Verb Clusters in Colloquial German

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Abstract

Although verb cluster formation has long been a topic of syntactic research, many of its properties are still controversial. In this paper, we contribute to the ongoing discussion by looking at verb order variation in 3- and 4-verb clusters in German on the basis of new empirical evidence. First, we present several experiments that have used the method of speeded grammaticality judgments in order to determine the orders within a verb cluster that are accepted by native speakers. A major result of our experiments is that native speakers accept more orders than are allowed in Standard German. Second, we give a theoretical account of the data which applies and extends Williams' (2003) CAT-language. We show how the variation between Standard German and the more liberal Colloquial German that was revealed in our experiments follows from slightly different lexical entries within this system. Standard German is characterized by a complexity requirement on modal verb complements that restricts verb order variation. The more liberal Colloquial German system lacks this feature and thus allows a larger variation of verb orders.

Keywords

CAT, experimental evidence (speeded grammaticality judgments), Colloquial German, verb clusters, verb order variation

0 Introduction[1]

A major puzzle in the syntax of Germanic OV languages is the behavior of verbs when they cluster together in clause-final position. In German, for example, when a verb selects another verb, the selected verb has to precede the selecting one. An example illustrating this property of German is given in (1).

(1) dass Peter ein Buch *lesen* MUSS.
that P. a book read must
'that Peter must read a book.'

Since German is an OV language and thus the complements of a verb normally appear to the left of their selecting verb, the order among the two verbs in (1) is not unexpected. Surprisingly, however, when we extend the 2-verb cluster in (1) to a 3-verb cluster by putting the sentence into the perfect tense, it is not the nested order V_3-Mod_2-Aux_1 which is grammatical but the order Aux_1-V_3-Mod_2 in which the perfective auxiliary precedes the other two verbs instead of following them.[2] This is illustrated by the sentences in (2).[3]

[1]This work was supported by the Deutsche Forschungsgemeinschaft (SFB 471, Project D2). We would like to thank Josef Bayer, Miriam Butt, Jana Häussler, Manfred Sailer and four anonymous reviewers for their helpful comments.

[2]Throughout this paper, we use the following conventions. First, auxiliaries are printed in boldface, modal verbs in small capitals, and main verbs in italics. Second, we follow standard practice in numbering the verbs in a verb cluster starting with the hierarchically highest verb. Since we are almost exclusively concerned with verb clusters consisting of an auxiliary, a modal verb and a main verb, we use abbreviations like 'Aux_1-V_3-Mod_2' showing both category labels and numeric indices.

[3]A further peculiarity of this construction is that the modal appears as an infinitive and not as a past participle, as would be expected in the perfect tense. For the purpose of this introduction, we will abstract away from this so-called 'Infinitivus Pro Participio' (IPP) property which will be discussed and

(2) dass Peter ein Buch (**lesen* MÜSSEN **hat** | **hat** *lesen* MÜSSEN).

read must has has read must

Unexpected orders among the elements of a verb cluster as in (2) have generated a large body of syntactic research. In her comprehensive review of this research, Wurmbrand (2006) concludes that a satisfying analysis of the syntax of verb clusters is still missing. In our opinion, a major reason for this state of affairs is the lack of an adequate understanding of the data on which to base syntactic analyses of verb clusters (although this state is changing, as witnessed by recent empirical investigations; cf. Schmid et al., 2005; Wurmbrand, 2004b). On the one hand, there is Standard German as defined by prescriptive grammar and assumed by many, although by no means all, syntactic analysis of verb cluster phenomena. In Standard German, a small number—often just one or two—of the possible permutations of a verb cluster are singled out as grammatical and sharply contrasted with all other permutations which are considered as ungrammatical. On the other hand, it has often been noted that German dialects exhibit a large amount of variation when it comes to word order within verb clusters. For example, various dialects of Swiss German are well-known for the completely inverted word order Aux_1-Mod_2-V_3 shown in (3a). For Bavarian-Austrian dialects, in contrast, the order V_3-Aux_1-Mod_2 is considered characteristic (cf. section 1 for more details and references). In the order V_3-Aux_1-Mod_2, the auxiliary is only halfway fronted whereas it is completely fronted in the Standard German order Aux_1-V_3-Mod_2. We will accordingly call the order V_3-Aux_1-Mod_2 in (3b) the 'partially fronted order' and the Standard German order Aux_1-V_3-Mod_2 in (2) the 'completely fronted order'.

(3) a. dass Peter ein Buch **hat** MÜSSEN *lesen*. Swiss Order

investigated in later sections.

b. dass Peter ein Buch *lesen* **hat** MÜSSEN. Bavarian-Austrian Order

Nowadays, most speakers of German are not dialect speakers in any narrow sense, but it must nevertheless be considered an open question how closely they adhere to the rules of prescriptive grammars. A first major aim of this article is therefore to determine to what extent the rules of prescriptive grammar coincide with judgments of native speakers. Our main tool in addressing this question is the experimental elicitation of grammaticality judgments. A main finding of our experiments is that native speakers of German—all students but with a variety of regional backgrounds—accept the partially-fronted order V_3-Aux_1-Mod_2 to a surprisingly high degree in addition to the Standard German order Aux_1-V_3-Mod_2 which is always accepted best.

The second major aim of this article is to present a syntactic analysis of verb clusters in German based on our experimental findings. Our analysis extends and modifies the verb cluster analysis presented in Williams (2003) and will thus belong to the class of approaches that assume that verb clusters are base-generated.

The organization of this paper is as follows. In section 1, we give a short overview of verb clusters in Standard German as well as in other varieties of German. Prior syntactic analyses of verb clusters are discussed in section 2. The judgment experiments investigating the acceptance of 3-verb clusters by native speakers of German are presented in sections 3-6. Based on the results of these experiments, we will introduce our syntactic analysis in section 7. A prediction of this analysis for 4-verb clusters is tested in a further experiment that is the topic of section 8. The article concludes with a summary and general discussion in section 9.

1 Verb Clusters in German

Verb cluster formation in the West-Germanic languages has been a major topic of research in generative syntax since Evers' (1975) influential dissertation. A comprehensive overview of this work is given by Wurmbrand (2006); two recent collections of articles demonstrating the range of data and analyses are Seuren & Kempen (2003) and Kiss & van Riemsdijk (2004). In spite of the large amount of literature on verb clusters, no consensus has been reached yet on the question as to how the existing verb order variation within and across languages should be derived. In this section, we will first discuss verb clusters in Standard German where we take Standard German to be defined by the rules of prescriptive grammars of German (in particular, Duden 4, 1998:816). Afterward, we will shortly introduce verb-cluster variation across German dialects.

In compliance with the OV nature of German, verbal complements normally precede their selecting verbs in Standard German. This requirement holds without exception in 2-verb clusters, independently of the form of the embedded verb (bare infinitive, past participle, etc.) and of the category of the finite verb (modal verbs, tense auxiliaries, control verbs, etc.) as illustrated in (4). In the following, we call orders in which all selected verbs precede their selecting verb nested or default orders.[4]

[4]For a control-verb sentence like (4b), an alternative serialization is available in more liberal variants of German although not in Standard German. This serialization—which is known as *third construction* (den Besten & Rutten, 1989)—is shown in (i).

(i) dass Marie das Buch *versucht* zu *lesen*.
that Marie the book tries to read
'that Marie tries to read the book.'

The syntactic analysis of such sentences is controversial, in particular with regard to the question of whether this is a case of extraposition or a case of verb-cluster formation. The same considerations apply

(4) Default verb order in 2-verb clusters

a. dass Marie das Buch *gelesen* **hat**.

that Marie the book read-PastP has

'that Marie has read the book.'

b. dass Marie das Buch *zu lesen versucht*.

that Marie the book to read tries

'that Marie tries to read the book.'

Strict precedence of the selected verb is still the predominant order when the cluster consists of more than two verbs. This is shown in (5) for the case of 3-verb clusters.

(5) Default verb order in 3-verb clusters

a. dass Marie das Buch zu *lesen* VERSUCHT **hat**.

that Marie the book to read tried has

'that Marie has tried to read the book.'

b. dass Max die Vögel *gekauft* **haben** KÖNNTE.

that Max the birds bought have could

'that Max might have bought the birds.'

Although the default verb order is strict in 2-verb clusters, there exist exceptions in verb clusters that consist of three and more elements. The best-known divergence from the default verb order is found in complex tense forms of modal verbs.[5] When a modal in its

to the 3-verb cluster sentence in (5a). For further discussion, cf. Wöllstein-Leisten (2001) and references cited there.

[5]From the German complex tense forms, namely perfect tense, past perfect tense, future tense, and future perfect we will concentrate on the perfect tense and the future tense here. The same mechanisms are at work also in the other complex tenses, leading to the same kind of verb order variation.

normal usage, that is, embedding an infinitival verb, occurs in a complex tense form, the auxiliary must or may appear in the first position of the cluster. As shown in (6), for the future tense of modals the auxiliary-first order Aux_1-V_3-Mod_2 is grammatical in addition to the nested order V_3-Mod_2-Aux_1.

(6) dass Marie das Buch (*lesen* WOLLEN **wird** | **wird** *lesen* WOLLEN) .
that Marie the book read want will will read want
'that Marie will want to read the book.'

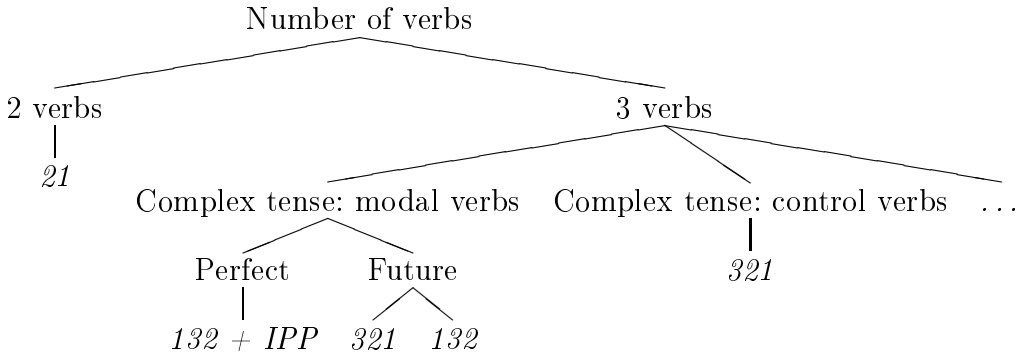
A different case is presented by the perfect tense. When a modal in the perfect tense embeds another verb, the auxiliary-first order shown in (7a) is not optional but in fact obligatory.

(7) Obligatory auxiliary-first order in the perfect tense
a. dass Marie das Buch **hat** *lesen* (*GEWOLLT-PastP | WOLLEN-Inf).
that Marie the book has read wanted want
b. dass Marie das Buch *lesen* (*GEWOLLT-PastP/* WOLLEN-Inf) **hat**

The morphology is exceptional here as well because the modal verb has to appear as a bare infinitive and not as a past participle which is normally required in the perfect tense. This morphological curiosity is called *Infinitivus Pro Participio* (IPP; 'infinitive instead of past participle') which is not only found in German but in other Germanic languages too (cf. Schmid, 2005, for comprehensive discussion). The nested order V_3-Mod_2-Aux_1 is ungrammatical independently of the form of the modal verb (bare infinitive or past participle). The IPP effect does not only show up with modal verbs, but also with a small class of other verbs selecting bare infinitives (e.g. *lassen* ('to force/to let') and perception verbs). Verbs selecting infinitives accompanied by the infinitive marker *zu* ('to'), like control verbs, display neither the IPP effect nor auxiliary-first order in German.

We conclude this section by summarizing the factors that influence verb order variation within verb clusters. These factors include the number of verbs in a cluster, the types of verbs involved (e.g., modal verbs versus control verbs), and the type of the auxiliary (perfect versus future tense auxiliary). A partial hierarchy showing the interplay of these factors is provided in (8).

(8) Factors determining the order among verbs



In the following, we are only concerned with modal verbs. In the beginning, we concentrate on 3-verb clusters and investigate several factors influencing their word order. Later we extend our investigation to include 4-verb clusters as well.

It is well known that the relatively strict constraints on order that hold for Standard German verb clusters are not valid in all varieties of German. In German dialects, different verb orders are preferred and a larger amount of verb order variation is found. We will illustrate this with 2- and 3-verb clusters in Bavarian (see Weiß, 1998:50-54). All Bavarian data presented below—including preferences for a certain order—are representative for Austrian as well (see Wurmbrand, 2004b, and Patocka, 1997, on similarities of these groups). Looking at Bavarian 2-verb clusters first, we see that verb order is more flexible than in Standard German. Both verb orders are possible when a lexical verb is either embedded under an auxiliary or a modal. The non-inverted variant is the preferred order,

however.[6]

(9) Bavarian: Variation in 2-verb clusters (data from Abraham, 1995:305)

daß wir Flüchtlinge (**ham** *versteckt* | *versteckt* **ham**). — Aux-V, V-Aux

that we refugees have hidden hidden have

'that we have hidden refugees.'

To illustrate verb order variation in 3-verb clusters, we give examples from Bavarian IPP-constructions (Wurmbrand, 2004b, 2006, reports the same results for Austrian). In these cases there are even three different orders which are grammatical, as shown in (10).

(10) Bavarian: Verb order variation in IPP-constructions (data from Weiß, 1998:53)

a. daß ned a jeda Firmdöd extra **hod** *einspanna* BRAUHA. —

that not an every godfather extra has yoke need

Aux-V-Mod

'that not every godfather has needed to yoke (horses)'

b. wa'a nimmer *reen* **hod** KINA/ KIND. — V-Aux-Mod

because-he no-more speak has can/could (Inf/PastP)

'because he could not speak any longer'

c. woa's **heijd** SOOLN *hairaddn.* —Aux-Mod-V

when-she had should marry

'where they should have married'

Apart from the completely-fronted order Aux_1-V_3-Mod_2 in (10a) which is the only possible order in Standard German, both the partially fronted order V_3-Aux_1-Mod_2 (10b)

[6]Weiß (1998, 52) states that the inverted order is even ungrammatical when a modal is embedded under the perfect tense auxiliary. He does not mention whether the modal appears as bare infinitive or past participle.

and the completely inverted order Aux_1-Mod_2-V_3 (10c) are grammatical in Bavarian. Weiß (1998:53) further remarks that the partially fronted order V_3-Aux_1-Mod_2 is preferred whereas the Standard German order Aux_1-V_3-Mod_2 is marked.

Standard German—as defined in prescriptive grammars—presents a simple and clearcut picture of word order in the verb cluster. For the perfect tense of model verbs, only the order Aux_1-V_3-Mod_2 is grammatical; for the future tense, there are two grammatical orders, namely Aux_1-V_3-Mod_2 and V_3-Mod_2-Aux_1. When looking at German variants, the picture becomes more complicated, as exemplified by the large variation found in Bavarian.

The discrepancy between Standard German and German variants was a major impetus for our investigation of Colloquial German. We wanted to see which verb orders are spontaneously accepted by non-dialect speakers of German. Do they only accept orders allowed by prescriptive grammars of Standard German, or do they also accept orders which are claimed to occur only in the various regional variants of German? Before we present our judgment experiments, we give a short review of the syntactic literature on verb clusters in the next section.

2 Former Analyses

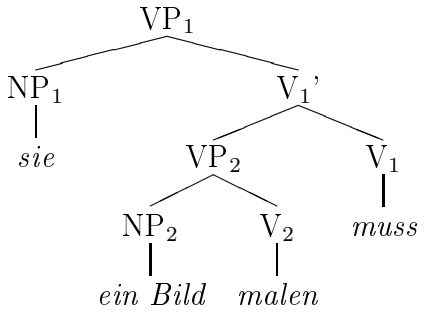
Verb cluster formation in the West-Germanic OV-languages has been the topic of formal syntactic investigations ever since it was first analyzed in a generative-transformational framework by Evers (1975). Verb clusters have been studied within the Theory of Principles and Parameters (Government and Binding Theory and later Minimalism) (e.g. Haegeman & van Riemsdijk, 1986; Haider, 1993; Koopman & Szabolcsi, 2000; Wurmbrand, 2001), Lexical-Functional Grammar (LFG) (Bresnan et al., 1982; Kaplan & Zae-

nen, 2003), Combinatorial Categorial Grammar (CCG) (e.g. Steedman, 1983, 2000), Tree-Adjoining Grammar (TAG) (e.g. Kroch & Santorini, 1991; Rambow, 2003), Head Driven Phrase-Structure Grammar (HPSG) (Hinrichs & Nakazawa, 1994; Kiss, 1995; Müller, 1999; Meurers, 2000), and Performance Grammar (Kempen & Harbusch, 2003), among others. Given limitations of space, we can only highlight some of the most important controversies surrounding the phenomena at hand. For a comprehensive review of work in the framework of Principles and Parameters, the reader is referred to Wurmbrand (2006).[7]

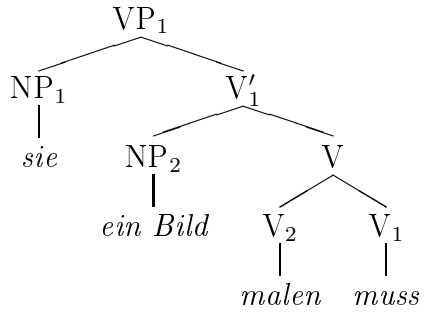
When considering sequences of two or more verbs, a kind of null-hypothesis would be that a sequence of verbs in an OV language like German is just the mirror image of the same sequence in an VO language like English. In other words, VPs would be head-initial in English but head-final in German. For the German OV sentence in (11), this would give us the tree in (12a) (because it is not relevant here, the CP layer has been left out).

