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An Extended and Revised HPSG-Analysis for Free Relative Clauses in German

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MIST, MIST
MIST... JETZT HAB
ICH'S SCHON WIEDER
GELESEN!!!
WER
DAS
LIEST
IST
DOOF
FRED & GÜNTER

Contents

1 Introduction

At the moment there is no theory for free relative clauses in German in the HPSG framework (Pollard and Sag, 1994). From GB literature[1] on the subject it is known that free relative clauses 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 relative clauses can take is not restricted to complements. Depending on the properties of the relative phrase, free relative clauses can be modifiers as well. I will argue that free relative clauses project to a category that is tightly related to the category of the relative phrase.

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 show that his subsumption based account is incompatible to standard assumptions in the HPSG framework. The set-based approach of Dalrymple and Kaplan (1997) which is similar in many respects to Ingria's approach will be discussed also. It will be shown that some of the problems of the subsumption based account still are present in the set-based approach. I will provide a different solution to the problem that relies on an additional case feature for the case form of NPs which is projected from the relative phrase and which is not affected by case requirements of the verb.

In general there are three possibilities to describe the projections of free relative clauses: firstly the direct projection of a phrase from the relative phrase and a finite sentence, secondly an empty head or a unary projection that projects a relative clause and thirdly a lexical rule that changes the subcategorization frames of governing heads in a way that they subcategorize for relative clauses. 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 with the verb in final position from which the relative phrase

[†]Thanks to Kordula De Kuthy, Andreas Kathol, Frank Keller, and an anonymous reviewer for comments on earlier versions of this paper. Thanks to Dan Flickinger for some discussion of English data. Thanks to Joanne Capstick and Uta Waller who helped me translate sample sentences from newspapers. Thanks to Jonas Kuhn who pointed me to the LFG literature. I also want to thank Walter Kasper for discussion of some related points and Barbara Schmidt for acceptability judgements. Thanks to Fred & Günther for the permission to use their cartoon.

This paper is an extended and revised version of (Müller, 1997b). After this paper was printed as (Müller, 1999b), I became aware of (Bresnan and Grimshaw, 1978). Their approach is similar to the one of Jackendoff which is discussed in section 4. A lot more has to be said about the paper by Bresnan and Grimshaw. This will be done in further publications.

[1]cf. (Bausewein, 1990)

is extracted.[2] The relative phrase appears to the left of the finite sentence. Both *d*-elements and *w*-elements can function as relative words:

(1) a. <table><tr><td>der Mann,</td><td>[der]</td><td>Maria</td><td>küßt</td></tr><tr><td>the man</td><td>who$_{nom}$</td><td>Maria</td><td>kisses</td></tr></table>
‘the man who is kissing Maria’

b. <table><tr><td>der Mann,</td><td>[den]</td><td>Maria</td><td>küßt</td></tr><tr><td>the man</td><td>who$_{acc}$</td><td>Maria</td><td>kisses</td></tr></table>
‘the man Maria is kissing’

c. <table><tr><td>der Mann,</td><td>[dem]</td><td>Maria</td><td>zuhört</td></tr><tr><td>the man</td><td>who$_{dat}$</td><td>Maria</td><td>listens.to</td></tr></table>
‘the man Maria is listening to’

d. <table><tr><td>der Mann,</td><td>[von dem]</td><td>Maria</td><td>geküßt</td><td>wird</td></tr><tr><td>the man</td><td>by who</td><td>Maria</td><td>kissed</td><td>is</td></tr></table>
‘the man by whom Maria is kissed’

e. <table><tr><td>der Stuhl,</td><td>[auf dem]</td><td>Karl</td><td>sitzt</td></tr><tr><td>the chair</td><td>on which</td><td>Karl</td><td>sits</td></tr></table>
‘the chair Karl is sitting on’

f. <table><tr><td>Änderungen,</td><td>[deren Tragweite]</td><td>mir</td><td>nicht</td><td>bewußt</td><td>war</td></tr><tr><td>modifications</td><td>the consequences</td><td>me</td><td>not</td><td>conscious</td><td>was</td></tr></table>
‘modifications the consequences of which I was not conscious of’

g. [. . .] es hätte die FDP zerrissen und Kandidat Scharping das Signal gebracht, [*dessen* entbehrend] er schließlich scheiterte.[3]
‘It would have caused a rift in the FDP and provided candidate Scharping with his signal, but since the signal never came, he failed.’

[2] Throughout the paper I will use square brackets to indicate the relative phrase and *italics* to mark the relative word. In some examples the whole relative clause or another constituent is enclosed in square brackets.

[3] taz, 20.10.98, p. 1

h. ein Umstand, [*den* zu berücksichtigen] meist vergessen
a fact that to consider usually forget
wird
is
'a fact that is usually neglected'

(2) a. Ich komme eben aus der Stadt, [*wo*] ich Zeuge eines Unglücks gewesen bin.[4]
'I have just come back from town where I was witness to an accident.'

b. Zufällig war ich in dem Augenblick zugegen, [*wo*] der Steppenwolf zum erstenmal unser Haus betrat und bei meiner Tante sich einmietete.[5]
'Incidently I was present at the moment in which the Steppenwolf entered our house for the first time and took lodgings in my aunt's house.'

c. Tage, [an *welchen*] selbst die Frage, ob es nicht an der Zeit sei, dem Beispiele Adalbert Stifters zu folgen und beim Rasieren zu verunglücken, ohne Aufregung oder Angstgefühle sachlich und ruhig erwogen wird[6]
'days when even the question whether it might not be time to follow Adalbert Stifter's example by accidentally killing oneself whilst shaving, is considered in an objective and calm manner, without agitation or fear'

d. War das, [*worum*] wir Narren uns mühten, schon immer vielleicht nur ein Phantom gewesen?[7]
'Had that which had occupied us fools never been more than a phantom?'

e. Dort vielleicht war das, [*was*] ich begehrte, dort vielleicht würde meine Musik gespielt.[8]
'Perhaps what I was longing for was there, perhaps my music would be played there.'

f. ..., das ist nun wieder eine Frage, [über *welche*] müßige Leute nach Belieben brüten mögen.[9]
'..., that is another question that idle people may ponder over at their leisure.'

[4](Duden, 1995, § 1280).
[5]Herman Hesse, *Der Steppenwolf*, Aufbau-Verlag, Berlin und Weimar, 1986, p. 6
[6]ib., p. 27
[7]ib., p. 39
[8]ib., p. 40
[9]ib., Tractat vom Steppenwolf, p. 6

If the relative word cannot be extracted because the phrase it occurs in is an extraction island, as in (1d–e), (1g), (2c) and (2f), the whole phrase is extracted. In general prepositions in German cannot be stranded.[10] Therefore the preposition is moved together with the relative word. The same holds for determiners as in (1f). Determiners cannot be extracted and therefore the whole NP is moved. Since (Ross, 1967, p. 108) this phenomenon is called pied piping.

Relative clauses can fulfill two functions. Firstly, they can modify nouns (1) – (2) and secondly, they can be a direct argument (3) – (5) or adjunct (6) of a verb.

(3) a. [*Wer*] schläft, sündigt nicht.
who sleeps sins not
'He who sleeps does not sin.'

b. [*Wer*] nie sein Brot im Bette aß, weiß nicht, wie
who never his bread in.the bed ate knows not how
Krümel piken.
crumbs prick
'Those who have never eaten a sandwich in bed, do not know how scratchy crumbs are.'

c. [*Wer*] das schriftliche Produkt eines Verwaltungsbeamten als „mittleren Schwachsinn“ bezeichnet, muß mit 2.400 Mark Geldstrafe rechnen.[11]
'Those describing the written work produced by an administrative clerk as 'average nonsense' face a fine of 2,400 DM.'

d. Sie hat, [*was*] sie geschenkt bekommen hat, sofort
she has what she given got has instantly
in den Schrank gestellt.[12]
in the cupboard put
'She put what she was given into the cupboard instantly.'

e. Macht kaputt, [*was*] euch kaputtmacht![13]
make broken what you broken.makes
'Destroy what destroys you!'

[10] See (Müller, 1997c) for cases where prepositions are stranded in relative clauses.

[11] taz, 11.30.95, p. 20. The *taz* is a newspaper that appears nation-wide in Germany (http://www.taz.de). Most of the real-world examples given throughout this paper are take from this newspaper. Some examples are taken from novels, some from the computer magazine c't, and some others from brochures.

