Subsumption or Unification – An HPSG-Analysis for Free Relative Clauses in German

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1 Introduction

At the moment there exists 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 partly behave 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. According to 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 only. 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.

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

(1) a. Wer schläft, sündigt nicht.

b. Wer das schriftliche Produkt eines Verwaltungsbeamten als „mittleren Schwachsinn“ bezeichnet, muß mit 2.400 Mark Geldstrafe rechnen.

c. Sie hat, was sie geschenkt bekommen hat, sofort in den Schrank gestellt.[2]

d. Ihr könnt beginnen, mit wem ihr (beginnen) wollt.[3]

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

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.[4]

(3) a. Die$_{nom \vee acc}$ da stehen, kennen wir nicht.

b. * Wer$_{nom}$ da steht, kennen wir nicht.

c. Sie ißt, was$_{nom \vee acc}$ übrig bleibt.

So for instance in (3a) *die* is selected as a complement of *stehen* and receives case by this verb. At the same time *kennen* selects an accusative complement. As the case form of *die* is $nom \vee acc$, (3a) is grammatical. (3b), however, is out since *wer* is not compatible with the accusative requirement of *kennen*.

[1] cf. (Bausewein, 1991)
[2] (Bausewein, 1991, p. 152)
[3] (Bausewein, 1991, p. 155) The word in brackets was inserted by me.
[4] The examples are taken from (Bausewein, 1991, p. 150).

3 The Categorial Properties of Free Relatives

To analyze sentences like (4) there exist three options.

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

One either could 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 that projects a phrase from a relative clause that depends on the relative phrase of the clause. The three possibilities will be discussed in the full paper. Here I will explain the analysis that uses a unary schema.

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

(5) Wer erster wird und wer den letzten Platz belegt, bekommt /* bekommen einen Preis.[5]

(6) 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.

(7) [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,

In (7) there must exist 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 has to be in the same subcat list with the reflexive.

If one looks at the linearization properties of free relatives, one finds more evidence for free relatives behaving like their relative phrase. In (8) the free relative clauses are linearized like noun phrases.

(8) a. Sie hat, was sie geschenkt bekommen hat, sofort in den Schrank gestellt.[6]

b. Schon heute muß, wer harte Informationen oder lockere Unterhaltung haben will, blechen, portionenweise, ...

c. ? Ich habe, daß Peter das interessiert, geglaubt.

In German there is a strong tendency to serialize sentences at the right periphery of the sentence, i.e. extrapose them. (8c) therefore is marked. (8a-b) however are not. In (8a-b) the relative clause behaves like a noun phrase.

4 Case Assignment and Feature Projection

In (9) the relative phrase is a NP and the relative clause *was noch übrig war* functions as a NP complement in the matrix clause.

(9) Ich habe gegessen, [was noch übrig war].

[5] (Oppenrieder, 1991, p. 143)

[6] (Bausewein, 1991, p. 152)

Ingria (1990) suggested that a subsumption test should be used for checking subcategorization requirements as unification seems to lead to conflicting case values. In the free relative shown in (9) the verb in the matrix clause needs an accusative complement and *war* needs a nominative NP. If the subcategorization requirements of both verbs are unified with the descriptions of their complements and if the result of the unification of the complement of *war* and *was* would be projected by the free relative a unification failure would be the result. If on the other hand the subcategorization requirements would just be checked without unification the case value of *was* would not be changed and would be compatible with both verbs.

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

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

If saturation does not instantiate case values then the case values of the NPs in (10) will remain $nom \vee acc$. In this case it is impossible to use LP-constraints to determine the prefered reading of (10) i.e. the one where the nominative NP precedes the accusative one.

Another problem with the subsumption based account is that it is incompatible to the standard approach for relative clauses. Relative clauses standardly are analyzed as a clause from which a relative phrase is extracted via a nonlocal dependency construction ((Pollard and Sag, 1994, Chapter 5), (Müller, 1997, Chapter 11)). 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 an 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 (11) would be admitted by the grammar.

(11) a. * Dem Mann kenne ich.

b. * der Mann, dem ich kenne,

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 then might be bound by a dative filler.

This shows that a subsumption test is inappropriate to solve the problem.

In what follows I will therefore 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 in section 2, one can see that the general pattern for free relatives is the following: A free relative is a constituent that has an internal structure which is similar to NP modifying relative clauses, 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 (9) *was noch übrig war* fulfills the function of an NP complement in the matrix clause whereas in (1d) *mit wem ihr (beginnen) wollt* has the function of a PP exactly as the relative phrase *mit wem* does.

(12) [Wo du schläfst], hält man es vor Lärm kaum aus.

In (12) *wo* is an adverb in the relative clause and the relative clause itself behaves like an adverb, it specifies the location of the sleeping. From looking at (12) 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. 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 than functions as complement of *gegessen* and receives accusative.

5 The Analysis

(1a) gets a structure shown in (13).

