

# CAT meets GO: Auxiliary Inversion in German Verb Clusters

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## 1. Introduction

Modal verbs as well as a small set of other so-called ‘functional’ verbs, including perception verbs and the verb *lassen* (‘to let’), have a range of properties which set them apart from the main bulk of German verbs. The property which has received most attention in the syntactic literature concerns the order among verbs when they cluster together in clause-final position. In accordance with the OV nature of German, a verb selecting another verb normally appears after the selected verb. An exception to this general rule is found when a modal verb (or any of the other verbs listed above) is put into the perfect or future tense. Consider, for example, a verb cluster consisting of a tense auxiliary, a modal verb, and a main verb. In a 3-verb cluster of this kind, the main verb has to precede the modal verb, as expected for an OV language, but the auxiliary does not necessarily have to follow the modal verb. In fact, a perfect tense auxiliary must obligatorily be put at the front of the verbal cluster according to prescriptive grammars of German. For the future tense auxiliary, fronting is optional. This property of German modal verbs is illustrated in (1).

- (1) ... *dass Peter ein Buch HAT lesen • müssen •*  
           that P.   a book has read   must  
           ‘... that Peter had to read a book.’

The only position of the auxiliary in (1) that is grammatical according to the grammar of Standard German is the cluster-initial position. The other two possible positions—marked by bullets in (1)—are doomed as ungrammatical. A further peculiarity of verb clusters of this kind is also visible in (1). Despite being in the perfect tense, the modal verb *müssen* occurs as a bare infinitival form instead of a past-participle form, as is normally required in the perfect tense. This property of modal verbs is called ‘Infinitivus Pro Participio’ (IPP).

What is illustrated in (1) with the help of a 3-verb cluster holds in similar ways for clusters of greater size. Whenever a verb-cluster consisting of three or more verbs is headed by a modal verb in the perfect tense, the perfect auxiliary must appear in cluster-initial position according to the rules of Standard German. What is actually accepted as grammatical by native speakers of German, however, diverges from the Standard German pattern in a precisely stateable way. In a broad-scale investigation of verb-cluster formation in German, Bader & Schmid (accepted) and Bader, Schmid & Häussler (accepted) obtained standard binary grammaticality judgments in an experimentally controlled way. A major conclusion stemming from this investigation is that native speakers of German indeed require the perfect auxiliary to invert in front of the modal verb, but that they accept any position preceding the modal verb and not just the cluster-initial position. Since the observed optionality with regard to auxiliary placement was found to be independent of participants’ regional background, we have used the term *Colloquial German* for the grammar underlying the observed grammaticality judgments. Furthermore, Bader & Schmid (accepted) have shown how the verb-cluster analysis of Williams (2003) can be extended in order to account for the experimentally obtained grammaticality judgments.

What was said so far holds for clusters with at least three elements, that is, clusters which minimally contain a tense auxiliary, a modal verb, and a main verb. The

complete picture is more complicated, however, due to a second puzzling property of modal verbs in German. This is the fact that they can be used without a main verb as complement, as illustrated in (2) for Standard German.

- (2) ... *dass Peter früh nach Hause (muss | gemusst HAT).*  
       that P. early to home must must-PART has  
       ‘...that Peter (has|had) to go home early.’

In (2), the modal verb seems to select a directional PP instead of a main verb. Some modal verbs can also appear together with NP arguments, but the usage illustrated in (2) is the most widespread one in that it is possible with all German modal verbs. Therefore, we will focus on this usage in the present paper. A first question raised by examples like this is how it is possible at all to combine a modal verb with a non-verbal complement. As shown in (2), this question also arises for modal verbs in the present tense, and is thus independent of the question of how verb clusters are serialized. As also shown in (2), modal verbs in Standard German occur in the expected order (selected verb before selecting verb) and the expected morphological form (past participle) when used without a verbal complement. In other words, modal verbs in this special usage behave like normal main verbs and not like modal verbs in clusters of size three or greater.

The obvious syntactic differences between modal verbs used with and without verbal complement has led to a debate as to whether we are dealing with a case of lexical ambiguity here—with a verb like *müssen* acting either as modal verb or as main verb—or whether there is only a single verb *müssen* behaving differently depending on its syntactic context. In this paper, we contribute to this debate by testing a prediction that our prior work on verb clusters makes for 2-verb clusters. As said above, the rules of Colloquial German are more liberal than the rules of Standard German in allowing the auxiliary in any position preceding the modal verb. For a 3-verb cluster as in sentence (3) with the main verb *fahren* included, this means that the order *V-Aux-Mod* is accepted in addition to the Standard-German order *Aux-V-Mod*.

- (3) ... *dass Peter nach Paris (fahren) HAT müssen.*  
       that P. to Paris drive has must  
       ‘...that Peter had to drive to Paris.’

As illustrated in (3), this order contains the subsequence *Aux-Mod*. A Standard German verb cluster can never contain this sequence. However, given that Colloquial German allows this sequence in longer clusters, it might as well occur on its own as a 2-verb cluster, that is, the main verb *fahren* might be optional in (3). We present experimentally gathered grammaticality judgments showing that there is indeed a tight connection between 3-verb clusters ((3) including *fahren*) and 2-verb clusters ((3) excluding *fahren*): Either speakers accept both, or they reject both. In order to account for this finding, we will combine the analysis that we have presented in Bader & Schmid (accepted) with the empty light verb (GO) analysis that is proposed in van Riemsdijk (2002) in order to account for the use of modal verbs without verbal complements.

The organization of this paper is as follows. The next section summarizes the syntactic analysis of verb clusters of length three or greater which we have developed in Bader & Schmid (accepted). In section 3, we argue that our own analysis is superior

to cartographic approaches to the syntax of verb clusters. In the remainder of this paper, we take a closer look at 2-verb clusters. Section 4 presents two studies that have obtained grammaticality judgments for 2-verb clusters in an experimentally controlled way. We integrate the results of this test into our existing analysis in section 5. The final section 6 contains a summary and a conclusion.

## 2. Verb Clusters and CAT

Verbs in clause-final position are ordered in German according to the schema in (4).

$$(4) \quad \overleftarrow{V}_n \quad \overleftarrow{V}_{n-1} \quad \dots \quad \overleftarrow{V}_2 \quad \overleftarrow{V}_1$$

The order among verbs in (4) transparently reflects the directionality of selection (indicated by an arrow above each verb) which is to be expected from an OV-language like German. When a verb  $V_n$  selects another verb  $V_{n+1}$ ,  $V_n$  follows its complement  $V_{n+1}$ . While most verb clusters in German strictly adhere to the schema in (4), some well-known exceptions also exist. Chief among them are verbal clusters with a modal verb in a complex tense form. According to the grammar of Standard German—as defined in prescriptive grammars (cf. Fabricius-Hansen et al., 2005)—the perfect tense auxiliary must obligatorily appear in cluster-initial position when it selects a modal verb; the future tense auxiliary, in contrast, is allowed to appear in cluster-final position, thereby respecting (4), but it can also show up in cluster-initial position, thereby behaving like its perfect-tense counterpart.

In the syntactic literature, additional auxiliary positions in verb clusters containing modal verbs have occasionally been reported to be grammatical (e.g., Meurers, 2000; Haider, 2003). Furthermore, it has long been known that different regional variants of German exhibit a large amount of variation with regard to the order in which the verbs of a verb cluster are serialized (see Schmid & Vogel, 2004, and references cited there). In order to have a firmer base for syntactic analyses of verb-cluster formation in German, we have run a series of experiments investigating which verb orders in verb clusters with three, four, or five verbs are accepted as grammatical by native speakers of German (see Bader & Schmid, accepted, for 3- and 4-verb clusters and Bader et al., accepted, for 5-verb clusters). The participants of these studies were all students of the University of Konstanz; their task was to judge sentences as either grammatical or ungrammatical as fast as possible (see section 4.1.1 for a detailed description of the experimental procedure).

Figure 1 presents selected experimental results for perfect tense 3-, 4-, and 5-verb clusters in which all verbs except the hierarchically highest one—the finite auxiliary—appear in completely nested order according to the schema in (4). For clusters of each size, the finite auxiliary occurred in any possible serial position.

The data in Figure 1 can be summarized as follows. First, verb clusters with the finite auxiliary in initial position received the highest percentages of judgments ‘grammatical’. Second, verb clusters in which the finite auxiliary occurs in cluster-final position, thereby following the modal verb, were rejected as ungrammatical most of the time. These two findings are in accordance with the grammatical rules of Standard German. With regard to the remaining positions of the auxiliary—that is, positions in

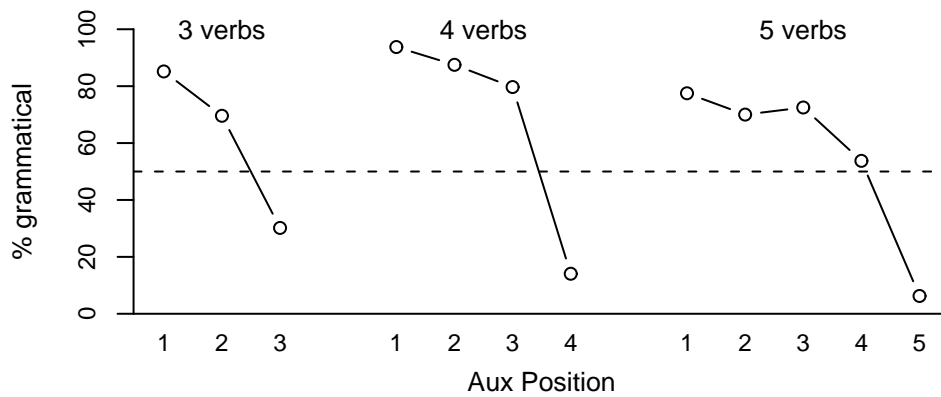


Figure 1. Mean percentages of judgments 'grammatical' for verb clusters with a modal verb in the perfect tense. Data for 3- and 4-verb clusters are from Bader & Schmid (accepted); data for 5-verb clusters are from Bader et al. (accepted).

which the auxiliary precedes the modal verb without occupying the initial position—the findings revealed by Figure 1 diverge from the rules of Standard German in a striking way. In Standard German, these positions are all ungrammatical. Nevertheless, the participants of our experiments judged verb clusters of this kind as only moderately worse than clusters with the auxiliary in initial position.<sup>1</sup>

In summary, if native speakers of German have to spontaneously assess the grammaticality of verb clusters containing modal verbs in the perfect tense, they accept the auxiliary in any position inside the verb cluster except in the final position, that is, in any position which precedes the modal verb. Since this result was found to be independent of the regional background of the speakers, we have called the grammar underlying this pattern 'Colloquial German'. Examples illustrating the data in Figure 1 are given in (5). In each sentence, the finite auxiliary appears in cluster-initial position. This is the position which is grammatical in Standard and in Colloquial German. The bullets in (5) mark additional positions in which the auxiliary is allowed to occur in Colloquial German, where 'allowed to occur' is defined as being accepted 50% or more of the time.