[12] (Bausewein, 1990, p. 152)

[13] Ton, Steine, Scherben, *Warum geht es mir so dreckig?*, produced by Indigo, David Volksmund Prod. as record and CD, 1971

f. [*Wem*] er vertraut, hilft er auch.[14]
who he trusts helps he too
'He helps those he trusts.'

g. Ich denke nach, [über *wen*] ich (nachdenken) will.
I think after about who I think want
'I'll think about whoever I like.'

h. Ihr könnt beginnen, [mit *wem*] ihr (beginnen) wollt.[15]
you can begin with who you begin want
'You can begin with whoever you like.'

i. [*Was*] bei Ingria ein Subsumptionstest ist, ist bei Dalrymple und Kaplan ein Enthaltenseinstest in einer Menge.[16]
'What is a subsumption test in Ingria's approach is a membership test in Dalrymple and Kaplan's approach.'

j. „Punk ist, [*was*] am besten zum Lebensgefühl der Jugend paßt", sagt er weise.[17]
'Punk fits best to the existential attitude of the younger generation.'

k. [*Wer*] den zivilen Ablauf dieses Prozesses mit allen Mitteln hintertreibt, sind Präsident Süleyman Demirel und der türkische Generalstab.[18]
'President Süleyman Demirel and the Turkish general staff are doing everything in their power to thwart a civil trial.'

l. [*Wo*] du wohnst, wollen sie auch wohnen.[19]
'They want to live where you live too.'

In (3a–c) the free relative clause is the subject of the matrix verb. In (3d–e) it is the accusative object in (3f) the dative object and in (3g–h) it is the prepositional object. The free relative clause in (3i) is the subject in a copula construction and in (3j) and (3k) it is the predicate in a copula construction.

Sentences (3g–h) are examples where a free relative clause contains a pied piped phrase. (4) is a more complex example for pied piping.

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[14] (Engel, 1977, p. 234)
[15] (Bausewein, 1990, p. 155). The word in brackets was inserted by me.
[16] (Müller, 1999a, Ch. 10)
[17] About a Punk from Peking, taz, 10.24./25.98, taz-mag, p. VI
[18] Okçuoglu im Interview mit dem Spiegel, 10/99, p. 210
[19] (Engel, 1977, p. 177)

(4) [*Wessen* Birne] noch halbwegs in der Fassung steckt, pflegt
whose nut yet halfway in the holder is uses
solcherlei Erloschene zu meiden; . . .[20]
such extinct to avoid . . .
'Those who still have their wits half way about them tend to avoid such vacant characters; . . . '

The sentences in (5) show that *d*-words can appear in relative phrases of free relative clauses.

(5) a. [*Der*] zeugt, darf auch erziehen.[21]
the begets be.permitted also bring.up
'He who fathers (a child) is allowed to raise (it).'

b. [*Der*] das sagt, war als Bundesvorsitzender der Grünen immerhin einer der Wegbereiter der Vereinigung mit den Bürgerrechtlern.[22]

'As the leader of the Green Party, the one who said that was, after all, one of those responsible for paving the way to the union with the civil rights movement.'

c. [*Der*] ihn zum Kronprinzen ernannt hat, hat alles getan, um einen Stabwechsel unmöglich zu machen.[23]

'The (same) one who appointed him crown prince did everything in his power to prevent him from taking over.'

In (6a) the *wo* (*where*) modifies *stigmatisiert* (*stigmatized*) and the whole relative clause modifies the matrix clause.

(6) a. [*Wo*] das Rauchen derartig stigmatisiert ist wie von Köppl geplant, kann man sich leicht als Rebell fühlen, bloß weil man raucht.[24]

'If smoking is to be stigmatized as much as Köppl plans it to be, smokers might easily end up feeling like rebels.'

b. [*Wo*] noch bis zum Dezember vergangenen Jahres die „Projekte am Kollwitzplatz“ und „Netzwerk Spielkultur“ ihren Sitz hatten, prangt heute das Schild „Zu vermieten“.[25]

[20] Thomas Gsella, taz, 12.02.97, p. 20
[21] taz, 06.27.97, p. 1
[22] taz, 12.18.96, p. 3
[23] taz, 08./09.08.98
[24] taz, 11.15.96, p. 10
[25] taz, berlin, 07.27.97, p. 23

'The places where the 'Projects at the Kollwitzplatz' and 'Network Play Culture' still had their headquarters up until December of last year now sport a resplendent sign bearing the words 'To Let'.'

c. [*Wo*] wir aufgerufen sind, selbst Gesetzgeber unserer Lebensform zu sein, haben auch Lebensmodelle Bestand, die Drogenerfahrungen einschließen.[26]

'When we are expected to be masters of our own existence, lifestyles which include drug experimentation will continue to have their place.'

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

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

'Those wanting to take pictures that are better than snapshots should not simply photograph whatever happens to be in front of their lens.'

Relative clauses can function as complements in almost all syntactic constructions in which their relative phrase can appear.

(8) a. Er ist, [wem er verpflichtet ist,] treu.
he is who he under.an.obligation is faithful
'He is faithful to those to whom he is under an obligation.'

b. Das Motiv ist klar: Haß auf den technischen Fortschritt und seine Repräsentanten, auf Naturwissenschaftler, Computerexperten, Vertreter der Holzindustrie oder [wen immer er für die Zerstörung der Natur verantwortlich machte].[27]

'The motive is clear: hatred for technical progress and its representatives, for scientists, computer experts, representatives of the timber industry or whoever he holds responsible for the destruction of nature.'

In (8a) the free relative clause functions as a dative object of an adjective and in (8b) the free relative clause *wen immer er für die Zerstörung der Natur verantwortlich machte* is a complement of the preposition *auf*.

Free relative clauses cannot function as a complement of a noun.

(9) a. die Zerstörung der Stadt
the destruction the city$_{gen}$
'the destruction of the city'

[26] taz, 08.14.97, p. 10
[27] taz, taz-mag, 11.08.97, p. 5

b. * die Zerstörung, dessen wir gedenken
the destruction who_{gen} we remember
Intended: 'the destruction of somebody/something we remember'

The reason for this might be that phrases like (9b) are too similar to noun phrases with modifying relative clauses like the one in (10).

(10) die Zerstörung, derer wir gedenken
the destruction $which_{gen}$ we remember

Verbs that take genitive complements are rather rare.

(11) a. Er erinnerte sich seines Vaters.
he remembered $REFL_{acc}$ his $father_{gen}$
'He remembered his father.'

b. Wir gedachten seines Vaters.
we remembered his $father_{gen}$
'We remembered his father.'

c. ?* Wir gedachten, wessen er sich erinnerte.
we commemorated who_{gen} he $REFL_{acc}$ remembered
Intended: 'We commemorated the person he remembered.'

(11c) is judged unacceptable, which is probably due to processing reasons as well.[28]

[28] Note that free relative clauses with a relative phrase in the genitive were possible in earlier stages of German.

(i) Wes das Herz voll ist, des geht der Mund über.
who_{gen} the heart full is the_{gen} goes the mouth over
'For out of the abundance of the heart the mouth speaketh.'

I assume that (i), which is a quote from Luther cited from (Jung, 1955, p. 156), is an instance of left dislocation (See (Altmann, 1981) on left dislocation). The phrase *wes das Herz voll ist* is projected to a genitive NP and this NP is taken up by the pronoun *des* again. That (i) really is an instance of left dislocation, and not—as claimed by Eisenberg (1994, p. 231)—a case where a relative clause is serilized to the left of the noun it modifies, can be demonstrated with the sentences in (ii).

(ii) a. *Wen* er kennt, *den* begrüßt er.
who he knows the greets he
'He greets those who he knows.'

b. * Er begrüßt, *wen* er kennt, *den*.
he greets who he knows the

If a relative clause functions as a complement, the relative phrase has to have a form that is compatible with the subcategorization requirement of its head.[29]

(12) a. Die da stehen, kennen wir nicht.
those$_{nom \vee acc}$ there stand know we not
'We don't know the ones that are standing over 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 (12a) *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*, (12a) is grammatical. (12b), however, is out since *wer* is not compatible with the accusative requirement of *kennen*.

There are exceptions to the compatibility requirement.

(13) a. Wem PB-Cache deshalb zu teuer in der Anschaffung ist, sollte darauf achten, zumindest ein Board mit einem sogenannten COAST-Sockel zu erwerben.[30]
'If for this reason you cannot afford a PB-Cache, you should at least make sure you buy a board with a so called COAST-socket.'

b. Wem der Anblick von FußgängerInnen Angst einflößt, schaltet bei Nissan auf das Infrarot-Passantenerkennungssystem um, ...[31]
'People who panic at the sight of pedestrians can switch on Nissan's infra-red pedestrian detector.'

c. Wem dieser Effekt nicht bekannt ist, interpretiert seinen schlechten Schlaf als Wiederkehr der ursprünglichen Schlafstörung.[32]
'Those who are not familiar with this effect interpret their bad sleep as a recurrence of their original insomnia.'

As (ii.b) shows, the appearance of the two phrases *wen er kennt* and *den* is restricted to the position in front of the finite verb (the *Vorfeld*). If *wen er kennt, den* were a normal noun phrase, (ii.b) would be grammatical.

[29] The examples are taken from (Bausewein, 1990, p. 150). For similar examples see (Gross and van Riemsdijk, 1981, p. 212).

