Gefördert vom
bmb+f
Bundesministerium für
Bildung, Wissenschaft,
Forschung und Technologie

Verbmobil
Verbundvorhaben

# An HPSG-Analysis for Free Relative Clauses in German

Stefan Müller

DFKI GmbH

Vm
**Report 224**
Juni 1998

Juni 1998

Stefan Müller
Deutsches Forschungszentrum für Künstliche Intelligenz GmbH
Stuhlsatzenhausweg 3
66123 Saarbrücken
Tel.: (0681) 302 - 5295
Fax: (0681) 302 - 5338
e-mail: Stefan.Mueller@dfki.de

**Gehört zum Antragsabschnitt:** 2.4

Die vorliegende Arbeit wurde im Rahmen des Verbundvorhabens Verbmobil vom Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie (BMBF) unter dem Förderkennzeichen 01 IV 701 V0 gefördert. Die Verantwortung für den Inhalt dieser Arbeit liegt beim Autor.
ISSN 0949-6084

# 1 Introduction

At the moment there is no theory for free relatives in German in the HPSG framework (Pollard and Sag, 1994). From GB literature[1] on the subject it is known that free relatives behave partly like noun phrases. They can fill argument positions of verbs. And although they are finite sentences, they are serialized like noun phrases in the German *Mittelfeld*. The function free relatives can take is not restricted to complements. Depending on the properties of the relative phrase, free relatives can be modifiers as well. I will argue that free relatives project to a category that is tightly related to the category of the relative phrase. The relation between the relative phrase and the projection of the free relative clause is established via a relational constraint. This accounts both for the syntactic regularities, and for the semantics of free relatives.

As Ingria (1990) has shown, assignment of different case in the relative and the matrix clause poses problems for grammars that rely on unification alone. In the following paper I will argue against his subsumption based account, and provide a different solution to the problem that relies on the above mentioned relational constraints for the projection of properties of the relative phrase.

In general there are three possibilities to describe the projections of free relatives: an empty head, a unary projection and a lexical rule. I will argue for the unary schema and discuss the alternatives.

# 2 The Phenomena

In German, relative clauses consist of a relative phrase which contains the relative pronoun and a finite sentence from which the relative phrase is extracted. Both *d*-elements and *w*-elements can function as relative words:

(1) a. der Mann, [*der*] Maria küßt
the man who Maria kisses
'the man who kisses Maria'

b. der Stuhl, [auf *dem*] Karl sitzt
the chair on which Karl sits

(2) a. Ich komme eben aus der Stadt, [*wo*] ich Zeuge eines Unglücks gewesen bin.[2]
'I have just come back from town where I was witness to an accident.'

b. War das, [*worum*] wir Narren uns mühten, schon immer vielleicht nur ein Phantom gewesen?[3]

[†]Thanks to Andreas Kathol and Frank Keller for comments on an earlier versions of this paper. Thanks to Joanne Capstick and Uta Waller who helped me translate sample sentences from newspapers.

This paper appeard in *Proceedings of Formal Grammar*, Aix-en-Provence, 1997.

[1]cf. (Bausewein, 1991)

[2](Duden, 1984, p. 672).

[3]in the same place, p. 39

‘Had that which had occupied us fools been no more than a phantom?’

c. Dort vielleicht war das, [*was*] ich begehrte, dort vielleicht würde meine Musik gespielt.[4]

‘Perhaps what I was longing for was there, perhaps my music would be played there.’

d. . . . , das ist nun wieder eine Frage, [über *welche*] müßige Leute nach Belieben brüten mögen.[5]

‘. . . , that is another question that idle people may ponder over at their leisure.’

Relative clauses can fulfill two functions. Firstly, they can modify nouns (1–2) and secondly, they can be an direct argument (3) or adjunct (4) of a verb.