- (5) a. *dass sie das Auto [HÄTTE waschen • müssen.]*  
 that she the car has wash must  
 'that she had to wash the car.'
- b. *dass das Auto [HÄTTE gewaschen • werden • müssen.]*  
 that the car has washed be must  
 'that the car had to be washed.'
- c. *dass das Auto [HÄTTE gewaschen • worden • sein • müssen.]*  
 that the car has washed been be must  
 'that the car should have been washed.'

The data shown in Figure 1 are only a subset of the data on verb-cluster formation that we have obtained so far. Additional data show, among other things, that future tense 3-verb clusters are accepted with the auxiliary in any of the three possible positions. Furthermore, while Bader & Schmid (accepted) and Bader et al. (accepted) only looked at clusters containing modal verbs, unpublished experiments have found similar results

for perception verbs and *lassen* ('make, allow').<sup>2</sup>

In summary, the canonical verb-cluster template in (4) must be supplemented by the templates in (6) in order to capture those cases of verb-cluster formation which involve auxiliary inversion.

(6) Verb clusters with auxiliary inversion

- a. *Standard German*  
 $(\overrightarrow{Aux_1}) \quad \overleftarrow{V_n} \quad \overleftarrow{V_{n-1}} \quad \dots \quad \overleftarrow{V_2} \quad (\overleftarrow{Aux} [Future]_1)$
- b. *Colloquial German*  
 $(\overrightarrow{Aux_1}) \quad \overleftarrow{V_n} \quad (\overrightarrow{Aux_1}) \quad \overleftarrow{V_{n-1}} \quad \dots \quad (\overrightarrow{Aux_1}) \quad \overleftarrow{V_2} \quad (\overleftarrow{Aux} [Future]_1)$

Conditions:

- $V_2 \in \{\text{modal verb, perception verb, } lassen\}$
- $Aux \in \{\text{perfect auxiliary, future auxiliary}\}$
- $Aux[Future] = \text{future auxiliary}$

With regard to auxiliary placement, Standard German and Colloquial German differ crucially in that the auxiliary inverts only to the cluster-initial position in Standard German whereas it inverts to any position in front of the modal verb in Colloquial German. In both Standard and Colloquial German, auxiliary inversion is obligatory in the perfect tense and optional in the future tense.

We next summarize the syntactic analysis that we have developed in Bader & Schmid (accepted) for the data discussed above. This analysis is an application and extension of Williams (2003) who suggests the formal language CAT as part of *Representation Theory*. The three most important properties of a CAT-based approach to verb-cluster formation are the following: First, verb clusters are base generated and not derived by movement. Second, most of the information relevant for ordering is put into the lexicon. Third, the optionality seen above follows without additional assumptions.

Williams (2003) presents a verb cluster analysis which avoids derivational complexity by providing the grammar with means to base-generate all observed verb-order patterns. To this end, Williams introduces the *Rule of Combination* which is the core of the CAT language:

(7) *Rule of Combination* (Williams, 2003: 205)

$$X\_Y + Y\_Z \rightarrow [X + Y]X\_Z$$

This rule is to be read as follows. ' $X\_Y$ ' is a syntactic unit of category X which subcategorizes for a syntactic unit of category Y. ' $Y\_Z$ ' is accordingly a syntactic unit of category Y which subcategorizes for a syntactic unit of category Z. If ' $X\_Y$ ' and ' $Y\_Z$ ' are combined by the Rule of Combination, the resulting unit is of category X and subcategorizes for Z. In other words, the complex category ' $X\_Z$ ' has the same type as the head ' $X\_Y$ ' and the same subcategorization as the complement ' $Y\_Z$ '. The Rule of Combination subsumes two rules from categorial grammar: functional application when  $\_Z$  is empty and functional composition when  $\_Z$  is not empty.

The Rule of Combination operates on lexical items which can be associated with the three types of subcategorization information listed in (8). Grammars of individual languages are obtained by associating lexical entries with the relevant subcategorization information.

- (8) a. Type of complement: N vs. V vs. ...  
 b. Order of selection: left vs. right  
 c. Level of complement:  $X^0$  vs.  $X^N$

Extending the verb cluster analysis provided by Williams (2003) himself, Bader & Schmid (accepted) have made use of the CAT language in order to account for the verb-cluster data that were summarized at the beginning of this section. Some sample lexical entries are given in (9). The direction of selection is specified by an arrow that points to the left when the complement precedes the selecting head and to the right when it follows the head. In (9), selection is always to the left; these entries are thus all canonical given the OV nature of German. When the Rule of Combination is applied to these entries, the syntactic structures in (10) result for 2-verb clusters.

- (9) Sample lexical entries for verbs in German  
 a. Main verbs —  $V_{Main}: DP \leftarrow \mid V_{Main}: PP \leftarrow \mid V_{Main}: DP PP \leftarrow \mid \dots$   
 b. Modal and auxiliary verbs —  $V_{Mod|Aux}: V \leftarrow$

- (10) a. 
$$\begin{array}{c} V_{Aux}: DP \leftarrow \\ \swarrow \quad \searrow \\ V_{Main}: DP \leftarrow \quad V_{Aux}: V \leftarrow \\ | \qquad \qquad | \\ \textit{gelesen} \quad \textit{hat} \end{array}$$
 b. 
$$\begin{array}{c} V_{Mod}: DP \leftarrow \\ \swarrow \quad \searrow \\ V_{Main}: DP \leftarrow \quad V_{Mod}: V \leftarrow \\ | \qquad \qquad | \\ \textit{lesen} \quad \textit{will} \end{array}$$

The ability of the Rule of Combination to pass on the subcategorization frame of a complement to the newly formed unit solves an issue that all theories which base-generate verb clusters have to deal with: The non-locality of head-argument combination inside a verb cluster. Taking (10-a) as an example, the main verb does not immediately combine with its DP complement but combines first with the perfect tense auxiliary. The subcategorization information of the main verb is not lost, however, but transferred to the complex auxiliary  $V_{Aux}$ . This kind of argument passing is shared by a whole family of syntactic accounts inspired by the mechanism of *functional composition* which was introduced by Geach (1970) into syntactic theory (e.g., Steedman, 1983, Johnson, 1986, Hinrichs & Nakazawa, 1994, and much subsequent work). The optionality of auxiliary placement in Colloquial German verb-clusters of the kind discussed above follows directly from the possibility of combining syntactic units by means of functional composition, as we show next.

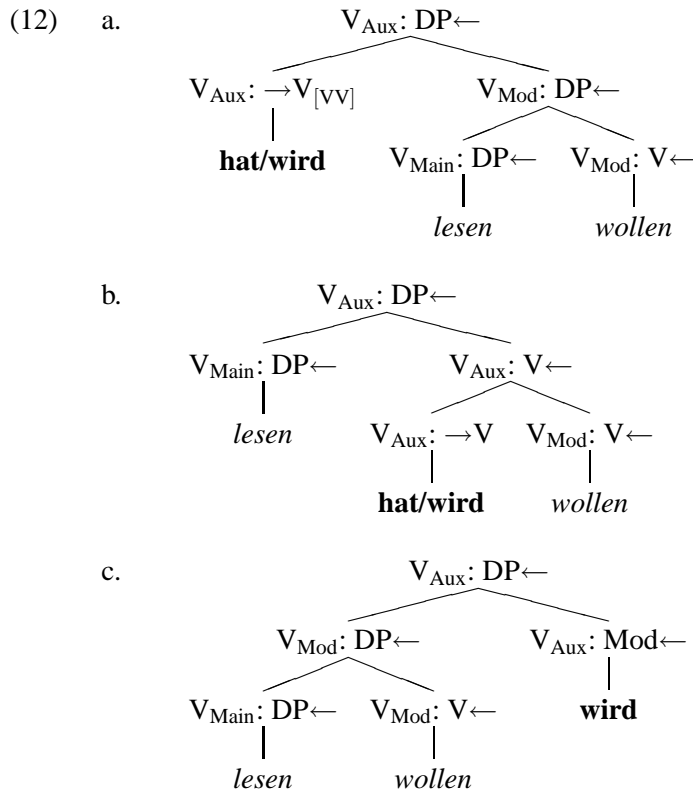
For Colloquial German, we posit the subcategorization frames in (11) for the perfect tense auxiliary *haben* and the future tense auxiliary *werden*.

- (11) Subcategorization frames for Colloquial German tense auxiliaries:  
 a. Perfect tense: *haben* —  $V_{Aux}$ :  
     (i)  $\rightarrow V_{Mod}$   
     (ii)  $V \leftarrow$   
 b. Future tense: *werden* —  $V_{Aux}$ :  
      $\rightarrow V_{Mod}$  or  $V \leftarrow$

The two subcategorization frames of the perfect tense auxiliary stand in an elsewhere relation. The perfect auxiliary selects modal verbs to the right and all other verbs to the

left. The future tense auxiliary shows the same subcategorization frames, but here they stand in a disjunctive relation. This has the consequence that the two options do not exclude each other: Selection of modals is to the right and selection of verbs in general is to the left. Since the label ‘verb’ (V) is a cover term for all kinds of verbs including auxiliaries and modals, modals can also instantiate the general case and be selected to the left.<sup>3</sup>

The Rule of Combination in (7) and the subcategorization frames in (11) are everything we need to account for the optionality that characterizes Colloquial German verb clusters involving modal verbs in a complex tense form. For the case of 3-verb clusters, the resulting structures are shown in (12).



For verb clusters containing more than three verbs, similar considerations show that the syntactic means introduced so far allow the generation of exactly those variants which are actually accepted as grammatical. For reasons of space, we abstain from showing the trees for these complex clusters.

As briefly mentioned in the introduction, German allows 2-verb clusters consisting of modal verb and auxiliary. Such clusters occur when the modal verb has a non-verbal complement. Our analysis for Colloquial German given so far predicts that auxiliary inversion is also possible in these cases. Thus, a sentence like (13) is predicted to be grammatical in Colloquial German.

- (13) ... *dass er ein Buch* HAT ← *wollen*.  
           that he a book has want  
           ‘... that he wanted a book.’



Since this prediction has not been tested so far, we present relevant experimental evidence on this issue in section 4.

In Standard German—to which we turn now—a sentence like (13) is ungrammatical. This is a consequence of the fact that verb cluster formation in Standard German is sensitive to the complexity of the cluster. Auxiliary inversion is not allowed in Standard German when the auxiliary embeds a single verb. Instead, auxiliary inversion requires that the auxiliary embeds a verb cluster, that is, a syntactic unit consisting of at least two verbs. Thus, auxiliary inversion does not occur in 2-verb clusters, and instead of (13) we get (14-a). In contrast to 2-verb clusters, clusters of at least three verbs, as in (14-b), allow or even require inversion.