[30] c't, 12/95, p. 145

[31] taz, 11.30.95, p. 20

[32] TK aktuell, 2/1997

d. Den deutschen Paß hat nicht verdient, wem Baguette aus seiner Tasche ragt.[33]
'If you walk around with baguette sticking out of your pocket you don't deserve a German passport.'

(14) a. Wen solche Lehren nicht erfreun, verdienet nicht, ein Mensch zu sein.[34]
'He who is not gladdened by such teachings does not deserve to be human.'

b. Wen der Streß des Tages häufig nicht losläßt, sollte eine Entspannungsmethode erlernen, zum Beispiel Autogenes Training.[35]
'Those who frequently fall prey to daily stress should make themselves familiar with a relaxation method like self hypnosis.'

In (13), the relative pronoun in the relative clause is in the dative case and in (14), it is in the accusative case. In all these sentences the free relative clause functions as subject, and should therefore have a relative phrase in the nominative case. Sentences like (13) and (14) are less acceptable than those in (3) and the grammatical sentences in (12). As Bausewein (1990, p. 154) has shown, even relative clauses with a prepositional phrase as relative phrase can function as NP complements.[36]

(15) a. Sie kocht, worauf sie Appetit hat.
she cooks where.on she appetite has
'She cooks what she feels like eating.'

b. Ohne dadurch eine Befreiung zu erzielen, zerstört er, wovon er abhängig ist.
'He destroys what he is dependent upon without freeing himself by doing so.'

c. Und soll man, wovon man nicht reden kann, einfach über den Haufen rennen?[37]
'Should you simply run over things you can't talk about?'

[33] Max Goldt, *Die Kugeln in unseren Köpfen*. München: Wilhelm Heine Verlag. 1997, p. 19. Note that this book contains the column that Max Gold writes for the satire magazine Titanic.
[34] Mozart, *Die Zauberflöte*, Reclam, Leipzig, 1937, p. 56
[35] TK aktuell, 2/1997
[36] The sentences (15a–b) are taken from (Bausewein, 1990, p. 154).
[37] From an article about the film „Lola rennt“, Spiegel, 34/98, p. 172

(16) a. Worauf man sich mit einer Pro-form beziehen kann,
where.upon one self with a Pro-form refer can
[...] ist eine Konstituente.[38]
is a constituent
'If you can refer to something with a Pro-form, [...] it is a constituent.'

b. Aus wem noch etwas herausgequetscht werden kann, ist sozial dazu verpflichtet, es abzuliefern; ...[39]
'Those who have not yet been bled dry are socially compelled to hand over their last drop.'

In (15) the relative clauses take the place of accusative complements, and in (16) they function as subjects, i.e. nominative complements in copula constructions. The sentences in (15) are remarkably good, those in (16) are somewhat marked. Bausewein proposes a hierarchy for these violations. Instead of a required accusative, a dative or a prepositional object can appear. Bausewein claims that the nominative is not a part of this hierarchy. It has to be realized. However, the examples in (13) and (14) show that the nominative can be replaced by dative or accusative. The sentences in (16) are examples where a relative clause with a prepositional phrase as relative phrase functions as a nominative complement. So, in the light of this data the hierarchy that was proposed by Bausewein can be completed in a way that is shown in (17).

(17) Nom > Acc > Dat/Prepositional Object

Note that it is not an option to ignore the requirement of the matrix category for a certain case or for a certain syntactic category. With such a proposal, sentences like (12b) and (18) – (19) would be admitted.[40]

(18) a. * Er vertraut, wen er kennt.
he trusts who$_{acc}$ he knows
Intended: 'He trusts those he knows.'

b. * Er lädt ein, wer ihm genehm ist.
he invites who$_{nom}$ him suits
Intended: 'He invites whoever he pleases.'

[38] From the main text of: Günther Grewendorf, *Aspekte der deutschen Syntax. Eine Rektions-Bindungs-Analyse*. Studien zur deutschen Grammatik, number 33. Tübingen: Gunter Narr Verlag. 1988, p. 16
[39] Wiglaf Droste, taz, 01.08.97, p. 16
[40] The sentences in (18) are taken from (Bausewein, 1990, p. 154–155).

c. * Er begegnet, mit wem er rechnete.
he meets with who he reckon
Intended: 'He is meeting whom he expected.'

(19) * Er hilft, wer ihn mag.
he helps who$_{nom}$ him likes
Intended: 'He helps those who like him.'

In the sentences (12b), (18) and (19) an argument position is filled by a relative clause with a relative phrase that is higher in the hierarchy than the expected argument. In (12b) we have nominative instead of accusative, in (18a) it is accusative instead of dative, in (18b) it is nominative instead of accusative and in (18c) we have a prepositional phrase instead of a dative complement. In (19) we have a nominative instead of a dative.

3 Relative Clauses in HPSG

In this section, I will provide a very brief introduction to HPSG and an analysis for relative clauses which modify a noun. This analysis is based on (Pollard and Sag, 1994, Ch. 5). The purpose of this section is not to justify each and every detail of the analysis suggested by Pollard and Sag, but rather to give the reader some basic facts. For a discussion of the nonlocal mechanism the reader is referred to (Pollard and Sag, 1994, Ch. 4). A detailed discussion of nonlocal dependencies in a grammar of German can be found in (Müller, 1999a, Ch. 9) and (Müller, 1999a, Ch. 10) is more explicit about linearization inside relative clauses and about problems which are related to pied piping.

3.1 Signs

In HPSG, feature structures are used to model linguistic objects (*signs*).[41] (20) shows such a feature structure containing the features that are relevant to understand this paper.

$$(20)\quad \begin{bmatrix} \text{PHON} & \begin{bmatrix}\textit{list of phoneme strings}\end{bmatrix} \\ \text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \begin{bmatrix} \text{CATEGORY} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\textit{head}\end{bmatrix} \\ \text{SUBCAT} & \begin{bmatrix}\textit{list of synsem-objects}\end{bmatrix}\end{bmatrix} \\ \text{CONTENT} & \begin{bmatrix}\textit{cont}\end{bmatrix}\end{bmatrix} \\ \text{NONLOCAL} & \begin{bmatrix}\textit{nonloc}\end{bmatrix}\end{bmatrix} \\ \textit{sign} & \end{bmatrix}$$

PHON contains a list of phoneme strings that correspond to the actual utterance. The value of SYNTAX-SEMANTICS (SYNSEM) is a feature structure containing all syntactic and semantic information about the sign. This information is divided into information that is relevant in a local context (LOC) and information that is used to establish nonlocal dependencies (NONLOC). The syntactic properties of a sign are represented under the path SYNSEM|LOC|CAT and the semantic contribution of a sign is represented under SYNSEM|LOC|CONT. The HEAD value contains all the features that are projected from a lexical head of a phrase to the complete phrase. SUBCAT is a valence feature. Its value is a list of *synsem* objects that have to be combined with a sign in order to yield a maximal projection.

The feature DTRS is appropriate for phrasal signs. Its value is a list of signs.

3.1.1 Referential Indices

For the description of the semantic contribution of nominal objects Pollard and Sag (1994, p. 24) assume feature structures of the sort *nominal-object*. Such structures have an attribute INDEX (IND) which is the HPSG analog of a reference marker in discourse representation theory or of a parameter introduced by an NP used in situation semantics. Structures of sort *nominal-object* may also have an attribute RESTRICTIONS (RESTR).

[41] See (Saussure, 1915) for the notion of sign.

The value of RESTR is a set of parameterized states of affairs (psoas).

(21) *book*:

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix}\textit{noun}\end{bmatrix} \\ \text{SUBCAT} & \left\langle \text{DET} \right\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{1} \begin{bmatrix} \text{PER} & \textit{3} \\ \text{NUM} & \textit{sg} \\ \text{GEN} & \textit{neu} \end{bmatrix} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{INST} & \boxed{1} \\ \textit{book} & \end{bmatrix} \right\} \\ \textit{npro} & \end{bmatrix} \\ \textit{loc} & \end{bmatrix}$$

3.1.2 Parameterized States of Affairs

The semantic contribution of a verbal element is a parameterized state of affairs (psoa). The sort *psoa* has various subsorts that correspond to relations. One such subsort is *walk*. It is a relation with one argument.

(22) *walks*:

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{VFORM} & \textit{fin} \\ \textit{verb} & \end{bmatrix} \\ \text{SUBCAT} & \left\langle \text{NP}[\textit{nom}]\text{:}\ \boxed{1}\ [\textit{3}, \textit{sg}] \right\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{AGENS} & \boxed{1} \\ \textit{walk} & \end{bmatrix} \\ \textit{loc} & \end{bmatrix}$$

In (22) the referential index of the NP complement is structure shared with the value of the agens role in the *walk* relation.

3.2 Complements

As was mentioned above, SUBCAT is a list that contains synsem objects that describe the elements with which a lexical head has to be combined in order to give a maximal projection.

The saturation of elements is described by the following principle.