(11) dass sie ein Bild *malen* MUSS.
that she a picture paint must
'that she must paint a picture'.

(12) a. Non-clustering structure:



b. Clustering structure:



For OV languages, however, the picture is not as simple as suggested by (12a).[8] First, as

[7] An overview of work within the framework of HPSG can be found in Meurers (2000).

[8] Verb-cluster phenomena are not restricted to West-Germanic OV-languages. For very similar phenomena in Hungarian, cf. Koopman & Szabolcsi (2000); for Romance languages, see Cinque (2004).

already discussed in the preceding section, when two or more verbs appear in sequence at the end of a clause, they do not always appear in the order 'selected verb before selecting verb', as would be expected given the structure in (12a). Second, there are a range of structural diagnostics which indicate that the verbs in a clause-final sequence behave like a single constituent to the exclusion of the object of the most deeply embedded verb (for summaries, cf. Bech, 1955; Evers, 1975; Grewendorf, 1988; von Stechow & Sternefeld, 1988). When taken at face value, these diagnostics imply that a sentence like (11) receives a structure as in (12b).

Verb clusters thus pose two challenges. First, the verbs of a verb cluster do not always appear in the expected order, as was amply illustrated in the preceding section. Second, verb clusters behave as a single constituent in many respects. How to account best for these two observations is a controversial issue. Some major dimensions of the controversies surrounding verb clusters are listed below (for a comprehensive overview, see Wurmbrand, 2006):

- Do the verbs of a verb cluster literally form a cluster—i.e., a common constituent—at some level of representation, as in the syntactic tree in (12b), or do they only behave like a single constituent without actually forming one?
- If so, how does lexical selection work?
- If the verb cluster really is a single constituent, is this constituent base-generated as is, or is it derived from an underlying structure along the lines of (12a)?
- What are the triggers for cluster formation and reordering?

With regard to these questions, two main lines of analysis have been pursued: (i) The *derivational approach* assumes a single underlying order from which all other orders are

derived, whereas (ii) the *base generation approach* assumes that all possible orders are base generated as such. In addition, mixtures between these two approaches have also been proposed.

Ever since its inception by Evers (1975), the derivational approach has figured prominently in the syntactic literature. Views diverge, however, on basically all aspects of the derivation. In Evers' original analysis, the verbs in verb-final position literally form a cluster on surface structure. This cluster is derived by two transformational operations—verb movement and S-pruning—from an underlying deep structure in which each verb heads its own clausal projection. A great step forward in our understanding of verb clusters was taken by Haegeman & van Riemsdijk (1986). Like Evers, Haegeman and van Riemsdijk assume the literal existence of a verb cluster which is derived from an underlying non-cluster representation. This is achieved by two mechanisms, *reanalysis* (two phrases not forming a constituent can be reanalyzed as a single constituent) and *inversion* (sister nodes change order under certain conditions). These mechanisms are very different from those deployed by Evers, and they are non-syntactic in the sense of deriving phonetic form (PF) from surface structure, not surface structure from deep structure.

Analyses like those of Evers (1975), Haegeman & van Riemsdijk (1986) and other work of this period was based on the widespread assumption that Dutch and German are head-final on the VP level. This assumption has been challenged in the wake of Kayne's (1994) *Linear Correspondence Axiom* that postulates that syntactic structures universally adhere to the scheme specifier–head–complement. Following the introduction of the Linear Correspondence Axiom, a head initial base structure has also been proposed for German and Dutch, with far reaching consequences for the analysis of verb-cluster phenomena (see, e.g., Hinterhölzl, 1999; Koopman & Szabolcsi, 2000; Zwart, 1996). A prominent feature of these analyses is that verb clusters in a literal sense (as in (12b)) are no longer part of

the analysis. Whether German is assumed to have an OV or a VO base structure, non-trivial transformational operations are necessary for deriving the possible order variations in verb clusters from a fixed underlying order. Wurmbrand (2006) compares the various approaches and comes to the conclusion that verb cluster data do not help to decide the headedness of the German VP.

The main alternative to the derivational approach is the base generation approach which assumes that all verb order variants in a cluster are directly generated by the grammar and not derived from an underlying common structure. Base generation accounts of verb cluster formation have not only been proposed within syntactic theories which eschew transformational devices anyway (e.g., Combinatorial Categorial Grammar or Head Driven Phrase-Structure Grammar; see references above) but also within syntactic theories which otherwise make free use of transformations. For German in particular, the base generation approach has been championed by H. Haider working within the Principles-and-Parameters framework (e.g., Haider, 1993; a more recent account combining base generation and movement is Haider, 2003). Williams (2003) has proposed a further base-generation approach to verb cluster formation which combines X-bar theory with certain means provided by categorial grammar. Since our own analysis is an extension of this approach, we will introduce it in some detail in section 7 after having presented the first part of our experimental data.

Independent of particular frameworks and analyses, a further set of questions raised by verb clusters concerns the reasons for their peculiar behavior. In particular, why do verb clusters show so much word order variation within and across the different variants of a language? When this question has been discussed, it has often been proposed that the reordering within verb clusters is motivated by requirements posed by the human performance mechanisms (e.g., Lötscher, 1978), although a thoroughgoing account of this

idea is still wanting. A discussion of this question is beyond the scope of the present paper.

On a much more specific level, the question is what the triggers are for each particular reordering of the verbs within a verb cluster. As shown in section 1 above, these triggers must include at least the verb class of the verbs involved and the complexity of the cluster. All analyses of verb order variation have to assume such triggers in one way or the other, and they have to specify whether particular verb orders appear optionally or obligatorily, as marked, for example, in inversion parameters (see Haegeman & van Riemsdijk, 1986:426).

A last point to mention is the status of what is meant by notions like 'preferred', 'marked', '(less) natural' etc. As noted in the last section, such notions are often found in linguistic descriptions of verb clusters, and they are also used by native speakers when asked about the status of particular orders within the verb cluster. Neither the theoretical status of such notions within grammatical theory, nor their relationship to issues of grammaticality, has been assessed thoroughly in the literature concerned with verb cluster variation. One way in which we have addressed this question is by obtaining grammaticality judgments on verb clusters in an experimentally controlled way. We present three of these experimental studies before starting to develop our own analysis. A more general consideration of the problems that arise in this connection will be provided in the final section.

3 Experiment 1: Word Order in 3-verb Cluster

A verb cluster with three elements can be ordered in six different ways. The aim of Experiment 1 was to determine to which degree these six orders are accepted by native speakers of German. For further reference, we will divide 3-verb clusters along the two

dimensions shown in (13).

(13)

	Aux = 1	*Aux = 2*	*Aux = 3*
$V < Mod$	Aux_1-V_3-Mod_2	V_3-Aux_1-Mod_2	V_3-Mod_2-Aux_1
$Mod < V$	Aux_1-Mod_2-V_3	Mod_2-Aux_1-V_3	Mod_2-V_3-Aux_1

The first dimension concerns the order between main and modal verb. As discussed above, Standard German is rather strict in this dimension in obligatorily requiring that a main verb always precedes a modal verb by which it is selected. Other Germanic dialects, in contrast, allow or even require the reverse order.

The second dimension concerns the position of the auxiliary relative to the other two elements. The auxiliary can come first, second, or third. As also discussed above, the perfect and the future auxiliary differ in Standard German with regard to their position within the verb cluster. In order to capture this property of verb clusters, Experiment 1 consists of two subexperiments. Each subexperiment investigates all six permutations among an auxiliary, a modal verb, and a main verb. Experiment 1a investigates the perfect tense of modal verbs and therefore has a finite form of *haben* as auxiliary. Experiment 1b investigates the future tense of modal verbs and thus uses a finite form of the auxiliary *werden*.

The experimental procedure that we have used for the following experiments is the method of speeded grammaticality judgments which works as follows. Sentences are presented to subjects with an experimenter-controlled presentation rate. As soon as the last word of the sentence has been presented, subjects have to give a fast grammaticality judgment. To ensure fast responses, a response deadline of a few seconds is typically imposed. So far, this method has been successfully used for psycholinguistic experiments concerned with syntactic ambiguity resolution (e.g., Ferreira & Henderson, 1991; Bader & Bayer,

2006). While there are obvious alternatives for obtaining experimentally controlled measures of grammaticality, like rating sentences on a scale from, say, 1 to 5, or magnitude estimation (cf. Bard et al., 1996), the method of speeded-grammaticality judgments as used here has its own merits. For example, judgments have to be given quickly to sentences which are presented rapidly, long enough to process the sentences completely but not long enough to give participants time for deliberate reasoning about issues of grammaticality. What we thus get is a spontaneous assessment of the grammatical status of each sentence. Furthermore, in all experiments that we will report below, the sentences of interest were always embedded within a much larger list of filler sentences, with a typical ratio between experimental and filler sentences of 1:5 or 1:6. Participants are thus not focused on the constructions under consideration, which further enhances the chance of obtaining grammaticality judgments which are uncontaminated by extraneous factors (like conscious believes about normative grammar) as far as this is possible at all.

Note finally that requiring binary grammaticality judgments from participants does in no way prejudge the question of whether grammaticality is perceived in a discrete or a gradual manner. Since the binary judgment that participants have to give in this task is often the source of objections against using speeded grammaticality judgments, let us shortly elaborate on this point. To see that binary judgments are neutral with regard to the nature of the underlying perception of grammaticality, consider the task of grammaticality judgments from the point of view of Signal Detection Theory (see Green & Swets, 1966). In terms of Signal Detection Theory, grammaticality judgments are simply an instance of a forced-choice classification task in which stimuli have to be sorted into the two categories of grammatical and ungrammatical stimuli. There are many tasks of this kind—ranging from simple laboratory tasks like classifying letter strings as familiar or unfamiliar to complex real-world tasks like interpreting X-ray pictures for signs of cancer—for which it

must be assumed that the judgment process partitions values on a continuous scale into two discrete response categories. Investigating issues of grammaticality by the method of speeded grammaticality judgments is thus completely neutral with regard to the deeper issue of whether grammaticality is a discrete or a gradient property. Furthermore, while each single judgment is binary, the resulting means across subjects and/or sentences are not. Thus, the data obtained by the method of speeded grammaticality judgments are clearly more fine-grained than a simple binary distinction between grammatical and ungrammatical. At the same time, they are much easier to interpret than results from grammaticality rating or magnitude estimation because of their close relationship with standard practices in linguistic theory. Bader & Häussler (2008) directly compared the two methods of magnitude estimation and speeded-grammaticality judgments and found that the two methods deliver closely corresponding results; furthermore, a simple model in terms of Signal Detection Theory was able to successfully predict binary judgments (obtained by the method of speeded grammaticality judgments) from gradient judgments (obtained by the method of magnitude estimation).

3.1 Procedure

All experiments that we will report in this paper 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 space-bar!"). After pushing the space bar, 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 make a response 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.

3.2 Participants

In this and all further experiments, 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. Following each experimental session information was obtained about the region where the participant had grown up. In addition, each participant was asked whether he or she speaks Standard German or a regional variant of German, and if the latter, which variant. The majority of our experimental subjects came from the state of Baden-Württemberg. This state, in which the University of Konstanz is located, is in the south-western corner of Germany. We will give more detailed information about the regional background after experiments 1-3 have been presented.

3.3 Experiment 1a: Perfect Tense of Modal Verbs

Experiment 1a investigates modal verbs in the perfect tense. Its purpose was to determine how native speakers of German judge the six possible permutations of a main verb, a modal verb, and the perfect auxiliary *haben*. As discussed above, Standard German allows only a single order for the perfect tense of modal verbs, namely the order Aux_1-V_3-Mod_2. If

our experimental participants were adhering closely to Standard German, we should thus get high percentages of judgments 'grammatical' for this order and low percentages for the remaining five orders.

3.3.1 Method

Participants 30 students of the University of Konstanz participated in Experiment 1a.

Materials 30 sentences were constructed with each sentence appearing in six versions according to the six permutations shown in (13). The six versions of each sentence differed only with respect to the order among the three elements of the verb cluster. A sample sentence for Experiment 1a is shown in Table 1.

All sentences consisted of a main clause followed by an embedded *dass* ('that') clause. The 3-verb cluster of interest always formed the end of the embedded clause and contained a ditransitive main verb. To satisfy the argument requirements of the main verb, embedded

Table 1: A Sample Sentence Set for Experiment 1a.

Ich weiß, dass Herr Lehmann seinem Mitarbeiter die neue Yacht ...		
I know that Mister L. his employee the new yacht		
	V < Modal	Modal < V
Aux=1	... **hat** *ausborgen* WOLLEN has lend want	... **hat** WOLLEN *ausborgen*
Aux=2	... *ausborgen* **hat** WOLLEN	... WOLLEN **hat** *ausborgen*
Aux=3	... *ausborgen* WOLLEN **hat**	... WOLLEN *ausborgen* **hat**

Translation for all conditions:

'I know that Mister Lehmann wanted to lend the new yacht to his employee.'

clauses contained a subject NP, followed by a dative NP, followed by an accusative NP. The subject NP was either a proper name or a definite NP; all other NPs were definite NPs.

Five different modal verbs were used in Experiment 1a: *können* ('can/to be able to'), *müssen* ('must/to have to'), *wollen* ('to want'), *dürfen* ('may/to be allowed'), and *sollen* ('should'). Each modal verb was contained in 6 experimental sentences and always appeared in the bare infinitive. Possible effects of the morphological form (IPP/bare infinitive versus non-IPP/past participle) will be investigated separately in Experiment 2.

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 two factors Aux-Position and Verb-Modal-Order. Each participant saw only one list. The sentences on each list were randomized individually for each participant and were presented interspersed within 162 filler sentences. These filler sentences represented a wide variety of grammatical and ungrammatical sentence structures and were partly taken from unrelated experiments.

3.3.2 Results

The results for Experiment 1a are shown in Table 2. In this as well as all other experiments, results were analyzed with either participants (F1) or items (F2) as an additional random factor.

Judgments. The results were first analyzed by three-way ANOVAs which took the five modal verbs which were used in the sentence material of Experiment 1a as a separate factor in addition to the two factors Aux-Position and Verb-Modal-Order. However, neither in the subject nor in the item analysis did the main effect of Modal-Verb or any inter-

Table 2: Mean percentages of judgments 'grammatical' and mean reaction times (RT) for judgments 'grammatical' and judgments 'ungrammatical' for Experiment 1a. Standard error (by subjects) is given in parentheses.

	V < Modal			Modal < V		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
% grammatical	79 (4.9)	61 (5.2)	28 (5.3)	25 (5.8)	5 (2.3)	4 (1.8)
RT grammatical	543 (33)	653 (34)	725 (42)	759 (51)	720 (74)	923 (59)
RT ungrammatical	709 (62)	782 (56)	695 (39)	525 (43)	503 (40)	485 (28)

action involving this factor reach significance (all p's > 0.5). Thus, the five modal verbs investigated here seem to form a coherent class as far as 3-verb-clusters in the perfect tense are concerned. Consequently, the factor Modal-Verb was dropped from all further statistical analyses, and the results were analyzed by two-way ANOVAs with the factors Aux-Position and Verb-Modal-Order.

Sentences in which the main verb preceded the modal received higher percentages of judgment 'correct' than sentences with the reverse order between modal and main verb, resulting in a significant main effect of Verb-Modal-Order ($F1(1,29) = 160.43$, $p < .001$; $F2(1,29) = 313.38$, $p < .001$). The factor Aux-Position was also significant ($F1(2,58) = 42.67$, $p < .001$; $F2(2,58) = 66.48$, $p < .001$), reflecting the finding that sentences were judged best when the auxiliary was in first position, second best when the auxiliary was in second position, and worst when the auxiliary was final.

