots M4 and M5 in the middle topology is optional. If *zullen2* selects the sharing option for M5, and *gezongen* indeed goes to M5 of *hebben*, the sequence *gezongen zullen hebben* results, i.e. example (7g). The black dots denote unification with substitution of S-nodes; the CMPtype values selected by unification have been underlined. Remember that "V" abbreviates for "V(E,F,R,S,T)".

Examples (7u-y) feature the past tense *zouden* of *zullen* because this form is better suited to bring out the *irrealis* meaning; this has no consequences with respect to word order. The various positions of *gezongen* depend on the level(s) at which a topology shares slot M5 with its upstairs neighbor — through the same promotion mechanism that is illustrated in example (7g) and Figure 10. The linear structure of the verb cluster of (7x) looks as follows:



We propose a similar approach to the placement of particles of so-called separable verbs. A case in point is sentence (10), which is identical to (7u) except for the particle *mee* 'together' preceding the past participle *gezongen* (*meezingen* = to sing together).

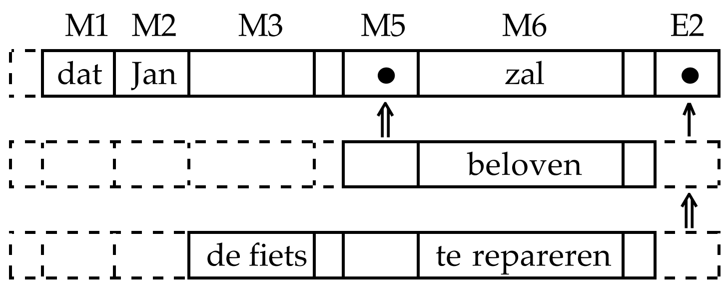
(10) … *dat ze deze liedjes zouden*$_1$ *kunnen*$_2$ *hebben*$_3$ *meegezongen*$_4$

The particle can be placed at any position in the verb cluster as long as it precedes the verb it belongs to (*zingen*). Since *zouden*, *kunnen* and *hebben* are only allowed to occur in this order while *gezongen* may occupy four different positions, there are ten different permutations. This is exactly the set licensed by the promotion mechanism:

- the CMPtype features in the three auxilaries guarantee they occur in the correct order,
- *gezongen* may follow or precede its governor *hebben*, and may even precede the other auxiliaries because the sharing configurations permit a promotion path to slot M5 in any of the three higher topologies, and
- since the PaRTicle can only land in an M4 slot while it may be promoted into any of the higher topologies, it will always precede *gezongen*.

In the sentences discussed so far, topology sharing was restricted to the left-periphery of the clausal topology. Cases such as (11a), however, with 'extraposed' constituents, require *right-peripheral topology sharing* as well. The rule for right-peripheral topology sharing is stated in (12), which partly repeats Table 2. The verb *beloven* 'promise' precedes its governor *zal* while its complement *de fiets te repareren* is clause-final (Figure 11). This discontinuity is due to the fact that *beloven* is a Third Construction verb and does not fit out its complement with a license to land in M5 or E1 (i.e. the CMPtype feature of the complement S-node does not include a reference to M5 or E1). Instead, *beloven* directs its complement to extraposition slot E2.

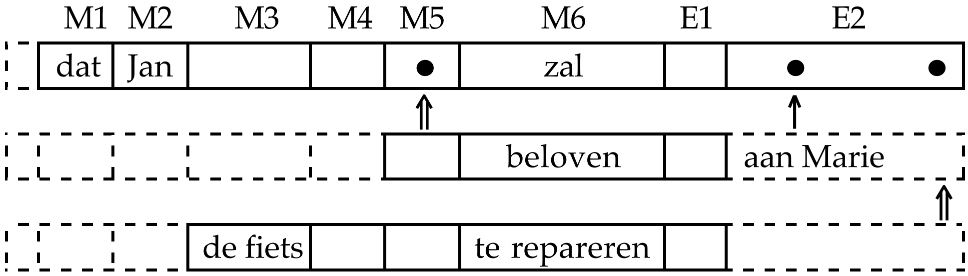
(11) a. … *dat Jan beloven zal de fiets te repareren*
that Jan promise will the bike to repair
'… that Jan will promise to repair the bike'



b. *... *dat Jan de fiets te repareren beloven zal*
c. ... *dat Jan zal beloven de fiets te repareren*

d. ... *dat Jan beloven zal aan Marie de fiets te repareren*

'... that Jan will promise (to) Marie to repair the bike'



(12) *Right-peripheral topology sharing in complement clauses of Dutch and German*

a. Right-peripheral topology sharing is restricted to E2 slots (*RS*=1 in Table 2)

b. Lexical frames headed by a Verb Raiser *obligatorily* share slot E2 of their topology with that of their complement (*RS*=1).

c. Lexical frames headed by a VP Extraposition or a Third Construction verb *optionally* share slot E2 of their topology with that of their complement (*RS*=0:1).

d. A finite complement clause does not right-peripherally share its E2 slot with that of its governor (*RS*=0).

e. If CoMPlement clauses from several clausal topologies land in the same E2 slot, they line up in increasing clause depth order.

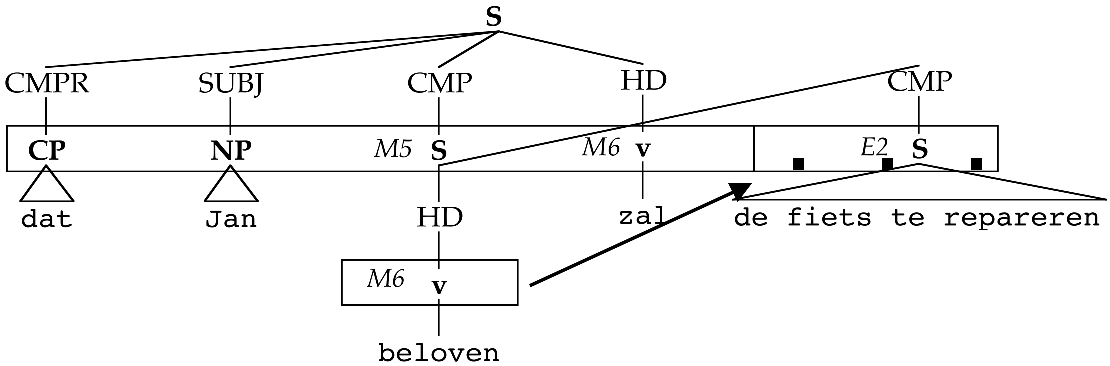


Figure 11. Right-peripheral topology sharing (shaded area E2) in sentence (11a)

The CMPtype features in the lexical frames of the modal auxiliaries in Figure 9 also account for the ordering phenomenon illustrated in (13) below. The order of modal auxiliary and main verb in clause-final verb clusters is arbitrary as long as the main verb does not take a sentential complement. If the auxiliary governs a complement-taking verb, Aux-MainV is the only acceptable sequence: see the grammaticality contrast between (13a/b) on the one hand and (13c/d) on the other.

(13) a. ... *dat Jan de fiets zal proberen te repareren*

'... that Jan will try to repair the bike'

b. *... *dat Jan de fiets proberen zal te repareren*

c. ... *dat Jan de fiets zal (uit)proberen*

'... that Jan will try (out) the bike '

d. *... dat Jan de fiets (uit)proberen zal*

e. *Ik weet niet welke fiets Jan zal proberen te repareren*

'I don't know which bike Jan will try to repair'

f. **Ik weet niet welke fiets Jan proberen zal te repareren*

g. *Ik weet niet welke fiets Jan zal (uit)proberen*

'I don't know which bike Jan will try (out)'

h. *Ik weet niet welke fiets Jan (uit)proberen zal*

The lexical frames for *zullen1* and *kunnen1* have a much narrower range of applicability than their counterparts *zullen2* and *kunnen2*. They can head finite clauses only, licensing MainV-Aux order exclusively to 'simple' verbs, which do not take sentential complements. The phenomenon holds irrespective of whether the dependent NP is promoted within the Midfield (*de fiets* in M3) or within the Forefield (*welke fiets* in F1) — cf. (13e-f).