Principle 1 (Subcategorization Principle) *In a headed phrase (i.e. a phrasal sign whose* DTRS *value is of sort headed-structure), the* SUBCAT *value of the head daughter is the concatenation of the phrase's* SUBCAT *list with the list of* SYNSEM *values of the complement daughters.*

With such a general formulation of the Subcategorization Principle it is possible to state the immediate dominance schema that licenses head complement structures as general as schema 1.

Schema 1 (Head Complement Schema (binary branching))

$$\begin{bmatrix} \text{DTRS} & \begin{bmatrix} \text{COMP-DTRS} & \left\langle [\,] \right\rangle \\ \textit{head-complement-structure} & \end{bmatrix} \\ \textit{phrasal-sign} & \end{bmatrix}$$

(23) shows schema 1 together with the constraints that are imposed on headed structures by the Subcat Principle and by the Head Feature Principle which says that in a headed structure, the HEAD value of the mother is identical to the HEAD value of the head daughter.

(23)
$$\begin{bmatrix} \text{SYNSEM}|\text{LOC}|\text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{SUBCAT} & \boxed{2} \end{bmatrix} \\ \text{DTRS} & \begin{bmatrix} \text{HEAD-DTR} & \begin{bmatrix} \text{SYNSEM}|\text{LOC}|\text{CAT} & \begin{bmatrix} \text{HEAD} & \boxed{1} \\ \text{SUBCAT} & \boxed{2} \oplus \boxed{3} \end{bmatrix} \end{bmatrix} \\ \text{COMP-DTRS} & \left\langle \begin{bmatrix} \text{SYNSEM} & \boxed{3} \end{bmatrix} \right\rangle \\ \textit{head-complement-structure} & \end{bmatrix} \\ \textit{phrasal-sign} & \end{bmatrix}$$

This immediate dominance schema is equivalent to the grammar rule in (24).

(24) $\text{H}[\text{SUBCAT}\ \boxed{2}\,] \rightarrow \text{H}[\text{SUBCAT}\ \boxed{2} \oplus \boxed{3}\,],\ \boxed{3}$

The immediate dominance schemata say nothing about the order of the daughters. The surface order is determined by linear precedence constraints (LP-constraints) which are stated independently from the dominance schemata.

Figure 1 shows an example analysis with the ditransitive verb *geben* (*give*).

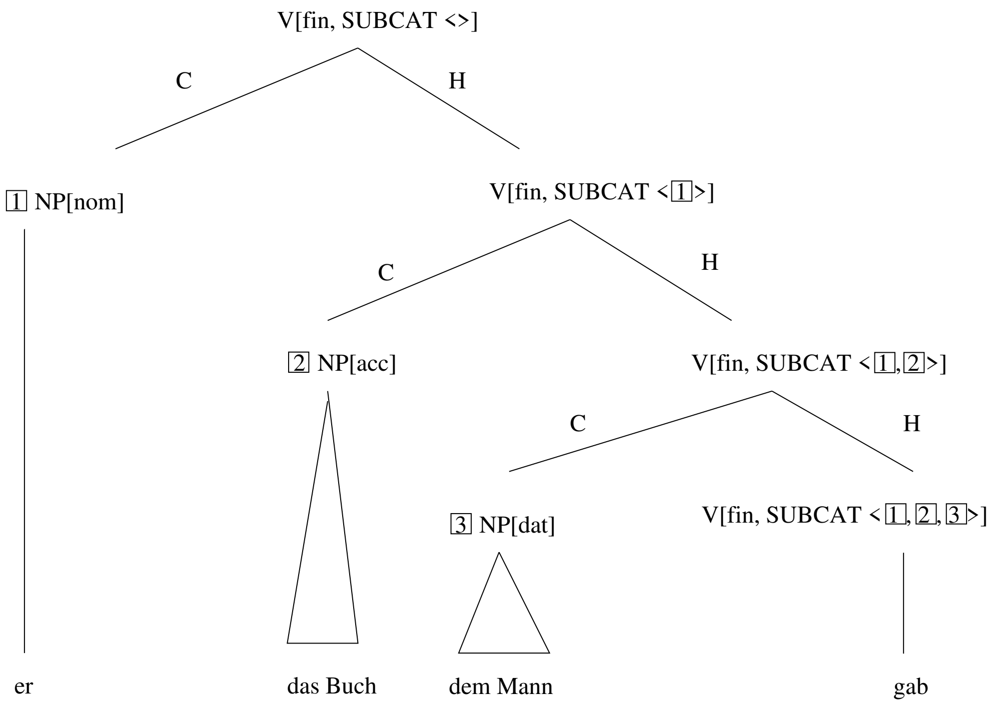

Figure 1: Binary Branching Head Complement Structure

3.3 Adjuncts

Pollard and Sag (1994, Ch. 1.8) assume that an adjunct selects the head it modifies via a feature MODIFIED (MOD). The value of MOD is a feature structure of type *synsem* that describes both syntactic and semantic properties.

(25) shows an example for a non-predicative adjective. This adjective selects a $\overline{\mathrm{N}}$, i.e. a nominal projection that needs a determiner to be a complete NP.

(25) *red*:

$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{PRD} & - \\ \text{MOD} & \overline{\mathrm{N}}: \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RESTR} & \boxed{2} \end{bmatrix} \\ \textit{adj} & \end{bmatrix} \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{INST} & \boxed{1} \\ \textit{red} & \end{bmatrix} \right\} \cup \boxed{2} \end{bmatrix} \\ \textit{loc} & \end{bmatrix}$$

The index of the modified $\overline{\text{N}}$ is structure shared with the index of the adjective. The set of restrictions is unioned with the set of the restrictions that are contributed by the adjective ($red(\boxed{1})$).

The combination of a head and an adjunct is licensed by the Head Adjunct Schema (Schema 2).

Schema 2 (Head Adjunct Schema)

$$\begin{bmatrix} \text{DTRS} & \begin{bmatrix} \text{HEAD-DTR}|\text{SYNSEM} & \boxed{1} \\ \text{ADJ-DTR}|\text{SYNSEM}|\text{LOC}|\text{CAT} & \begin{bmatrix} \text{HEAD}|\text{MOD} & \boxed{1} \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \textit{head-adjunct-structure} & \end{bmatrix} \\ \textit{phrasal-sign} & \end{bmatrix}$$

If the adjective is combined with a noun like *book* the semantics of the phrase is contained in the adjective. The Semantics Principle ensures that the semantic content of a head adjunct phrase is determined by the semantic content of the adjunct:

Principle 2 (Semantics Principle) *In a headed phrase, the* CONTENT *value is token-identical to that of the adjunct daughter if the* DTRS *value is of sort head-adjunct-structure, and with that of the head daughter otherwise.*

Therefore (26) is the result of combining (21) and (25).

red book:

(26)
$$\begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{noun} \end{bmatrix} \\ \text{SUBCAT} & \left\langle \text{DET} \right\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{1} \begin{bmatrix} \text{PER} & \mathit{3} \\ \text{NUM} & \textit{sg} \\ \text{GEN} & \textit{neu} \end{bmatrix} \\ \text{RESTR} & \left\{ \begin{bmatrix} \text{INST} & \boxed{1} \\ \textit{red} & \end{bmatrix}, \begin{bmatrix} \text{INST} & \boxed{1} \\ \textit{book} & \end{bmatrix} \right\} \\ \textit{npro} & \end{bmatrix} \\ \textit{loc} & \end{bmatrix}$$

The SYNSEM value of *book* is unified with the MOD value of *red*. The referential index of *book* (the $\boxed{1}$ in (21)) is unified with the referential index of *red* (the $\boxed{1}$ in (25)). The set of restrictions of *book* is unified with the $\boxed{2}$ in the description of red. This restriction is set unioned with the restriction contributed by the adjective *red*.

3.4 Nonlocal Dependencies

German is assumed to be a verb second language, i.e., in a finite main clause the finite verb is in second position. The first position can be occupied by an adjunct or by a complement. Verb second sentences are derived from verb first sentences by the extraction of one element.

(27) a. Kenne ich das Buch?
know I the book
'Do I know the book?'

b. Das Buch kenne ich.
the book know I
'I know the book.'

In the following, the HPSG treatment of nonlocal dependencies will be introduced by the explanation of the analysis of (27b).

In HPSG a special mechanism is used to establish nonlocal dependencies. In (Pollard and Sag, 1994, Ch. 4), a nonlocal dependency is introduced by a phonologically empty element (a trace).

A Trace:

(28)
$$\begin{bmatrix} \text{PHON} & \langle\rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \boxed{1} \\ \text{NONLOCAL} & \begin{bmatrix} \text{INHERITED} & \begin{bmatrix} \text{QUE} & \langle\rangle \\ \text{REL} & \langle\rangle \\ \text{SLASH} & \left\langle \boxed{1} \right\rangle \end{bmatrix} \\ \text{TO-BIND} & \begin{bmatrix} \text{QUE} & \langle\rangle \\ \text{REL} & \langle\rangle \\ \text{SLASH} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \textit{lexical-sign} & \end{bmatrix}$$

Such a trace can function as a complement or as an adjunct depending on the local context it appears in. The properties of the object that are represented under SYNSEM|LOCAL are introduced into the list under SYNSEM|NONLOCAL|INHERITED|SLASH. The nonlocal feature QUE is used to describe questions and REL to model certain nonlocal dependencies in the relative phrase (see below). Pollard and Sag (1994, p. 366, fn. 23) assume a further feature for extraposition, which they call EXTRA. Throughout the paper I will omit the QUE feature since it is irrelevant for the present discussion.