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

The noun phrase introduces an index the restrictions of which are identical to the semantic contribution of the finite sentence in the relative clause.[7]

(14)

$$
\begin{bmatrix} \text{IND} & \boxed{1} \begin{bmatrix} \text{PER } \mathit{3} \\ \text{NUM } \mathit{sg} \\ \text{GEN } \mathit{mas} \end{bmatrix} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{THEMA } \boxed{1} \\ \mathit{schlafen} \end{bmatrix} \right\} \\ \mathit{nom\text{-}obj} & \end{bmatrix}
$$

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

As was shown in the section 2 the properties of the noun phrase depend on those of the relative phrase. In order to be able to describe this adequately, the information about the relative phrase must be accessable 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[8] 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 like in (15).

(15) 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!

In (15) the relative phrase daughters are not directly accessable. 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 instead project it to the next level and bind it off in the NP or PP projection. This approach however is not compatible with the treatment of extraposition as a nonlocal dependency as was suggested by Keller (1995) and Müller (1997). Relative clauses can be extraposed. But a condition for the introduction of a nonlocal dependency for extraposition is an empty slash set. This 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 unary schema 1 then can access this value and the appropriate values that are a function of RP-LOCAL can be projected. Structures of type *relativizer-projection-structure* of course are not subtypes of *headed-structure*.

[7] See (Bausewein, 1991, p. 149) for remarks on the genus of *wer* (*who*).

[8] (Pollard and Sag, 1987, p. 142-143)

Schema 1 (Relative Clause Projection Schema)

$$\left[\begin{array}{ll}
\textsc{synsem} & \left[\textsc{loc}\ \mathit{free_rc_loc}(\boxed{1},\boxed{2})\right] \\
\textsc{dtrs} & \left[\begin{array}{ll}
\textsc{rs-dtr} & \left[\begin{array}{ll}
\textsc{synsem}|\textsc{loc} & \left[\begin{array}{ll}
\textsc{cat} & \left[\textsc{head}\ \left[\begin{array}{l}\textsc{rp-loc}\ \boxed{1} \\ \mathit{relativizer}\end{array}\right]\right] \\
\textsc{cont} & \boxed{2}
\end{array}\right]
\end{array}\right] \\
\mathit{relativizer\text{-}projection\text{-}structure} &
\end{array}\right] \\
\mathit{phrasal\text{-}sign} &
\end{array}\right]$$

free_rc_loc relates the projected LOCAL value to the LOCAL value of the relative phrase in a way that is shown in (16-17).

$$\mathit{free\_rc\_loc}(\text{NP}[\textsc{morph-case}\ \boxed{1}, \textsc{cont}|\textsc{ind}\ \boxed{2}], \boxed{3}) =$$

$$(16)\quad \left[\begin{array}{ll}
\textsc{cat} & \left[\begin{array}{ll}
\textsc{head} & \left[\begin{array}{l}\textsc{cas}|\textsc{syn-case}\ \boxed{1} \\ \mathit{noun}\end{array}\right] \\
\textsc{subcat} & \langle\rangle
\end{array}\right] \\
\textsc{cont} & \left[\begin{array}{ll}
\textsc{ind} & \boxed{2} \\
\textsc{restr} & \{\ \boxed{3}\ \}
\end{array}\right]
\end{array}\right]$$

The SYN-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 by the case requirements of the verb. For an example let's take the sentence (3a). 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 SYN-CASE value $nom \vee acc$. *Kennen* then assigns *acc* to its object and further specifies the disjunction to become *acc*.

$$\mathit{free\_rc\_loc}(\text{PP}[\textsc{cat}|\textsc{head}\ \boxed{4}\ [\textsc{mod}\ \mathit{none}], \textsc{cont}|\textsc{ind}\ \boxed{5}], \boxed{6}) =$$

$$(17)\quad \left[\begin{array}{ll}
\textsc{cat} & \left[\begin{array}{ll}
\textsc{head} & \boxed{4} \\
\textsc{subcat} & \langle\rangle
\end{array}\right] \\
\textsc{cont} & \left[\begin{array}{ll}
\textsc{ind} & \boxed{5} \\
\textsc{restr} & \{\ \boxed{6}\ \}
\end{array}\right]
\end{array}\right]$$

If the relative phrase is a complement PP then their 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 (12) *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 with 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 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. The arguments however are the relative clause and the matrix clause.

6 Conclusion

In this paper, 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 (Müller, 1996a) that employs a set of other headless and unary branching schemata for instance for modifying relative clauses and for the introduction of nonlocal dependencies, respectively (Müller, 1996b). The decision to use a unary schema will be discussed in more detail in (Müller, To appear).

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.

The Babel-system has Bottom-Up-Chart-Parser that is implemented in Prolog. It uses Prolog-term unification. Because no subsumption tests have to be made, the system is very fast. Sentences like (12) are processed in less than a second on a SPARC Ultra 2 with 300 Mhz. The lexicon has more than 30.000 full form entries.

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