A construction of Dutch which has no counterpart in German or English, is governed by verbs such as *zitten* 'sit', *staan* 'stand' and *liggen* 'lie'. They take an infinitival complement expressing an ongoing action performed by the referent of the SUBJect NP (cf. Progressive aspect in English) and simultaneously mention the bodily position assumed by the SUBJect referent during the action. The examples in (14) demonstrate, interestingly, that the status of the complement's HeaD verb varies in function of the status the governor: If the governing verb is finite, the complement has PInfin status (with *te*); in all other cases, the complement's HeaD verb is a bare infinitive without *te* (status = Infin).

(14) a. ... dat Jan een boek zit/staat/ligt te lezen

that Jan a book sits/stands/lies to read

'... that Jan is reading a book (while sitting/standing/lying)'

b. ... dat Jan een boek zou zitten/staan/liggen lezen

'... that Jan would be reading a book'

c. ... dat Jan een boek heeft zitten/staan/liggen lezen

'... that Jan has been reading a book'

We propose to treat these complement-takers in a way similar to the modal verbs in Figure 9 (e.g. *kunnen* and *zullen*), that is, to associate with them separate lexical frames for use in finite and infinitival constructions. (The verbs cannot take participial status.) Figure 12 shows the CMPtype features.

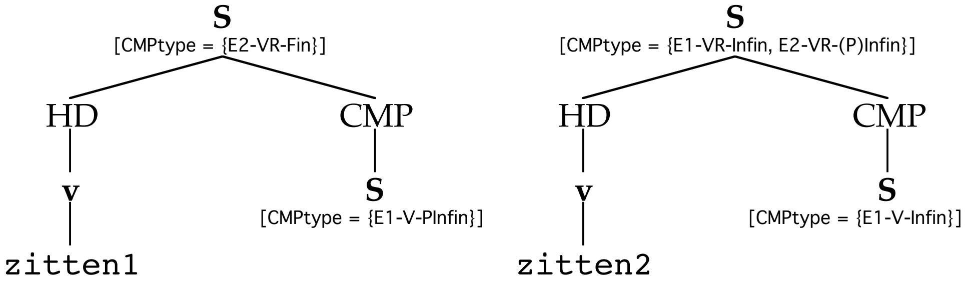


Figure 12. Lexical frames for the complement-taking verb *zitten* in example (14).

We finally turn to verb clustering in passive constructions, as exemplified by the examples (15) and (16), which are more or less synonymous. (15a-f) list all six permutations of two past-participles (*aangeboden* and *geworden*) and the finite passive auxiliary *was*. Three of these are ungrammatical. Version (15g) is the sole (marginally) acceptable ordering where the particle *aan* and the main verb *geboden* are not contiguous. The past-participle *geworden* is nearly always omitted in modern standard Dutch. So, in everyday usage, the verb cluster has three possible orderings: *was aangeboden*, *aangeboden was* and *aan was geboden*. The grammaticality ratings of the seven versions of (16) run parallel to their counterparts in (15). We take this as evidence for a parallel treatment of *aangeboden gekregen had* and *aangeboden geworden was*. That is, we analyze not only *geworden* but also *gekregen* as a complement-taking verb, and they both can take *aangeboden* as non-finite complement. The lexical frames of the verbs involved are depicted in Figure 13. (The entry for *had* 'had', the past tense of *hebben* 'have', has been copied from Figure 9; *zijn* 'be' is the infinitival form of *was*.) The reader may verify for her/himself that, in conjunction with the cross-clausal topology sharing rule (Table 2), these lexical frames generate exactly the set of (marginally) acceptable verb orderings.

(15) a. ... *dat deze baan haar niet aangeboden*$_3$ *(geworden*$_2$*) was*$_1$
that this job her not PRT-offered been was
'... that this job had not been offered to her'
b. ... *aangeboden was (geworden)*
c. *... *(geworden) was aangeboden*
d. *... *(geworden) aangeboden was*
e. *...*was (geworden) aangeboden*
f. ... *was aangeboden (geworden)*
g. ?... *aan was geboden (geworden)*

(16) a. ... *dat ze deze baan niet aangeboden*$_3$ *gekregen*$_2$ *had*$_1$
that she this job not PRT-offered gotten had
'... that she had not been offered this job'
b. ... *aangeboden had gekregen*

c. *... *gekregen had aangeboden*

d. *... *gekregen aangeboden had*

e. *... *had gekregen aangeboden*

f. ... *had aangeboden gekregen*

g. ?... *aan had geboden gekregen*

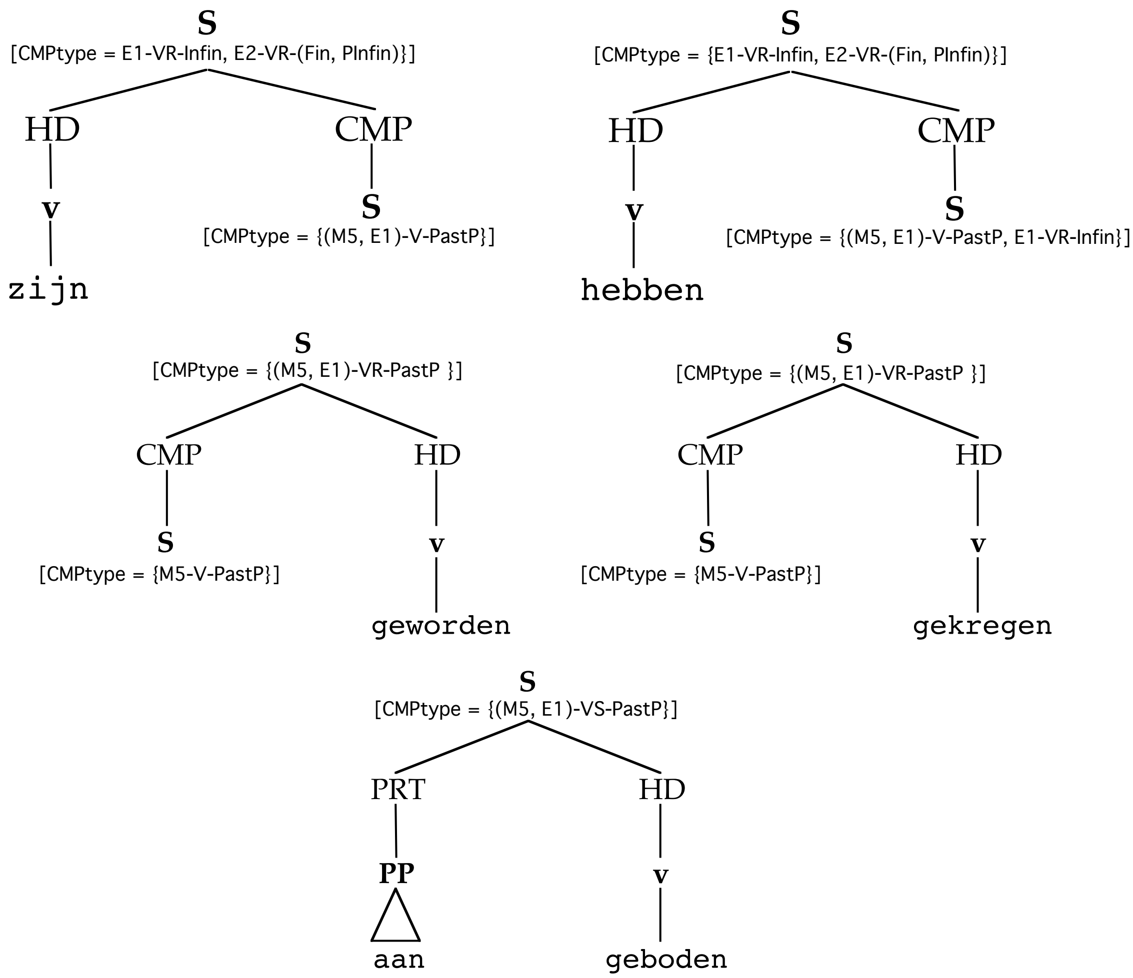


Figure 13. Lexical frames and CMPtype features for the verbs in (15) and (16).