The Nonlocal Feature Principle ensures that nonlocal information is percolated up to the mother node of complex signs.

Principle 3 (Nonlocal Feature Principle) *For each nonlocal feature, the* INHERITED *value of the mother is the concatenation of the* INHERITED *values on the daughters minus the* TO-BIND *value on the head daughter.*

A SLASH element can be bound off by the Head Filler Schema.

Schema 3 (Head Filler Schema (for German))

$$\begin{bmatrix} \text{DTRS} & \begin{bmatrix} \text{FILLER-DTR} & \begin{bmatrix}\text{SYNSEM}|\text{LOCAL} & \boxed{1}\end{bmatrix} \\ \text{HEAD-DTR}|\text{SYNSEM} & \begin{bmatrix} \text{LOCAL} & \begin{bmatrix}\text{CAT} & \begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{VFORM} & \textit{fin}\\ \text{INITIAL} & +\\ \textit{verb} & \end{bmatrix}\\ \text{SUBCAT} & \langle\rangle\end{bmatrix}\end{bmatrix}\\ \text{NONLOC} & \begin{bmatrix}\text{INHER}|\text{SLASH} & \left\langle \boxed{1}\right\rangle \\ \text{TO-BIND}|\text{SLASH} & \left\langle\boxed{1}\right\rangle\end{bmatrix}\end{bmatrix} \\ \textit{head-filler-structure} & \end{bmatrix} \\ \textit{phrasal-sign} & \end{bmatrix}$$

This schema describes structures where a finite sentence with the verb in initial position (INITIAL+) and with an element in INHER|SLASH ($\boxed{1}$) is combined with a phrase with appropriate LOCAL properties. In the example (27b), *kenne ich* (*know I*) is the finite clause with an appropriate element in SLASH and *das Buch* (*the book*) is the filler. Figure 2 shows the analysis for (27b) in more detail.

3.5 Relative Clauses

As was hinted at in the previous section, relative clauses in German are finite clauses with the finite verb in the right sentence bracket, i.e. in final position if nothing is extraposed and if the verbs are in normal order. The relative phrase is extracted from the finite clause. It contains a relative word and is located to the left of the clause it is extracted from.

(29) der Mann, [$_{\text{RC}}$ [$_{\text{PP}}$ von dem] [$_{\text{S}}$ Maria [ein Bild $\_{\text{PP}}$]
the man, of who Maria a picture
gemalt hat]],
drawn has
'the man who Maria has drawn a picture of'

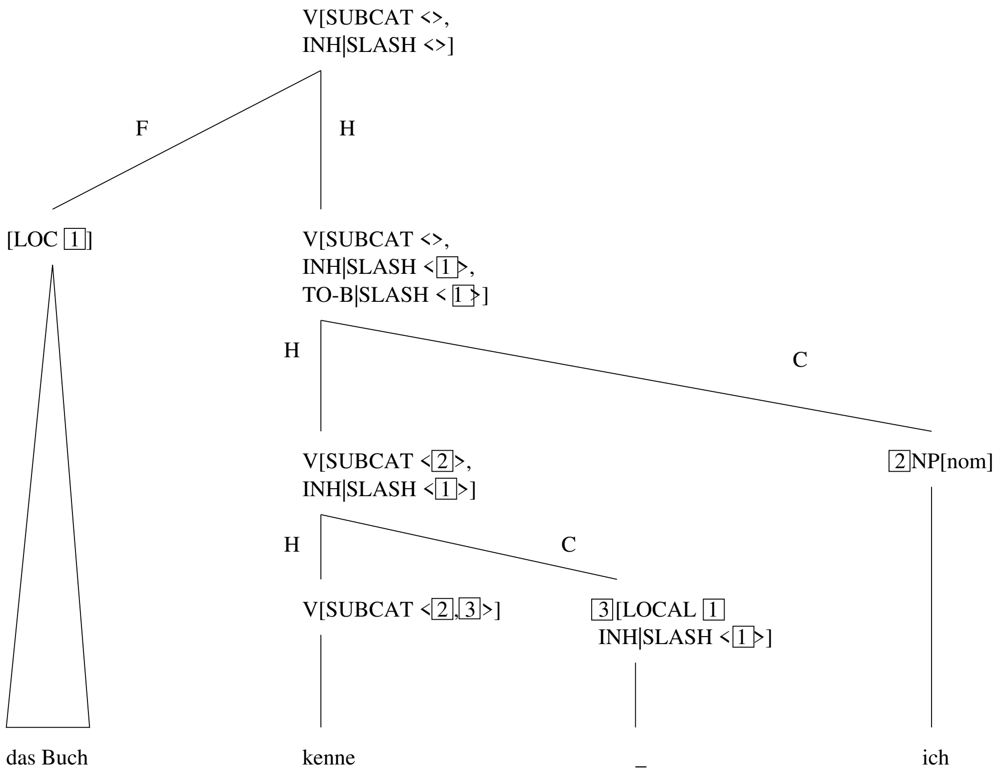

Figure 2: Analysis for: *Das Buch kenne ich.*

The information about the relative word, i.e. *dem* in (29), must be available in the description of the relative phrase. This is ensured by the means of the nonlocal mechanism that is used in HPSG to establish nonlocal dependencies.

(30) shows the lexical entry for the relative word *dem*.

(30)
$$\begin{bmatrix} \text{PHON} & \langle \textit{dem} \rangle \\ \text{SYNSEM} & \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{CAS} & \textit{dat} \\ \textit{noun} & \end{bmatrix} \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \text{CONT} & \begin{bmatrix} \text{IND} & \boxed{1} \begin{bmatrix} \text{PER} & \textit{3} \\ \text{NUM} & \textit{sg} \\ \text{GEN} & \textit{mas} \vee \textit{neu} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER} & \begin{bmatrix} \text{REL} & \left\langle \boxed{1} \right\rangle \\ \text{SLASH} & \langle\rangle \end{bmatrix} \\ \text{TO-BIND} & \begin{bmatrix} \text{REL} & \langle\rangle \\ \text{SLASH} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \textit{lexical-sign} & \end{bmatrix}$$

The referential index of the relative word is identical to the element in NONLOC|-INHER|REL. Principle 3 ensures that the REL value is percolated from this lexical element upwards until the element is bound off in an appropriate way.

Having said this, I can discuss two alternative analyses for relative clauses that modify nouns.

3.6 An Empty Head

The first possibility is to assume an empty head that selects for the relative phrase and for the finite clause from which it is extracted. The lexical entry for the empty relativizer in (31) is completely analogous to the one that was given by Pollard and Sag

(1994, p. 216).

Empty Relativizer:

$$
(31)\quad \begin{bmatrix}
\text{LOC} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{MOD } \overline{\text{N}}\,[\text{TO-B}|\text{REL} \langle \boxed{1} \rangle]: \begin{bmatrix}\text{IND} & \boxed{1}\\ \text{RESTR} & \boxed{2}\end{bmatrix} \\ \textit{relativizer}\end{bmatrix}\\
\text{SUBCAT} & \left\langle \begin{array}{l} [\text{LOC } \boxed{3}, \text{INHER}|\text{REL} \langle \boxed{1}\rangle], \\ \text{S}[\textit{fin}, \text{INHER}|\text{SLASH} \langle \boxed{3}\rangle]: \boxed{4}\end{array}\right\rangle
\end{bmatrix}\\
\text{CONT} & \begin{bmatrix}\text{IND} & \boxed{1}\\ \text{RESTR} & \boxed{2} \cup \{\ \boxed{4}\ \}\end{bmatrix}
\end{bmatrix}\\
\text{NONLOC}|\text{TO-BIND}|\text{SLASH} \langle \boxed{3}\rangle & \\
\textit{synsem} &
\end{bmatrix}
$$

Like the adjective discussed in the previous section, the relative clause modifies a $\overline{\text{N}}$. The semantic content of the complete relative clause is an index ($\boxed{1}$) that is restricted by the set of restrictions contained in the $\overline{\text{N}}$ ($\boxed{2}$), plus the restriction that corresponds to the semantic contribution of the finite clause ($\boxed{4}$).

Figure 3 shows the analysis for (32).