- (14) a. ... *dass er ein Buch gewollt* ← HAT.  
           that he a book wanted has  
           ‘... that he wanted a book.’  
       b. ... *dass er ein Buch* HAT → *lesen wollen*.  
           that he a book has read want  
           ‘... that he wanted to read a book.’

The complexity requirement for auxiliary inversion that is found in Standard German cannot be captured by the subcategorization specifications given in (8)—syntactic category, order, and level information. Furthermore, in cases where an auxiliary is placed in a position preceding the modal verb, only a single position is allowed in Standard German, namely the cluster-initial position. This contrasts with Colloquial German in which an auxiliary can occur in any position preceding the modal verb. What we therefore need is a means to force the auxiliary to occur in initial position in complex verb clusters. Although we cannot make reference to the initial position directly, it is still easy to encode the necessary feature within the subcategorization information of the auxiliary selecting the modal verb. To achieve the desired effect, we replace the non-stem feature proposed in Williams (2003: 226) by the feature [VV-max] which is defined in (16).

- (15) Additional complexity feature for verb clusters  
       a. Verb cluster: [VV-max]  
       b. Simple verb: [V]  
       (16) Definition: A verb cluster counts as [VV-max] if it contains at least two verbs and all subcategorization requirements for verbs have been saturated.

The maximality requirement [VV-max] is imposed on verb clusters by Standard German auxiliaries. Only in cases of full auxiliary inversion as in *hat lesen wollen* (‘has read want’) is the complexity requirement [VV-max] fulfilled since in *lesen wollen* all subcategorization requirements for verbs have been saturated, as reflected by the label of this verb cluster, namely  $V_{Mod} : NP \leftarrow$ . In contrast, verb clusters which are not maximal in the sense of [VV-max] carry the label  $V_{Mod} : V_{Main} \leftarrow$  (see the tree in (12-b)). They cannot be combined with Standard German auxiliaries.

We thus arrive at the subcategorization frames for Standard German tense auxiliaries in (17).

- (17) Subcategorization frames for Standard German tense auxiliaries:

- a. Perfect tense: *haben* –  $V_{Aux}$ :
  - (i)  $\rightarrow V_{Mod-[VV-max]}$
  - (ii)  $V \leftarrow$
- b. Future tense: *werden* –  $V_{Aux}$ :
  - $\rightarrow V_{Mod-[VV-max]}$  or  $V \leftarrow$

In summary, Bader & Schmid (accepted) have presented an analysis of auxiliary inversion in verb clusters containing three or more verbs in Standard and Colloquial German. Two of the other main phenomena with regard to verb-cluster formation—namely VP topicalization and verb projection raising—are also shortly addressed in Bader & Schmid (accepted). For reasons of space, we do not include this part of our analysis here. Still outstanding is the behavior of the auxiliary in 2-verb clusters in Colloquial German. The analysis summarized in this section predicts that the inverted order *Aux-Mod* is grammatical in Colloquial German in addition to the Standard German order *Mod-Aux*. Before we put this prediction to an empirical test, we first compare our CAT-based account of verb-cluster formation to an account in terms of the cartographic framework that has been developed in work by Rizzi, Cinque and others (e.g., Rizzi, 1997, Cinque, 1999, and much subsequent work) and ask how an analysis based on cartographic principles fares in comparison to our CAT-based approach.

### 3. CAT versus Cartography: A Comparison

Looking at verb cluster formation more generally, two main approaches can be distinguished (see Wurmbrand, 2006, for a detailed overview): (i) The *base generation approach* which assumes that each verb order variant in the verb cluster is directly generated by the grammar (e.g., Haider, 1993), and (ii) the *derivational approach* in the tradition of Evers (1975) which assumes that all verb order variants are derived from a single underlying structure. Derivational theories can be further subdivided with regard to the clausal status of the embedded infinitival complement. Bi-clausal theories assume that the infinitival forms its own clausal domain (see Hinterhölzl, 2006, for a recent analysis based on this assumption). According to mono-clausal theories, in contrast, infinitival and matrix verb are part of a single clause (see Wurmbrand, 2007).

A cartographic approach to verb-cluster formation will necessarily fall into the class of derivational theories because cartography is built on two key assumptions of Kayne (1994). According to the first assumption, all phrases adhere to the order Spec-Head-Complement. Consequently, a head-initial VP must be assumed even for languages for which traditionally a head-final VP had been assumed. The verb-cluster languages German and Dutch have thus to be reanalyzed as having an underlying VO base structure (see Zwart, 1996). The second assumption is that all languages share a universal base structure which reflects a fixed hierarchy of functional projections. Surface orders which diverge from the underlying base order are derived by movement operations. Taken together, these two assumptions imply one of the major tenets of cartography, namely the existence of a universal head-initial base structure. The cartographic approach has been extensively applied to the left periphery of the clausal domain, initiated by the seminal work of Rizzi (1997), and the structure of DP (e.g., Cinque, 2005). Cinque (2004) has extended this approach to “restructuring” phenomena that are found

in the verbal domain, concentrating on restructuring in Romance languages.

A crucial aspect of the analysis presented in Cinque (2004) is that the sequence of verbs exhibiting restructuring properties is analyzed as belonging to a single clausal domain. This is achieved by postulating a hierarchy of functional projections above VP; the heads of these functional projections can be filled by various ‘functional’ verbs, including all kinds of auxiliaries as well as modal verbs. Thus, a cartographic approach along the lines of Cinque (2004) postulates a mono-clausal structure for verbal clusters of the sort considered here, a property which it shares with our CAT-based analysis presented in the preceding section.<sup>4</sup> What is different, however, is the way how verb order variation is accounted for, by movement in the cartographic approach or by base-generation in the CAT-based approach.

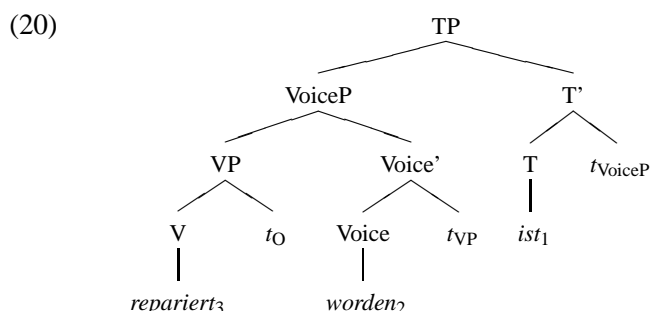
To our knowledge, a full-fledged cartographic analysis of verb-cluster formation in the West-Germanic languages is still wanting. A first step in this direction has been taken by Svenonius (2007) who sketches a cartographic analysis of German verb-cluster formation with a special focus on verb order. We next discuss how the variation that is empirically observed with regard to the linearization of verbs in 3-, 4- and 5-verb clusters can be derived in accordance with cartographic principles. The particular derivations that we show are in the spirit of the proposals found in Svenonius (2007) concerning German verb clusters and the analysis of DP-internal word-order variation presented in Cinque (2005), although we have made certain simplifications which do not affect our main arguments.

The first simplification concerns the hierarchy of functional projections above VP. For ease of presentation, we operate with the simplified functional hierarchy given in (18). This hierarchy contains five positions and thus subsumes all clusters that we have discussed so far. Furthermore, when discussing particular verb clusters, we only include as much elements of the hierarchy in (18) as are required to provide a place for each element of the verb cluster.

- (18) T > Mod > Perf > Voice > V

We begin by showing how a canonical verb cluster—that is, one adhering to the scheme in (4)—is derived. The example that we use for this purpose is shown in (19). The syntactic tree for the cluster in (19) is given in (20).

- (19) *dass das Auto repariert<sub>3</sub> worden<sub>2</sub> ist<sub>1</sub>*  
 that the car repaired been is  
 ‘that the car has been repaired.’

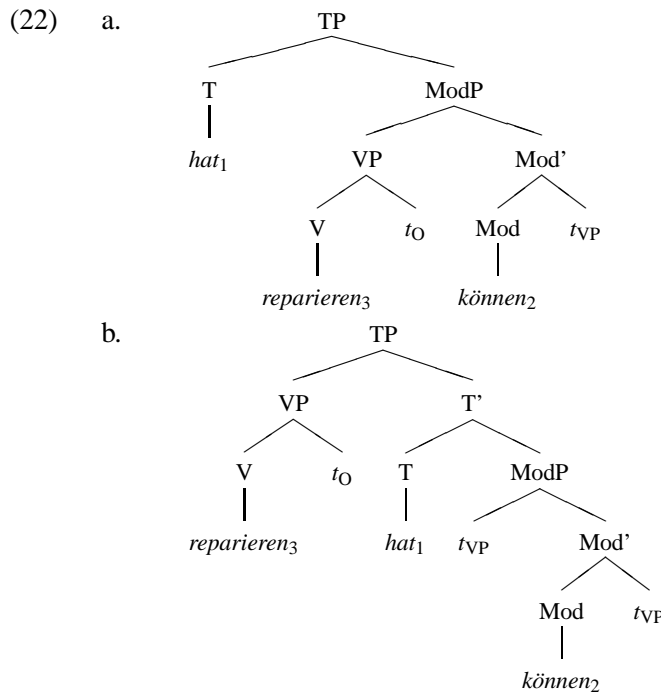


The order among the verbs in (19)/(20) is the mirror image of the base order. This is achieved by first moving VP to the left of its selecting head Voice into the specifier of VoiceP, and then moving the resulting VoiceP to the left of its selecting head T into the specifier of TP.

Consider next the case of a 3-verb cluster with a modal verb in the perfect tense. A relevant example of this kind is shown in (21).

- (21) *dass Peter das Auto hat<sub>1</sub> reparieren<sub>3</sub> • können<sub>2</sub>*  
 that P. the car has repair can  
 ‘that Peter has been able to repair the car.’

The two syntactic trees corresponding to the two possible auxiliary positions in (21) are provided in (22).



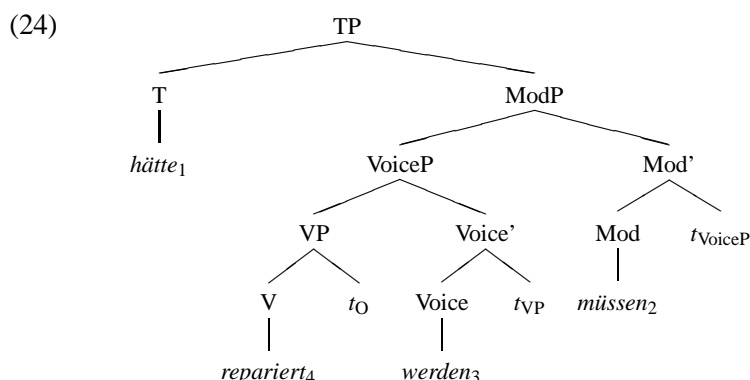
The two trees in (22) share with the tree in (20) the first step of the derivation, namely the movement of the most deeply embedded phrase (VP) into the specifier of the next higher phrase (VoiceP in (20), ModP in (22)). For the cluster with the finite auxiliary in initial position, that is, (22-a), we can already stop here. In order to get the cluster with partially inverted auxiliary, that is, (22-b), an additional movement step is necessary. In contrast to the completely inverted cluster in (19)/(20), this final step does not target the complement of the highest verb as a whole, but only its specifier, that is, the VP that has been moved there in the initial step of the derivation.