(3) a. Wer schläft, sündigt nicht.
who sleeps sins not
’He who sleeps does not sin.‘

b. Sie hat, was sie geschenkt bekommen hat, sofort in
she has what she given got has instantly in
den Schrank gestellt.[6]
the cupboard put
‘She put what she was given into the cupboard instantly.’

c. Ihr könnt beginnen, mit wem ihr (beginnen) wollt.[7]
you can begin with who you begin want
‘You can begin with whoever you like.’

(4) Wo das Rauchen derartig stigmatisiert ist wie von Köppl geplant, kann man sich leicht als Rebell fühlen, bloß weil man raucht.[8]

‘Where smoking is stigmatized in such a way as is planed by Köppl, one easily can feel like a rebel simply because one smokes.’

Contrary to the claim of Koch (1996, p. 32) there may be more than one relative clause in complement function in one matrix clause.

(5) Wer mehr als nur Schnappschüsse machen will, sollte nicht einfach photographieren, was ihm vor die Linse kommt.

‘He who wants to take pictures that are better than snapshots should not simply photograph whatever happens to be in front of his lens.’

[4] in the same place, p. 40
[5] in the same place, Tractat vom Steppenwolf, p. 6
[6] (Bausewein, 1991, p. 152)
[7] (Bausewein, 1991, p. 155) The word in brackets was inserted by me.
[8] taz, 11.15.96, p. 10

If a relative clause functions as a complement, the relative phrase has to have a form that is compatible with the subcategorization requirements of the verb.[9]

(6) a. Die da stehen, kennen wir nicht.
those$_{nom \vee acc}$ there stand know we not
'We don't know those people who are standing there.'

b. * Wer da steht, kennen wir nicht.
who$_{nom}$ there stands know we not

c. Sie ißt, was übrig bleibt.
she eats what$_{nom \vee acc}$ left remain
'She eats what is left.'

So for instance, in (6a) *die* is selected as a complement of *stehen* and receives case from this verb. At the same time *kennen* selects an accusative complement. As the case form of *die* is $nom \vee acc$, (6a) is grammatical. (6b), however, is out since *wer* is not compatible with the accusative requirement of *kennen*.

There are exceptions to the compatibility requirement.

(7) a. Wem der Anblick von FußgängerInnen Angst einflößt, schaltet bei Nissan auf das Infrarot-Passantenerkennungssystem um, …[10]

'People who panic by the sight of pedestrians can switch on Nissan's infrared pedestrian detector.'

b. Wen solche Lehren nicht erfreun, verdienet nicht, ein Mensch zu sein.[11]

'He who is not gladdened by such teachings does not deserve to be human.'

In (7a), the relative pronoun in the relative clause is in the dative case and in (7b), it is in the accusative case. In all three sentences the free relative functions as subject, and should therefore have a relative phrase in the nominative case. Sentences like (7) are less acceptable than those in (3) and the grammatical sentences in (6), and will not be handled in this paper.

## 3 The Categorial Properties of Free Relatives

To analyze sentences like (8) there are three options.

(8) [$_{RS}$ Wer schläft], sündigt nicht.
who sleeps sins not
'Those who sleep do not sin.'

[9] The examples are taken from (Bausewein, 1991, p. 150).
[10] taz, 11.30.95, p. 20
[11] Mozart, Die Zauberflöte, Reclam, Leipzig, 1937, p. 56

One could either assume a lexical rule that applies to the verb *sündigt* (*sins*) to produce a new entry that subcategorizes for a relative clause instead of the nominative NP. The alternative would be to assume an empty head that selects a relative clause and projects the local properties of the relative phrase, or a unary schema which projects a phrase from a relative clause that depends on the relative phrase of the clause. Due to space limitations only the last option will be discussed in this paper.

As Oppenrieder (1991, p. 143) has shown, free relative clauses behave like sentences rather than noun phrases in respect to coordination.

(9) Wer erster wird und wer den letzten Platz belegt, bekommt /* bekommen einen Preis.[12]
'Both the winner and the looser get prizes.'

(10) Karl und Maria *bekommt / bekommen einen Preis.

Coordinated noun phrases introduce a plural index, whereas coordinated sentences are singular.

Free relative clauses behave like their relative phrase.