(32) der Mann, [$_{\text{PP}}$ von dessen Schwester] [$_{\text{S}}$ Maria
the man of whose sister Maria
[ein Bild $_{\text{–PP}}$] gemalt hat],
a picture drawn has
'the man a picture of whose sister Maria has drawn'

The PP *von dessen Schwester* is extracted out of the NP *ein Bild*. The Nonlocal Feature Principle percolates the appropriate SLASH feature up to the phrase *Maria ein Bild gemalt hat*. This phrase is the first complement of the empty relativizer. The SLASH value of *Maria ein Bild gemalt hat* ($\boxed{3}$) is bound off by the Nonlocal Feature Principle, since the empty relativizer is the head of the head complement structure. In a second step the empty relativizer is combined with the prepositional phrase. Inside the PP *von dessen Schwester*, the REL value of *dessen* is percolated up. This REL value cannot be bound off during the combination with the empty relativizer if binary branching structures or the schema 1 of Pollard and Sag is used to combine the relativizer with the prepositional phrase. The reason for this is that the projection of the empty relativizer has an empty TO-BIND|REL value after the saturation of the sentential complement. Therefore Pollard and Sag suggested a trick that binds off the inherited REL value after

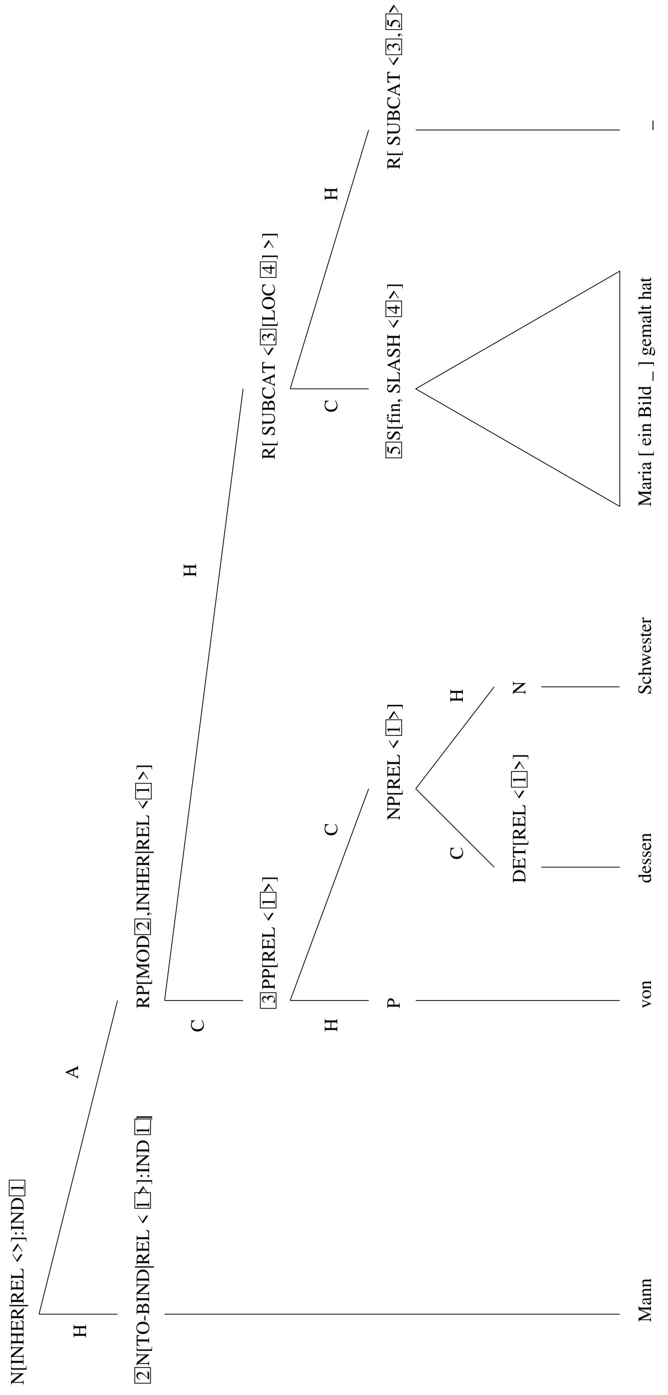

Figure 3: Analysis for: *Mann, von dessen Schwester Maria ein Bild gemalt hat.*

the relative clause has modified the $\overline{\text{N}}$. This binding off is enforced by the specification of the TO-BIND|REL of the modified $\overline{\text{N}}$ via MOD.

The index of *dessen* ($\boxed{1}$) is structure shared with the index of the noun (*Mann*) that is selected via MOD.

The TO-BIND|REL values of all schemata but the head adjunct schema have to be specified as the empty list. Without such a specification REL elements could be bound off in head complement structures, for instance. All modifiers that are not relative clauses have to specify the TO-BIND|REL value of the modified head as the empty list. Otherwise REL elements could be bound off incorrectly, which would provide wrong analyses for sentences like (33).

(33) die Frau, die in der sitzen muß
the woman who in the/which sit must
'the woman who has to sit in it'

If the PP *in der* does not specify the TO-BIND|REL value of *sitzen*, the REL element introduced by *der* can be bound off in the phrase *in der sitzen*. *Die in der sitzen muß* would then have two analyses, an incorrect one with *der* as relative pronoun and a correct one with *der* as demonstrative pronoun.

In the next section, I will provide a more direct description of relative clauses that does not have to stipulate empty elements.

3.7 A Schema

The alternative to an empty head is a schema that directly combines the relative phrase with a finite sentence with the verb in final position (INITIAL−). The schema also provides the correct semantic description at the mother node: The semantic contribution of the relative clause ($\boxed{3}$) is set unioned with the set of restrictions of the modified noun ($\boxed{2}$).

Schema 4 (Relative Clause Schema, preliminary version)

$$
\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix}
\text{LOC} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{MOD}\ \overline{\text{N}}{:}\begin{bmatrix}\text{IND} & \boxed{1}\\ \text{RESTR} & \boxed{2}\end{bmatrix} \\ \textit{relativizer}\end{bmatrix}\\
\text{SUBCAT} & \langle\rangle
\end{bmatrix}\\
\text{CONT} & \begin{bmatrix}\text{IND} & \boxed{1}\\ \text{RESTR} & \boxed{2}\cup\{\ \boxed{3}\ \}\end{bmatrix}
\end{bmatrix}\\
\text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \langle\rangle\\ \text{SLASH} & \langle\rangle\end{bmatrix}\end{bmatrix}
\end{bmatrix}\\
\text{DTRS} & \begin{bmatrix}
\text{RP-DTR} & \begin{bmatrix}\text{SYNSEM} & \begin{bmatrix}\text{LOC} & \boxed{4}\\ \text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \left\langle \boxed{1} \right\rangle\\ \text{SLASH} & \langle\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix}\\
\text{S-DTR} & \begin{bmatrix}\text{SYNSEM} & \begin{bmatrix}\text{LOC} & \begin{bmatrix}\text{CAT} & \begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{INITIAL} & -\\ \text{VFORM} & \textit{fin}\\ \textit{verb} & \end{bmatrix}\\ \text{SUBCAT} & \langle\rangle\end{bmatrix}\\ \text{CONT} & \boxed{3}\end{bmatrix}\\ \text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \langle\rangle\\ \text{SLASH} & \left\langle \boxed{4} \right\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix}\\
\textit{relativizer-structure} &
\end{bmatrix}\\
\textit{phrasal-sign} &
\end{bmatrix}
$$

The type *relativizer-structure* is not a subtype of *headed-structure*. Neither the Head Feature Principle, nor the Subcat Principle, nor the Nonlocal Feature Principle applies. The inheritance of nonlocal features is a special property of the relative clause construction.

A similar treatment of English relative clauses has been suggested by Sag (1997). Sag uses a type hierarchy to capture generalizations about the different phrasal types for various relative clause constructions in English. For German only one schema is necessary to describe modifying relative clauses, so I will not go into the details of type hierarchies for phrasal types here.

Apart from the advantage that this schema provides an analysis for relative clauses that does not use empty elements (see Section 8 for a discussion of the problems with empty elements), there is the advantage that the nonlocal information about the index in the relative phrase (the REL element) is kept locally, i.e., it does not leave the relative clause. This is crucial if one wants to explain relative clause extraposition via the nonlocal mechanism that HPSG provides. Since the same issue is relevant for the analysis of free relative clauses as well, the discussion is postponed to Section 7 (see pages 46–49).

4 The Categorial Properties of Free Relative Clauses

To analyze sentences like (34) there are three options.

(34) Wer schläft, sündigt nicht.
who sleeps sins not
'Those who sleep do not sin.'

Firstly, one can follow Jackendoff (1977, p. 225), who proposed a rule analogous to (35).

(35) $\mathrm{NP} \rightarrow \mathrm{NP}\boxed{1}[\textsc{rel}\ \langle\ [\ ]\ \rangle\ ], \mathrm{S}[\textsc{slash}\ \boxed{1}]$

Secondly, one 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 third alternative would be to assume an empty head that projects the syntactic 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. This approach implements the intuition that a relative clause modifies an empty head.