Let us consider next the case of 4-verb clusters, as illustrated by sentence (23).

- (23) *dass das Auto [HÄTTE repariert • werden • müssen.]*  
 that the car has repaired be must  
 ‘that the car had to be repaired.’

The three elements embedded below the auxiliary appear in inverted order. This is

achieved in a now familiar way by first moving VP (*gewaschen*) past Voice (*werden*) and the resulting VoiceP past Mod (*müssen*). The resulting tree is shown in (24).



The tree in (24) represents a 4-verb cluster with the finite tense auxiliary in initial position. In order to derive the two remaining auxiliary positions 2 and 3 from (24), an additional movement step becomes necessary. When only the VP *repariert* is moved to the left of *h tte*, *h tte* ends up in the second position of the cluster. When the larger VoiceP *repariert werden* is moved, a cluster with *h tte* in third position results.

The derivation of 5-verb clusters as in (5-c) proceeds analogously. The main difference to the 4-verb case is that the structure in which the four elements below T have been inverted by successive movement gives rise to three additional structures instead of two. In  $[T \text{ } [[VP \text{ } Voice \text{ } t_{VP}] \text{ } Perf \text{ } t_{VoiceP}] \text{ } Mod \text{ } t_{PerfP}]]$ , VP, VoiceP and PerfP are all possible targets for movement around T.

Summarizing the discussion so far, we have seen that all cluster-internal orders that have been found to be grammatically licit in Colloquial German are derivable from an underlying head-initial base structure. Since Standard German is just a subset of Colloquial German, all Standard German verb-clusters can of course be derived too. This implies that a comparison between the cartographic approach and the CAT-based analysis cannot revolve around the question of generative capacity. We will instead base our comparison on the issue of optionality as it is found in Colloquial German, and on the relationship between Colloquial and Standard German. As we will argue now, a CAT-based analysis fares better than a cartographic analysis on both counts.

Consider first the finding that the position of the auxiliary within a larger verb cluster shows a high degree of optionality in Colloquial German. As we have shown in the preceding section, in our CAT-based analysis this optionality follows automatically from the way how the Rule of Combination applies to a sequence of items which consistently select to the left with the exception of the hierarchically highest element which selects to the right. In a cartographic analysis along the lines sketched above, the observable optionality is much harder to state. Two alternative formulations of the derivations that must come out as grammatical are given in (25).

- (25)
- a. Invert anything below the finite auxiliary, and then move either nothing, or the specifier of the auxiliary's complement, or the specifier of the specifier of the auxiliary's complement, ...
  - b. Invert anything below the finite auxiliary, and then optionally move VP, optionally pied-piping any material except the complete complement of

the auxiliary.

For a working cartographic analysis of the verb-cluster data under consideration, the generalizations in (25) would have to be translated into a system of features which have the effect that all and only those parts of the verb cluster are moved which result in a well-formed linearization of the verbs. Since it is not our aim to provide such an analysis, we do not even try to provide the relevant feature system. We strongly suspect, however, that the triggers for accomplishing the necessary movement steps lead to a grammar that is more complex than a CAT-based approach to verb-cluster formation, in particular because the observed optionality with regard to the position of the inverted auxiliary follows for free in the latter kind of approach.<sup>5</sup>

This conclusion becomes even stronger when we consider the relationship between Colloquial and Standard German. Under a CAT-based approach to verb-cluster formation, the grammar of Colloquial German is less complex than the grammar of Standard German because only the latter must include the feature [VV-max]. For the case at hand, a grammar with optionality is thus simpler than a grammar without optionality. In effect, a highly idiosyncratic feature [VV-max] is needed to prevent this kind of optionality from occurring. Given that Colloquial German reflects native speakers' spontaneous judgments, we surmise that it represents a natural grammar, and that Standard German imposes an artificial restriction on this grammar.

A cartographic analysis along the lines sketched above makes exactly the opposite claim. Under such an analysis, it would be easier to state a grammar without optionality. Instead of the complex generalization in (25), a much simpler statement would do. As shown by a comparison of the tree in (20) for a canonical nested verb clusters with the trees in (22-a) and (24) for inverted verb clusters, an auxiliary selecting a modal verb differs from canonical auxiliaries in that it does not trigger the final movement step which normally moves the auxiliary's complement to the left of the auxiliary. If we are correct in assuming that Colloquial German represents a less complex system than Standard German, the cartographic analysis thus postulates the wrong relationship between the two grammars. We therefore conclude that a CAT-based analysis of verb-cluster formation is to be preferred to a cartographic analysis.

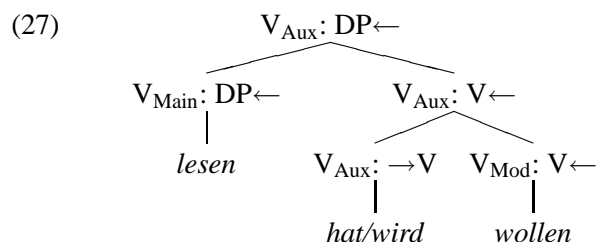
#### 4. Experimental Evidence

The CAT-based verb-cluster analysis that was summarized in section 2 was based on evidence from clusters with 3 or more verbs. An obvious question is how 2-verb clusters fit into the larger picture. That this question arises at all is due to the well-known property of Germanic languages—with the exception of English—that modals may appear without an embedded verb (for discussion and further references, cf. Barbiers, 2006; van Riemsdijk, 2002). For German, this was already shown by the examples in the introduction. A further example is provided in (26).

- (26) ... *dass Peter in die Stadt **gemusst*** HAT.  
           that P.   to the town must-PART has  
           'that Peter had to go to town.'

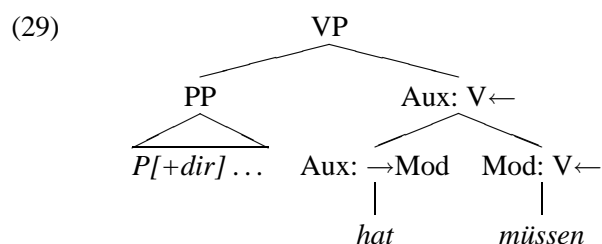
In (26), the modal verb appears as past participle and it precedes the auxiliary. In other words, the 2-verb cluster in (26) conforms to the default rules for verb clusters in German, and does not show the deviations found for clusters with modal verbs of size three or greater. According to the grammar of Standard German, (26) is the only grammatically licit form for clusters of this type.

A different situation holds for Colloquial German. Consider the tree in (27) which can be derived given the lexical specifications for Colloquial German in (11).



An unusual feature of the tree in (27) is the fact that the modal verb does not directly combine with its main verb complement. Instead, first modal verb and auxiliary are combined with each other and only then is the resulting complex combined with the main verb. This feature leads to an interesting prediction concerning verb order in 2-verb clusters. Since Colloquial German allows the derivation of substrings of the form *Aux-Mod*, a sentence like (28) might also be grammatical. In Standard German, in contrast, substrings of this form cannot be derived, and a sentence like (28) is therefore also impossible to derive. The relevant part of the tree for (28) is shown in (29).

- (28) ... dass Peter in die Stadt HAT **müssen**.  
 that P. to the town has must.  
 ‘that Peter had to go to town.’



Although Colloquial German allows to combine an auxiliary with a modal verb in the order *Aux-Mod*, a tree like the one in (29) cannot already be the final representation for 2-verb clusters because it raises the following two issues. First, what happens with the subcategorization feature of the modal verb which requires a verb as complement? Note that this subcategorization feature is still present in (29) because this tree has been derived under the assumption that modal verbs have a single lexical entry, whether appearing in a 2-verb or a 3-verb cluster. Second, how is the resulting verb cluster combined with the directional PP? Before addressing these questions and proceeding with our syntactic analysis, we first present two experiments that have investigated the predicted relationship between 2- and 3-verb clusters.

Experiment 1 tests the prediction of a close connection between 2- and 3-verb clusters containing modal verbs. In particular, it is predicted that someone who accepts the string *Aux-Mod* should do so with and without an additional main verb, and conversely for someone who rejects such a string. Thus, speakers should either accept both 3-verb clusters of the form *V-Aux-Mod* and 2-verb clusters of the form *Aux-Mod*, or reject them both. The subsequent Experiment 2 takes a closer look at the morphological form of the modal verb in 2-verb clusters.

#### 4.1. Experiment 1: The Relationship between 2-verb and 3-verb Clusters

Experiment 1 has two objectives. The first one is to determine whether German speakers accept non-standard 2-verb clusters of the form *Aux-Mod* at all. If so, the second objective is to test whether judgments on sentences with *V-Aux-Mod* clusters correlate with judgments on sentences with *Aux-Mod* clusters. Experiment 1 investigates both the perfect and the future tense of modal verbs. For modals in the perfect tense, only the infinitival form is used in this experiment. Possible effects of the morphological form are the topic of Experiment 2.

##### 4.1.1. Method

*Participants.* 24 students of the University of Konstanz participated in Experiment 1. In this and the next experiment, all participants were native speakers of German and naive with respect to the purpose of the experiment. Participants were either paid or received course credits for participation in the experiment.

*Materials.* The materials for Experiment 1 consisted of 30 sentences each appearing in six different versions. All sentences consisted of a main clause followed by an embedded clause introduced by the complementizer *dass* ('that'). The verb cluster of interest was always the final element of the embedded clause. Two factors were manipulated. The factor Verbal Cluster varied the form of the cluster which could be one of *Aux-V-Mod*, *V-Aux-Mod*, or *Aux-Mod*. The second factor Tense varied the tense of the modal verb by using either a finite form of *haben* (perfect tense) or a finite form of *werden* (future tense) as finite tense auxiliary.

All embedded clauses had a directional meaning. Sentences with a 3-verb cluster therefore contained a motion verb like *gehen* ('to go'), *fahren* ('to drive'), *steigen* ('to climb'), etc., and a directional PP specifying the target of the motion. Sentences with a 2-verb cluster were derived from sentences with a 3-verb cluster by omitting the motion verb. A sample sentence with all of its six versions is shown in Table 1.