The interpretation of the main effects has to be qualified by a significant interaction between them ($F1(2,58)=9.80$, $p < .001$; $F2(2,58)=17.07$, $p < .001$). The position of the auxiliary had a different effect in sentences with 'V < Modal' order than in sentences with 'Modal < V' order. When the verb preceded the modal, sentences with the auxiliary in

first position were judged significantly better than sentences with the auxiliary in second position (79% vs. 61%; t1 = 5.79, p < .01; t2 = 7.58, p < .01). The latter were in turn judged significantly better than sentences with the auxiliary in final position (61% vs. 28%; t1 = 3.13, p < .01; t2 = 4.09, p < .01). When the modal preceded the main verb, sentences with the auxiliary in first position were again judged significantly better than sentences in which the auxiliary was either in second or third position (25% vs. 5%; t1 = 3.36, p < .01; t2 = 4.39, p < .01). However, in contrast to the condition 'V < Modal', there was no difference between 'Aux=2' and 'Aux=3' when the main verb followed the modal (5% vs. 4%; t1 and t2 both < 1).

Judgment Times. Judgment times for responses 'grammatical' and responses 'ungrammatical' are also shown in Table 2. Analysis of variance of judgment times is made impossible because of too many empty cells for both kinds of judgments. This limitation notwithstanding, the reaction time data show a clear pattern when compared with the percentages of judgments 'grammatical' and 'ungrammatical'. It seems that reaction times index the confidence with which participants make their judgment. In each condition, the response that occurred with higher frequency received faster judgment times than the response that occurred with lower frequency. For example, for sentences with the Standard German order Aux_1-V_3-Mod_2, a clear majority of all responses (79%) were judgments 'grammatical'. These judgments received a mean reaction time of 543ms whereas the alternative judgment 'ungrammatical' received a substantially higher 709ms. Furthermore, the higher the percentages in a given condition, the faster the response times. This results in significant correlations between percentages of judgments and reaction times, for both judgments 'grammatical' (r=.-83, p<.05) and judgments 'ungrammatical' (r=.-83, p<.05).

In sum, it seems that when participants are confident about whether to classify a sentence as grammatical or ungrammatical, they do so quickly whereas judgments which are less confident require more time. Since reaction times thus do not provide information independent from percentages of judgments 'grammatical/ungrammatical', and given the statistical problems due to empty cells, for the experiments to follow we will report reaction times but will not discuss them any further.

3.4 Experiment 1b: Future Tense of Modal Verbs

Experiment 1b is almost identical to Experiment 1a. The only difference is that modal verbs do not occur in the perfect tense but in the future tense. Instead of a finite form of *haben*, the sentences in this experiment therefore contain a finite form of the future auxiliary *werden*. According to the grammar of Standard German, two of the six possible permutations of a future tense 3-verb cluster are considered grammatical: in addition to the auxiliary-first order Aux_1-V_3-Mod_2 (i.e., the only order allowed in the perfect tense), the auxiliary-final nested order V_3-Mod_2-Aux_1 is also allowed.

3.4.1 Method

Participants 30 students of the University of Konstanz participated in Experiment 1b.

Materials The sentence materials for Experiment 1b were adopted from Experiment 1a (cf. Table 1). First, the perfective auxiliary was replaced by the future auxiliary *wird* ('will'). Second, many of the introductory main clauses were modified or completely rewritten in order to make them semantically compatible with an embedded clause in the future tense.

Six experimental lists were prepared in the same way as for Experiment 1a. Each list

was presented to participants interspersed with 162 filler sentences.

3.4.2 Results

Table 3: Results for Experiment 1b.

	V < Modal			Modal < V		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
% grammatical (All modals)	71 (3.8)	36 (5.3)	46 (5.8)	11 (3.7)	5 (2.8)	5 (1.9)
% grammatical (Without *sollen*)	84 (4.1)	42 (6.1)	54 (6.7)	12 (3.9)	5 (3.0)	7 (2.4)
RT grammatical	713 (52)	912 (64)	898 (46)	721 (56)	646 (23)	956 (81)
RT ungrammatical	699 (50)	746 (39)	738 (53)	562 (37)	527 (39)	589 (36)

In contrast to Experiment 1a, three-way ANOVAs with the three factors Modal Verb, Aux-Position and Verb-Modal-Order revealed a significant main effect of Modal Verb ($F1(4,116) = 25.77$, $p < .001$; $F2(4,25) = 16.97$, $p < .001$) as well as a significant interaction between Modal Verb and V-Modal-Order ($F1(4,116) = 19.19$, $p < .001$; $F2(4,25) = 11.28$, $p < .001$). The interaction between Modal Verb and Aux-Position and the three-way interaction involving Modal Verb were not significant. The reason for getting a main effect of Modal Verb and an interaction between Modal Verb and V-Modal-Order is the finding that sentences with the modal verb *sollen* were judged very poorly. Sentences with *sollen* received 4.4% judgments 'grammatical' in the condition 'Modal before Main Verb' (other modals: 6.7-8.9%) and 13.33% in the condition 'Main Verb before Modal' (other modals: 51.1-70%). Although we did not anticipate this finding when preparing the experimental material, it is also not unreasonable. We suspect that sentences with *sollen*

in the future tense were rejected by our participants because the meaning of *sollen* is inherently oriented toward the future. This might have led to an impression of redundancy when *sollen* was put into the future tense, and this impression might in turn have resulted in the judgment 'ungrammatical' for sentences of this type. When the 6 sentences with *sollen* were removed from the analysis, the factor Modal Verb was no longer significant.

Table 3 shows percentages of correct judgment both with *sollen* sentences included and with *sollen* sentences removed. Given the peculiar behavior of *sollen* sentences, the following analyses are all based on the 24 sentences with the remaining four modal verbs. Since there were no significant modal-specific differences after *sollen* was removed, we present only analyses collapsed over the individual modal verbs. Two-way ANOVAS (3 Aux-Positions × 2 Verb-Modal-Orders) revealed a significant main effect of Aux-Position ($F1(2,58)=19.84$, $p < .001$; $F2(2,58)=30.23$, $p < .001$) which reflects the finding that sentences with auxiliary in first position were judged better than sentences with auxiliary in third position which in turn were judged better than sentences with auxiliary in second position. Sentences in which the main verb preceded the modal were judged much better than sentences with the reverse order between main and modal verb, resulting in a significant main effect of V-Modal-Order ($F1(1,29)=145.77$, $p < .001$; $F2(1,29)=103.82$, $p < .001$). In addition to the two main effects, there was a significant interaction between Aux-Position and V-Modal-Order ($F1(2,58)=7.16$, $p < .01$; $F2(2,58)=12.84$, $p < .001$). This interaction is due to the fact that sentences with 'Mod < V' order received very low percentages of judgments 'grammatical' independently of the position of the auxiliary. For sentences with 'V < Mod' order, in contrast, auxiliary position had a strong effect.

3.5 Discussion

The two subexperiments of Experiment 1 have investigated the six permutations that are possible in a verb cluster consisting of three elements. A clear difference showed up between permutations in which the main verb preceded the modal verb and permutations with the reverse order between main and modal verb. As to the latter, all three different permutations were judged rather low. The two orders in which the modal verb preceded the main verb and the auxiliary followed the modal verb (orders Mod_2-Aux_1-V_3 and Mod_2-V_3-Aux_1) never received more than 5% judgments 'grammatical'. It can thus be safely concluded that these two orders are completely ungrammatical for the participants of Experiment 1. When the auxiliary preceded the modal verb (the completely inverted order Aux_1-Mod_2-V_3), the percentages of judgments 'grammatical' were somewhat higher for the perfect tense of modal verbs (25%) but still rather low for the future tense of the modal verbs (11%). With respect to the order between main and modal verb, we thus conclude that our experimental subjects closely adhered to the grammar of Standard German which strictly requires that a modal verb follows a main verb which it selects. Even if the position of the auxiliary confirms to the Standard German requirements and occupies the initial position is it highly dispreferred for the modal verb to precede the main verb (cf. Section 4 for further discussion of the order between main and modal verb).

We now turn to the three permutations in which the main verb precede the modal verb. For the perfect tense of modal verbs, the order with the auxiliary in first position—Aux_1-V_3-Mod_2—is the only order allowed in Standard German as defined by prescriptive grammar. For the future tense of modal verbs, the order Aux_1-V_3-Mod_2 is considered grammatical alongside with the nested order V_3-Mod_2-Aux_1. In accordance with the rules of Standard German, the auxiliary-first order Aux_1-V_3-Mod_2 was judged best in both subex-

periments. The rest of our experimental results, however, diverges in important respects from the grammar of Standard German. First, the nested order V_3-Mod_2-Aux_1 was judged too good in the perfect tense but too bad in the future tense. In the perfect tense, this order received still 28% judgments 'grammatical' despite being banned within Standard German. For the future tense, the nested order is a fully grammatical alternative to the completely fronted order, but it nevertheless received only 54% judgments 'grammatical' in contrast to the 84% for the order Aux_1-V_3-Mod_2. Second, the partially fronted order V_3-Aux_1-Mod_2 was judged surprisingly good. This order—which has no grammatical usage in Standard German at all—received 61% for the perfect tense of modal verbs which is way better than the 28% obtained for the nested order V_3-Mod_2-Aux_1. For the future tense, this order received still 42% which is only 12% less than the 54% for the nested order V_3-Mod_2-Aux_1 which is considered to be fully grammatical according to the grammar of Standard German.

4 Experiment 2: Infinitive or past participle?

One of the peculiarities of modal verbs and certain other functional verbs in German is that under some conditions they form the perfect tense with the infinitive instead of the expected past participle. Note that this so-called IPP effect is not simply due to a lack of a participle form for these verbs. As illustrated in (14), modal verbs can be used without an accompanying main verb, and then they appear as participles in the perfect tense.

(14) a. dass Peter ein Fahrrad GEWOLLT **hat**.

that P. a bike wanted has

'that Peter wanted a bike.'

b. dass Peter in die Schule GEMUSST **hat**.

that P. into the school must has

'that Peter had to go to school.'

c. dass Peter Englisch GEKONNT **hat**.

that P. English could has

'that Peter could speak English.'

According to the grammar of Standard German, the perfect tense of a modal verb which is used without a verbal complement is formed like the perfect tense of every normal main verb: the modal verb has to appear in the past participle form and it has to precede the perfective auxiliary. The morphological form of the modal verb is thus dependent on its position relative to the auxiliary. Modal verbs in the perfect tense occur in the bare infinitival form when following the auxiliary ('Aux-$\text{Mod}_{\text{infinitive}}$') but in the participle form when preceding the auxiliary ('$\text{Mod}_{\text{participle}}$-Aux'). This raises the possibility that the low judgments for the nested order V_3-Mod_2-Aux_1 in Experiment 1a—as in sentence (15)—were not a genuine order effect, but instead an effect of an unpreferred morphological form in an otherwise acceptable verb cluster permutation.

(15) dass Peter ein Buch *lesen* (GEWOLLT | WOLLEN) **hat**.

that P. a book read wanted want has

Experiment 2 was run to test for this possibility. Since verb clusters in which the modal verb precedes the main verb were judged rather low in the preceding experiments, in this and also all following experiments only clusters in which the main verb precedes the modal verb will be considered. Thus, the present experiment investigates the three orders Aux_1-V_3-Mod_2, V_3-Aux_1-Mod_2 and V_3-Mod_2-Aux_1, with the modal verb occurring either in the infinitive or the participle form.

Table 4: A Sample Sentence Set for Experiment 2

Ich weiß, dass Herr	Lehmann	seinem	Mitarbeiter	die neue Yacht	...
I know that Mister L.		his	employee	the new yacht	
Aux=1 (*Aux*$_1$-*V*$_3$-*Mod*$_2$)	...	**hat**	*ausborgen*	(WOLLEN|GEWOLLT)	
		has	lend	want|wanted	
Aux=2 (*V*$_3$-*Aux*$_1$-*Mod*$_2$)	...	*ausborgen*	**hat**	(WOLLEN|GEWOLLT)	
Aux=3 (*V*$_3$-*Mod*$_2$-*Aux*$_1$)	...	*ausborgen*	(WOLLEN|GEWOLLT)	**hat**	

Translation for all conditions:

'I know that Mister Lehmann wanted to lend the new yacht to his employee.'

4.1 Method

Participants 24 students of the University of Konstanz participated in Experiment 2.

Materials The sentence material for Experiment 2 was again adopted from Experiment 1a. The 30 sentences from this experiment were first of all transformed to conform to the six conditions of the current experiment. These six conditions resulted from crossing the two factors *Aux-Position* (first vs. second vs. third) and *Morphological-Form* (infinitive vs. participle) (see Table 4).

An informal corpus survey both in the newspaper corpus provided by the Institut für Deutsche Sprache (IDS)[9] and in the internet using Google's search function revealed that the participle of *sollen* ('should')—*gesollt*—occurs with very low frequency and most of the time in the fixed expression *Was hat das gesollt?* ('What did that mean?/Why did you do that?'). Since this raised the possibility that sentences with *gesollt* would be rejected

[9] 'Institute for the German Language', in Mannheim/Germany which can be accessed over the web with the help of the COSMAS system (cf. *http://www.ids-mannheim.de/cosmas2/uebersicht.html*).

for purely lexical reasons, we decided not to use *sollen/gesollt* in the current experiment. Since the four remaining modal verbs would not have resulted in a balanced design, we also dropped *dürfen* from the current experiment because the participle of *dürfen* had the lowest frequency among the remaining modal verbs. Thus, Experiment 2 used the following three modal verbs in ten sentences each: *wollen* ('to want'), *können* ('to be able to') and *müssen* ('to have to').

The experimental materials were used to construct six sentence lists in the way described for Experiment 1a. Each experimental list was presented together with 108 unrelated filler sentences comprising a broad spectrum of grammatical and ungrammatical sentences.

4.2 Results

Table 5: Results for Experiment 2.

	Infinitive			Participle		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
% grammatical	83 (4.3)	69 (5.6)	17 (5.2)	7 (2.8)	7 (2.8)	17 (5.2)
RT grammatical	684 (39)	819 (48)	943 (50)	824 (38)	956 (84)	911 (659)
RT ungrammatical	709 (65)	835 (76)	676 (39)	576 (32)	662 (49)	638 (64)

As in the two preceding experiments, we first computed three-way ANOVAS with the three different modal verbs as a separate factor in addition to the two factors position of the auxiliary and morphological form of the modal verb. Since neither the main effect of modal verb nor any interaction involving this factor reached significance (all p's $> .14$), the verb-specific factor was dropped from all further analyses. The results for Experiment 2 broken down by the remaining two factors are shown in Table 5. Two-

way ANOVAS (3 Aux-Positions × 2 Modal Forms) revealed the following. As expected given the prior experiments, sentences with the auxiliary in first position were judged best, followed by sentences with the auxiliary in second position, and sentences with the auxiliary in final position were judged lowest. This resulted in a significant effect of Aux-Position ($F1(2,58)=30.90$, $p < .001$; $F2(2,58)=57.60$, $p < .001$). The second factor Morphological-Form was also significant ($F1(1,29)=170.67$, $p < .001$; $F2(1,29)=388.20$, $p < .001$), reflecting the much better judgments for sentences with an infinitival form of the modal verb than for sentences with a participle.

In addition to the two main effects, there was a significant interaction between Aux-Position and Morphological-Form ($F1(2,58)=75.25$, $p < .001$; $F2(2,58)=131.44$, $p < .001$). The reason for this interaction is that for the two auxiliary positions 1 and 2, the morphological form of the modal had a tremendous effect: participles led to almost complete rejection whereas infinitives were accepted most of the time. For sentences with the auxiliary in third position, in contrast, the morphological form of the modal verb had no effect. Both with a participle and with an infinitive, sentences with the modal verb preceding the auxiliary were judged as grammatical with only 17%. Although this is a rather low value, for sentences with a participle of the modal verb the 17% in the condition 'Aux=3' are still significantly higher than the 7% in the conditions 'Aux=1' and 'Aux=2'($t1 = 2.30$, $p < .05$; $t2 = 3.19$, $p < .01$).

4.3 Discussion

The results of Experiment 2 are clearcut: When the auxiliary was in either first or second position and thereby preceded the modal verb (orders Aux_1-V_3-Mod_2 and V_3-Aux_1-Mod_2), participants accepted sentences with the infinitival form of the main verb to rather high degrees but rejected sentences with the participle form of the main verb almost completely.