In the following section the properties of free relatives will be explored. If they behave like their relative phrase and not like clauses, then this would be an argument for the first option. If they behave like sentences and not like NPs, PPs or AdvPs, the lexical rule based approach will be most appropriate. If it can be shown that free relatives behave partly like NPs, PPs or AdvPs and partly like sentences, the third alternative must be followed.

4.1 Agreement and Coordination

Oppenrieder (1991, p. 143) claims that free relative clauses behave like sentences rather than noun phrases with respect to coordination.

(36) Wer erster wird und wer den letzten Platz
who first becomes and who the last place
belegt, bekommt /* bekommen einen Preis.[42]
takes gets /* get a prize
'Both the winner and the loser get prizes.'

(37) Karl und Maria *bekommt / bekommen einen Preis.
Karl and Maria gets / get a prize

Coordinated noun phrases usually introduce a plural index, whereas coordinated sentences are singular. However, there are examples where the coordination of two NPs does not give a plural NP.

(38) a. Viel Wein und Schnaps wurde getrunken.
much wine and schnapps was_{sg} drunk

b. Bei mir geht prinzipiell jeder Montag und jeder
at me $goes_{sg}$ in principal every Monday and every
Donnerstag.[43]
Thursday
'In principal every Monday and every Thursday is okay for me.'

In (38a) mass nouns are coordinated. In (38b) the coordinated NPs contain the quantifier *jeder* and the resulting NP is singular. So, another reason for the agreement phenomena in (36) might be that the semantics of (36) corresponds to (39).

(39) Jeder, der erster wird und jeder, der den
everybody who first becomes and everybody who the
letzten Platz belegt, bekommt /* bekommen einen Preis.
last place takes gets get a prize
'Everybody who wins and everybody who is last gets a prize.'

The structure in (40) would be appropriate under such assumptions.

(40) $[_{NP}$ $[_{NP}$ $[_{RC}$ Wer erster wird]] und $[_{NP}$ $[_{RC}$ wer den letzten Platz belegt]]], bekommt einen Preis.

[42](Oppenrieder, 1991, p. 143)
[43]The sentence is taken from the Verbmobil corpus. For information on the Verbmobil project see (Wahlster, 1993).

Even if one assumes that the relative clauses are coordinated first, this is not a valid argument for the sentential status of free relative clauses, as the structure in (41) can be assigned to (36).

(41) [$_{NP}$ [$_{RC}$ [$_{RC}$ Wer erster wird] und [$_{RC}$ wer den letzten Platz belegt]]], bekommt einen Preis.

The relative clauses could be coordinated first and then the result could be projected to a singular NP. For the analysis of (36) such a structure is not wanted because with standard assumptions about symmetric coordination[44] categorial and nonlocal information of the relative clauses would be shared, which would result in a structure sharing of the indices of both *wer* (*who*) (For details see below).

For sentences like (42), the structure shown in (41) would be appropriate.

(42) [*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![45]

‘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 (42) both *wer* and *dessen* refer to the same discourse referent. So, the relative clauses are coordinated and the resulting relative clause is projected to a noun phrase that refers to one discourse entity. The structure in (41) corresponds to the structure one gets with other modifiers that modify the same head.

(43) die schöne und erfolgreiche Frau
the beautiful and successful woman

(44) die [$_{A}$ [$_{A}$ schöne] und [$_{A}$ erfolgreiche]] Frau

For (43) the structure in (44) is appropriate.

The two different structures that correspond to two different interpretations are available just in case a relative clause is projected. Neither the Jackendoff nor the lexical rule based approach license two structures.

[44]Cf. (Pollard and Sag, 1994, p. 202).
[45]taz, 19.01.96, p. 14

4.2 Coordination

Although there is currently no completely worked out theory of coordination, the analysis of the sentence (8b) about the Unabomber—repeated here as (45) for convenience—is straightforward, if one assumes that the free relative clause *wen immer er für die Zerstörung der Natur verantwortlich machte* projects to an NP which can then be coordinated with the other NP complements of the preposition symmetrically.

(45) Das Motiv ist klar: Haß auf den technischen Fortschritt und seine Repräsentanten, auf [$_{NP}$ [$_{NP}$ Naturwissenschaftler], [$_{NP}$ Computerexperten], [$_{NP}$ Vertreter der Holzindustrie] oder [$_{NP}$ [$_{RC}$ wen immer er für die Zerstörung der Natur verantwortlich machte]].[46]

Both the Jackendoff approach and the approach with an empty head or a unary projection are compatible with this data. The lexical rule based approach is not.

4.3 Semantic Properties

Semantically, free relative clauses behave like their relative word. This is proved by examples like (4)—repeated as (46a) for convenience.

(46) a. [*Wessen* Birne] noch halbwegs in der Fassung steckt,
whose nut yet halfway in the holder is
pflegt solcherlei Erloschene zu meiden; …[47]
uses such extinct to avoid …
'Those who still have their wits half way about them tend to avoid such vacant characters; …'

b. [*Wessen* Schuhe] „danach“ besprenkelt sind, hat keinen
whose shoes after.that speckled are has no
Baum gefunden und war nicht zu einem Bogen in der
tree found and was not to a bow in the
Lage.[48]
position
'If you end up with spattered shoes afterwards it is either because you couldn't find a tree or you were incapable of peeing in an arc.'

[46] taz, taz-mag, 11.08.97, p. 5
[47] Thomas Gsella, taz, 12.02.97, p. 20
[48] taz, taz mag, 08./09.08.98, p. XII

It is not the referent of *wessen Birne* (*whose nut*) that fills the argument role in the matrix clause, but the referent of *wessen* (*whose*). The same applies to (46b): *wessen* fills the role in the matrix clause and *Schuhe* (*shoes*) in the relative clause. This is reflected by the agreement patterns. The finite verb in the relative clause (*sind*) is plural and the finite verb in the matrix clause is singular.

In Chapter 6 of their 1994 book, Pollard and Sag developed a Binding Theory for the HPSG framework. They formulated three principles that restrict the possibility for two referential expressions to be coindexed. Two referential expressions are said to be coindexed if their IND values are structure shared. The first principle (Principle A) says that a reflexive pronoun that is locally o-commanded has to be bound locally. O-command is defined with reference to obliqueness: The subject is less oblique than the primary object and the primary object is less oblique than the second object. The members of the subcat list are ordered according to their obliqueness. Two elements are local to each other if they are members of the same subcat list.

In (47) *Bill* is less oblique than *himself*. Both are members of the subcat list of *know*. *Himself* is o-commanded by *Bill* locally and has to be bound by *Bill*.

(47) Bill$_i$ knows himself$_i$.

If one follows these assumptions of the standard Binding Theory, then this means for (48) that there must be a phrase with an appropriate index in the local domain of the reflexive pronoun *sich*.

(48) [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, [49]

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

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.

All three approaches are compatible with this data as long as the semantic content of the projection or the relative clause itself is of the same semantic type as the relative word.

4.4 Linearization

If one looks at the linearization properties of free relative clauses, one finds more evidence of them behaving like their relative phrase. In (49), the free relative clauses are linearized in the same way as noun phrases.

[49] Wochenpost, 48/95, p. 50

(49) a. Sie hat, [was sie geschenkt bekommen hat,] sofort in den Schrank gestellt.[50]
'She put what she was given into the cupboard instantly.'

b. Schon heute muß, [wer harte Informationen oder lockere Unterhaltung haben will,] blechen, portionenweise, ...[51]
'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.'

In German there is a strong tendency to serialize sentences at the right periphery of the sentence, i.e. to extrapose them.

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

b. Ich habe geglaubt, [daß Peter das interessiert].

Therefore (50a) is marked, whereas the examples in (49) are not. So, the sentences in (49) constitute evidence against the lexical rule based approach.

Free relative clauses (as in (51c)), like ordinary relative clauses (as in (51a)), can be extraposed.[52]

(51) a. Der Hans hat das Geld zurückgegeben, das er
the Hans has the money returned that he
gestohlen hat.
stolen has
'Hans has returned the money that he has stolen'

b. * Der Hans hat zurückgegeben das Geld, das er gestohlen hat.

c. Der Hans hat zurückgegeben, was er gestohlen hat.

Although there are examples of NP-extraposition, the extraposition of NPs is usually marked (51b).[53] This is an argument against Jackendoff's proposal. In his analysis *was er gestohlen hat* would be an NP and therefore (51b) should be as grammatical as (51c). Furthermore, I have never found instances of multiple extraposition where an extraposed PP precedes an extraposed complement NP.

[50] (Bausewein, 1990, p. 152)
[51] c't, 10/96, p. 3
[52] The examples are taken from (Gross and van Riemsdijk, 1981, p. 185).
[53] See (Müller, 1999a, Ch. 13) for examples of NP-extraposition both in written and in spoken language.

(52) Aber der Mann, der das künftige Kinderzimmer in seinem möglicherweise künftigen Heim besichtigt, kann machen [$_{PP}$ in diesen Tagen], [$_{RC}$ was er will], es findet alles Interesse.[54]

‘But the man, who is viewing the future children’s room in what may become his future house, can do what he wants during these days, everything is of interest.’