3. Verb clustering in German

Our treatment of word order in German clauses is based on the topology slot selection rules inTable 1, the topology sharing rule in Table 2, and CMPtype features such as those listed in the lexical items of Figure 14 and Figure 16. The German slot selection rules closely resemble the Dutch ones, the main difference being that the PaRTicle of separable verbs goes to M6 rather than M4. The left-peripheral topology sharing rule is essentially the same as the one for Dutch, except that Verb Raisers like *wollen* do not want their complements to share slot M5. As to right-peripheral sharing, we assume that the Dutch rule in (12) above also applies to German.

In designing the German linearization system we were guided by the numerous facts discussed by Kathol (2000) and Meurers (2000). They present detailed surveys of both traditional and contemporaneous linguistic proposals for dealing with word order in German, and develop their own HPSG-style solutions. Other publications we consulted include Uszkoreit (1987); Engelkamp, Erbach & Uszkoreit (1992); Reape (1993); Haider (1993); Nerbonne, Netter & Pollard (1994); Hinrichs & Nakazawa (1994, 1998); Seuren (1996); Bouma & Van Noord (1998); Richter (2000), and Seuren (this volume). The confines of the present paper do not allow us to describe in detail the numerous phenomena and concomitant theoretical explanations in these sources.

Figure 15 illustrates how the value of CMPtype features constrains linear order within the verb clusters in (17). Figure 16 shows the CMPtype feature values of the lexical frames referenced in (18) — examples mostly due to Seuren (this volume). Figures 17 and 18 illustrate the analyses of four of them. The notational conventions are identical to those for Dutch (see previous Section). Notice that the figures do not contain lexical frames for past participles of modal auxiliaries. We have assumed that, in standard German, forms like *gekonnt* 'been able' and *gewollt* 'wanted' do not subcategorize for non-finite clausal complements. Thus we can account for the unacceptability of examples like (17j) and (18c).

(17) a. ... *dass sie das Lied singen*$_2$ *können*$_1$/*werden*$_1$
that they the song sing be-able/will
'... that they can/will sing the song'
b. *... *dass sie das Lied können*$_1$/*werden*$_1$ *singen*$_2$
c. ... *dass sie das Lied singen*$_3$ *können*$_2$ *werden*$_1$
that they the song sing be-able will
'... that they will be able to sing the song'
d. ... *werden*$_1$ *singen*$_3$ *können*$_2$
e. *... *singen*$_3$ *werden*$_1$ *können*$_2$
f. *... *werden*$_1$ *können*$_2$ *singen*$_3$
g. *... *können*$_2$ *werden*$_1$ *singen*$_3$
h. *... *können*$_2$ *singen*$_3$ *werden*$_1$
i. ... *haben*$_1$ *singen*$_3$ *können*$_2$
have sing be-able
'... (that they) have been able to sing'
j. *... *singen*$_3$ *gekonnt*$_2$ *haben*$_1$

(18) a. ... *dass sie ausgehen*$_2$ *will*$_1$
that she out-go wants
'… that she wants to go out'

b. ... *dass sie hat*$_1$ *ausgehen*$_3$ *wollen*$_2$

that she has out-go want

'… that she has wanted to go out'

c. *... *dass sie ausgehen*$_3$ *gewollt*$_2$ *hat*$_1$

that she out-go wanted has

'… that she has wanted to go out'

d. ... *dass sie mich ausgehen*$_2$ *sah*$_1$

that she me out-go saw

'… that she saw me go out'

e. ... *dass sie mich hat*$_1$ *ausgehen*$_3$ *sehen*$_2$

that she me has out-go see

'… that she has seen me go out'

f. ... *dass sie mich ausgehen*$_3$ *gesehen*$_2$ *hat*$_1$

that she me out-go seen has

'… that she has seen me go out'

g. *... *dass sie wird*$_1$ *ausgehen*$_2$

that she will out-go

'… that she will go out'

h. ... *dass sie ausgehen*$_2$ *wird*$_1$

that she out-go will

'… that she will go out'

i. ... *dass sie wird*$_1$ *ausgehen*$_3$ *wollen*$_2$

that she will out-go want

'… that she will want to go out'

j. ... *dass sie ausgehen*$_3$ *wollen*$_2$ *wird*$_1$

that she out-go want will

'… that she will want to go out'

k. ... *dass sie wird*$_1$ *haben*$_2$ *auszugehen*$_5$ *versuchen*$_4$ *wollen*$_3$

that she will have out-go try want

'… that she will have wanted to try to go out'

k'. ... *dass sie wird*$_1$ *haben*$_2$ *versuchen*$_4$ *wollen*$_3$ *auszugehen*$_5$

l. … *dass ich sie habe*$_1$ *tanzen*$_4$ *gehen*$_3$ *lassen*$_2$

that I her have dance go let

'… that I have let her go dance'

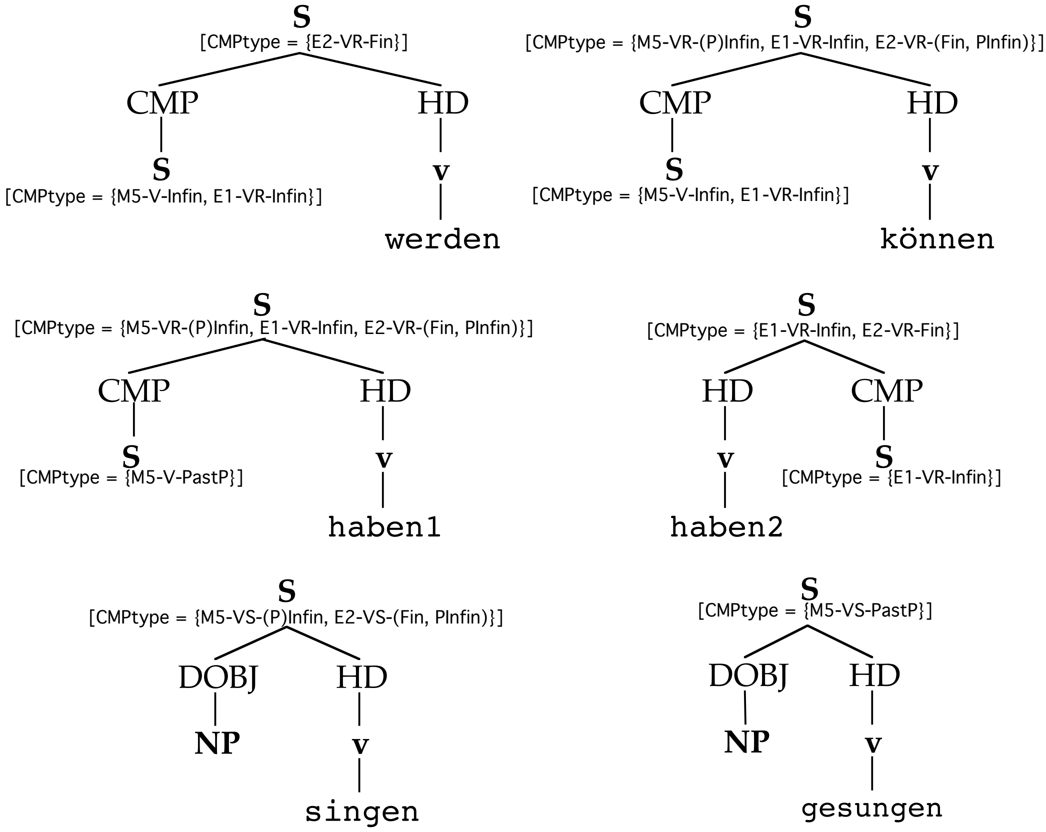


Figure 14. The CMPtype features which control the placement of complement clauses in the lexical frames for the verbs in (17).