When the auxiliary was in final position, and thus followed the modal verb, no difference showed up between infinitival and participle form of the main verb. In both cases, sentences were rejected most of the time, although they were still accepted somewhat more often than sentences with a participle form of the modal verb and the auxiliary in non-final position.

The main conclusion to be drawn from the current experiment is that IPP is basically an obligatory rule in 3-verb clusters consisting of the perfect tense of modal verbs. When the modal verb followed the auxiliary, the participle of the modal verb led to almost complete rejection. But even when the participle of the modal verb preceded the auxiliary, the acceptance was only moderately higher. Additionally, the results of Experiment 2 confirm the prior results of Experiment 1a that in sentences with an infinitival form of the modal verb, the two orders Aux_1-V_3-Mod_2 and V_3-Aux_1-Mod_2 are accepted most of the time, with an advantage for the Standard German order 'Aux-V-Mod' of around 15%. The order V_3-Mod_2-Aux_1 was again judged rather low, and the morphological form of the modal did not make any difference. It therefore seems safe to conclude that the rejection of the nested order V_3-Mod_2-Aux_1 is a genuine order effect.

5 Experiment 3: Focus Effects on Verb Clusters

It has long been known that word order variation within verb clusters has multiple causes (see Maurer, 1926; Lötscher, 1978). Apart from purely syntactic factors, information structural properties and stress placement have been proposed to affect the order among the elements of a verb cluster (for recent work, see Schmid & Vogel, 2004; Wurmbrand, 2004b; Sapp, 2006).

Schmid & Vogel (2004) obtained grammaticality judgments and production data from dialect speakers using a written questionnaire in which main stress was indicated by uppercase letters and a context sentence was provided to ease judgments. Their results indicate that stress placement on a particular verb can license a reordering in the verb cluster. However, the exact nature of the intonation contours produced by the dialect speakers is not specified, and usually just a single speaker was questioned. Given the subject population of the current investigation (cf. Section 6), the finding of Schmid & Vogel (2004) most relevant to the current investigation is that in Swabian (as spoken in Tübingen), the order V_3-Aux_1-Mod_2 is only possible if either the object, the main verb, or the modal verb is narrowly focused. In addition to the dialect data, Schmid & Vogel (2004, p. 239) claim that speakers of Standard German unanimously accept the order V_3-Aux_1-Mod_2 only if the verb or the modal is focused.

Sapp (2006) also investigated word-order variation in 3-verb clusters using the experimental method of magnitude estimation. Sapp finds effects of focus on the acceptability of sentences with future tense 3-verb clusters, but only one type of focus seems to differentiate between the three orders tested by Sapp. When the modal had to be narrowly focused, the order V_3-Aux_1-Mod_2 improved, the order V_3-Mod_2-Aux_1 declined, and the order Aux_1-V_3-Mod_2 remained the same. In addition, Sapp (2006) presents a wealth of interesting corpus data on verb cluster use in Early New High German. He distinguishes two types of focus: 'new' if an argument was new within a defined amount of text, and 'contrastive' if an argument could be interpreted as contrastive. In his data, he finds an overall focus effect for 3-verb clusters, but orders could not be tested individually because there were not enough instances in the corpus.

Despite the studies by Schmid & Vogel (2004) and Sapp (2006), the issue of focus structure and verb-cluster formation cannot be considered settled. We therefore run Ex-

periment 3 in order to further investigate this issue. Experiment 3 uses the same method as all preceding experiments: Participants judge sentences which they read silently. Focus could therefore not be manipulated by varying intonational properties. Instead, focus was manipulated by inserting focus particles at three different positions within a sentence, as illustrated in (16).

(16) dass (sogar) Peter (sogar) ein Buch (sogar) *VERB-CLUSTER*
that even Peter even a book even

In (16), the focus particle either immediately precedes the subject, the object or the verb cluster. When the focus particle precedes the verb cluster, there are still two possibilities for what is focused: either the main verb or the modal verb.[10] This ambiguity is unavoidable because a focus particle cannot be inserted into the cluster in order to unambiguously fix its associated focus. However, evidence from reading experiments (cf. Bader, 1998) shows that readers prefer stress on content words over stress on function words when they have a choice. We therefore assume that a focus particle preceding the verb cluster is preferentially associated with focus on the main verb.

In the same way as Experiment 2, Experiment 3 will investigate focus effects only for the three orders in which the main verb precedes the modal verb (orders Aux_1-V_3-Mod_2, V_3-Aux_1-Mod_2, and V_3-Mod_2-Aux_1). Because crossing three orders with three positions of the focus particle still results in 9 conditions, Experiment 3 will consist of two subexperiments with 6 conditions each, so that again each participant had to judge no more than

[10]Focusing the auxiliary is hardly possible in this context. In main clauses, focusing a finite auxiliary leads to verum focus but in embedded clauses this effect is achieved by focusing the complementizer (cf. Höhle, 1992). To focus narrowly on the tense specification, other means like the use of temporal adverbials seem to be necessary.

30 sentences containing a complex verb cluster. In Experiment 3a, the focus particle will either precede the subject or the object, and in Experiment 3b either the object or the verb.

5.1 Method

Participants 24 students of the University of Konstanz participated in Experiment 3a and 36 in Experiment 3b.

Materials The materials for Experiments 3a and 3b were again adopted from Experiment 1a. All sentences consisted of a main clause and an embedded clause; the embedded clause contained a subject, an indirect object, a direct object, and the 3-verb cluster. In both subexperiments, all sentences appeared in six versions according to a two-factorial design. The first factor *Aux-Position* (first vs. second vs. third) was identical in Experiments 3a and 3b. The second factor *Focus-Position* differed between the two subexperiments. In Experiment 3a, either the subject or the direct object was immediately preceded by a focus particle; in Experiment 3b, a focus particle immediately preceded either the direct object or the verb cluster. A sample sentence set for Experiment 3 is shown in Table 6.

The same five modal verbs were used as in Experiment 1a: *können* ('can/to be able to'), *müssen* ('must/to have to'), *wollen* ('to want'), *dürfen* ('may/to be allowed'), and *sollen* ('should'). Each modal verb occurred in 6 sentences and always had the form of the infinitive.

The final preparation of experimental lists followed the description given for Experiment 1a. The number of filler sentences was 162 in Experiment 3a and 108 in Experiment 3b.

Table 6: A Sample Sentence Set for Experiment 3.

Ich	glaube,	dass	(nur_1)	Maria	unserem Vater (nur_2)	die Schubkarre (nur_3) ...
I	think	that		M.	our dad	the wheelbarrow
			Aux=1 (Aux_1-V_3-Mod_2)		...	**hat** *leihen* WOLLEN
						has lend want
			Aux=2 (V_3-Aux_1-Mod_2)		...	*leihen* **hat** WOLLEN
			Aux=3 (V_3-Mod_2-Aux_1)		...	*leihen* WOLLEN **hat**

Note:

The focus particle *nur* ('only') occured at only one position in each sentence

Translation for all conditions:

'I think that (only) Maria (only) wanted to lend (only) the wheelbarrow to dad.'

5.2 Results

For both Experiment 3a and Experiment 3b, the results were first analyzed by three-way ANOVAs taking the five modal verbs used in the sentence material as a separate factor. Since neither the main effect of Modal-Verb nor any interactions involving this factor were significant, the factor Modal Verb was dropped from all subsequent analyses.

The results for Experiment 3a are shown in the upper part of Table 7. Two-way ANOVAS (3 Aux-Positions × 2 Focus-Positions) revealed a significant effect of Aux-Position ($F1(2,46)=30.19$, $p < .001$; $F2(2,58)=66.62$, $p < .001$) which reflects the same pattern that was already found in Experiments 1a and 2: Sentences with Aux=1 were judged best, followed by sentences with Aux=2, followed by sentences with Aux=3. The focus manipulation, in contrast, was without any effects: Neither the main effect of Focus-Position was significant ($F1(1,23)=.53$, n.s.; $F2(1,29)=.68$, n.s.), nor the interaction be-

Table 7: Results for Experiment 3.

	Subject Focus			Object Focus		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
% grammatical	90 (2.7)	69 (6.7)	39 (7.8)	89 (2.9)	68 (6.2)	36 (7.1)
RT grammatical	602 (43)	726 (42)	788 (63)	564 (30)	692 (61)	919 (67)
RT ungrammatical	870 (63)	909 (68)	855 (64)	691 (68)	804 (65)	796 (53)
	Object Focus			Verb Focus		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
% grammatical	91 (3.1)	77 (4.7)	38 (5.2)	86 (3.4)	79 (4.6)	38 (6.2)
RT grammatical	595 (37)	672 (43)	831 (52)	629 (39)	674 (45)	879 (49)
RT ungrammatical	980 (28)	911 (53)	770 (39)	801 (68)	891 (47)	755 (36)

tween Aux-Position and Focus-Position ($F1(2,46)=.10$, n.s.; $F2(2,58)=.05$, n.s.).

The results for Experiment 3b are shown in the lower part of Table 7. Two-way ANOVAS (3 Aux-Positions $\times$ 2 Focus-Positions) revealed again a significant main effect of Aux-Position ($F1(2,70)=80.29$, $p < .001$; $F2(2,58)=183.53$, $p < .001$), reflecting the same ranking as in the preceding experiments. The difference between the Aux=1 and the Aux=2 orders was larger in sentences with object focus (14%) than in sentences with verb focus (7%), as predicted by the focus accounts discussed above. However, this did neither result in a significant main effect of Focus-Position ($F1(1,35)=.12$, n.s.; $F2(1,29)=.12$, n.s.) nor a significant interaction between Aux-Position and Focus-Position ($F1(2,70)=.99$, n.s.; $F2(2,58)=.71$, n.s.).

5.3 Discussion

Taken together, Experiments 3a and 3b have investigated three different positions of a focus particle: directly in front of the subject, directly in front of the object, and directly in front of the verb cluster. No significant effects of the position of the focus particle were observed. In Experiment 3a, not even a numerical difference was found between sentences in which either the subject or the object was narrowly focused by an immediately preceding focus particle. In Experiment 3b, a slight numerical difference in the expected direction showed up, but the interaction was not significant, either because the observed differences are spurious, or because they are too small. Either way, the two subexperiments of Experiment 3 allow the conclusion that focus is not decisively involved in determining the grammatical status of 3-verb clusters involving modal verbs. The partially inverted order V_3-Aux_1-Mod_2, in particular, was unaffected by the position of the focus particle in both experiments. Most importantly, this order was accepted to a substantial degree independent of any particular focus properties. Two unpublished experiments with auditive sentence presentation could confirm that the results of Experiment 3 are not an artifact of the visual presentation mode used here. In these experiments, sentences with partially inverted order V_3-Aux_1-Mod_2 were judged as grammatical most of the time, with no difference whatsoever between sentences with nuclear pitch accent on the object and sentences with nuclear pitch accent on the main verb. This strongly argues that the lack of any focus effects in 3 is not due to the fact that sentences were presented visually.

With regard to the corpus findings presented in Sapp (2006), two possibilities of why he found focus related effects whereas we did not suggest themselves. First, the data from Sapp (2006) are from an older stage of German (Early New High German), and the licensing condition on verb clusters might have changed in the course of time. This

would not be implausible given that—as a general trend—word order within verb clusters has become much more rigid over time as a result of standardization. A second possibility arises from the fact that Sapp investigated corpus frequencies whereas we obtained grammaticality judgments. Other work (e.g., Featherston, 2005; Kempen & Harbusch, 2005; Bader & Häussler, 2008) has shown that differences in corpus frequencies are not necessarily reflected in judgment data. In particular, structures which occur only rarely can nevertheless be judged as fully grammatical. It is clearly conceivable that the use of particular cluster orders depends on information-structural properties even if the orders to choose from are grammatical to an equal degree.

6 Summary: Experimental Results for 3-Verb Clusters

Before summarizing the data obtained so far, we have to ask which variant of German our results represent. As we said in the introduction to Experiment 1, each participant was queried for his or her regional background. Reflecting the location of the University of Konstanz in the state of Baden-Württemberg (BW), which is the state in the south-west of Germany, a majority of participants came from BW, ranging between 53% and 62% in each of the prior experiments. Since participants not from BW were distributed rather widely across Germany, we will not present regional data for individual experiments, as this would not give a representative picture for the non-BW participants.

Instead, we will present a regional analysis of the experimental results for modal verbs in the perfect tense with the three orders Aux_1-V_3-Mod_2, V_3-Aux_1-Mod_2, and V_3-Mod_2-Aux_1. These three orders were part of the four experiments 1a, 2, 3a, and 3b, representing a total of 120 experimental participants. 68 participants were from BW, 48 from outside BW, and 4 either had a mixed background or their background information was missing

due to an experimenter error. These four participants were excluded from further analysis.

Table 8 shows the results combined for all remaining 116 participants, as well as separately for the 68 participants from BW and the 48 participants from outside BW. With respect to the percentages of judgments 'grammatical', Table 8 does not reveal any difference between the BW and the non-BW participants for the three orders under consideration.

Table 8: Percentages of sentences judged as grammatical broken down by regional background of participants (reaction times in parentheses)

	All Subjects (n=116)	BW Subjects (n=68)	Non-BW Subjects (n=48)
Aux-V-Mod	85 (607)	84 (652)	87 (548)
V-Aux-Mod	70 (705)	69 (736)	71 (666)
V-Mod-Aux	30 (815)	32 (800)	28 (832)

For a more fine grained analysis, we grouped participants into the six regional language areas that are identified by Ammon et al. (2004) for Germany: South-West/Baden-Württemberg (SW/BW); South-East/Bavaria (SE/BA); Middle-West (MW; Hesse, Rhineland-Palatinate, North Rhine-Westphalia); Middle-East (ME; Thuringia, Saxony); North-West (NW; Bremen, Hamburg, Lower Saxony, Schleswig-Holstein); North-East (NE; Berlin, Brandenburg, Mecklenburg-Western Pomerania). In addition, there was a single participant from Switzerland who was excluded from the following analysis.

For each of the six regions just defined, the mean data for the three experimental conditions under consideration are shown in Figure 1. The number of participants coming from each region is given in parentheses after the region label. The most striking feature visible in Figure 1 is that—abstracting away from small non-significant differences—all regions show the same ranking among the three orders: judgments for sentences with

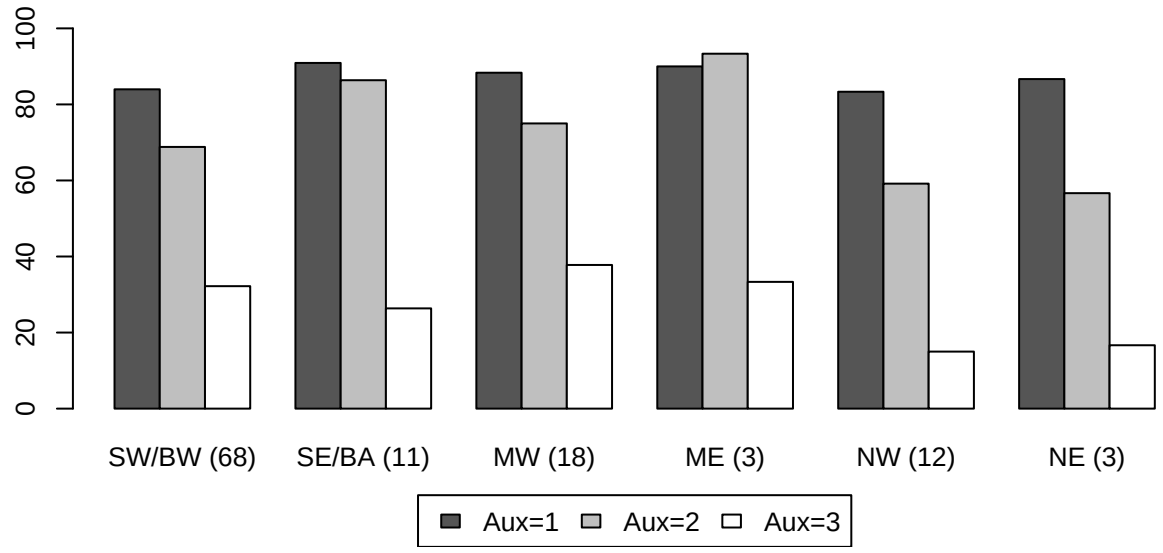


Figure 1: Combined results from Experiments 1a, 2, 3a, and 3b for the perfect of modal verbs by region of participants. The three orders shown are Aux_1-V_3-Mod_2 (Aux=1), V_3-Aux_1-Mod_2 (Aux=2), and V_3-Mod_2-Aux_1 (Aux=3). (SW/BW = South-West/Baden-Württemberg; SE/BA = South-East/Bavaria; MW = Middle-West; ME = Middle-East; NW = North-West; NE = North-East)

the auxiliary in first position (Aux_1-V_3-Mod_2) are either identical or closely followed by judgments for sentences with the auxiliary in second position (V_3-Aux_1-Mod_2); sentences with the auxiliary in final position (V_3-Mod_2-Aux_1) follow with a substantial distance.