(11) [Wer$_i$ einen Langzeitüberblick über die geographische Verteilung von Totalverlusten erstellen will], muß sich$_i$ schon selbst durch kiloschwere Listen der »Underwriters« der Lloyd's-Versicherung graben, [13]

'Those wishing to get a longterm overview of total losses, have to wade through masses of underwriter's lists of Lloyd's insurance company themselves .'

In (11), there must be a phrase with an appropriate index in the local domain of the reflexive pronoun *sich*, if one follows assumptions of standard Binding Theory (Pollard and Sag, 1994, Chapter 6). From this observation it follows that the relative clause, or the relevant projection of it, has to have the semantic content of a nominal object, and that it must be in the same subcat list with the reflexive.

If one looks at the linearization properties of free relatives, one finds more evidence of them behaving like their relative phrase. In (12), the free relative clauses are linearized in the same way as noun phrases.

(12) a. Sie hat, [was sie geschenkt bekommen hat,] sofort in den Schrank gestellt.[14]

b. Schon heute muß, [wer harte Informationen oder lockere Unterhaltung haben will,] blechen, portionenweise, . . . [15]
'It is already the case that you have to cough up, bit by bit, both for hard facts and entertainment of a less serious nature.'

[12](Oppenrieder, 1991, p. 143)
[13]Wochenpost, 48/95, p. 50
[14](Bausewein, 1991, p. 152)
[15]c't, 10/96, p. 3

c. ?? Ich habe, [daß Peter das interessiert,] geglaubt.
I have that Peter that interests believed
'I believed that Peter was interested in that.'

In German there is a strong tendency to serialize sentences at the right periphery of the sentence, i.e. to extrapose them. Therefore (12c) is marked, whereas (12a-b) are not. In (12a-b), the relative clauses behave like noun phrases.

## 4 Case Assignment and Feature Projection

In (13), the relative phrase is an NP and the relative clause *was noch übrig war* functions as an NP complement in the matrix clause.

(13) Ich habe gegessen, [was noch übrig war].
I have eaten$_{acc}$ what$_{nom \vee acc}$ still left was$_{nom}$
'I ate what was left over.'

Ingria (1990) suggested that a subsumption test should be used for checking subcategorization requirements, since unification seems to lead to conflicting case values. In the free relative shown in (13), the verb in the matrix clause needs an accusative complement, and *war* needs a nominative NP. If the subcategorization requirements of both verbs were unified with the descriptions of their complements, and if the result of the unification of the complement of *war* and *was* were projected by the free relative, a unification failure would be the result. If on the other hand, the subcategorization requirements were checked without unification, the case value of *was* would not be changed, and would hence be compatible with both verbs.

The problem with this approach is that there are other constraints in the grammar that refer to case values.

(14) , weil sie [was angeliefert wurde] sofort
because she$_{nom \vee acc}$ what$_{nom \vee acc}$ delivered was immediately
in den Schrank gestellt hat.
in the cupboard put has
'because she put what was deliverd in the cupboard immediately'

If saturation does not instantiate case values, then the case values of the NPs in (14) will remain $nom \vee acc$. In this case it is impossible to use LP-constraints under the standard assumptions (see (Uszkoreit, 1987)) to determine the preferred reading of (14), i.e. the one where the nominative NP precedes the accusative one.

If one states an LP rule like (15), then either sentences like (14) are ruled out, or the rule is never applied to those sentences:[16] If one assumes that a description in an

[16]Of course nobody would use LP rules like (15) in an actual German grammar. Instead one would use a disjunction of LP statements. See (Uszkoreit, 1987) for the details. But the argument still stands; if one uses a disjunction instead of the strict rule above, one gets a degree of markedness of a sentence: the more LP statements are violated, the worse the sentence. In a disjunctive LP rule the statement corresponding to (15) would be violated and the sentence would be regarded as marked, which it is not.

LP rule has to unify with the linearized element, then the rule would exclude (14). If one assumes that an LP rule applies if the descriptions in the LP rule subsume the constituents to be checked, then the LP rule would not be applied to examples like (14).