Three different modal verbs were used in this experiment: *wollen* ('to want'), *dürfen* ('may'), and *müssen* ('must'). Each modal verb appeared in 10 sentences. From the experimental material, 6 lists were prepared. Each list contained exactly one version of each sentence, with an identical number of sentences in each of the six conditions that result from crossing the two factors Verb Cluster and Tense. Each participant saw only one list. The sentences on each list were randomized individually for each participant and were presented interspersed within 108 filler sentences representing a wide variety of syntactic structures.



Table 1. A Sample Sentence for Experiment 1.

Ich weiß, dass Klaus im Sommer ans Meer ...					
I know that K. in summer to sea					
Perfect	Aux-V-Mod	... HAT	<i>fahren</i>	<b>wollen</b>	
			has	drive	want
	V-Aux-Mod	... <i>fahren</i>	HAT	<b>wollen</b>	
Future	Aux-Mod	... HAT	<b>wollen</b>		
	Aux-V-Mod	... WIRD	<i>fahren</i>	<b>wollen</b>	
			will	drive	want
	V-Aux-Mod	... <i>fahren</i>	WIRD	<b>wollen</b>	
	Aux-Mod	... WIRD	<b>wollen</b>		
Translation for all conditions:					
‘I know that Klaus (wanted will want) to drive to the sea during the summer.’					

*Procedure.* The following two experiments were run using the DMDX software developed by K.I. Forster and J.C. Forster at Monash University and the University of Arizona. Each trial began with the presentation of the words “Bitte Leertaste drücken” (“Please press the space-bar”). After the space bar was pushed, a fixation point appeared in the center of the screen for 1050 ms. Thereafter, the sentence was presented in a word-by-word fashion with each word successively appearing in the center of the screen. The presentation time for each word was 225 ms plus an additional 25 ms per character. There was no interval between words. Immediately after the last word, three question marks appeared on the screen, indicating to participants that they now had to judge the grammaticality of the sentence. Participants had to give their answer by pressing the right shift key for judging a sentence as grammatical and the left shift key for judging a sentence as ungrammatical. Type of response and response time were recorded automatically. If a participant did not respond within 2000 ms, the words “zu langsam” (“too slow”) appeared on the screen and the trial was finished. Each participant received at least 10 practice items before the experimental session started.

#### 4.1.2. Results

The percentages of judgments ‘grammatical’ for Experiment 1 are shown in Table 2.<sup>6</sup> The results were analyzed by three-way ANOVAs which included the individual modal verbs (*wollen*, *dürfen*, *müssen*) as an additional factor Modal Verb in addition to the two factors of main interest (Verb Cluster and Tense). Results were analyzed with either participants (F1) or items (F2) as an additional random factor.

Table 2. Percentages of judgments ‘grammatical’ for Experiment 1. Standard errors by participants are given in parentheses.

	AuxVMod	VAuxMod	AuxMod
Perfect	87 (4.1)	71 (6.3)	61 (7.4)
Future	79 (6.1)	60 (6.5)	50 (7.8)

The main effect of the factor Modal Verb reached significance ( $F(2,46)=7.20$ ,  $p < .01$ ;  $F(2,58)=8.22$ ,  $p < .01$ ), but none of the interactions involving this factor did (all  $p$ 's  $> .1$ ). The reason for a significant effect of Modal Verb is the fact that sentences with the modal verb *müssen* were more often judged as grammatical than sentences with either *dürfen* or *wollen* (77% for *müssen* versus 63% for *dürfen* and 65% for *wollen*). Since neither of the interactions involving Modal Verb was significant, this means that sentences containing the modal verb *müssen* were judged as more grammatical than sentences with one of the other two modal verbs across the board. Given that each modal verb occurred in ten different sentences, this finding might have come about because the particular ten sentences for the modal verb *müssen* were somewhat more plausible than the sentences for the remaining modal verbs.

The factor Verb Cluster also resulted in a significant main effect ( $F(2,46)=16.53$ ,  $p < .001$ ;  $F(2,58)=23.36$ ,  $p < .001$ ). This reflects the finding that sentences with a Standard German cluster *Aux-V-Mod* received higher percentages of judgments 'grammatical' than sentences with a Colloquial German cluster *V-Aux-Mod* (83% vs. 65%) which in turn received higher ratings than sentences with a 2-verb cluster *Aux-Mod*, that is, clusters not containing a main verb (65% vs. 55%). Furthermore, judgments for perfect-tense sentences were about 10% higher than judgments for future-tense sentences, resulting in a significant main effect of the factor Tense ( $F(1,23)=6.41$ ,  $p < .05$ ;  $F(1,29)=6.82$ ,  $p < .05$ ). In contrast to the main effects, the interaction between Verb Cluster and Tense was not significant (both F-values  $< 1$ ).

The main purpose of Experiment 1 was to test the hypothesis of a tight connection between speakers' judgments on 2-verb and 3-verb clusters. In particular, speakers are expected to either accept both 3-verb-clusters of the form *V-Aux-Mod* and 2-verb clusters of the form *Aux-Mod*, or reject both and only accept Standard German 3-verb clusters *Aux-V-Mod*. Thus, judgments on sentences in the 3-verb condition *V-Aux-Mod* should correlate positively with judgments on sentences in the 2-verb condition *Aux-Mod*. The relevant correlations between speakers' mean percentages in the various conditions of Experiment 1 are shown in Table 3 under the heading "Raw correlations."

Table 3. Correlations for Experiment 1.

	Perfect		Future	
	r	p	r	p
<i>Raw correlations</i>				
VAuxMod BY AuxMod	.82	$< .001$	.87	$< .001$
AuxVMod BY AuxMod	.40	$< .1$	.62	$< .01$
AuxVMod BY VAuxMod	.55	$< .01$	.52	$< .01$
<i>Partial correlations</i>				
AuxVMod BY AuxMod	.79	$< .001$	.82	$< .001$

As can be seen in Table 3, judgments on sentences with 2-verb clusters *Aux-Mod* strongly correlate with judgments on sentences with 3-verb clusters *V-Aux-Mod*, for both the perfect and the future tense. Note, however, that these two sentence types also correlate significantly with judgments on sentences containing Standard German clusters *Aux-V-Mod*. Since in Standard German the order *Aux-V-Mod* is either the only licit order (perfect tense) or one of two alternative orders (future tense) for 3-verb

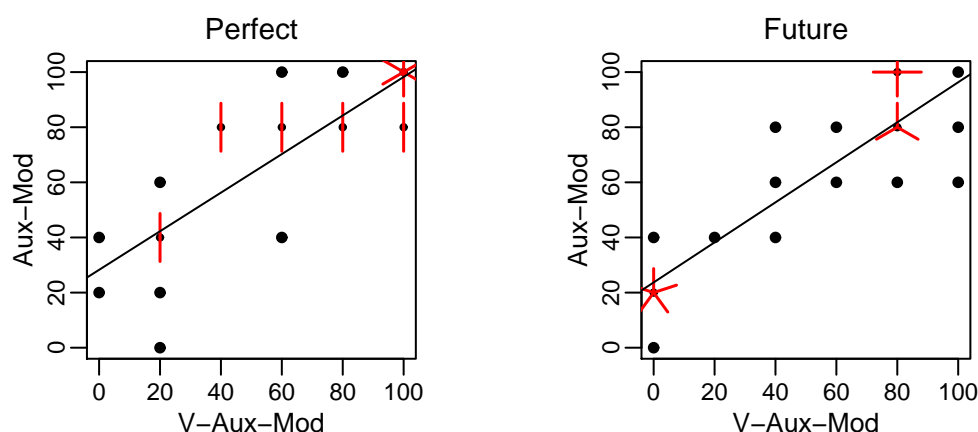


Figure 2. Judgments for *V-Aux-Mod* sentences plotted against judgments for *Aux-Mod* sentences, for both perfect tense (left side) and future tense (right side). Points represent single participants; stars represent sets of participants, with each beam standing for one participant.

clusters of the type considered here, and since all of our participants were students who should be acquainted with this order, we might have expected that sentences with *Aux-V-Mod* clusters are accepted at a 100%. There are several “performance” reasons for why judgments on *Aux-V-Mod* clusters were actually below 100%. For example, the judgment task by itself is somewhat demanding because of the fairly rapid presentation rate and the short time window for giving a response; this can easily lead to occasional errors which are independent of the particular syntactic structures under investigation.

Because performance factors affect all experimental conditions, we have to worry that the strong correlations between *V-Aux-Mod* and *Aux-Mod* sentences are simply a side effect of individual differences in overall performance. One piece of evidence arguing against this possibility comes from the fact that the correlations between *V-Aux-Mod* and *Aux-Mod* are much higher than the correlations between each of these orders and the Standard German order *Aux-V-Mod*. Furthermore, we computed partial correlations between *V-Aux-Mod* sentences and *Aux-Mod* sentences with Standard German *Aux-V-Mod* sentences taken as common factor measuring participant’s overall performance level.<sup>7</sup> The resulting partial correlation coefficients, which are shown in the last line of Table 3, are almost as high as the original coefficients. This strongly argues that the observed correlation between *V-Aux-Mod* and *Aux-Mod* is not a spurious one due to unspecific performance factors.

A graphical depiction of these correlations is provided in Figure 2. For both perfect and future tense, Figure 2 shows a clear positive linear relationship between judgments for *V-Aux-Mod* sentences and *Aux-Mod* sentences. Before we discuss the results of Experiment 1 in more detail, we first present Experiment 2 in order to complete the picture of 2-verb clusters obtained in the current experiment.

#### 4.2. Experiment 2: Morphological Form and 2-verb Clusters

In Standard German, the morphological form of the modal verb in the perfect tense correlates with the number of elements in the cluster and with the order among auxiliary and modal verb, as shown in (30).

(30)

	Cluster size: 2 verbs	Cluster size: $\geq 3$ verbs
Aux before Mod	–	infinitive
Mod before Aux	past participle	–

The infinitival form occurs in clusters with three or more verbs; in clusters of this size, the auxiliary must precede the modal. In clusters with 2 verbs, in contrast, the auxiliary follows the modal verb and the participle form of the modal verb has to be used. Experiment 2 investigates which of the two dimensions shown in (30) is responsible for the IPP effect: Is the morphological form of the modal verb determined by the order among modal verb and auxiliary or by the complexity of the cluster?

As shown by Experiment 1, 2-verb clusters of the form *Aux-Mod* with the infinitival form of the modal verb—even in the perfect tense (IPP)—are accepted to a considerable degree by speakers of Colloquial German. On the basis of this finding, we hypothesize that it is in fact the order among auxiliary and modal verb which is responsible for the IPP effect, and not the size of the cluster. Experiment 2 thus tests the prediction that the infinitival form of the modal verb, but not the participle form, should be accepted in clusters of the form *Aux-Mod* whereas the reverse should be true for clusters of the form *Mod-Aux*.

##### 4.2.1. Method

*Participants and Procedure.* 24 students of the University of Konstanz participated in Experiment 2. The procedure was the same as the one used in Experiment 1.