No significant difference between the completely fronted Standard German order Aux_1-V_3-Mod_2 and the partially fronted order V_3-Aux_1-Mod_2 is found for participants from Bavaria. While this is not unexpected given that this order is sometimes even called the "Austrian-Bavarian" order, this order is clearly not restricted to speakers from East Southern Germany. There is also no significant difference for speakers from Middle-East Germany. For speakers from the Middle-West, the difference between Aux_1-V_3-Mod_2 and V_3-Aux_1-Mod_2 was just 13%. The three speakers from the North-East had the largest difference with 30%, but this difference is still smaller than the difference between V_3-

Aux_1-Mod_2 and V_3-Mod_2-Aux_1.

Given the results of the regional analysis, it seems justified to conclude that the pattern of experimental results obtained in Experiments 1-3 reflects what might be called *Colloquial German*. On the one hand, our results show systematic deviations from what is prescribed by grammars of Standard German. On the other hand, the results do not seem specific to a particular regional variant of German, as shown by Figure 1. Before proceeding, one caveat to this conclusion should be mentioned. One possibility which we cannot exclude is that the patterns of grammaticality judgments obtained in the experiments above represent Southern German, and that participants from outside Southern Germany acquired the non-standard order V_3-Aux_1-Mod_2 only during the time they stayed in Southern Germany for studying at the University of Konstanz. While we do not have exact data concerning this time span, a plausible estimation would be somewhere between 1 and 3 years. This estimate is based on the fact that all our participants were undergraduate students, and the average time to graduation is around four to five years. While we doubt that participants changed their grammar in such a short time, this topic clearly deserves more research. Should this nevertheless turn out to be correct, it would mean that word order within verb clusters is a rather superficial property to which speakers can adjust easily. As will become clear below, such a conclusion would be quite sympathetic to the analysis we present later.[11]

We are finally in a position to summarize the main findings from Experiments 1-3:

- In all experiments, the Standard German order *Aux-V-Mod* received the best judgments.

[11] As one reviewer suggested, one way to investigate whether our results indeed reflect Colloquial German and not Southern German as acquired by our 'Northern' German participants during the stay in Konstanz would be to test a control group of Northern Germans that have not lived in Southern Germany.

- As expected, for the nested order *V-Mod-Aux*—which is ungrammatical in the perfect tense but grammatical in the future tense—judgments varied depending on the particular combination of matrix verb and auxiliary. For modal verbs in the perfect tense, this order was judged rather low, with mean judgments ranging from 17-39%. For modal verbs in the future tense judgments were better with 54%.

- The partially inverted order *V-Aux-Mod* was judged surprisingly good. For modals in the perfect, this order always scored second best, with a difference of 10-20% in comparison to the Standard German order *Aux-V-Mod*. For modals in the future, this order ranked third, but it was judged only 12% worse than the Standard German order *V-Mod-Aux*.

- Use of the infinitive instead of the past participle of the modal verb was found to be basically obligatory. Even in the nested order, sentences with a participle form of the modal verb were judged as grammatical with only 17%, which was exactly the value for the nested order with an infinitival modal verb.

- The focus manipulations that were the topic of Experiment 3 had no significant effects.

In the remainder of this paper, we develop an analysis of German verb clusters that accounts for our experimental findings. Ideally, this analysis should lead to a full account of the rich experimental details that were delivered by our experiments. Since such an analysis is beyond the scope of the current paper, we will transform percentages of judgments 'grammatical' into the usual binary distinction between grammatical and ungrammatical sentences. Based on the experimental evidence provided so far, we assume the distribution of grammaticality shown in (17).

(17) Transformation of mean judgment data into binary grammatical-ungrammatical distinction.

	V < Modal			Modal < V		
	Aux=1	Aux=2	Aux=3	Aux=1	Aux=2	Aux=3
Perfect tense	√	√	*	*	*	*
Future tense	√	√	√	*	*	*

With one exception, the table in (17) is based on the assumption that the dividing line between grammatical and ungrammatical sentences is 50%. For most sentences—in particular sentences with perfect tense verb clusters—we could have used a much more stringent criterion because the majority of sentences which we will consider as grammatical in the following were judged so with at least 70% whereas sentences which are treated as ungrammatical were judged as grammatical with 30% or less. The fact that we also consider the order V_3-Aux_1-Mod_2 in the future tense as grammatical—despite a value of 42% in Experiment 1b is based on additional experimental evidence from Bader & Schmid (submitted). While Bader & Schmid (submitted) also found lower values for future tense sentences in comparison to perfect tense sentences, the absolute level was substantially higher with 60% for V_3-Aux_1-Mod_2 clusters.

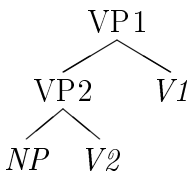
In the next section we present an analysis of the results so far in terms of the CAT language proposed in Williams (2003). This analysis will lead to a hypothesis concerning 4-verb clusters which will be experimentally tested subsequently.

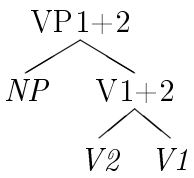
7 Generating Verb Clusters

In this section, we present an analysis of German verb clusters that builds on the analysis of verb clusters presented in Williams (2003). Williams' analysis—which belongs to the

class of theories according to which verb clusters are base-generated as is (cf. Section 2 for discussion and references)—makes use of a restrictive variant of categorial grammar, hence the name of its central grammatical device, the formal language CAT. It would surely be possible to frame our analysis in terms of other versions of the base-generation approach—for example, in terms of more powerful versions of categorial grammar (e.g., Steedman, 1983, 2000) or in terms of base-generation theories proposed within the principles-and-parameters framework (e.g, Haider, 1993). However, we will argue in due course that the formal means provided by Williams (2003) have exactly the expressive power needed to account for the array of data presented in this paper.

Before introducing CAT, let us shortly consider the general challenge faced by any theory which posits that verb clusters are base-generated. For purposes of illustration, consider the two trees in (18).

(18) a. 

b. 

The tree in (18a) is a tree without verb cluster formation. In this tree, V1 is a verb which selects a VP, VP2, as argument; the head of VP2, V2, in turn selects an NP argument. Since V1 and V2 do not form a verbal cluster, they combine with their respective arguments in a local and transparent manner: First, V2 combines with its argument NP, forming VP2; VP2 in turn serves as the argument of the higher verb V1. In other words, head and argument are sister constituents in (18a). The corresponding tree with verb-cluster formation is shown in (18b). Neither the selectional properties of V1 nor those of V2 are transparently represented in (18b). First, V1 combines with a verb instead of a VP in (18b); in fact, (18b) does not even contain a VP with which V1 might combine. Second, V2 does not combine with its argument NP but with V1; only the complex formed by

V1 and V2 combines with NP. In sum, a theory which base-generates verb clusters must provide for two non-transparent ways of combining verbs with their arguments. First, a verb selecting a VP must be able to combine with the head of the VP instead; second, a verb selecting some XP argument (exemplified by NP in (18)) must be able to transmit its selectional requirements to the verbal complex of which it becomes a part.[12]

With this much background information at hand, let us now turn to the formal language CAT that is introduced by Williams (2003) as part of *Representation Theory*. Representation Theory in general, and CAT in particular, provide an alternative to the *Universal Base Hypothesis* (cf. Cinque, 1999; Kayne, 1994) according to which there is a fixed hierarchy of functional categories which is present in the grammar of every language. This hypothesis has led to highly abstract and complex analyses making heavy use of movement operations in order to capture the attested variation between languages (e.g., Koopman & Szabolcsi, 2000). CAT avoids such complexity by providing the means to base-generate structures which in mainstream minimalist analysis could only be derived by movement and other transformational devices. Williams (2003) defines the formal language CAT and presents a short analysis of Dutch and German verb clusters as one of the applications of CAT.

The language CAT is a restricted variant of categorial grammar. Central to CAT is

[12]The way we have formulated the base-generation challenge presumes that V1 selects a VP and not a V°. For the case of German modal verbs, this assumption seems justified given the existence of examples like (i) in which the VP complement of the the modal verb *wollte* has been topicalized.

(i) [$_{VP}$ Ein Buch schreiben] wollte er schon immer.
a book write wanted he already always
'He always wanted to write a book.'

the Rule of Combination in (19) (Williams, 2003: 205).

(19) Rule of Combination

$X\_Y + Y\_Z \rightarrow [X + Y]_{X\_Z}$

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'.

In terms of other versions of Categorial Grammar, the Rule of Combination subsumes both functional application (when the subcategorization feature Z of Y in (19) is empty) and functional composition (when Z is not empty). These two options are illustrated in tree notation in (20a) (empty subcategorization feature on Y) and (20b) (non-empty subcategorization feature on Y).

(20) a. Functional Application b. Functional Composition

The Rule of Combination is meant to apply to lexical elements which are associated with the three types of subcategorization information listed in (21).

(21) Subcategorization specification

a. Type of complement: N vs. V vs. ...

b. Order of selection: left vs. right

c. Level of complement: X° vs. X^{N}

The language CAT is defined by Williams (2003) as the set of all permutations that can be derived from a given set of items which only specify the type of their complement(s), but neither order nor level. The grammar of a particular language will then specify a subset of CAT by imposing further subcategorization requirements on order and/or level. In contrast to theories like Combinatorial Categorial Grammar (cf. Steedman, 2000), CAT is severely restricted because it provides only one extra rule of combination—functional composition—in addition to the basic rule of functional application, whereas combinatory means of greater complexity, like e.g. type shifting, are not made available.

Sample lexical specifications for German main verbs, modal verbs, and auxiliaries are shown in (22). V without any further specification stands for verbs of any category, that is, for V_{main}, V_{mod} and V_{aux}. The direction of selection is specified by a preceding arrow pointing to the right for complements that follow their selecting head or a following arrow pointing to the left for complements that precede their head.[13]

(22) Sample lexical entries for verbs in German

a. Main verbs — V_{Main}: DP← | V_{Main}: PP← | V_{Main}: DP PP← | ...

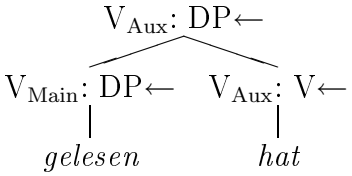
b. Modal and auxiliary verbs — $\text{V}_{\text{Mod|Aux}}$: V←

The subcategorization frames shown in (22) differ with respect to the syntactic category of the selected elements—phrases of various sorts for main verbs, verbs for modal and auxiliary verbs—whereas the direction of selection is uniformly to the left. To illustrate

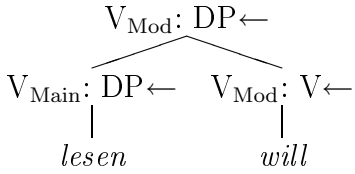
[13]Here and in the following, we work under the assumption that auxiliaries and modal verbs are a subcategory of verbs. We therefore use syntactic category labels like V_{Main}, V_{Modal} and V_{Aux}. As far as we can see, our analysis would also be compatible with the alternative assumption according to which auxiliaries and modal verbs form major categories by themselves (as a part of the extended projection of the verb, cf. Grimshaw, 2005). For the pro and cons of the different positions, see e.g. Reis, 2001; van Riemsdijk, 2002; Wurmbrand, 2001.

the Rule of Combination at work, (23) shows the structures that are derived for 2-verb clusters.

(23) a.



b.



One of the peculiar features of verb cluster formation in Dutch and German is the fact that word order within a verb cluster is sensitive to the cluster's complexity. In Standard German, the perfective auxiliary follows the modal verb when the modal verb does not itself embed a further verb but comes in first position when the modal verb selects a further verb (compare (24a) and (24b)).

(24) 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 dependency of word-order on the complexity of the verb cluster cannot be captured by the means provided by the subcategorization specifications in (21). In particular, the difference between (24a) and (24b) is not a level difference in terms of X-bar Theory (X° vs. X^N) because it is assumed that the verb cluster is composed of X° elements in both cases.[14] Williams (2003, 184) therefore introduces an additional complexity feature which

[14]With respect to verb cluster formation, the level specification can be used to capture the difference between 'verb-raising' and 'verb-projection raising' structures. This issue is discussed in the final section of this paper. Until then, verbal complements will always bear the level specification X° in the subcategorization frames that we present, reflecting the fact that our focus is on 'verb raising' constructions.

he calls 'stem' versus 'non-stem'. In order to be more in line with the terminology used here, we rename this feature as shown in (25). The definition of the complexity feature [VV] will be revised when we consider 4-verb clusters in more detail in section 8.

(25) Additional complexity feature for verb clusters (preliminary)

a. Verb cluster: [VV] (= William's non-stem)

b. Simple verb: [V] (= William's stem)

For Standard German—as described in section 1—verb cluster formation involving perfect and future tense auxiliaries can now be specified by the subcategorization frames given in (26).

(26) Subcategorization frames for Standard German tense auxiliaries:

a. Perfect tense: *haben* — V_{Aux}:

(i) $\rightarrow V_{Mod-[VV]}$

(ii) $V\leftarrow$

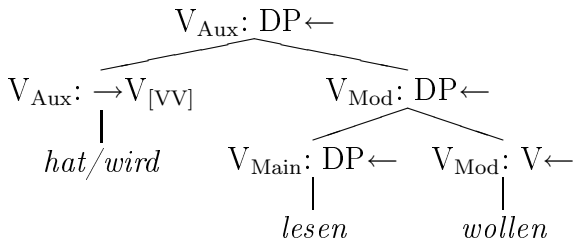
b. Future tense: *werden* — V_{Aux}:

$\rightarrow V_{Mod-[VV]}$ or $V\leftarrow$

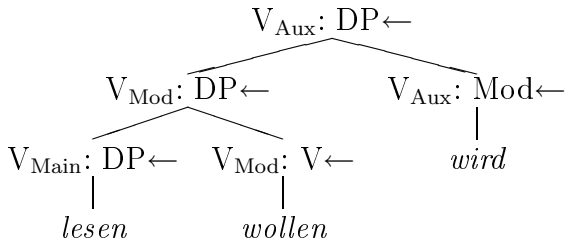
The lexical entries in (26) are to be understood as follows. First, the perfect tense auxiliary is associated with two subcategorization frames which stand in an elsewhere relationship. That is, when the perfect auxiliary selects a verb cluster headed by a modal verb, selection is to the right. In all other cases, selection is to the left. Second, the future tense auxiliary is also associated with two subcategorization frames which, however, stand in a disjunctive relation. This is meant to capture the fact that (i) the future auxiliary selects verb clusters headed by modal verbs to the right, (ii) it selects verbs in general to the left, and (iii) options (i) and (ii) do not exclude each other, that is, as an instantiation of the general case modal verbs can also appear to the left of the future tense auxiliary. The tree diagrams

in (27) show the resulting verb order possibilities for 3-verb clusters in the perfect tense (cf. (27a)) and in the future tense (cf. (27a) and (27b)).

(27) a.



b.



The possibility of enriching subcategorization frames with requirements concerning the complexity of an auxiliary's complement allows us to define three different systems of 3-verb clusters, as shown in (28). Note that order, type, and level specifications are kept the same in (28) and only the complexity requirement varies.

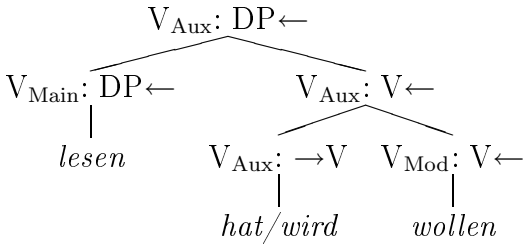
(28)

V-orders	System 1: → $\text{Mod}_{[VV]}$	System 2: → $\text{Mod}_{[V]}$	System 3: →Mod
AUX V MOD	√	–	√
V AUX MOD	–	√	√

Selection of a complex modal to the right results in the Standard German system that requires the perfect tense auxiliary at the beginning of the verb cluster (System 1). Selection of a non-complex modal to the right results in a system which only allows the partially fronted order V_3-Aux_1-Mod_2 in 3-verb clusters (System 2). This is the system of 3-verb clusters described by Louden (1990) for Pennsylvania German. A system of this kind may also have occurred in former stages of German. At least, the order V_3-Aux_1-Mod_2 has

been strongly preferred then (see Askedal, 1998), and it is still favored in some German dialects as, e.g., Bavarian (see Weiß, 1998). The diagram in (29) shows the tree for a verb cluster V_3-Aux_1-Mod_2 with partial fronting of the auxiliary as it is derived in System 2. Here, the auxiliary first combines with the modal verb; the resulting complex inherits the subcategorization property of the modal verb which allows it to combine with the main verb.