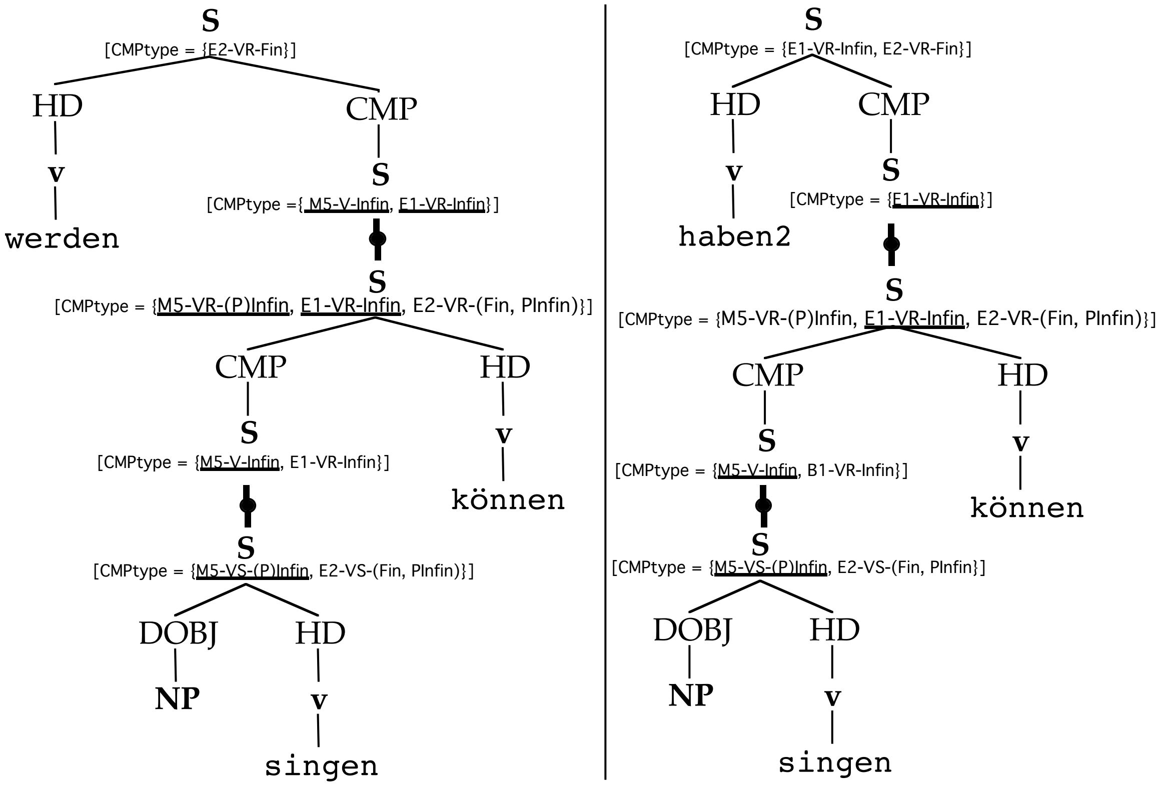


Figure 15. Left-hand side: unification in the verb cluster of examples (17c-h). Right-hand side: idem for (17i). W*erden* licenses both M5 and E1 as legal landing sites for its VR complement, yielding *werden singen können* and *singen können werden*. The order *singen werden können* ensues if the upper and middle topologies share their M5 slots. Of the two lexical entries for *haben*, only *haben2* can unify with infinitival *können*.

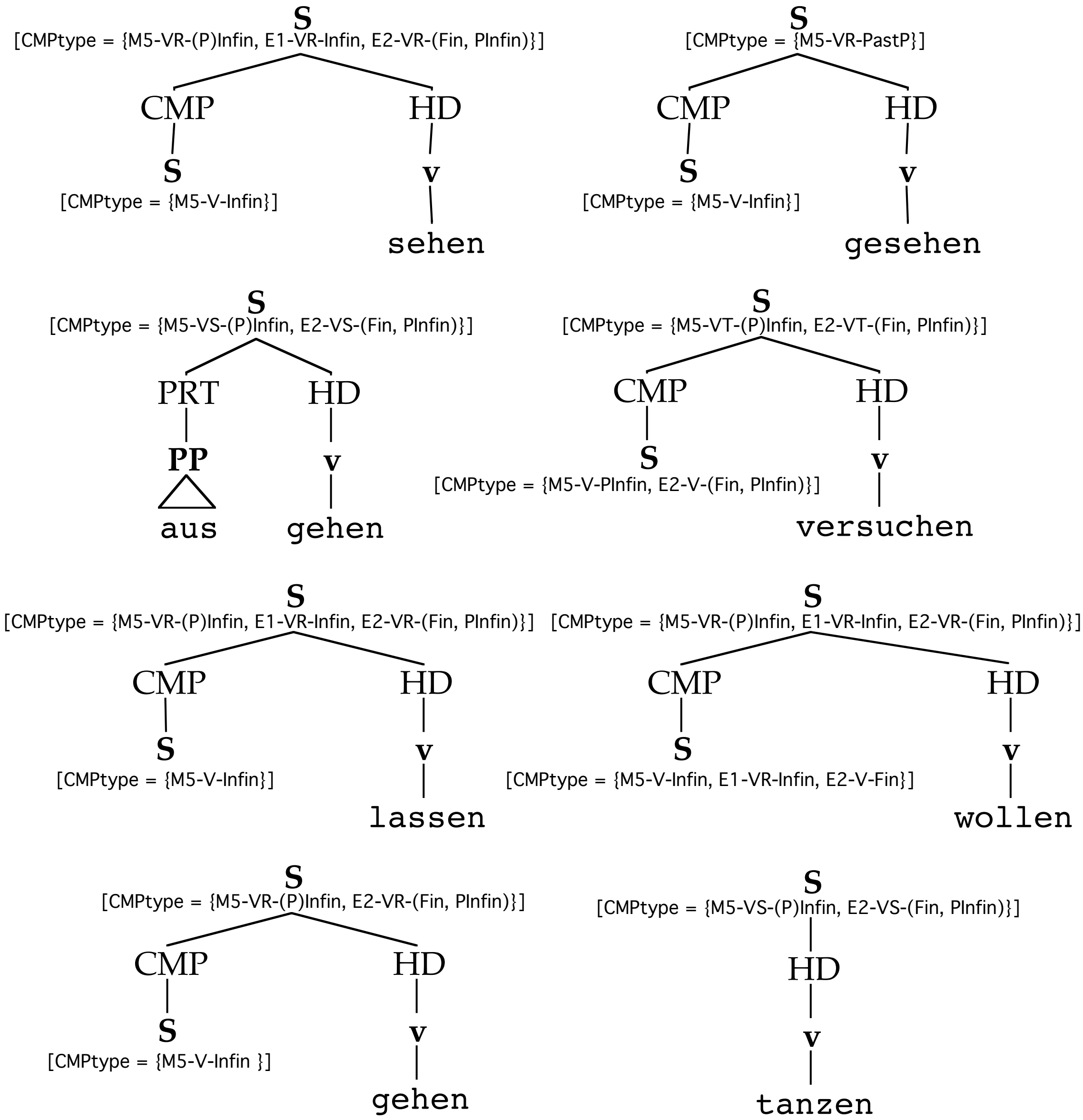


Figure 16. Partial lexical entries for the verbs in examples (18).