*Materials.* For Experiment 2, we transformed the 30 sentences from Experiment 1 in such a way that each sentence appeared in six versions according to the two factors Tense/Form and Order. The factor Tense/Form jointly varied the tense of the verb cluster and the morphological form of the modal verb. This factor could take one of three values: perfect tense with infinitival modal verb, perfect tense with past-participle modal verb, and future tense with infinitival modal verb. In contrast to the preceding experiment, the current experiment only tests sentences in which the modal verb does not have a main verb complement. All clusters therefore consist of a modal verb and an auxiliary. According to the factor Order, the modal verb either preceded the auxiliary (*Mod-Aux*) or followed it (*Aux-Mod*). Table 4 shows a complete sample sentence.

As before, 6 lists of experimental sentences were created, with each list containing only one version of each sentence and an equal number of sentences within each factor combination. Each participant saw only one list which was randomized on an individual basis and presented together with 138 filler sentences.

Table 4. A sample sentence set for Experiment 2. The auxiliary in parentheses occurred either before the modal verb (order *Aux-Mod*) or after it (order *Mod-Aux*).

Ich weiß, dass Klaus im Sommer ans Meer ...			
I know that K. in summer to sea			
Perfect/Infinitive	... (HAT)	<b>wollen</b> (HAT)	
	has	want	has
Perfect/Participle	... (HAT)	<b>gewollt</b> (HAT)	
	has	wanted	has
Future/Infinitive	... (WIRD)	<b>wollen</b> (WIRD)	
	will	want	will
Translation for all conditions:			
‘I know that Klaus (wanted will want) to go to the sea during the summer.’			

#### 4.2.2. Results

Table 5 shows the results obtained in Experiment 2. These results were again analyzed by three-way ANOVAS including the factor Modal Verb in addition to the two factors of main interest, Tense/Form and Order. As expected given that the sentence material for the current experiment was derived from the material for Experiment 1, sentences with *müssen* were judged better than sentences with either *dürfen* or *wollen* (60% for *müssen* versus 54% for *dürfen* versus 52% for *wollen*). However, the advantage of sentences with *müssen* was smaller in this experiment, and the factor Modal Verb therefore did not reach significance ( $F(2,46)=2.38$ ,  $p=.10$ ;  $F_2<1$ ), nor did any interaction involving Modal Verb (all  $p$ 's  $>.1$ ).

Table 5. Percentages of judgments ‘grammatical’ for Experiment 2. Standard errors by participants are given in parentheses.

	Perfect/Part	Perfect/Inf	Future/Inf
ModAux	87 (5.6)	37 (7.4)	64 (7.8)
AuxMod	24 (6.0)	67 (7.4)	48 (6.2)

Of the two remaining factors, the factor Tense/Form was significant ( $F(1,23)=11.31$ ,  $p<.01$ ;  $F_2(1,29)=32.68$ ,  $p<.001$ ) but the factor Order was not ( $F_1<1$ , n.s.;  $F_2(2,58)=1.00$ , n.s.). Importantly, the interaction between Order and Tense/Form was also highly significant ( $F(2,46)=53.19$ ,  $p<.001$ ;  $F_2(2,58)=95.70$ ,  $p<.001$ ). This interaction reflects the following finding. In the condition perfect tense/past participle, sentences with order *Mod-Aux* were judged much better than sentences with order *Aux-Mod* (87% vs. 24%); in the condition perfect tense/infinitive, the reverse relation was found (37% vs. 67%). For sentences in the condition Future/Infinitive finally, *Mod-Aux* sentences were again judged better than *Aux-Mod* sentences (64% vs. 48%). There is clear difference to the condition perfect tense/past participle, however. First of all, even sentences with the standard German order *Mod-Aux* were judged as grammatical only 64% of the time in the future tense, in contrast to corresponding perfect tense sentences which received 87% judgments ‘grammatical’. This confirms the results of Experiment 1 that the future tense of modal verbs is accepted to a lower degree than

the perfect tense. The 48% for the order *Aux-Mod* must be interpreted in relation to the already low value for the Standard German order *Mod-Aux*. What we see is a drop of about 16% between the Standard and the Colloquial German order. This is quite similar to the difference we see in the perfect tense, from 87% (*Mod-Aux*, participle) to 67% (*Aux-Mod*, infinitive).

#### 4.3. Discussion

The two experiments presented in this section show that many native speakers of German accept auxiliary inversion even in sentences containing a modal verb without verbal complement. In other words, auxiliary inversion is not confined to clusters with three or more elements but is also found in 2-verb clusters.

The CAT-based analysis of verb clusters presented in Bader & Schmid (accepted) led us to expect a positive correlation between judgments on 3-verb clusters with auxiliary-second order (i.e., *V-Aux-Mod*) and judgments on 2-verb clusters with auxiliary first-order (i.e., *Aux-Mod*). A grammar in which the perfect auxiliary *haben* selects modal verbs to its right without any further restrictions (Colloquial German) allows all three of *Aux-V-Mod*, *V-Aux-Mod*, and *Aux-Mod*. A grammar with the additional complexity feature [VV-max] on the tense auxiliaries (Standard German), in contrast, allows *Aux-V-Mod* but neither *V-Aux-Mod* nor *Aux-Mod*. The predicted correlation between judgments on 2- and 3-verb clusters was clearly borne out in Experiment 1, for modal verbs in both the perfect and future tense.

Experiment 2 has furthermore provided new evidence on the licensing conditions of the IPP effect. A clear interaction between order (*Aux-Mod* vs. *Mod-Aux*) and morphological form (past participle vs. infinitive) was found. What this definitely excludes is verb-cluster complexity as the defining feature for the IPP effect. Instead, the results would by and large be compatible with a rule stating that a modal verb in the perfect tense must appear as a bare infinitive instead of a past participle just in case the perfect auxiliary precedes the modal verb. A closer look at the results reveals, however, that the IPP effect might not even be contingent on the position of the auxiliary. In particular, sentences with perfect tense *Mod-Aux* clusters and an infinitive instead of the normally required past participle were not as sharply rejected as one might have expected. This additional finding points in the direction of an order-independent IPP effect, that is, a rule simply stating that modal verbs in the perfect tense occur as bare infinitives. An implementation of this idea will be presented below.

### 5. CAT meets GO: The Final Analysis

With regard to auxiliary inversion in verb-cluster formation, Experiment 1 has provided evidence for two grammars: The Standard German grammar imposes the complexity feature [VV-max] on tense auxiliaries selecting a modal verb whereas the grammar of Colloquial German lacks this complexity feature. Standard German therefore requires complete inversion of the finite auxiliary in clusters with three or more elements while at the same time prohibiting inversion in 2-verb clusters. Colloquial German, in contrast, allows both complete and partial inversion in clusters of all size.

Furthermore, Experiment 2 has shown that the morphological form of the modal verb (past participle or bare infinitive) in 2-verb clusters is largely a function of the order between auxiliary and modal verb, although there was also some indication that the use of the bare infinitive (the IPP effect) is not strictly confined to the order *Aux-Mod*.

What remains to be shown is how the preceding experimental results can be integrated into the analysis proposed in Bader & Schmid (accepted). When we discussed the generation of 2-verb clusters consisting of a modal verb and an auxiliary within CAT, we pointed out that such clusters raise non-trivial questions. In particular, we have to worry how a modal verb, which normally selects a verbal complement, can combine with a non-verbal complement like a PP, as it did in the current experiments. Note that this issue is independent of the question of verb order. As already shown by example (2), the same alternation also occurs in the present tense.

There are two main classes of accounts for modal verbs taking non-verbal complements. According to the first class, each modal verb has only a single lexical entry specifying that it can combine with a verbal complement. Under this assumption, sentences which do not contain a verbal complement for the modal verb on the surface are either derived from an underlying structure containing such a verb which is deleted at a later point in the derivation (cf. Vanden Wyngaerd, 1994), or they contain a phonetically empty light verb GO, as proposed in van Riemsdijk (2002). According to a second class of accounts, modal verbs are associated with two lexical entries, one for the modal use and a second one for the main verb use (cf. Barbiers, 1995, 2006, and references cited there).

Based on data from Swiss German, van Riemsdijk (2002) has adduced an intriguing argument in favor of the first kind of account. His argument rests on two premises. First, as in all Germanic OV languages, directional PPs in Swiss German cannot occur after a clause-final verb; second, Swiss German has *Aux-Mod-V* as the preferred order within 3-verb clusters and freely allows verb-projection raising. These two properties are summarized in (31).

- (31) a. \*C ... V PP<sub>+dir</sub>  
       b. C ... Aux [VP ... Mod [VP ... V]]

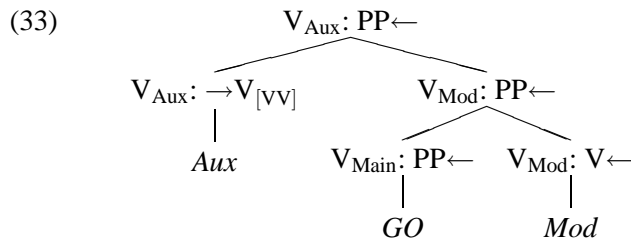
Despite the ban on extraposed directional PPs, sentences like the following are grammatical in certain Swiss German varieties (example (10a) from van Riemsdijk, 2002).

- (32) ... *das si nöme HÄT wele [PP i d schuel]*  
       that she no-longer has wanted in the school  
       ‘... that she no longer wanted to go to school’  
       a. \*C ... Aux [VP Mod PP<sub>+dir</sub>]  
       b. C ... Aux [VP Mod [VP PP<sub>+dir</sub> GO]]

In (32), the modal verb is not accompanied by a main verb. If modal verbs used in this way were main verbs, a sentence like (32) should be ungrammatical because—as a comparison between its schematic representation in (32-a) and the general pattern in (31-a) shows—it would exhibit the forbidden extraposed-PP pattern. If however, as argued by van Riemsdijk, (32) actually contains a 3-verb cluster with an empty main verb GO (an empty light-verb of motion), its grammaticality is no longer a mystery. As a comparison of (32-b) with the general pattern in (31-b) shows, a sentence like

(32) simply instantiates a verb-projection structure under the empty-GO hypothesis.

This is a strong argument in favor of analyses which postulate that modal verbs uniformly take verbal complements, and the data cited in van Riemsdijk (2002) must accordingly be considered a benchmark test for theories of verb cluster formation. Nevertheless, our data prevent us from importing the empty GO analysis of van Riemsdijk (2002) into our own account without any further ado. The reason is that the availability of an empty GO together with the Standard German order *Aux-V-Mod* results in clusters of the form *Aux-GO-Mod*. Since GO is phonetically empty, the phonetic form of a 3-verb cluster *Aux-GO-Mod* is indistinguishable from the phonetic form of a 2-verb cluster *Aux-Mod*. This is shown in (33).