(29)



If we finally drop the complexity feature completely, a system results which is a combination of System 1 and System 2. This system—System 3 in (28)—allows the generation of both the completely fronted Standard German order Aux_1-V_3-Mod_2 and the partially fronted order V_3-Aux_1-Mod_2. We hypothesize that System 3 is the grammatical system underlying Colloquial German as observed in our experiments. As demonstrated by Figure 1, two orders are accepted as grammatical in colloquial German when we abstract away from more fine-grained details: the two orders Aux_1-V_3-Mod_2 and V_3-Aux_1-Mod_2. Since these are exactly the two orders generated by System 3, an important preliminary result of our analysis is that the orders accepted by speakers of Colloquial German form a natural class within the CAT language of Williams (2003): These are the orders in which the auxiliary precedes the modal, without an additional feature specifying the complexity level of the auxiliary's sister. Given that such a feature is highly idiosyncratic to begin with, another way to state this is to say that Colloquial German differs from Standard German in having dropped an artificial feature from its system of lexical specifications.

We thus end up with the subcategorization frames in (30) for the perfective auxiliary

haben and the future auxiliary *werden*. These frames complement the lexical entries in (22) which are shared by Standard and Colloquial German. Note that (30) only shows the subcategorization part of each entry because the category label is always the same, namely V_{Aux}.

(30) Subcategorization frames peculiar to auxiliaries when applied to modal verbs

	Perfect auxiliary	Future auxiliary
Standard German	$\rightarrow V_{[Mod-VV]}$	$\rightarrow V_{[Mod-VV]}$ or $V\leftarrow$
Colloquial German	$\rightarrow V_{Mod}$	V_{Mod}

Besides the lexical entries listed above, we postulate the morphological rule (31) in order to account for the IPP effect.

(31) Rule of Morphological Realization

Modal verbs appear as bare infinitives if selected by tense auxiliaries.

Note that this rule states a general property of modal verbs without reference to either cluster complexity or order between modal verb and auxiliary. One reason for stating the rule in this way comes from those German dialects (including parts of Bavaria and Austria) in which the verbs of a verb cluster preferentially occur in nested order, and which nevertheless exhibit the IPP effect. An example from Upper Austrian is shown in (32) (Martina Wiltschko, p.c.).

(32) wei a kumma miassn hot.

because he come must has

'because he had to come.'

The only case where a modal verb appears as a participle is the use of modal verbs with non-verbal complements, as shown in (33) (see also the examples in (14)).

(33) dass Peter ein Buch (GEWOLLT **hat** | **hat** WOLLEN).

that P. a book wanted has has want

'that Peter wanted to have a book.'

In Standard German, the modal verb behaves like a normal main verb in this usage: It occurs as a past participle and it precedes the finite auxiliary. However, both dialects and Colloquial German allow the reversed order in two verb clusters consisting of a modal and an auxiliary. In this case, the IPP effect shows up again. We have argued in Bader & Schmid (submitted) (see general discussion section for further information) that modal verbs can be inserted into the derivation either as modal verbs proper (Aux_1-Mod_2 with IPP) or as recategorized main verbs (V_2-Aux_1 without IPP). Under this assumption, the rule for the IPP effect can be stated in the most simple way by directly tying it to the category modal verb.

The subcategorization frames postulated in this section were developed on the basis of data from 3-verb clusters, but their applicability is not confined to 3-verb clusters. In particular, they also determine word order in 4-verb clusters without the need for additional assumptions. Experiment 4 investigates whether the orders predicted to be grammatical according to our analysis are actually accepted by native speakers of German.

8 Experiment 4: Verb Order in 4-Verb Cluster

The analysis that we have presented in the preceding section makes a straightforward prediction for 4-verb clusters in which a modal verb in the perfect tense does not select a single verb, as in the 3-verb clusters considered so far, but a verb cluster consisting of two verbs. Consider first sentence (34) which contains a verb cluster in which a finite form of the modal verb *müssen* ('must') selects an additional verb cluster consisting of the passive

auxiliary *werden* ('be') plus a past participle.

(34) dass das Auto *repariert* ← werden ← MUSS.

that the car repaired be must

'that the car must be repaired.'

All verbs in (34) select their complements to the left. For the verb cluster in (34), the only licit linearization is thus the one shown in (34). Consider next what happens when we extend the 3-verb cluster in (34) to a 4-verb cluster by putting it into the perfect tense. As shown in (35), four different 4-verb clusters result when only the position of the auxiliary varies.

(35) a. **hat** → [*repariert* ← werden ← MÜSSEN]

b. *repariert* ← **hat** → [werden ← MÜSSEN]

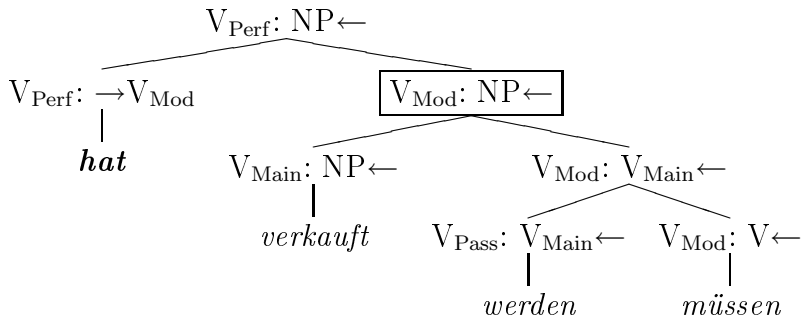
c. *repariert* ← werden ← **hat** → [MÜSSEN]

d. *repariert* ← werden ← MÜSSEN ← **hat**

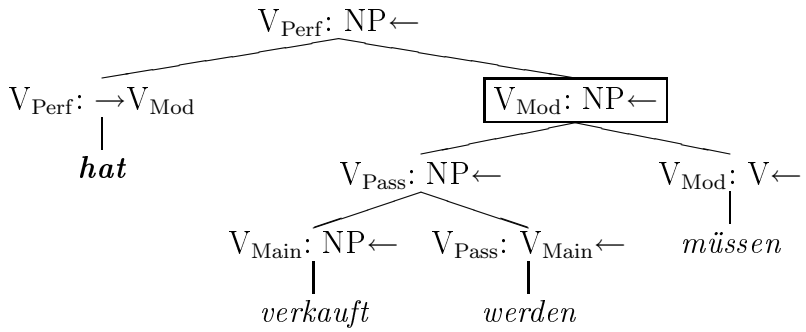
According to the CAT grammar of Colloquial German developed above, the only positional requirement for a perfective auxiliary selecting a modal verb is that it occurs to the left of the modal verb. This predicts that three of the four possible verb clusters shown in (35) should be accepted by speakers of colloquial German: (35a)-(35c) should all be grammatical but (35d) should not. We test this prediction in the current experiment.

The syntactic representations that are generated by CAT for those three 4-verb clusters which are predicted to be grammatical are shown in (36), (37) and (38). Note that when the perfective auxiliary is either in first position (cf. (36)) or in third position (cf. (38)), CAT allows two alternative derivations. Whether this is an disadvantage or not must be left open at this point.

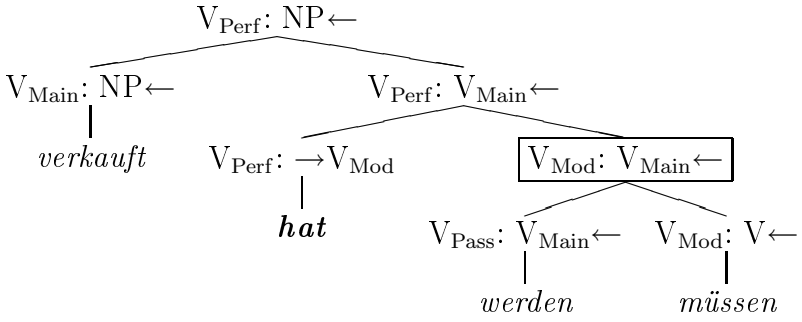
(36) a.


V_Perf: NP←
V_Perf: →V_Mod
V_Mod: NP←
hat
V_Main: NP←
V_Mod: V_Main←
verkauft
V_Pass: V_Main←
V_Mod: V←
werden
müssen

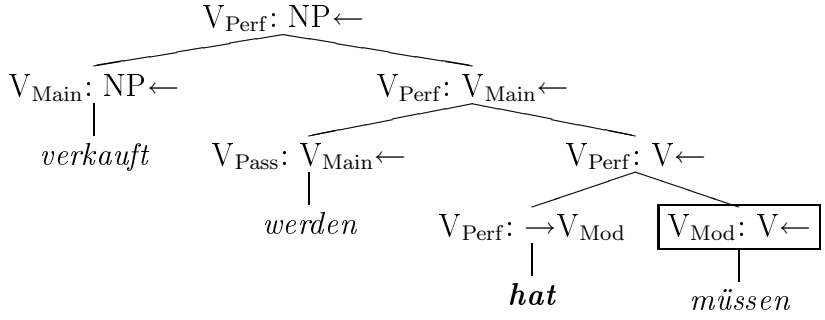
b.


V_Perf: NP←
V_Perf: →V_Mod
V_Mod: NP←
hat
V_Pass: NP←
V_Mod: V←
V_Main: NP←
V_Pass: V_Main←
müssen
verkauft
werden

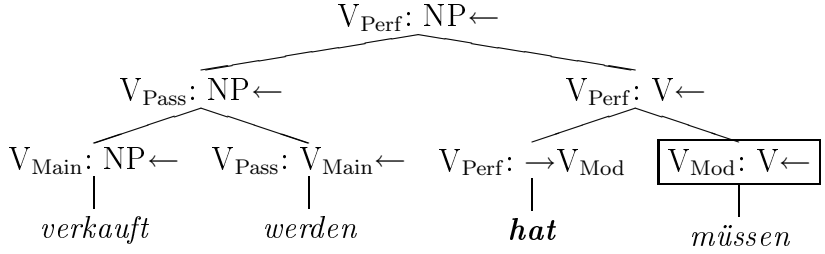
(37)


V_Perf: NP←
V_Main: NP←
V_Perf: V_Main←
verkauft
V_Perf: →V_Mod
V_Mod: V_Main←
hat
V_Pass: V_Main←
V_Mod: V←
werden
müssen

(38) a.


V_Perf: NP←
V_Main: NP←
V_Perf: V_Main←
verkauft
V_Pass: V_Main←
V_Perf: V←
werden
V_Perf: →V_Mod
V_Mod: V←
hat
müssen

b.


V_Perf: NP←
V_Pass: NP←
V_Perf: V←
V_Main: NP←
V_Pass: V_Main←
V_Perf: →V_Mod
V_Mod: V←
verkauft
werden
hat
müssen

The syntactic trees in (36)–(38) show that the complexity feature proposed in Williams (2003) (reproduced in (25)) is not sufficiently general. The complexity feature as defined thus far correctly differentiates between Standard German 2- and 3-verb clusters, but it makes wrong predictions for clusters of greater length. To see why, let us consider the trees in (36), (37) and (38) more closely.

In (36), the auxiliary *hat* is in first position and combines with a verb cluster *verkauft werden müssen*. When the auxiliary *hat* is in second position, as in (37), it still combines with a verb cluster, namely *werden müssen*. Only when the auxiliary is in third position, as in (38), does it combine with a non-cluster, that is, with the single verb *müssen*. These trees are therefore excluded by the complexity feature in its current form. The trees with the auxiliary in either first or second position are compatible with this feature because the auxiliary combines with a verb cluster. For Standard German, this is not the correct result. In Standard German, the finite auxiliary *hat* has only one licit position, namely the cluster-initial one.

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 add a maximality requirement to the non-stem feature of Williams (2003). As an inspection of the syntactic trees in (36)–(38) shows, formally this maximality feature requires that the auxiliary must combine with a verb cluster in which all subcategorization requirements for verbs have already been saturated. We therefore replace (25) with the complexity features in (39).

(39) Additional complexity feature for verb clusters

a. Verb cluster: [VV-max]

b. Simple verb: [V]

In (40) we give the final subcategorization frames for Standard German tense auxiliaries.

(40) 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 order to demonstrate how the feature [VV-max] correctly accounts for Standard German, consider again the trees in (36)–(38). The crucial part of the trees is the complement of the finite auxiliary *hat*; this part is shown within a box in each tree. When the auxiliary is in initial position, its complement does no longer contain a subcategorization feature for a verb, but only for an NP. This contrasts with clusters in which the auxiliary is in second or third position. In these cases, the complement of the auxiliary contains an unsaturated requirement for a verbal complement; it is thus not maximal in the sense of the feature [VV-max].

On first sight, the flexibility offered by CAT might be considered a disadvantage. However, verb clusters are well known for their flexibility, as becomes particularly evident when topicalization data are considered. The flexibility offered by CAT seems rather promising in this regard. A subpart of the verb cluster can be topicalized if it forms a 'maximal' complement. The notion of 'maximal' is the same as for the complexity feature [VV-max] that was discussed above. A complement is maximal if all subcategorization features for verbs have been saturated. With this restriction, all possible topicalization patterns of a 4-verb cluster can be derived and the ungrammatical options be excluded. For

example, in a 4-verb cluster *hat verkauft werden müssen* as in (36a) *verkauft*, and *verkauft werden müssen* are maximal—they do not subcategorize a verb but an NP. The partial cluster *werden müssen* is not, however, because it still subcategorizes a main verb. In (36b), even three complements are maximal, namely *verkauft werden* in addition to *verkauft*, and *verkauft werden müssen*. The remaining tree structures in (37) and (38) do not add any additional maximal complements. Consequently, only these three complements may be topicalized as shown in (41).

(41) a. [Verkauft] hatte das Auto werden müssen.
Sold had the car been must
'The car had to be sold.'

b. [Verkauft werden] hatte das Auto müssen.
Sold been had the car must

c. [Verkauft werden müssen] hatte das Auto.
Sold been must had the car

Altogether, a verb cluster with four elements allows 4! = 24 different permutations. While it was not feasible to include all of them within the current experiment, four additional permutations were included. These are all based on 3-verb clusters of the form shown in (42).

(42) dass das Auto MUSS → [*repariert* ← werden].
that the car must repaired be
'that the car must be repaired.'

The verb cluster in (42) differs from the one in (34) with respect to the position of the modal verb, that is, the highest verb in terms of complement selection: The modal verb is cluster-initial in (42) whereas it was cluster-final in (34). Inverting a modal verb as in (42)

is considered ungrammatical in Standard German although inversions of finite modal verbs are sometimes found in actual language use (cf. Zifonun et al., 1997, p.1286f.). However, when the modal verb is put into the perfect tense and the 3-verb cluster thus expanded to a 4-verb cluster, inverting the modal verb together with the perfective auxiliary is considered grammatical (see Bech, 1955: 63). In this case, the auxiliary has to precede the modal verb. The resulting pattern is shown in (43). Of the four possible positions where an auxiliary can be inserted into a cluster like (42), only the one in (43a) is considered grammatical.

(43) a. **hat** → MÜSSEN → [*repariert* ← werden]

b. * MÜSSEN → ← **hat** [*repariert* ← werden]

c. * MÜSSEN → [*repariert* ← **hat** ← werden]

d. *MÜSSEN → [*repariert* ← werden] ← **hat**

Experiment 4 encompasses eight different conditions, corresponding to the four sentences in (35) and the four sentences in (43). Besides testing the predictions stemming from our CAT-based analysis of German verb clusters, Experiment 4 will thus also test whether inverting the modal verb together with the perfect auxiliary is a grammatical option in Colloquial German.

8.1 Method

Participants 32 students of the University of Konstanz participated in Experiment 4.

Materials 32 sentences were created for Experiment 4. Each sentence appeared in eight versions according to the two factors *Position of Perfective Auxiliary* (First vs. Second vs. Third vs. Fourth) and *Order among Remaining Verbs* (V_3-$Aux_{\text{Pass:2}}$-Mod_1 vs. Mod_1-V_3-$Aux_{\text{Pass:2}}$).

Table 9: A Sample Sentence Set for Experiment 4.