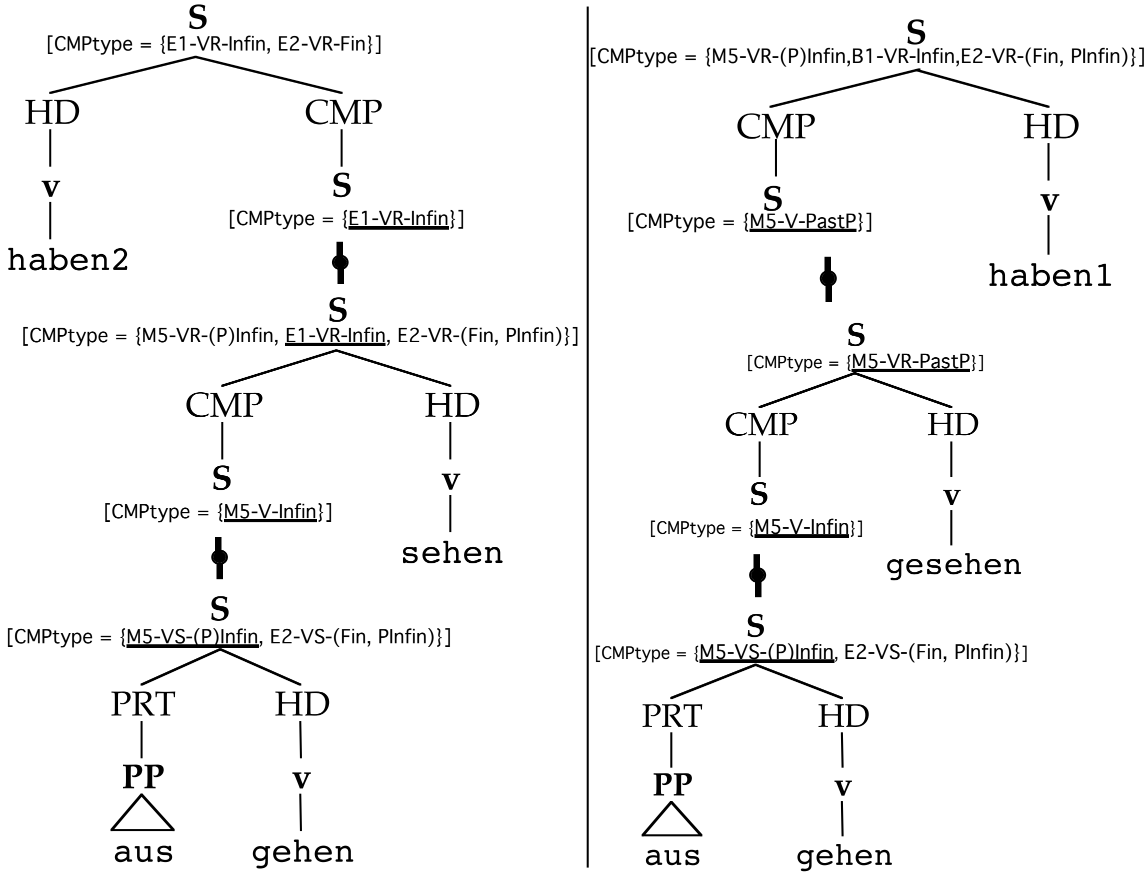


Figure 17. Analysis of examples (18e/f).

The lexical entry of the future auxilary *werden* in Figure 14 assumes — in line with a suggestion by Meurers (2000, p. 223) — that this verb can only occur in finite form. This property accounts, among other things, for the grammaticality contrast between (19a) and(19b). *Können* but not *werden* is allowed to head the complement of *haben2*, as shown in the CMPtype features of these auxiliaries (Figure 14)[9]. Furthermore, *haben2* is not allowed to govern a complement clause with PInfin status. The verb *behaupten* — similarly to *versuchen* (Figure 16) — licenses slot E2 but not E1 as a landing site for its complement. This rules out (19d) while (19c), with *haben1*, is unproblematic.

(19) a. …. *dass er es hätte*$_1$ *singen*$_3$ *können*$_2$

b. *… *dass er es hätte*$_1$ *singen*$_3$ *werden*$_2$

c. *Er behauptete, es gesungen*$_2$ *zu haben*$_1$
he claimed it sung to have
'He claimed to have sung it'

d. **Er behauptete, es zu haben*$_1$ *singen*$_3$ *können*$_2$
he claimed it to have sing be-able-to
(intended) 'He claimed to have been able to sing it