A tree like (33) has the unwelcome consequence that it makes a 2-verb cluster of the form *Aux-Mod* grammatical in Standard German because such a cluster is really a 3-verb cluster under the empty light verb analysis, namely a 3-verb cluster with a phonetically empty main-verb. Thus, contrary to our results, speakers of Standard German and speakers of Colloquial German should both accept surface clusters of the form *Aux-Mod* if an empty verb GO were freely available.

This problem only arises if 2-verb clusters *Aux-Mod* are underlyingly 3-verb clusters *Aux-V-Mod* with an empty V. It does not arise if modal verbs in German could be ordinary lexical verbs selecting non-verbal complements. In this case, they would be able to select a directional PP directly instead of a verbal complement, and the subcategorization mismatch would no longer arise. Furthermore, sentences as in (34) (repeated from above) would not be mysterious anymore.

- (34) ... *dass Peter in die Stadt **gemusst*** HAT.  
           that P.   to the town must-PART has  
           ‘that Peter had to go to town.’

If *müssen* in (34) were a main verb, this sentence conformed to the general pattern according to which the perfect tense is formed with a past participle that precedes the perfect auxiliary. Thus, a modal verb in a sequence like *in die Stadt gemusst hat* (‘to the town wanted has’), in which it does not embed a verbal complement, behaves overtly like any main verb with NP or PP complement.

However, postulating that modal verbs in 2-verb clusters are generally main verbs cannot be the correct solution either. As shown by our experimental results, many native speakers of German accept 2-verb clusters of the form *Aux-Mod* in which the modal verb appears as bare infinitive, as in (35) (repeated from above).

- (35) ... *dass Peter in die Stadt HAT **müssen***.  
           that P.   to the town has must-INF



‘that Peter had to go to town.’

The IPP effect and auxiliary inversion in verb clusters are confined to modal verbs and a few other functional verbs. Purely lexical verbs, in contrast, never appear in the bare infinitive and to the right of the selecting auxiliary in the perfect tense (\*... *dass sie das Buch hat lesen* ‘that she has read-Inf the book’), neither in Standard nor in Colloquial German. The Swiss German data that were used by van Riemsdijk (2002) in order to argue for the empty GO analysis point to the same conclusion. As already discussed above, if *welle* (‘want’) in sentence (32) were a main verb, it could not precede its PP complement.

In sum, both morphological and syntactic properties indicate the existence of two types of 2-verb clusters involving modal verbs: Either the order is *Mod-Aux* and the modal verb appears as past participle, or the order is *Aux-Mod* and the modal verb appears as infinitive (IPP). The order *Aux-Mod* is only grammatical in Colloquial German. In fact, as already implicated by the lexical entries in (11), modal verbs in Colloquial German behave like true modal verbs in clusters of any size, thereby allowing auxiliary inversion and the IPP effect even when they are not accompanied by a main verb, that is, in 2-verb clusters. This leaves us with two open issues. First, how is the directional PP in (35) licensed, and second, what happens to the subcategorization requirements of *müssen*?

To address these issues, we integrate the empty light verb analysis of van Riemsdijk (2002) with the CAT-based analysis of Bader & Schmid (accepted). To do so, we first have to introduce another ‘ingredient’ into our analysis: the notion of a *spanning vocabulary* provided by CAT. By way of illustration, (36) shows how the hierarchy of verbal functional elements is realized in English (from Williams, 2003, p. 214).

- (36)    T > Agr<sub>S</sub> > Asp > Agr<sub>O</sub> > V  
           | - - was - - |  
                                   | - - - seeing - - - |

As indicated in (36), the auxiliary *was* and the main verb *seeing* both realize more than a single element of the verbal hierarchy. The auxiliary *was* simultaneously realizes T and Agr<sub>S</sub>, and the main verb *seeing* realizes the three elements Asp, Agr<sub>O</sub>, and V.

The way we adopt the notion of a spanning vocabulary is shown in (37).

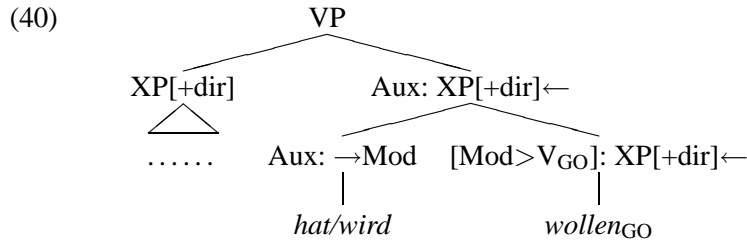
- (37)    Aux >    Mod >    V<sub>GO</sub> >    PP  
           | - - - wollen - - - |

The basic idea is that a modal verb like *wollen* is able to realize simultaneously both itself and the empty verb GO. In a sense, GO gets incorporated into the modal verb. We will assume that a micro parameter in the sense of Kayne (2005) determines whether modal verb and empty GO are combined in the lexicon or in the syntax. As we show next, in Standard and in Colloquial German the parameter value is set to ‘combination in the lexicon’. Thus, in addition to the two simple lexical entries in (38), both variants of German have the complex lexical entry [Mod > V<sub>GO</sub>] shown in (39), which enters syntax as one single element.

- (38)    a.    GO – V: XP[+dir] ←  
           b.    *wollen* – Mod: V<sub>x</sub> ←

(39)  $wollen_{GO} - [Mod > V_{GO}]: XP[+dir] \leftarrow$

The lexical entry in (39) allows the derivation of the tree in (40). This is the tree for a sentence with a 2-verb cluster *Aux-Mod*.



The tree in (40) answers the two questions raised above. First of all, the empty verb GO satisfies the subcategorization feature of the modal verb which requires a verb as complement. When modal and GO are combined in the way indicated, the resulting lexical item is of the complex category  $[Mod > V_{GO}]$  and inherits the subcategorization properties of the empty motion verb; that is, the modal now subcategorizes for a directional XP. This answers the second question, namely what licenses a directional XP in the construction at hand. This XP is ultimately licensed by empty GO which transmits its subcategorization properties first to the combination of modal and GO, and then to the verb cluster as a whole. The final verb cluster can therefore be combined with a directional PP even in the absence of a visible verb of motion.

A tree as in (40) can be derived in Colloquial German but not in Standard German. In Standard German, tense auxiliaries select modal verbs to their right, subject to the complexity feature  $[VV-max]$ . Because the tree in (40) contains only a modal of the category  $[Mod > V_{GO}]$ , but no cluster consisting of GO and modal verb, such a tree is excluded in Standard German because the complement of the tense auxiliary is not of the required complexity. The perfect tense auxiliary of Colloquial German, in contrast, selects a modal to the right without any complexity requirements. It thus can combine with  $[Mod > V_{GO}]$ , and the tree in (40) is accordingly allowed. This small difference implies the correlation between 2- and 3-verb clusters revealed by Experiment 1, namely that speakers who accept the order *V-Aux-Mod* also accept the order *Aux-Mod* (Colloquial German), and speakers who reject the order *V-Aux-Mod* also reject the order *Aux-Mod* (Standard German).

What is still missing is an account of 2-verb clusters in which the modal verb behaves like a main verb. In Standard German, this is the only option for modal verbs in 2-verb clusters. Because all our experimental participants accepted Standard German *Mod-Aux* clusters, it must be assumed that this is a grammatical option in Colloquial German too, alongside of *Aux-Mod* clusters which are grammatical only in Colloquial German. The easiest way to solve this issue would be to postulate that modal verbs are in fact homophone, being either modal verbs proper or main verbs. In Standard German, only the main verb use would be allowed in 2-verb clusters; in Colloquial German, modal verbs could be used either way in 2-verb clusters, with the now well-known syntactic and morphological consequences.

In our opinion, plain homophony would miss an important point, however. In the examples considered so far, the non-verbal complement of the modal verb was always a directional PP. Directional PPs can be used with all modal verbs. However, there are

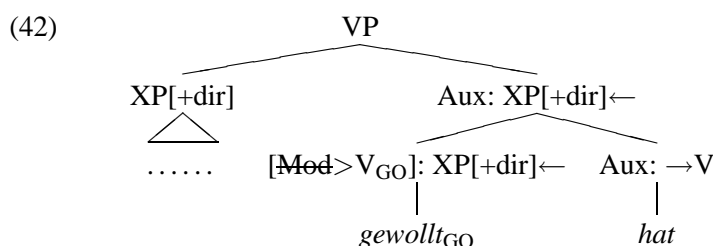
also more idiosyncratic usages. For example, *wollen* can take an NP complement, as illustrated in (41).

- (41) ... *dass Peter ein Fahrrad (gewollt hat / hat wollen).*  
           that P.   a   bicycle wanted has   has want  
           ... that Peter wanted to have a bicycle.

Our experimental evidence only pertains to modal verbs used with directional PPs, but it seems to us that for speakers who accept *Aux-Mod* at all there is always free variation between *Aux-Mod* and *Mod-Aux*, without any noticeable meaning differences between the two variants.<sup>8</sup> If correct, this intuition strongly argues that clusters of the form *Aux-Mod* and clusters of the form *Mod-Aux* contain one and the same modal verb at some level of representation. Otherwise, we should find examples in which an *Aux-Mod* cluster cannot be freely interchanged with a *Mod-Aux* cluster (and finding such examples would accordingly falsify the current analysis).

Integrating the main-verb use of modal verbs into our analysis thus faces two conflicting demands. On the one hand, we see two different types of 2-verb clusters, one in which modal verbs exhibit the morphological and syntactic properties of main verbs (*Mod-Aux*: no auxiliary inversion, no IPP effect) and a second one in which modal verbs behave like modal verbs proper (*Aux-Mod*: auxiliary inversion, IPP effect). On the other hand, modal verbs in 2-verb clusters seem to have the same selectional restrictions irrespective of whether occurring in an *Mod-Aux* or in an *Aux-Mod* cluster.

At the moment, we can only make a tentative proposal how a formal analysis which fulfills both demands might look like. What we propose is that a modal verb with incorporated GO allows an alternative use in which the modal part of the complex category becomes syntactically inactive, although it is still active for purposes of selection and interpretation. We will indicate this by crossing out the modal part. The resulting category of type [~~Mod~~>V<sub>GO</sub>] acts as a lexical verb: It is selected to the left of the auxiliary and it appears as a past participle in the perfect tense, just as any other lexical verb. The resulting tree is shown in (42).



The change of [~~Mod~~>V<sub>GO</sub>] to [~~Mod~~>V<sub>GO</sub>] can be seen as a kind of reanalysis which is caused by the fact that modal verbs used without verbal complement superficially look like main verbs, in particular in non-complex tense forms like the present tense. For the child acquiring language, the input will contain many examples in which there is no overt difference between a real main verb and a modal used as main verb, as shown in (43). The assumed reanalysis comes therefore at no surprise.