Ich glaube, dass die Schubkarre schon letzte Woche ...			
I think that the wheelbarrow already last week			
	V < Mod	Aux=1	... **hätte** *repariert* werden MÜSSEN
			had repaired be must
		Aux=2	... *repariert* **hätte** werden MÜSSEN
		Aux=3	... *repariert* werden **hätte** MÜSSEN
		Aux=4	... *repariert* werden MÜSSEN **hätte**
	Mod < V	Aux=1	... **hätte** MÜSSEN *repariert* werden
		Aux=2	... MÜSSEN **hätte** *repariert* werden
		Aux=3	... MÜSSEN *repariert* **hätte** werden
		Aux=4	... MÜSSEN *repariert* werden **hätte**
Translation for all conditions:			
'I think that the wheelbarrow had to be repaired already last week.'			

The general structure of all sentences was the same as in the preceding experiments. A main clause was always followed by an embedded verb-final clause containing a 4-verb cluster of the sort described above. All embedded clauses consisted of the complementizer *dass* ('that'), a subject NP, an adverbial, and the clause-final verb cluster. Half of the sentences contained animate subjects; the other half contained inanimate subjects. Because inanimate subjects are not compatible with the modal verb *wollen* ('to want'), only the following four modal verbs were used: *müssen* ('must/to have to'), *können* ('can'), *dürfen* ('may/to be allowed'), *sollen* ('should'). Each modal verb occurred in eight different sentences.

Eight experimental lists were created. Each list contained only one version of each

sentence and a balanced number of items in each of the eight conditions of this experiment. The experimental lists were presented interspersed with 130 filler sentences, again representing a wide variation of syntactic structures.

8.2 Results

Table 10: Results for Experiment 4.

%		Aux_{Perf}=1	Aux_{Perf}=2	Aux_{Perf}=3	Aux_{Perf}=4
grammatical	V Aux_{Pass} Mod	94 (2.2)	88 (3.0)	80 (4.8)	14 (4.3)
	Mod V Aux_{Pass}	35 (5.2)	8 (3.4)	5 (2.2)	2 (1.1)
RT		Aux_{Perf}=1	Aux_{Perf}=2	Aux_{Perf}=3	Aux_{Perf}=4
grammatical	V Aux_{Pass} Mod	538 (38)	587 (36)	696 (54)	773 (50)
	Mod V Aux_{Pass}	696 (60)	640 (76)	644 (26)	1191 (65)
RT		Aux_{Perf}=1	Aux_{Perf}=2	Aux_{Perf}=3	Aux_{Perf}=4
ungrammatical	V Aux_{Pass} Mod	656 (64)	990 (83)	858 (64)	698 (45)
	Mod V Aux_{Pass}	785 (54)	565 (41)	571 (41)	523 (32)

As before, we first computed three-way ANOVAS with the four different modal verbs forming a separate factor in addition to the two factors Position of the Auxiliary and Position of the Modal Verb. These three-way ANOVAS revealed a significant interaction between Modal Verb and Position of the Modal Verb ($F1(3,93) = 4.39$, $p < 0.01$; $F2(3,28) = 2.23$, $p = .107$). The main effect of Modal Verb as well as the remaining interactions involving Modal Verb were not significant.The significant interaction between Modal Verb and Position of the Modal Verb was caused by the fact that when the modal was in final position, percentages of judgments 'grammatical' increased from 63% for *dürfen* ('may')

to 75% for *sollen* ('shall'). When the modal verb preceded its complement, in contrast, percentages decreased from 14% for *dürfen* ('may') to 8.6% for *sollen* ('shall'). Since the observed differences are rather small in absolute terms, it seems reasonable to assume that they were not caused by inherent differences between the different verbs but by plausibilty differences between the individual sentences. In the following, we will therefore only present results collapsed across the factor Modal Verb. However, everything which is significant in the collapsed two-way analyses is also significant in the complete three-way analysis.

Table 10 shows the results for Experiment 4 broken down by the remaining two factors. Two-way ANOVAS (4 Aux-Positions × 2 Modal-Positions) revealed that both main effects were significant: Sentences without inversion of the modal verb were judged much better than sentences with modal verb inversion, resulting in a main effect of Modal Position: $F1(1,31)=472.66$, $p < .001$; $F2(1,31)=502.68$, $p < .001$; the main effect of Aux-Position was also significant($F1(3,93)=113.68$, $p < .001$; $F2(3,93)=112.10$, $p < .001$), reflecting the fact that later positions of the auxiliary were associated with lower percentages of judgment 'grammatical'. Importantly, the interaction between the two factors was highly significant too ($F1(3,93)=40.82$, $p < .001$; $F2(3,93)=53.40$, $p < .001$). When the modal verb followed the passive auxiliary and the main verb, judgments for auxiliary positions 1–3 were quite high whereas judgments for position 4 were on a very low level. When the modal verb preceded the passive auxiliary and the main verb, in contrast, judgments for auxiliary 1 position were already reduced, but judgments for all other positions were nearly zero.

8.3 Discussion

The results of Experiment 4 provide a striking confirmation for the analysis presented in this paper. For sentences in which the modal verb followed the passivized main verb (order V_3-$Aux_{\text{Pass:2}}$-Mod_1), we found that sentences were accepted to rather high degrees as long as the perfective auxiliary preceded the modal verb. When the auxiliary was in cluster-final position, however, and thus followed the modal verb, sentences were rejected most of the time. This distribution of grammaticality judgments is at odds with prescriptive grammar but it strongly confirms our CAT-based analysis of Colloquial German. According to this analysis, the subcategorization properties of a perfective auxiliary selecting a modal verb has only a positional requirement: The auxiliary must precede its modal complement. Complexity requirements (cluster versus non-cluster), in contrast, do not play any role. This automatically predicts the availability of three grammatically licit positions for a perfective auxiliary in 4-verb clusters of the sort investigated here, and all of them were indeed judged as grammatical to a high degree.

For sentences in which the modal verb preceded the passivized main verb (order Mod_1-V_3-$Aux_{\text{Pass:2}}$), the following picture emerged. When the perfective auxiliary followed the modal verb (Aux_{Perf} in position 2, 3 or 4), sentences were rejected completely. This underscores the observation that in complex verb clusters containing a modal verb in the perfect tense, the perfective auxiliary is constrained to precede the modal verb. However, even when the perfective auxiliary preceded the modal verb (Aux_{Perf} in position 1), judgments were clearly degraded, although with 35% they were still substantially higher than when the auxiliary followed the modal verb (judgments between 2% and 8%). With respect to the claim that modal verbs can invert together with the auxiliary in complex clusters of the sort considered here, the results of Experiment 4 thus provide mixed evidence. On the

one hand, clusters with inverted modal verbs in which the auxiliary preceded the modal verb were rated much better than all other clusters with an inverted modal verb. On the other hand, the absolute acceptance level was still rather low. Inverting a modal verb thus does not lead to outright rejection of sentences althouth it is clearly a dispreferred option. Note that a similar conclusion emerged from Experiment 1a for sentences with completely inverted Aux_1-Mod_2-V_3 clusters, as in the additional example in (44).

(44) dass Peter das Buch am Dienstag **hat** MÜSSEN → *lesen*

that P. the book on Tuesday has must read

' that Peter had to read the book on Tuesday.'

As was shown in Table 2, sentences of this sort received 25% judgments 'grammatical', which is rather low but still substantially higher than what was obtained for sentences with inverted modal verb and the auxiliary following the modal verb (orders Mod_2-Aux_1-V_3 and Mod_2-V_3-Aux_1). We must leave it as a question for future research whether fronting of modal verbs would be accepted under different conditions, for example when the cluster selected by the modal verb contains more than two elements, as in the following example:

(45) dass das Buch vor Dienstag **hätte**$_1$ MÜSSEN$_2$ *gelesen*$_5$ worden$_4$ sein$_3$.

that the book before Tuesday had must read been be

'that the book should have been read before Tuesday.'

A further type of example to consider in this connection is shown in (46).

(46) ob Peter das Buch **wird**$_1$ **haben**$_2$ *lesen*$_4$ KÖNNEN$_3$

whether P. the book will have read can

'whether Peter will have been able to read the book.'

In this example, the modal verb appears in the future perfect tense and is therefore

embedded below two auxiliaries: The future tense auxiliary selects a perfect tense auxiliary which in turn selects the modal verb. For sentences of this type, the inversion of both auxiliaries is required by prescriptive grammar. Determining which of the cluster orders that are possible for such sentences are spontanously accepted by native speakers is a further task for future research.

In summary, Experiment 4 has confirmed the predictions made by our analysis for 4-verb clusters in which a modal verb in the perfect tense selects a 2-verb cluster consisting of past participle and passive auxiliary. As predicted, when the non-finite verbs showed up in the underlying order V_3-$Aux_{\text{Pass:2}}$-Mod_1, all three positions in which the finite perfective auxiliary preceded the modal verb were accepted as grammatical. Furthermore, the one order in which the perfect auxiliary followed the modal verb was rejected as ungrammatical. This strengthens the conclusion that in Colloquial German, the only requirement for a perfective auxiliary selecting a modal verb is that it must precede the modal verb. This requirement was also visible for clusters in which the non-finite verbs appeared in the order Mod_1-V_3-$Aux_{\text{Pass:2}}$, that is, in which the modal verb was inverted too.

9 General Discussion

This paper has presented four experiments that have obtained grammaticality judgments in an experimentally controlled way for 3-verb and 4-verb modal verb clusters in German. The main empirical findings of our experiments are as follows:

- For 3-verb clusters, the Standard German order Aux_1-V_3-Mod_2 was always accepted best. However, the order V_3-Aux_1-Mod_2—an ungrammatical order according to the grammar of Standard German—was also accepted to a high degree, independently of the regional background of the participants.

- The IPP requirement was clearly respected by our participants. 3-verb clusters in the perfect tense were only accepted if the morphological form of the modal verb was an infinitive (instead of a past participle as would be normally expected for the perfect tense).

- The position of a focus particle—directly preceding the subject, the object, or the verb cluster—had no effect on participants' judgments.

- For 4-verb clusters consisting of a modal verb in the perfect tense selecting a main verb in the passive voice (past participle plus passive auxiliary), all three orders were accepted in which the perfective auxiliary preceded the modal verb and the modal verb followed the passivized main verb.

We have accounted for these findings by extending the verb-cluster analysis proposed in Williams (2003). The major claims of our analysis can be summarized as follows. First, verb clusters are base-generated. Second, a major difference between Colloquial German and Standard German is that the complexity requirement on auxiliary inversion which is found in Standard German for complex tense forms of modal verb clusters has been dropped in Colloquial German. We have explored the consequences of this difference only for 3- and 4-verb clusters, but clusters of other sizes are of course affected too. For 5-verb clusters, Bader et al. (accepted) could show that native speakers accept the finite auxiliary in all positions preceding the modal verb but reject the auxiliary in cluster-final position.

Furthermore, our analysis makes a strong prediction with regard to the relationship between 2-verb and 3-verb clusters. As was already pointed out above, German modal verbs can be used without an embedded infinitival verb under certain circumstances. A further example of this use of modal verbs is provided in (47) (cf. (14) for additional examples).

(47) dass Peter in die Stadt GEMUSST **hat**.

that P. to the town must-PARTICIPLE has

'that Peter had to go to town.'

According to the grammar of Standard German, modal verbs behave like main verbs when used without a verbal complement: They have to precede the auxiliary in the perfect tense and they occur with past-participle morphology. However, experimental evidence provided by Bader & Schmid (submitted) shows that many speakers also accept the reverse order in (48a).

(48) a. dass Peter nach Paris **hat** MÜSSEN.

that P. to Paris has must

'that Peter had to go to Paris.'

b. dass Peter nach Paris *fahren* **hat** MÜSSEN.

that P. to Paris drive has must

'that Peter had to drive to Paris.'

What is even more striking is the finding of a strong correlation between judgments on non-standard Aux_1-Mod_2 clusters as in (48a) and judgments on corresponding non-standard V_3-Aux_1-Mod_2 clusters as in (48b): Either speakers accept both 2-verb clusters with auxiliary fronting (Aux_1-Mod_2) and 3-verb clusters with partial fronting of the auxiliary (V_3-Aux_1-Mod_2), or they reject both.

What the two sentences (48a) and (48b) have in common is the subpart *hat müssen*. In (48a), this subpart occurs on its own, in (48b) it occurs with an additional infinitival verb. In Standard German, a subsequence like *hat müssen* can never appear. The finding of a strong correlation between judgments on 2- and 3-verb clusters containing this subsequence provides further evidence for the analysis provided here, in particular for the claim

that Standard German and Colloquial German differ as to whether verb cluster formation is subject to a complexity requirement or not. In Standard German, auxiliaries selecting a modal verb can only appear to the left of a complex modal cluster and therefore (48a) and (48b) are both excluded. In Colloquial German, in contrast, an auxiliary can precede a modal verb independent of complexity, and therefore both sentences are grammatical. In Bader & Schmid (submitted) we propose an extension of the analysis presented here which integrates the empty light verb analysis proposed in van Riemsdijk (2002) in order to account for the use of modal verbs without verbal complements.

In the rest of this paper, we would like to address a couple of remaining questions raised by the findings presented above. A first obvious question concerns the nature of the data that we have presented in due course. While the particular task employed in our experiments required participants to give a binary grammaticality judgment on each sentence—quite similar to the normal linguistic practice of giving grammaticality judgments—the final results were nevertheless gradient due to averaging. While a thoroughgoing discussion of the issue of gradience and grammaticality is beyond the scope of the current paper, we can at least point out that the gradience visible in our results is not just an artifact of averaging across participants.[15]

Since every participant had to judge several instances of each experimental condition (5 in the first three experiments, 4 in the last experiment), it is possible to test whether gradience is also visible in individual participants' judgments. For purposes of illustration, consider the condition V_3-Aux_1-Mod_2 of Experiment 1a. Each of the 30 participants had

[15] In a study comparing the method of speeded-grammaticality judgments with the method of magnitude estimation which allows participants to judge sentences in a gradient way, Bader & Häussler (2008) included the sentence material of Experiment 1a and found exactly the same result patterns with both methods.

to judge 5 sentences in this condition. For each participant, there are thus 6 possible outcomes: 0%, 20%, 40%, 60%, 80%, or 100% judgments 'grammatical'. The mean over participants that was obtained in the condition V_3-Aux_1-Mod_2 of Experiment 1a was 61% (cf. Table 2). The distribution of the 30 participants' individual results are shown in (49) in the row labeled 'Observed'.

(49)

Nr of Participants	0%	20%	40%	60%	80%	100%
Observed	3	1	3	12	6	5
Theoretical	0.3	2.1	6.5	10.4	8.2	2.6

The observed distribution peaks at 60%, that is, approximately at the mean. It is thus clearly not a bimodal distribution consisting of one set of participants rejecting verb clusters of the form V_3-Aux_1-Mod_2 most of the time, and another set mostly accepting such clusters.[16] The row labeled 'Theoretical' in (49) shows the expected distribution of individual responses assuming a binomial distribution with the probability of judging a sentence as grammatical set to 0.61 (i.e., to the observed mean expressed as a proportion). The observed and the theoretical distribution look very similar (there are too few observations to corroborate this claim by a chi-square test). We therefore conclude that gradience in this case is a property of individual subjects and not an artifact of averaging across subjects. Specifying the mechanisms underlying this gradience is an important task which we must leave to future research.

[16] A bimodal distribution of this kind is not just a theoretical fiction. In an experimental investigation of *do*-support in German, Bader & Schmid (2006) found a bimodal distribution for judgments on sentences with *do*-support, suggesting that one group of speakers closely adhered to the grammar of Standard German which normally forbids *do*-support, while a second group of speakers was more liberal and accepted *do*-support.

Whereas our experimental results reflect the more liberal version of German which we labeled Colloquial German, evidence for the stricter Standard German variant can also be found. The table in (50) shows the results of a corpus study of 3-verb clusters in German and Austrian newspapers based on the newspaper corpus of the Institut für Deutsche Sprache ('Institute for the German Language', see footnote 9 on page 31). We present preliminary findings for perfect tense clusters with the modal verb *können* ('can'), which has the highest overall frequency in the given corpus.

(50)

	Aux-V-Mod	V-Aux-Mod	V-Mod-Aux
German	2030	11	0
Austrian	783	364	2

Table (50) shows a discrepancy between German and Austrian newspapers. In German newspapers, the completely fronted order Aux_1-V_3-Mod_2 occurs with a frequency of about 99.5%.[17] These newspapers adhere almost without exception to the normative rule and thus show that the verb-cluster syntax of Standard German governs certain aspects of actual language use, namley the production of formal written language. Interestingly, Austrian newspapers do not adhere to normative grammar. As in Colloquial German, two orders account for almost all instances: The Standard German order Aux_1-V_3-Mod_2 accounts for about 70% and the 'Bavarian-Austrian' order for the remaining 30%. We suspect that this difference is due to sociolinguistic factors like different normative pressure in Austria and Germany rather than to language-internal factors.