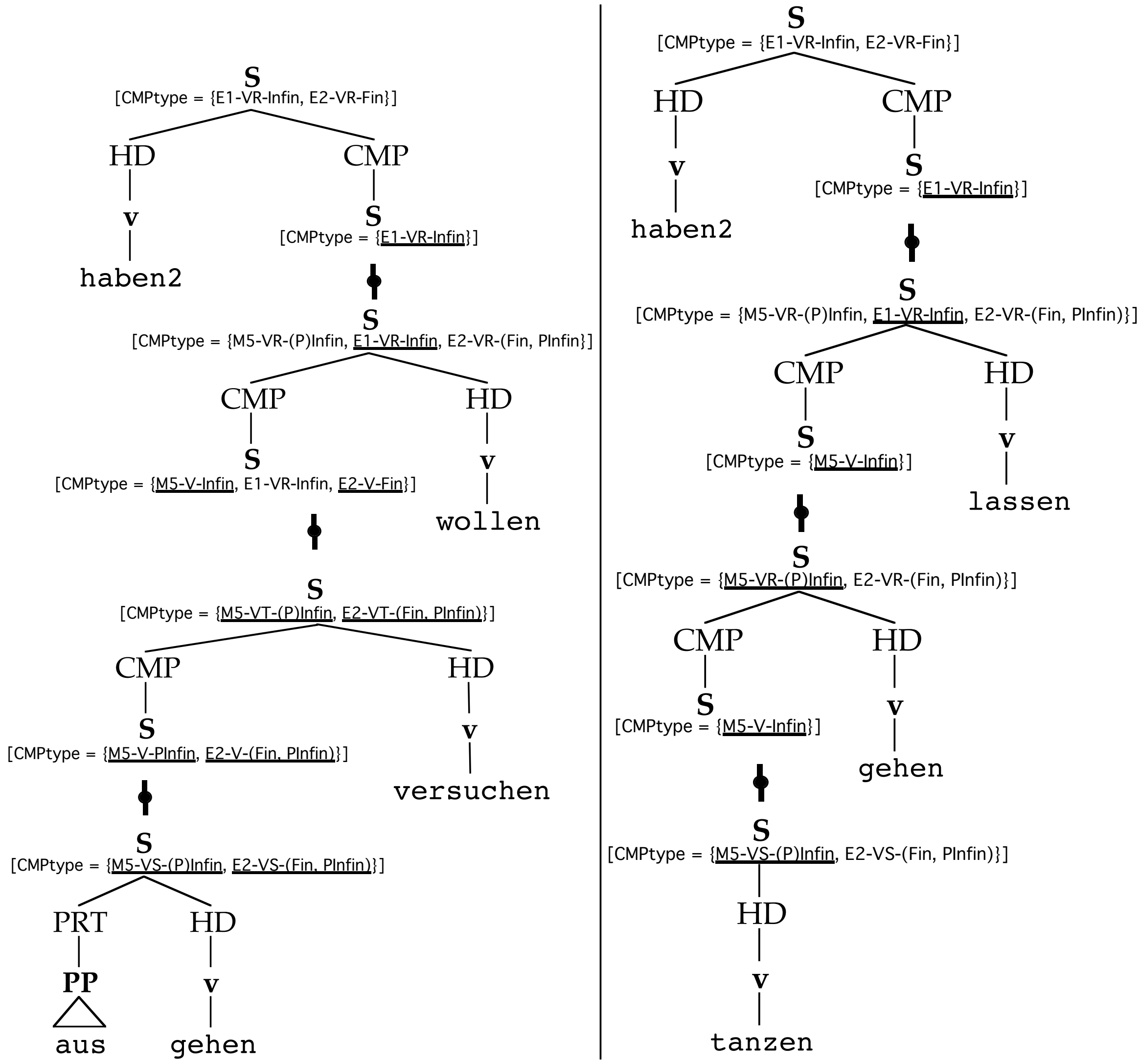


Figure 18. Analysis of examples (18k/l). Alternative (18k′) ensues if option E2-V-PInfin is selected for *versuchen*'s complement (due to obligatory sharing of E2 slots).

The latter observation relates to the fact that *haben2* cannot head the non-finite complement of a preposition or a noun (Haider, 1993). While (20a) below, with a finite complement of *ohne* 'without', is perfectly grammatical, the IPP version (20b) is ruled out. *Ohne* can take a non-finite complement headed by *haben2*, as illustrated by (20c). Example (20d), with the complement-taking noun *Gelegenheit* 'opportunity', is ill-formed for the same reason as (20b). We can account for these phenomena on the assumption that CMP-S nodes of nouns and prepositions contain a CMPtype feature that specifies slot E2 as the only possible landing site for non-finite complements, thus preventing unification of these CMP-S nodes with the *haben2* frame (see Figure 19)[10].

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[9] Interestingly, the Dutch translation equivalent of (19b), with clause-final verb cluster *had*$_1$ *zullen*$_2$ *zingen*$_3$, is perfectly acceptable. It requires the lexical frame *zullen2* rather than *zullen1*. See example (7o) above.

[10] Meurers (2000, p.70-71) argues that this construction occurs frequently enough to consider it well-formed, *contra* Haider (1993) who does not accept it.

Interestingly, if we make the same CMPtype assumption for CMP-S nodes of Dutch nouns and prepositions, the Dutch counterparts of (20a) and (20d) are predicted to be grammatical: The CMPtype

(20) a. … *ohne dass sie es hat*$_1$ *singen*$_3$ *können*$_2$
without that she it has sing be-able-to
'…without her being able to sing it'

b. *….*ohne es zu haben*$_1$ *singen*$_3$ *können*$_2$
(intended) '…without having been able to sing it'

c. … *ohne es gesungen*$_2$ *zu haben*$_1$
'…without having sung it'

d. *… *eine Gelegenheit es zu haben*$_1$ *singen*$_3$ *können*$_2$
an opportunity it to have sing be-able-to
(intended) '…an opportunity to have been able to sing it'

e. ?…*ohne es haben*$_1$ *singen*$_3$ *zu können*$_2$

f. ?… *eine Gelegenheit es haben*$_1$ *singen*$_3$ *zu können*$_2$

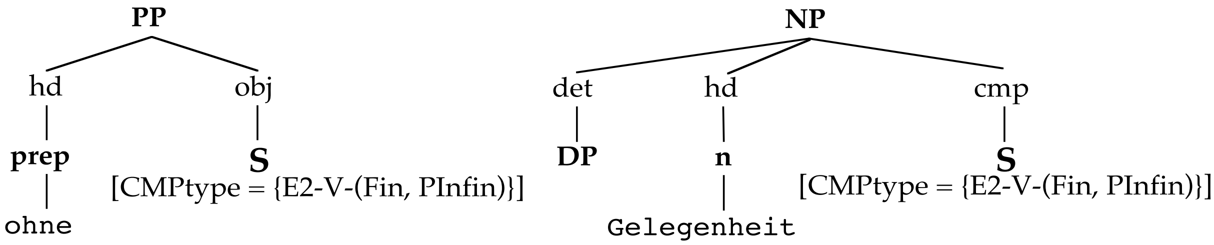


Figure 19. Analysis of example (20d).

Various scrambling phenomena in German involve *fronting* of constituents — in our terminology: placement of focused or topicalized constituents in slot F1 of a main clause. Examples (21a) through (21f), from Engelkamp, Erbach & Uszkoreit (1992), represent *Simple Fronting*: slot F1 hosts exactly one constituent — a single NP, AdvP, Head verb, or clause. In cases of *Complex Fronting*, slot F1 seems to accommodate several phrases, as exemplified by (21g) and (21h), also from Engelkamp *et al.* (1992). Such cases seem to challenge the widely held view that in main clauses of German no more than one constituent is allowed to precede the finite verb. The mechanism of left-peripheral topology sharing can solve this problem on the assumption that the focus/topic relations within the complement clause overrule the topology sharing defaults stated in Table 2. Auxiliaries like *wollen* and *sollen* standardly cause sharing of slots F1 through M4 of the complement topology. This default presumably does not apply to focused or topicalized constituents of the complement. These do not undergo promotion and are

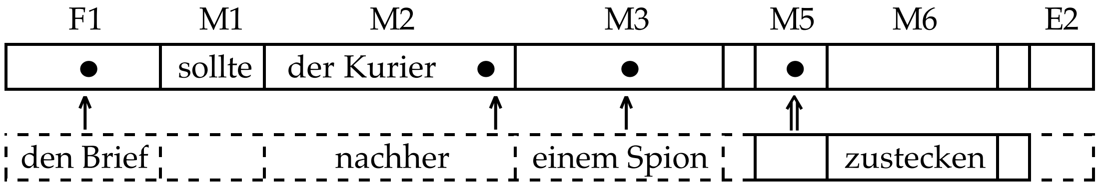
feature in the root S-node of *hebben* does include E2 as an optional landig site (see Figure 9). This prediction is indeed verified by the full grammaticality of literal translations (i) and (ii):
(i) zonder het te hebben kunnen zingen
(ii) een gelegenheid het te hebben kunnen zingen

fronted while the promoted parts of the complement are slotted into the standard Midfield positions of the matrix topology[11].