(15) NP[*nom*] $<$ NP[*acc*]

Even the order-based approach to LP rules suggested by Kasper, Kathol, and Pollard (1995), that is able to instantiate underspecified features relevant to linearization, would lead to strange results with the above LP rule.

(16) , weil sie$_{nom}$ [was$_{acc}$ angeliefert wurde]$_{acc}$ sofort in den Schrank gestellt hat.

As the case value of *was angeliefert wurde* and *was* would be structure shared in Ingria's approach, both would be *acc*. *acc* however, is incompatible with the requirement of *angeliefert wurde*, which is *nom*. This means, for (16) to be accepted by the grammar, one would have to stipulate an order for the application of constraints which is not declarative.

Another problem with the subsumption based account is that it is incompatible with the standard approach for relative clauses. Relative clauses are generally analyzed as clauses from which a relative phrase is extracted via a nonlocal dependency construction ((Pollard and Sag, 1994, Chapter 5), (Müller, To appear, Chapter 12)). If a nonlocal dependency is introduced the subcategorization requirements would have to be checked against an underspecified element, i.e. a trace, a description in a unary schema or in a lexical rule. This means that an element with a totally unconstrained case value will be introduced into SLASH. Therefore ungrammatical sentences like (17) would be admitted by the grammar.

(17) a. * Dem Mann kenne ich.
the$_{dat}$ man know I
'I know the man.'

b. * der Mann, dem ich kenne,
the man who$_{dat}$ I know

*Kennen* needs an accusative complement. The case requirements are checked locally against a trace, say. As the case value of the trace is unspecified, it is compatible with the accusative specification. The trace might then be bound by a dative filler.

This shows that a subsumption test is inappropriate for solving the problem. Therfore I will now propose a different account that uses relational constraints to describe the case phenomena and unification for functor argument combination.

If one looks at sentences like (3c) and (14-15), one can see that the general pattern for free relatives is as follows: A free relative is a constituent that has an internal structure similar to an NP modifying relative clause, i.e. it is a finite clause with verb last position and an extracted constituent that is moved to the initial position of the relative clause. In addition, free relatives share certain syntactic and semantic properties with their relative phrase. In (13) *was noch übrig war* fulfills the function of an NP complement in the matrix clause, whereas in (3c) *mit wem ihr (beginnen) wollt* has the function of a PP just as the relative phrase *mit wem* does.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (18) | [Wo | du | schläfst], | hält | man | es | vor | Lärm | kaum | aus. |
| | where | you | sleep | stand | one | it | in front | noise | almost | out |

'Where you sleep the noise is almost unbearable.'

In (18) *wo* is an adverb in the relative clause and the relative clause itself behaves like an adverb; it specifies the place where the sleeping is done. From looking at (18), it is clear that it is neither SYNSEM nor the CAT features nor the HEAD features of *wo* that are projected by the free relative. As modifiers in HPSG select the head they modify, and as this is done via the head feature MOD, the HEAD values of the adverb *wo* and the free relative *Wo du schläfst* must be different. They are, however, very tightly related. The MAJ feature is identical, the relation under SYNSEM|CONT is identical, and the syntactic structure of the head that is selected via MOD is identical too. If the relative phrase is a complement PP, the head features are identical, and if it is an NP, the MAJ feature is identical. But instead of projecting the case of the NP, which would lead to unification clashes in certain cases, the morphological case is projected by a relational constraint.[17,18] The morphological case is the value of a separate feature MORPH-CASE, which is not changed if heads and complements are combined. The value for MORPH-CASE for *was* is $nom \vee acc$. This value gets projected, so that the projection of the relative clause [RC was übrig war] becomes an NP $nom \vee acc$ [NP$nom \vee acc$ [RC was übrig war]].

This NP then functions as a complement of *gegessen* and receives accusative.

## 5 The Analysis

As was explained in section 3, free relatives behave like their relative phrases. (3a) therefore gets the structure shown in (19).