- (43) a. ... *dass Peter in die Stadt fährt / will.*  
           that P.   in the town drives   wants

- ‘...that Peter drives/wants (to drive) into town.’
- b. ... *dass Peter einen Apfel hat / will.*  
 ... that P. an apple has wants  
 ‘...that Peter has/wants (to have) an apple.’

Note that in Standard German the distinction between modal and lexical use of the unit [Mod>V<sub>GO</sub>] does not lead to any visible consequences, in contrast to Colloquial German where we get two different verb orders with different morphology. Even if the unit [Mod>V<sub>GO</sub>] would oscillate between modal and lexical use also here, the complexity requirement in the subcategorization frame of Standard German auxiliaries would prevent the distinction between modal and lexical verb from surfacing. We nevertheless assume that [Mod>V<sub>GO</sub>] can only be used as a main verb in Standard German, that is, in the form [~~Mod~~>V<sub>GO</sub>]. By making this assumption, the differences between Standard and Colloquial German are kept to a minimum. Furthermore, this implies that modal verbs behave completely uniform with respect to auxiliary inversion and the IPP effect, allowing a maximally simple statement of the latter (see (46) below).

The final set of lexical entries for auxiliaries, modals, and lexical verbs resulting from our analysis is shown in (44) and (45). (44) lists lexical entries that are shared by Standard and Colloquial German. V<sub>X</sub> stands for verbs of any category, that is, for V<sub>Main</sub>, V<sub>Mod</sub> and V<sub>Aux</sub>.

- (44) Sample lexical entries common to Standard and Colloquial German
- a. Main verbs – V<sub>Main</sub>: DP← | V<sub>Main</sub>: PP← | V<sub>Main</sub>: DP PP← | ...
  - b. Modal verbs
    - (i) Mod: V<sub>X</sub>←
    - (ii) [Mod>V<sub>GO</sub>]: XP[+dir]←
  - c. Auxiliary verbs
    - (i) Perfect auxiliary: V<sub>aux</sub>: V<sub>X</sub>←
    - (ii) Future auxiliary: V<sub>aux</sub>: V<sub>X</sub>←

In addition to the shared entries in (44), we need to postulate lexical entries for auxiliaries selecting modal verbs. It is here where Standard and Colloquial German differ from each other. As shown in (45), Standard German imposes a complexity requirement on verb-cluster formation whereas Colloquial German does not. Note that (45) only shows the subcategorization part of each entry because the category label is always the same, namely V<sub>aux</sub>.

- (45) Subcategorization frames peculiar to auxiliaries when applied to modal verbs

	Perfect auxiliary	Future auxiliary
Standard German	→V <sub>[Mod/VV-max]</sub>	→V <sub>[Mod/VV-max]</sub> or V←
Colloquial German	→V <sub>[Mod]</sub>	→V <sub>[Mod]</sub> or V←

To complete our analysis, we need a morphological rule to account for the IPP effect, that is, the use of the bare infinitive instead of the past participle in the perfect tense. To achieve this effect, we postulate the rule in (46).

- (46) Rule of morphological realization:  
 Modal verbs appear as bare infinitives if selected by tense auxiliaries.

This rule is stated in the most general way by not making reference to any verb-cluster specific properties. Cluster complexity cannot be a defining feature of the IPP effect because Experiment 2 revealed an IPP effect in two-verb clusters. That the order between auxiliary and modal verb is not crucial either is suggested by those Austrian and Bavarian dialects which strongly prefer the nested order *V-Mod-Aux* and nevertheless use the bare infinitive of the modal verb in the perfect tense as shown by the following example from Upper Austrian (Martina Wiltschko, p.c.) (see also Wurmbrand, 2004b).

- (47) ... *wei a kumma miassn hot*  
           because he come must has  
           ‘...because he had to come’

The final question to consider is how the Swiss German data from van Riemsdijk (2002)—which gave rise to the empty GO analysis (cf. (32))—fit into the current account. The crucial Swiss German example is repeated in (48).

- (48) ... *das si nöme HÄT wele [PP i d schuel]*  
           that she no-longer has wanted in the school  
           ‘...that she no longer wanted to go to school’

An obvious difference between Swiss German and the German data presented here is the direction in which modal verbs select their verbal complements: Whereas selection by modals is uniformly to the left in Colloquial and Standard German, it is to the right in Swiss German. Thus, Swiss German modal and auxiliary verbs have subcategorization frames like  $V_{Mod}/V_{Aux} : \rightarrow V_X$ .<sup>9</sup>

Stating different subcategorization frames for Standard and Colloquial German on the one hand and the Swiss German variants reported in van Riemsdijk (2002) on the other hand is not sufficient, however, to account for the word order differences in sentences with modal verb and directional PP. In the Swiss German example (48), the directional PP appears at the right edge of the clause, a position which is excluded in both Standard and Colloquial German. A modal verb with incorporated GO does not allow the generation of such a sentence because it selects its complement in the same direction as GO itself, namely to the left.

In order to obtain (48), empty GO must be combined with its PP complement in syntax. In contrast to Standard/Colloquial German, the (micro) parameter responsible for the combination of modal verb and empty GO must therefore be set to ‘syntax’ in Swiss German. For the Swiss German sentence (48), this gives us the tree in (49). This tree is nothing else than a literal translation of van Riemsdijk’s analysis of Swiss German into the CAT framework of Williams (2003) as used here.

- (49)
- 
- ```

graph TD
    AuxP --> Aux["Aux: →Mod"]
    AuxP --> ModP
    Aux --> hat["hat"]
    ModP --> Mod["Mod: →V"]
    ModP --> VP
    Mod --> wollen["wollen"]
    VP --> XP["XP[+dir]"]
    VP --> V["V: XP←"]
    XP --> dots["....."]
    V --> gehen["gehen/GO"]
  
```

(50) and (51) summarize the differences between Standard, Colloquial, and Swiss German. The differences concern either lexical subcategorization properties of auxiliary and modal verbs, or the setting of the micro parameter governing empty GO.

- (50) Differences captured in subcategorization frames:  
Verbs select their complements to the [left/right]
- a. Standard German:
    - Modal verbs: left
    - Tense auxiliaries selecting modal verb clusters: right / [VV-max]
  - b. Colloquial German:
    - Modal verbs: left
    - Tense auxiliaries selecting modal verb clusters: right
  - c. Swiss German:
    - Modal verbs: right
    - Tense auxiliaries selecting modal verb clusters: right
- (51) Differences captured by parameter governing empty GO:  
Empty light verbs are active [in the lexicon/in the syntax]
- a. Standard/Colloquial German: lexicon
  - b. Swiss German: syntax

These small differences together with the ability of the grammar to base generate structures according to the CAT-language lead to the range of verb order variation discussed in this paper.

## 6. Summary and Conclusion

In this paper we have linked two phenomena occurring with modal verbs in German: First, auxiliary inversion as it is found with complex tense forms of modal verbs, and second, the property of modals to appear with non-verbal complements. We have presented experimental evidence from native speakers of German showing the following connection between these two phenomena: Speakers either accepted both the non-standard order *V-Aux-Mod* in 3-verb clusters and the non-standard order *Aux-Mod* in 2-verb clusters, or they rejected both. Standard German orders were accepted by all speakers. Based on these findings, we can identify two grammars—Standard and Colloquial German—with Standard German forming a subset of Colloquial German.

To account for these two grammars, we extended the CAT-based analysis of verb cluster formation of Bader & Schmid (accepted) which is itself an extension of the analysis presented in Williams (2003), and combined it with the empty GO hypothesis of van Riemsdijk (2002). The most striking feature of auxiliary inversion in Colloquial German that comes out of our work is its generality: Auxiliary inversion occurs in clusters of all sizes, and it can target any position in front of the modal verb. We have argued that this generality follows naturally from a CAT-based analysis as proposed in Bader & Schmid (accepted) but not from an analysis of verb-cluster formation phrased in cartographic terms.

## Notes

1. For reasons of space, we have to gloss over all issues related to the gradience of judgment data; see Bader & Häussler (2008) for detailed discussion.
2. We have also investigated verb-clusters in which the modal verb was inverted too. For the case of a 4-verb clusters, this is shown in (i).

- (i) ... dass das Auto hätte müssen gewaschen werden.  
          that the car has must wash been  
          ‘that the car had to be washed.’

- Although such sentences are often considered grammatical in the syntactic literature, they were judged as grammatical only 35% of the time in Experiment 4 of Bader & Schmid (accepted). More work is needed to clarify the status of clusters of this kind.
3. Since the future tense auxiliary can appear in all possible positions, it is also possible to state its subcategorization frame as “V<sub>Mod</sub>”, that is, by specifying the syntactic category of its complement without imposing any order requirements. The statement in (11) was chosen because it reveals the relationship to Standard German in a transparent way.
  4. The assumption of mono-clausality is also shared by Wurmbrand (2001, 2007). Since verb order variation is not in the focus of Wurmbrand’s work, we don’t discuss it here.
  5. As pointed out to us by Jana Häussler (p.c.), an obvious candidate for a triggering feature might be a feature related to focus. Indeed, Wurmbrand (2004a) has proposed that the verb in a 3-verb cluster *V-Aux-Mod* is moved in front of the auxiliary if it is focused. However, Bader & Schmid (accepted) obtained judgment data to test this claim but did not find any evidence for focus effects on verb-cluster order.
  6. We do not show reaction time data because they do not provide additional information. By and large, reaction times mirror judgments: A condition with a high percentage value (either a high percentage of judgments ‘grammatical’ or a high percentage of judgments ‘ungrammatical’) is typically associated with a fast mean reaction time for the respective response type (judgment ‘grammatical’ or judgment ‘ungrammatical’), whereas a low percentage value is associated with a long reaction time.
  7. Partial correlations were computed as follows. First, we computed linear regression equations with judgments on *Aux-V-Mod* sentences as predictor variable and either judgments for *V-Aux-Mod* sentences or *Aux-Mod* sentences as predicted variable. Second, we computed residual percentages by subtracting from the actually observed values the values which are predicted if judgments on *Aux-V-Mod* sentences would completely determine judgments on *V-Aux-Mod* sentences or *Aux-Mod* sentences. Finally, the residual percentages obtained in this way were correlated with each other.
  8. This sets the modal and main verb use of modal verbs apart from verbs like *versprechen* (‘promise’) or *drohen* (‘to threaten’) which have both a raising and a control verb use, but which show clear semantic differences depending the particular use.
  9. In the subcategorization frames given so far we did not distinguish between V<sup>o</sup> and VP but used the unspecified label ‘V’ instead. This was done to allow for verb projection raising, i.e., combination with VPs, without going into further detail. Verb projection raising is the unmarked option in Swiss German as shown in the tree in (49) but it is also documented in German, see Meurers (2000) and the literature cited there.





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