(21) a. *Der Kurier sollte nachher einem Spion den Brief zustecken*
the courier should later a spy the letter slip
'The courier was later supposed to slip a spy the letter.

b. *Zustecken sollte der Kurier nachher einem Spion den Brief*

c. *Den Brief sollte der Kurier nachher einem Spion zustecken*

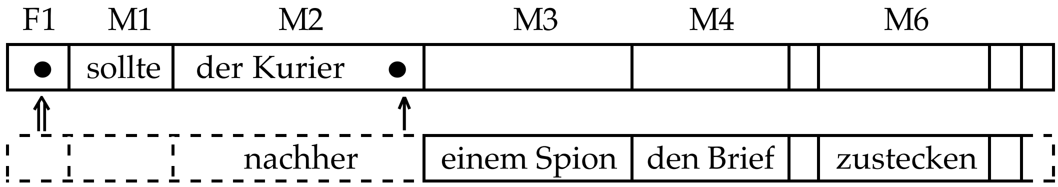


d. *Einem Spion sollte der Kurier nachher den Brief zustecken*

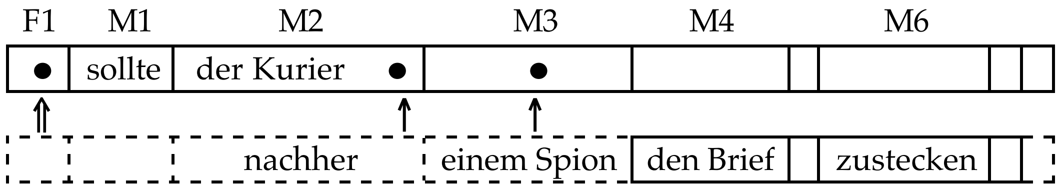
e. *Nachher sollte der Kurier einem Spion den Brief zustecken*

f. *Nachher einem Spion den Brief zustecken sollte der Kurier*

g. *Einem Spion den Brief zustecken sollte der Kurier nachher*



h. *Den Brief zustecken sollte der Kurier nachher einem Spion*



Complex Fronting may involve a stack of non-finite complement clauses. The sentence in (22a), from Kathol (2000), contains two complements headed by the verbs *können* and *finden*. The seven logically possible variants embodying simple or complex fronting are shown in (22b) through (22h). These are all grammatical, except for (22d) and (22f). When drawing the linear structures, we have assumed that the complements either go to slot M5 of their governor or, if focused or topicalized, to F1[12]. All five grammatical cases can be generated by our linearization system. With respect to (22e) we assume, like we did in the context of some of the examples in (21) above, that focus/topicalization can prevent promotion of phrasal arguments (here the Direct OBJect

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[11] Table 1 does not specify landing sites for Adverbial Phrases. Here, we assume that the adverbial modifier *nachher* is assigned a late position in slot M2, unless focused or topicalized.

das Buch). The ill-formedness of variants (22d) and (22f) follows from the fact that *können* cannot be fronted without taking *finden* along: if *finden* is not going to F1, it can only land in M5 — a slot that Verb Raisers like *können* never share with their complement. Interestingly, the system does not rule out a (marginally) acceptable case such as **(23)**, from Kathol (2000, p. 234). The basic reason is that the complement of *versprochen*, unlike the complement of *können*, is free to land in E2 as well as in M5.

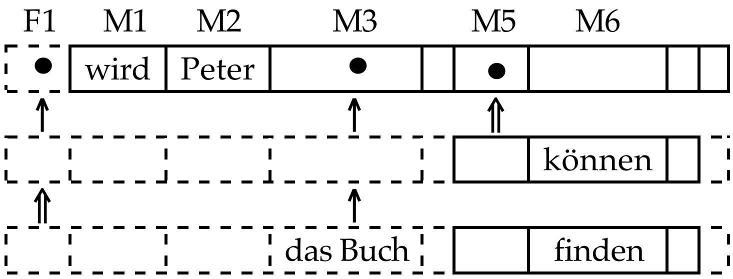
(22) a. *Peter wird das Buch finden können*

Peter will the book find be-able-to

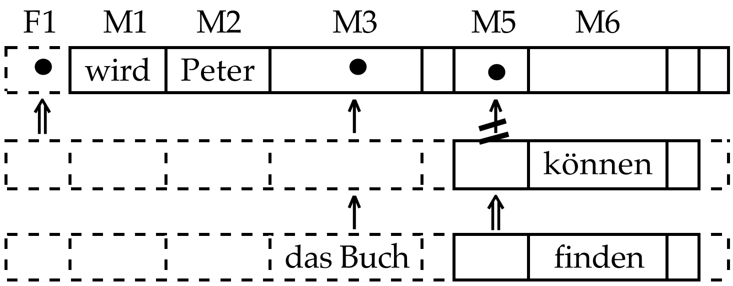
'Peter will be able to find the book'

b. *Das Buch wird Peter finden können*

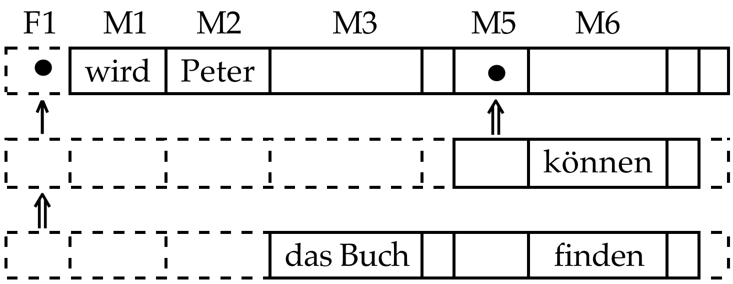
c. *Finden wird Peter das Buch können*



d. **Können wird Peter das Buch finden*

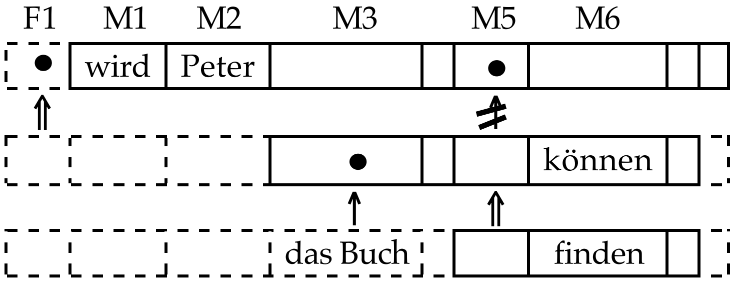


e. *Das Buch finden wird Peter können*

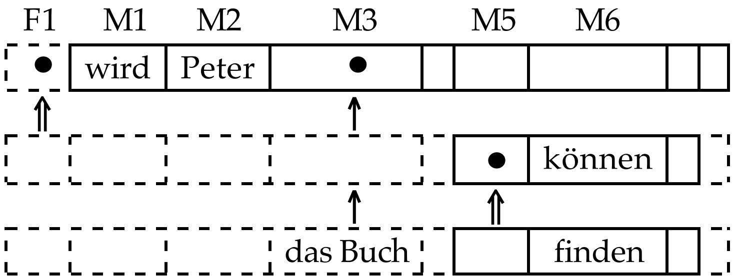


[12] The lexical item *werden*, shown in Figure 14, also allows its complement to land in slot E1. This additional possibility does not affect our account of the examples in (22).

f. **Das Buch können wird Peter finden*



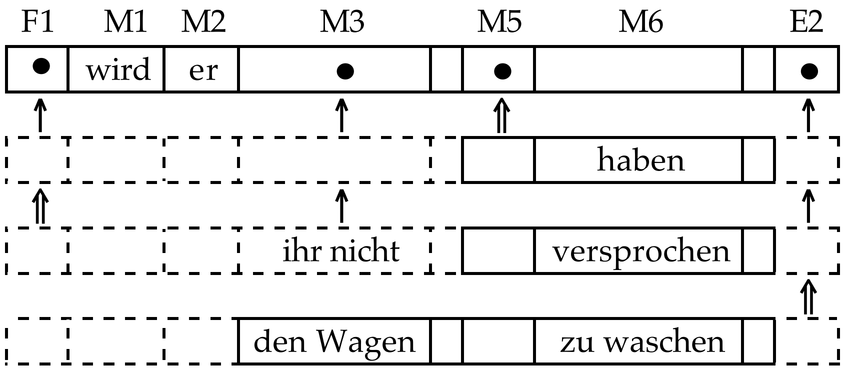
g. *Finden können wird Peter das Buch*



(23) *?Versprochen wird er ihr nicht haben den Wagen zu waschen*

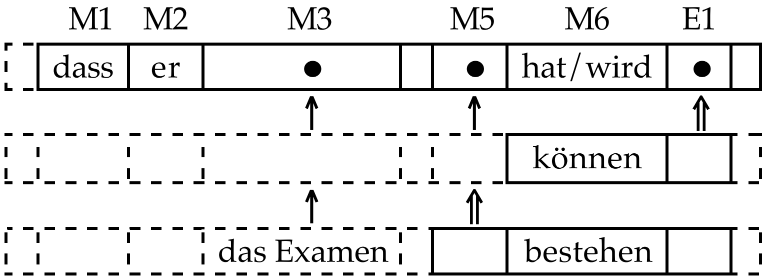
promised will he her not have the car to wash