(19) $[_{NP}$ $[_{RS}$ Wer schläft]], sündigt nicht.

[17]Note that it is not possible to leave the projected case value unconstrained, as sentences like (7) might suggest. This would lead to overgeneration, as the free relative in (i) could be interpreted as a dative argument of *kaufen*.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (i) | Karl | hat | das Buch, | das | ich | kenne, | gekauft. |
| | Karl | has | the book | that$_{nom \vee acc}$ | I | know | bought |

'Karl bought the book that I know.'

[18]The relational constraint is basically a disjunction. For an implementation it is sufficient to unify the MOPRH-CASE value of the relative phrase with the projected case value.

The noun phrase introduces an index the restrictions of which are identical to the semantic contribution of the finite sentence in the relative clause.[19]

(20)
$$\begin{bmatrix} \text{IND} & \boxed{1} \begin{bmatrix} \text{PER} & \textit{3} \\ \text{NUM} & \textit{sg} \\ \text{GEN} & \textit{mas} \vee \textit{fem} \end{bmatrix} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{THEMA} \boxed{1} \\ \textit{schlafen} \end{bmatrix} \right\} \\ \textit{nom-obj} & \end{bmatrix}$$

The index is identical to the index of the relative phrase.

As was shown in section 2, the properties of the noun phrase are dependent on those of the relative phrase. In order to be able to describe this adequately, the information about the relative phrase must be accessible in the description of a relative clause. There are three possible ways to achieve this. Firstly, the information which is present in the daughters of the relative clause is used. Secondly, the information could be projected by a nonlocal dependency, and thirdly there could be a special feature for relative clauses, the value of which is identical to the local value of the relative phrase.

The first option would violate the locality principle[20] which forbids a head to access information under the path DTRS. Apart from the violation of the locality principle, this approach would fail if the daughters are conjuncts in a coordination, as in (21).

(21) Wer den Unterschied zwischen einem „taxierenden Blick“ und beispielsweise einem netten Zulächeln nicht kennt, wer Komplimente nur über Figur und Aussehen machen kann und dessen zweite Frage schon „Geh'ma zu mir oder geh'ma zu dir?“ lautet, sollte die Finger, Augen und sonstiges von Frauen lassen!

‘Those who cannot tell the difference between an “appraising glance” and, for instance, a pleasant smile; those who only know how to pay compliments about physical appearance, and whose second question is already “your place or mine?”, should keep well away from women.’

In (21) the relative phrase daughters are not directly accessible. Therefore only the last two options remain. The second option is not to bind off the SLASH value of the relative clause when the relative clause gets saturated, but project it to the next level and bind it off in the NP or PP projection. However, this approach however is not compatible with the treatment of extraposition as a nonlocal dependency, as was suggested by Keller (1995) and Müller (To appear). Relative clauses can be extraposed, but a condition for the introduction of a nonlocal dependency for extraposition is an empty slash set. This

[19] See (Bausewein, 1991, p. 149) for remarks on the genus of *wer* (*who*).
[20] (Pollard and Sag, 1987, p. 142-143)

assumption would conflict with the projection of SLASH values higher than the relative clause level.

The third option does not have this problem. I introduce a feature RP-LOCAL that has a value which is identical to the local value of the relative phrase. The identity of the LOCAL value of the relative phrase and the RP-LOCAL value has to be enforced by a structure sharing in the schema that licenses the relative clause, which is not given here due to space limitations. Schema 1 can then access the RP-LOCAL value and the appropriate values that are a function of RP-LOCAL can be projected.[21]

**Schema 1 (Relative Clause Projection Schema)**

$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{LOC } free\_rc\_loc(\boxed{1},\boxed{2}) \end{bmatrix} \\ \text{DTRS} & \begin{bmatrix} \text{RS-DTR} & \begin{bmatrix} \text{SYNSEM}|\text{LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{RP-LOC } \boxed{1} \\ \textit{relativizer} \end{bmatrix} \end{bmatrix} \\ \text{CONT } \boxed{2} & \end{bmatrix} \end{bmatrix} \\ \textit{relativizer-projection-structure} & \end{bmatrix} \\ \textit{phrasal-sign} & \end{bmatrix}$$

Structures of type *relativizer-projection-structure* are, of course, not subtypes of *headed-structure*.