The next question to consider is how the analysis that we have presented compares to other analyses of verb cluster phenomena in German. For reasons of space, we have

[17] We also looked at Swiss newspapers which behaved like German newspapers in favoring order Aux_1-V_3-Mod_2 with about the same percentage.

to limit this comparison to a few selected alternatives. A predecessor of the analysis presented here is the analysis of Steedman (1983, 2000). Steedman's analysis is couched within the framework of *Combinatorial Categorial Grammar (CCG)* and—as an early incarnation of the base-generation approach to verb-cluster formation—pioneered functional composition for base-generating verb clusters. As this is a generalized version of categorial grammar, it subsumes the expressive power provided by William's (2003) Rule of Combination in (19).[18] Our own analysis is based on two mechanisms—functional application and functional composition—together with the proper means to leave certain pieces of subcategorization information underspecified. Every theory providing these formal means will be able to incorporate an analysis of the sort presented here. Deciding between the various approaches will only be possible if more data—including data going far beyond verb-cluster formation—are taken into account.

We consider next the verb-cluster analysis presented by Wurmbrand (2004a) because this analysis also makes use of some of the machinery developed in Williams (2003). As shown by Williams (2003), a grammar incorporating the Rule of Combination is strongly equivalent to a grammar with a strict underlying order among elements together with the two operations *Flip* and *Reassociate*. These two operations go back to the influential analysis of verb and verb-projection raising by Haegeman & van Riemsdijk (1986). Flip allows the inversion of sister nodes according to language specific rules. Reassociate allows a certain amount of re-bracketing within a syntactic tree. Taken together, Flip and Reassociate form a derivational analogue to the Rule of Combination. For a verb cluster containing three verbs, all 6 possible orders can be generated either way. In her analysis,

[18] Verb-cluster analyses within the GPSG/HPSG tradition have also been inspired by the mechanism of functional composition as found in categorial grammar; cf. Johnson (1986) for an early GPSG analysis; for HPSG, see Meurers (2000) and references there.

Wurmbrand (2004a) makes use of the operation Flip but not of the operation Reassociate which means that she can base-generate only four of the possible six word orders of a 3-verb cluster, independent of whether an underlying head-initial or head-final base-order is assumed. For the case of head-final base structures, this is shown in (51).

(51) a. [[V Mod] Aux] – base order

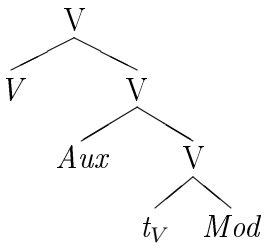
b. [Aux [V Mod]] – Flip applied to Aux and [V Mod]

c. [[Mod V] Aux] – Flip applied to V and Mod

d. [Aux [Mod V]] – Flip applied both to Aux and [V Mod] and to V and Mod

Order V_3-Mod_2-Aux_1 is the base structure. Order Aux_1-V_3-Mod_2 results when the highest node is flipped, order Mod_2-V_3-Aux_1 when the lowest node is flipped, and, finally, order Aux_1-Mod_2-V_3 when both nodes are flipped. The same four orders would result under the assumption of a head-initial base structure. The two orders V_3-Aux_1-Mod_2 and Mod_2-Aux_1-V_3 cannot be derived by Flip alone because this operation is confined to sister constituents. Instead of applying Williams' additional operation Reassociate, Wurmbrand assumes that these two orders are derived by syntactic movement. The tree in (52) shows how the order V_3-Aux_1-Mod_2, which was found to be accepted alongside the Standard German order in our experiments, is derived by a combination of Flip and leftward movement in Wurmbrand's system.

(52)



Wurmbrand makes the further assumption that movement and Flip belong to two different components of the grammar. Whereas movement operates in the syntactic component,

Flip is assumed to be a PF operation. Relegating Flip to the PF side of grammar is partly motivated by the fact that the linear order within the verb cluster has normally no semantic repercussions. Wurmbrand speculates that this is not true, however, for the two orders derived by additional syntactic movement. These two orders are claimed to have an impact on the focus potential of a sentence which is not found in the orders derived by Flip alone. Semantic effects of this kind have e.g. been reported for two German variants in Schmid & Vogel (2004). Our experimental results, however, show that such effects are not a necessary feature of this verb order: Order V_3-Aux_1-Mod_2 was judged as grammatical to such a high degree that it is not plausible to assume that it only occurs under specific focus conditions (the data provided by Sapp, 2006, allow the same conclusion).[19] Furthermore, the focus manipulation used in Experiment 3 had no effect on verb order. Deriving verb clusters by two fundamentally different operations—a syntactic operation and a PF operation—therefore does not seem justified by the currently available evidence.

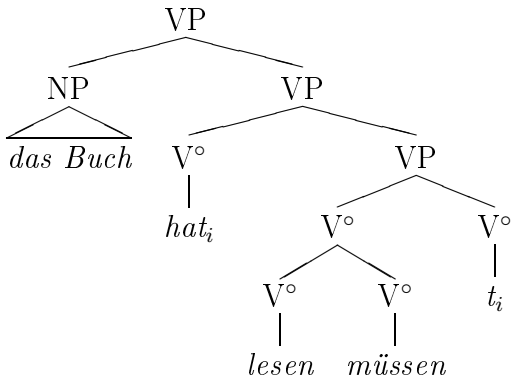
The final analysis that we would like to consider is the one presented in Haider (2003). Besides its theoretical contribution, Haider (2003) is of particular relevance in the current context because he discusses data quite similar to ours, for both 3- and 4-verb clusters. In contrast to his earlier work, Haider (2003) no longer assumes that verb-cluster formation is pure base generation. In order to account for all relevant order variations—including the Colloquial order V_3-Aux_1-Mod_2—he suggests instead that base generation and head

[19] Additional evidence against this assumption comes from the corpus data in the table in (50) on page 73. As is shown there, the rate of V_3-Aux_1-Mod_2 sentences within Austrian newspapers amounts to 31.7%. It seems unlikely to us that such high rates are caused by narrow focus on the main verb within the verb cluster. An informal survey of the relevant corpus sentences also did not lend evidence to the hypothesis that the order V_3-Aux_1-Mod_2 is associated with narrow verb focus.

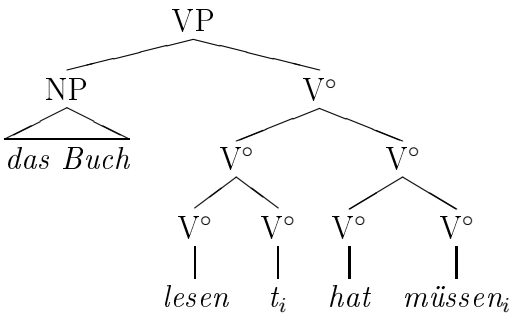
movement must be combined. Order variation is accounted for by taking the OV structure as base generated and applying different types of head movement operations, subject to language and/or item specific variation. First, head movement can be local adjunction to an adjacent verbal head inside the verbal cluster. This so-called *verbal cliticization* occurs either as pre-cliticization or as post-cliticization (postulated for IPP cases). The second type of head movement is head movement to the left, either in the form of left adjunction to the root node of the cluster or as a VP-shell forming operation. Left-adjunction to the root node is a cluster-internal operation which derives verbal clusters consisting strictly of heads, that is, without the possibility of non-verbal material within the cluster (verb-projection raising). Clusters of this type are assumed for Dutch. The creation of VP-shells is postulated for German because German—in contrast to Dutch—allows verb-projection raising in which non-verbal material occurs inside the verbal sequence.

The VP-shell structure and the cliticization structure are not derived from each other but form independent structural options in German. Syntactic trees illustrating these two options are provided in (53) and (54). The tree in (53) illustrates the derivation of a Aux_1-V_3-Mod_2-cluster by means of VP-shell forming left-adjunction. The tree in (54) shows how a cluster of the form V_3-Aux_1-Mod_2 is derived by post-cliticization of the modal verb *müssen* to the finite auxiliary *hat*.

(53)



(54)



In comparison to our analysis, the analysis presented by Haider (2003) is more complex insofar as it postulates two independent mechanisms for deriving the different auxiliary positions that are allowed for 3- and 4-verb clusters. It is not so clear why a grammar should provide both mechanisms and thus why there is exactly the kind of variation that is empirically attested. Furthermore, Haider argues in favor of his account also in terms of parsing considerations. However, the structures postulated here fare even better in this regard because all verb clusters that are accepted can be assigned strictly right-branching trees which are uniformly base-generated. Of course, Haider (2003) accounts for a range of further data that we have not discussed here.

For reasons of space, we consider only one additional set of data which is provided by sentences exhibiting *verb-projection raising* (a different phenomenon, namely particle climbing in Dutch, is discussed in Bader et al., accepted). Verb projection raising is a technical term introduced by Haegeman & van Riemsdijk (1986) for cases where non-verbal material appears inside a verbal cluster. In the following, we briefly discuss this phenomenon and show how it can be integrated into a CAT-based approach. Since verb projection raising is already analysed by Williams (2003) in his application of CAT to the syntax of verb-cluster formation, the difficult part is not so much the technical side of the analysis but rather the status of the data.

Verb projection raising is a well-known property of certain West Germanic variants like Swiss German and West Flemish (see Haegeman & van Riemsdijk, 1986). In a larger clus-

ter, several positions for non-verbal elements are possible as illustrated in (55) for a Swiss German 4-verb cluster consisting of a lexical verb with an NP-complement, two modal verbs and a perfect tense auxiliary (following Haegeman & van Riemsdijk, 1986:428):

(55) das er [[[[en arie singe] chöne] wele] hät]

$NP < V_4 < Mod_3 < Mod_2 < Aux_1$

a. Aux_1 **NP** Mod_2 Mod_3 V_4

b. Aux_1 Mod_2 **NP** Mod_3 V_4

c. Aux_1 Mod_2 Mod_3 **NP** V_4

d. *Aux_1 Mod_2 Mod_3 V_4 **NP**

In a 4-verb cluster like (55) the order of the verbs is fixed: the selecting verb always has to precede its selected verb (or VP) whereas the direct object NP can appear anywhere inside the cluster as long as it precedes the lexical verb, that is, the verb by which it is selected. Thus, despite all flexibility, the OV nature of Swiss German is strictly obeyed.

Williams (2003:224ff) presents a CAT-based account of the verb projection raising data of Haegeman and van Riemsdijk (1986). He argues that a non-application of level restrictions has the desired result of covering both verb raising and verb projection raising. He accounts for the data in (55) by postulating that modal verbs and auxiliaries in Swiss German have lexical entries as in (56). An example entry for a lexical verb is shown in (57); this entry would be the same in Standard or Colloquial German.

(56) a. V_{Aux}: $\rightarrow$V

b. V_{Mod}: $\rightarrow$V

(57) V: NP$\leftarrow$

Williams (2003:226) explicitly assumes that the notation 'V' without further level restrictions is to be understood as either V° or VP, i.e., the term covers both verb raising (a

verb cluster consisting of verbal heads alone) and verb projection raising (a verb cluster consisting of verbal heads and non-verbal material). The lexical specification in (56) can thus be read as follows: auxiliaries and modal verbs select a V° or a VP to the right. The fact that the NP argument of the lexical verb is free to appear in any position inside the cluster as long as it precedes its selecting verb (see (55)), is accounted for by the simple statement that a verb selects its NP complement to the left—without further specification. This restriction is obeyed by all grammatical patterns in (55) but violated by the ungrammatical one.

The empirical situation concerning verb projection raising in German is much less clear. The prescriptive German grammar, Duden 4 (1998), mentions that elements which 'closely' belong to a verb of the verbal complex may appear inside the complex. The notion 'closely' remains vague, however. In the linguistic literature, verb projection raising in Standard German is considered ungrammatical by some authors (e.g., Haegeman & van Riemsdijk, 1986) but grammatical by others (e.g., Kefer & Lejeune, 1974; Meurers, 2000). In an ongoing series of experiments Bader et al. (2004) found that sentences like (58a) were accepted as grammatical by native speakers of German 80% of the time. In this case, a directional PP was inserted between auxiliary and lexical verb inside the verb cluster. As in Swiss German, non-verbal material inside the verb cluster is restricted to a position preceding the verb it modifies as shown by the ungrammaticality of (58b).

(58) a. Es ist schön, dass Max neulich hat **zu dem Nationalpark** fliegen dürfen.
It is nice that Max lately has to the national-park fly may
'It is nice that Max has been allowed to fly to the national park lately'

b. *Es ist schön, dass Max neulich hat fliegen **zu dem Nationalpark** dürfen.

Thus, we may safely conclude that verb projection raising is acceptable, at least in Colloquial German. In sequences of more than three verbs, non-verbal material may appear in several positions inside the verb cluster, similar to Swiss German. This is shown for a 4-verb cluster (future perfect subjunctive) in (59).[20]

(59) a. ..., dass sie ihn nicht **um Geld** würde haben fragen müssen
that she him not for money would have ask must
'that she would not have had to ask him for money'

b. ..., dass sie ihn nicht würde **um Geld** haben fragen müssen

c. ..., dass sie ihn nicht würde haben **um Geld** fragen müssen

d. *..., dass sie ihn nicht würde haben fragen **um Geld** müssen

e. *..., dass sie ihn nicht würde haben fragen müssen **um Geld**

If we follow Williams' analysis of VPR and assume that the notation V_{Mod} without level restriction stands either for $V°_{Mod}$ or for VP_{Mod} we account for cases of VPR in Colloquial German without any additional devices. We repeat the relevant lexical specifications of Colloquial German in (60), only replacing the NP argument of the lexical verb by a PP argument.

(60) a. V_{Aux}: $\rightarrow V_{Mod}$

b. V: PP$\leftarrow$

These two specifications together with the assumption of a non-specified level restriction on V_{Mod} result in the pattern of grammaticality shown in (59). In (59a) and (59b), the auxiliary *haben* ('have') selects a $V°_{Mod}$ to the right whereas it selects a VP_{Mod} in (59c).

[20]These data are due to an anonymous reviewer. In the future perfect, the future tense auxiliary (*würde* 'would' in our example) obligatorily selects its verbal complement to the right. We will not go into details of an analysis here but concentrate on the position of the PP *um Geld*, 'for money' instead.

In these grammatical sentences the PP argument is always selected to the left whereas it would be selected to the right in the ungrammatical versions (59d) and (59e) - cases which could not be generated given the assumption in (60b).

The final point we would like to consider concerns the great deal of variation found among the West-Germanic languages in the area of verb-cluster formation. In his review of theories of verb cluster phenomena, Bobalijik (2004) points out that the conclusion is inevitable that the variation found in this domain contains a high amount of arbitrariness. Nevertheless, he goes on, 'if it is the case that the language variation is itself arbitrary, we may still ask the question of how (or how well) the various theoretical approaches succeed in encoding the arbitrariness' (Bobalijik, 2004, p. 135). How well does the CAT-based analysis presented here fare in this regard?

As already pointed out above, CAT allows the derivation of all 6 permutations that are possible for a 3-verb cluster. All 6 six permutations have been reported (see Schmid & Vogel, 2004). Despite initial appearance, the generative power provided by CAT thus seems to be empirically motivated. For a 4-verb cluster, 22 of the possible 24 permutations can be derived, but there are not enough data on 4-verb clusters to determine how many of the possible orders really occur. However, the various orders do not seem to appear with equal frequency, and a way to approach the question of how the variation found with verb clusters is encoded best is by asking what the 'natural' verb cluster systems are under a CAT perspective.

When we concentrate on the data provided in the present paper, the variation to be accounted for is the variation between Standard German (as defined in prescriptive grammars) and Colloquial German (as reflected by our experimental results). As far as this variation is concerned, we would claim that an account like the one presented here fares rather well. First, Standard German and Colloquial German differ only minimally, namely

with regard to a single constraint that is present in Standard German but absent in Colloquial German. According to this constraint, auxiliary inversion with complex tense forms of modal verbs is only allowed (future tense)/required (perfect tense) when the cluster is complex. In colloquial German, in contrast, inversion is always allowed/required. If we now make the plausible assumption that Colloquial German is more natural than Standard German—in the sense that it is much less the product of prescriptive reasoning—the variation to be accounted for can be stated as follows: Standard German imposes a complexity requirement which is of a rather dubious status. By simply dropping this complexity requirement, Colloquial German results. We can thus conclude that the difference between Standard and Colloquial German finds an adequate reflection in our CAT-based analysis because the analysis does not have to postulate anything else than the absence versus presence of the complexity requirement just discussed. Determining whether the analysis presented here can be insightfully extended to a wider array of verb cluster phenomena must be left as an important task for future research.

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