' He will not have promised her to wash the car'

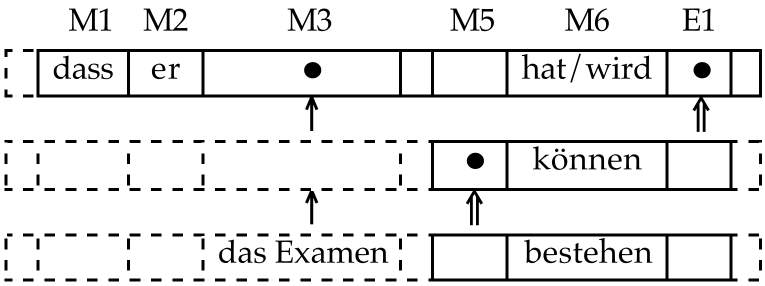


We now turn to some special German word order phenomena whose explanation exceeds the scope of the PG framework developed so far but may be accommodated by slight extensions of the formalism. The first example is provided by the Verbal Complex Split, a construction that seems to be acceptable to many speakers of German. Kathol (2000, pp. 204-205) gives four illustrations, one of them sentence (24a)[13]. They all feature the auxiliaries *werden* or *haben* (IPP) in the role of finite verb. It is clear that the current linearization model only generates the variant (24b). In order to enable the Verbal Complex Split, we need to add a special subcategorization property to the lexical items *werden* and *haben2*, namely, that they license the embedded clause to share slot M5 — over and above the slots F1 through M4 that are already shared by virtue of the default rule in . The clause S3 headed by *bestehen* will then get promoted into to S1, there preceding *hat/wird* in slot M5. However, because an extension of the model along this line may have undesirable side-effects, and in view of the insecure status of the Verbal Complex Split as a construction of standard German, we have not explored this approach any further. (Interestingly, the modified version of the German cross-clause topology sharing rule resembles the Dutch one more closely than the original one; see Table 2.)

(24) a. … *dass er das Examen bestehen wird/hat können*
that he the exam pass will/has be-able-to
'…that he will be/has been able to pass the exam



b. … *dass er das Examen wird/hat bestehen können*



The rule for left-peripheral topology sharing in Table 2 states that Verb Raisers like *wollen* and other auxiliaries cause their complements to share the slots F1 through M4. Because, in subordinate clauses, the finite Verb Raiser and the governed non-finite verb land in adjacent slots (the Verb Raiser itself in M6, the HeaD verb of the governed clause in M5 or E1), it follows that the region M5 through E1 of the subordinate clause can only be populated by verbs. This implication is falsified by examples like **(25**), from Kathol (2000, p. 233), where *geben*'s Direct OBJect interrupts the verb cluster. Such cases, although relatively rare, call for a somewhat more lenient version of the topology sharing rule for Verb Raisers — one that offers a wider range of Midfield locations where to put the boundary between shared and non-shared constituents than just at the end of slot M4. It is not clear, however, which conditions control the exact position of the boundary.

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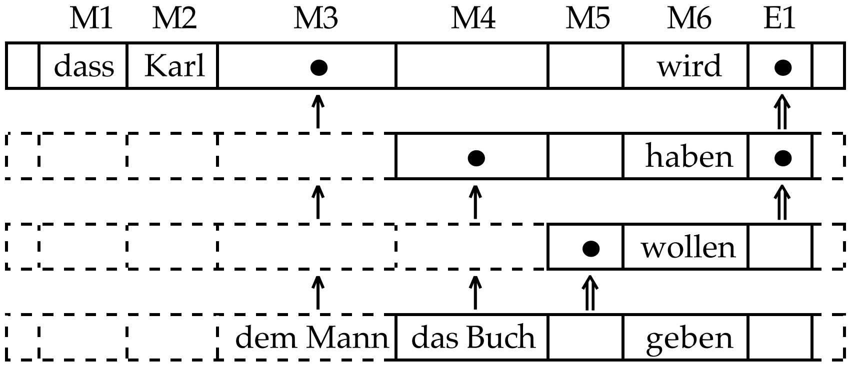
[13] Kathol (*o.c.*) refers to an unpublished workshop paper by Meurers (1994) as the original source of these examples. See Meurers (2000) for additional examples.

(25) *… dass Karl dem Mann wird das Buch haben geben wollen*
that Karl the man will the book have give want-to
'… that Karl will have wanted to give the man the book



4. Conclusion

We have presented a linearization formalism capable of capturing a broad range of verb clustering phenomena in Dutch and German. It is part of the psycholinguistically motivated formalism of Performance Grammar, which has separate but interrelated components for assembling the hierarchical and the linear structure of sentences. Particularly importantly in the present context, PG's linearization component deals not only with 'horizontal' position assignment (left-to-right arrangement of constituents within clauses) but also with a broad class of (vertical) 'movement' (constituents being left-right arranged at a clause level higher than their level in clause hierarchy). Unlike what happens in other grammar formalisms, these movement types take place without affecting the hierarchical structure. (Another class of movement phenomena, we assume, does affect the clause hierarchy, in particular the PG equivalents of Subject-to-Subject and Subject-to-Object Raising. The distinction between movement classes at issue here corresponds to the distinction between $\bar{\text{A}}$- and A-movement in Chomskyan Generative Grammar.) Responsible for this behavior are a data structure called *topology* and the mechanism of *lateral topology sharing*. A topology is a one-dimensional array of positions ('slots') serving as landing sites for syntactic constituents. For every pair of a grammatical category (NP, PP, V, etc.) and a grammatical function (Subject, Object, Head, etc.), there is a set of one or more landing sites. The topology sharing mechanism causes unification of left- or right-peripheral slots of clausal topologies at adjacent levels of the clause hierarchy, and thereby virtual vertical movement of constituents landed in a shared slot.

The treatments we proposed for the two target languages are uniform both from a cross-linguistic and from an intralinguistic perspective (see Harbusch & Kempen, 2002, for a treatment along the same lines of movement phenomena in English). The topologies, the topology sharing rules, the constraints on topology sharing, and the CoMPlement-type features are very similar across languages. Word order contrasts between the target languages largely reduce to a few narrowly confined and relatively minor differences concerning topology slot fillers and topology sharing rules. The most salient contrasts between Dutch and German verb clusters are caused by lexical factors — the detailed composition of the CMPtype value in the S-nodes of verb frames.

Acknowledgement

We are indebted to Camiel van Breugel (Leiden Institute for Advanced Computer Science, Leiden University) for implementing, in his Performance Grammar Workbench, a PG for Dutch that includes the rule system described in Section 2. The PGW is accessible through the internet and can be run as an applet in JAVA-enabled browsers (www.liacs.nl/home/cvbreuge/pgw).

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