$free\_rc\_loc$ relates the projected LOCAL value to the LOCAL value of the relative phrase in a way that is shown in (22-23).

$$free\_rc\_loc(\text{NP}[\text{MORPH-CASE } \boxed{1}, \text{CONT}|\text{IND } \boxed{2}], \boxed{3}) =$$

(22) $$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{CAS}|\text{SURF-CASE } \boxed{1} \\ \textit{noun} \end{bmatrix} \\ \text{SUBCAT} \langle\, \rangle & \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{2} \\ \text{RESTR} & \{ \boxed{3} \} \end{bmatrix} \end{bmatrix}$$

The SURF-CASE value is the one that is unified with the description in the subcat list of the verb in the matrix clause.

If the relative phrase is a complement nominal phrase, its morphological case is projected. The morphological case is the value of a separate feature that is not mentioned in the subcat list of the governing verb, and therefore does not get instantiated

[21] Sag (1997) uses unary schemata to analyze English relatives.

by the case requirements of the verb. Let us take the sentence (6a) as an example. The morphological case of *die* is $nom \vee acc$. The verb *stehen* assigns nominative to *die*. This, however, does not affect the morphological case of *die*, which remains $nom \vee acc$ and gets projected. The resulting noun phrase *die da stehen* therefore has the SURF-CASE value $nom \vee acc$. *Kennen* then assigns $acc$ to its object and further specifies the disjunction to become $acc$.

(23)
$$free\_rc\_loc(\text{PP}[\text{CAT}|\text{HEAD}\ \boxed{4}\ [\text{MOD}\ none], \text{CONT}|\text{IND}\ \boxed{5}], \boxed{6}) = \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{4} \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{5} \\ \text{RESTR} & \{\ \boxed{6}\ \} \end{bmatrix} \end{bmatrix}$$

If the relative phrase is a complement PP (23), then its head features are identical to the projected features. The matter is more complicated for modifying relative phrases. The MOD value to be projected is different from the one of the relative phrase. The relation is identical, but the arguments are not. In (18) *wo* modifies the verb in the relative clause. The MOD value has to be appropriate. The projection of *wo du schläfst* has as its MOD value the verb of the matrix clause.

$free\_rc\_local$ relates the relative phrase and its semantic content to the semantic content of the projection. Nominal projections introduce an index which is identical to the index of the relative phrase, and which is restricted by the CONT value of the relative clause. For *die da stehen* one gets a plural index with the restriction *da stehen*.

Note that in the revised theory for modification developed by Kasper (1995), the semantic contribution of the relative clause can be accessed directly. In his theory the CONT value of the relative clause is a parameterized state of affairs (psoa) rather than an index as in the standard theory of Pollard and Sag (1994).

For modifying relative phrases, $free\_rc\_local$ provides the same relation as is expressed by the relative phrase. However, the arguments are the relative clause and the matrix clause.

# 6 Conclusion

I suggest using a unary schema for the description of free relatives. This avoids empty elements, allows to describe head complement relations by just one very general schema and fits nicely in an implemented fragment of German[22] (Müller, 1996) that employs a set of other headless and unary branching schemata for instance for mo-

[22] http://www.dfki.de/~stefan/Babel/e_babel.html

difying relative clauses and for the introduction of nonlocal dependencies, respectively (Müller, 1997).

Due to space limitations the mentioned alternatives, i.e. an empty head and a lexical rule could not be discussed. The reader is referred to the longer version of this paper (Müller, 1998).

It has been shown that a subsumption based approach is not suited for solving the free relative problem and an alternative solution has been proposed.

## References

Bausewein, Karin. 1991. Haben kopflose Relativsätze tatsächlich keine Köpfe? In Giesbert Fanselow and Sascha W. Felix, editors, *Strukturen und Merkmale syntaktischer Kategorien*. Gunter Narr Verlag, Tübingen, pages 144–158.

Duden. 1984. *Grammatik der deutschen Gegenwartssprache*, volume 4. Mannheim, Wien, Zürich: Dudenverlag.

Ingria, Robert J. P. 1990. The limits of unification. In *Proceedings of the Twenty-Aightst Annual Meeting of the ACL*, pages 194–204, Pittsburgh, Pennsylvania. Association for Computational Linguistics.

Kasper, Robert. 1995. Semantics of recursive modifikation. ftp://ling.ohio-state.edu/pub/HPSG/Workshop.Tue.95/Kasper/modification-handout.ps.gz. 21.05.97. talk at HPSG-Workshop in Tübingen 1995.

Kasper, Robert T., Andreas Kathol, and Carl J. Pollard. 1995. Linear precedence constraints and reentrancy. In James Kilbury and Richard Wiese, editors, *Integrative Ansätze in der Computerlinguistik*, pages 49–54, Düsseldorf. http://linguistics.berkeley.edu/~kathol/Papers/DGfS-CL95.ps.gz. 14.04.97.

Keller, Frank. 1995. Towards an account of extraposition in HPSG. In *Proceedings of the Seventh Conference of the European Chapter of the Association for Computational Linguistics*, Dublin. ftp://ftp.ims.uni-stuttgart.de/pub/papers/keller/eacl95.ps.gz. 04.15.97.

Koch, Ulrich. 1996. Deutsche Relativsätze in HPSG. http://www.uni-koblenz.de/~koch/stuarb.ps.gz. 04.08.97. Studienarbeit, Universität Koblenz-Landau.

Müller, Stefan. 1996. The Babel-System—an HPSG Prolog implementation. In *Proceedings of the Fourth International Conference on the Practical Application of Prolog*, pages 263–277, London. http://www.dfki.de/~stefan/Pub/e_babel.html. 06.11.1998.

Müller, Stefan. 1997. Yet another paper about partial verb phrase fronting in German. Research Report RR-97-07, Deutsches Forschungszentrum für Künstliche Intelligenz, Saarbrücken. A shorter version appeared in *Proceedings of COLING 96*, pages 800–805. http://www.dfki.de/˜stefan/Pub/e_pvp.html. 06.11.1998.

Müller, Stefan. 1998. An extended and revised HPSG-analysis for free relative clauses in German. Verbmobil Report 225, Deutsches Forschungszentrum für Künstliche Intelligenz, Saarbrücken. http://www.dfki.de/˜stefan/Pub/e_freeRel.html. 06.11.1998.

Müller, Stefan. To appear. *Deutsche Syntax deklarativ. Head-Driven Phrase Structure Grammar für das Deutsche*. Linguistische Arbeiten. Tübingen: Max Niemeyer Verlag. http://www.dfki.de/˜stefan/Pub/e_hpsg.html. 06.11.1998.

Oppenrieder, Wilhelm. 1991. *Von Subjekten, Sätzen und Subjektsätzen*. Linguisitische Arbeiten, number 241. Tübingen: Max Niemeyer Verlag.

Pollard, Carl J. and Ivan A. Sag. 1987. *Information-Based Syntax and Semantics Volume 1 Fundamentals*. CSLI Lecture Notes, number 13. Stanford: Center for the Study of Language and Information.

Pollard, Carl J. and Ivan A. Sag. 1994. *Head-Driven Phrase Structure Grammar*. Studies in Contemporary Linguistics. Chicago, London: University of Chicago Press.

Sag, Ivan A. 1997. English relative clause constructions. *Journal of Linguistics*, 33(2):431–484. ftp://ftp-csli.stanford.edu/linguistics/sag/rel-pap.ps.gz. 04.13.97.

Uszkoreit, Hans. 1987. *Word Order and Constituent Structure in German*. CSLI Lecture Notes, number 8. Stanford: Center for the Study of Language and Information.