In (52) *der Mann, der das künftige Kinderzimmer in seinem möglicherweise künftigen Heim besichtigt,* fills the *Vorfeld*, the finite verb *kann* (*can*) is located in the so-called left sentence bracket, the *Mittelfeld* is empty and the right sentence bracket is filled by *machen* (*make*). The PP *in diesen Tagen* (*in these days*) and *was er will* (*what he wants*) are extraposed. If *was er will* is analyzed as a clause, the serialization in (52) is expected.

However, the extraposition data is not an argument for the lexical rule analysis as one can assume that in (51c) just the relative clause complement of an empty head is extraposed. For details of the extraposition analysis, which is also compatible with a unary projection approach, see (Müller, 1999a, Ch. 13). As Gross and van Riemsdijk (1981, p. 187–193) noticed, the assumption of empty heads admits analysis for ungrammatical sentences.

(53) a. Ich habe mich sehr über die Sachen gefreut, die er
I have myself very about the things rejoiced that he
zurückbrachte.
back.brought
’I was very pleased about the things that he brought back.‘

b. Ich habe mich sehr über was er zurückbrachte gefreut.

c. * Ich habe mich sehr über gefreut, was er zurückbrachte.

In (53c) the empty head would fill the position of the prepositional complement. (53c) is totally ungrammatical. Complements of prepositions cannot be extraposed. With an empty head or a unary projection it is not easy to formulate the constraint that the complement of the prepositional complement, i.e. the relative clause, cannot be extraposed. This constraint cannot be implemented via selectional restrictions in the subcat list as the internal structure of complements cannot be subcategorized. The daughters of a sign are not accessible via SUBCAT. If a lexical rule is used, the lexical rule could specify that a complement cannot be extraposed if the rule is applied to a preposition. However, this would be as ad hoc a solution as a constraint that rules out the extraposition in an empty head analyses. I believe that the extraposition data neither supports

[54] taz, 05.09./10.98, p. 6

the projection analyses nor the lexical rule based one and I leave it for further research what rules out sentences like (53c).

In conclusion, it can be said that only the approach with an empty head or a unary projection is appropriate to account for all the data that was presented in this section.

5 Relative Clauses or *w*-Clauses?

The pronoun *wer* (*who*) does not appear in relative clauses that modify a noun.

(54) a. Wer einen Dieb anzeigt, bekommt eine Belohnung.
who a thief reports gets a reward
'Those who report a thief get a reward.'

b. Jeder, der einen Dieb anzeigt, bekommt eine Belohnung.
everybody who a thief reports gets a reward
'Everybody who reports a thief gets a reward.'

c. * Jeder, wer einen Dieb anzeigt, bekommt eine Belohnung.
everybody who a thief reports gets a reward

The *w*-word *was* (*what*) can be used both in relative clauses with an antecedent and in free relative clauses.

(55) a. Das, was er gestohlen hat, war wertvoll.
that what he stolen has was valuable
'The thing/things that he stole was/were valuable.'

b. Was er gestohlen hat, war wertvoll.
what he stolen has was valuable
'What he stole was valuable.'

Wer can appear in embedded questions:

(56) a. Ich möchte wissen, wo er es gestohlen hat.
I would.like.to know where he it stolen has
'I would like to know where he stole it.'

b. Ich möchte wissen, wie er heißt.
I would.like.to know how he is.called
'I would like to know what his name is.'

c. Ich möchte wissen, wer das gestohlen hat.
I would.like.to know who that stolen has
'I would like to know who stole it.'

d. Ich möchte wissen, wem er es gestohlen hat.
I would.like.to know who he it stolen has
'I would.like to know from whom he stole it.'

e. Ich möchte wissen, wen er damit beeindrucken
I would.like.to know who he with.it impress
will.
wants.to
'I would like to know who he wants to impress with this.'

Since the structure of embedded questions and relative clauses is very similar, it might be reasonable to analyze sentences with *w*-words as *w*-clauses. This would contradict Ross's (1979) claim that all clauses that can function as embedded questions can function as relative clauses too, since *wer das gestohlen hat* would be a question only.

Höhle (1983, Ch. 8.1) discovered a difference between *w*-clauses and free relative clauses. If a free relative is used in the Left Dislocation Construction, the anaphor agrees with the relative pronoun.

(57) a. *Wen* er kennt, *den* begrüßt er.
who he knows the greets he
'He greets those who he knows.'

b. * *Wen* er dort sieht, *das* begrüßt er.
who he there sees that greets he

The anaphor for interrogative clauses is *das* (*that*). Since *wissen* cannot take an object NP that refers to a person (58c) is ungrammatical.

(58) a. Ob er kommt, das weiß niemand.
whether he comes that knows nobody
'Nobody knows, if he's coming.'

b. Wen er dort sieht, das weiß niemand.
who he there sees that knows nobody
'Nobody knows who he sees there.'

c. * Wen er dort sieht, den weiß niemand.
who he there sees the knows nobody

The verb *zeigen* can take both an NP and an interrogative sentence as complement.

(59) a. Er soll uns zeigen, wen er kennt.
He is.to us show who he knows
'He is to show us the person who he knows.'

b. Wen er kennt, den soll er uns zeigen.
who he knows the is.to he us show

c. Wen er kennt, das soll er uns zeigen.
who he knows that is.to he us show

Another difference between free relative clauses and *w*-clauses was found by Eisenberg (1986, Ch. 10.1.3).

(60) a. Karl besorgt, was Emma haben will.
Karl gets what Emma have wants.to
'Karl gets what Emma wants to have.'

b. Karl fragt, was Emma haben will.
Karl asks what Emma have want.to
'Karl asks what Emma wants to have.'

Only a small set of verbs allows for indirect questions as complements. One of these verbs is *fragen* (*ask*). Verbs like *besorgen* cannot be combined with *w*-clauses.

(61) * Karl besorgt, wann / warum / wo Emma schlafen
Karl gets when why where Emma sleep
will.
wants.to
Intended: 'Karl gets when / why / where Emma wants to sleep.'

Wissen (*know*) allows both kinds of objects.[55]

[55]Note that the same is true for *fragen* (*ask*), although this is denied by Eisenberg.

(62) a. Ulla weiß, was Egon vermutet.
Ulla knows what Egon suspects

b. Ulla weiß das, was Egon vermutet.
Ulla knows the what Egon suspects
'Ulla knows the fact that Egon suspects.'

c. Ulla weiß, was es ist, das Egon vermutet.
Ulla knows what it is the Egon suspects
'Ulla knows what it is that Egon suspects.'

The sentence in (62a) is ambiguous. It has the relative clause reading that corresponds to (62b) and the interrogative clause reading that corresponds to (62c). Eisenberg constructs the following example to make the two different readings more obvious: If Egon assumes that a certain team won the soccer match, Ulla may already know what Egon is still only suspecting (62b). The other meaning is that Ulla simply knows what the thing is that is assumed by Egon.

However, the arguments by Höhle and Eisenberg do not provide enough evidence against an analysis that assumes that certain free relative clauses are projections of *w*-clauses. The tests can be used to see which properties the projection of the clause in (60a) has. If the complement clause in (60a) is projected to an NP, it does not matter whether the source of the projection was a relative clause or a *w*-clause. However, there are other arguments to assume that the NP is projected from a relative clause and not from a *w*-clause. *W*-clauses have a semantic contribution of type *psoa* whereas relative clauses have a CONT value of type *nom-obj*. The semantics of the projection can be obtained from the relative clause very easily (see Section 7) while a pretty ad hoc construction of the semantics would be necessary if free relative clauses were the result of the projection of a *w*-clause. Apart from this, it would be unclear how the sentence (55b) should be analyzed. Since *was* can appear both in relative clauses with an antecedent and in *w*-clauses, one would get spurious ambiguities for sentences like (55b).

(i) Karl fragt das, was Emma schon immer fragen wollte.
Karl asks that what Emma already always ask wanted.to
'Karl asks the question that Emma has always wanted to ask.'

(ii) is ruled out for semantic reasons.

(ii) * Karl fragt das, was Emma haben will.
Karl asks that what Emma have wants.to

In normal contexts, *fragen* cannot take object NPs that refer to inanimate things a person wants to have.

If the free relative clause in (54a) is not projected from a *w*-clause, *wer einen Dieb anzeigt* must be a relative clause and the free relative must be a projection of it. Another explanation for why the relative clause *wer einen Dieb anzeigt* cannot modify a noun as in (54c) has to be provided.

(54c) can be explained as follows: The class of nouns that can be modified by relative clauses that contain *was* is rather small. According to the Duden (1995, § 1289) *was* can be used if the modified noun is a nominalized adjective or participle that expresses something general, something vague, or a concept.

(63) All das Schöne, was wir in diesen Tagen erlebten,
all the good what we in those days experienced
war zerstört.
was destroyed
'All the good things that we experienced during those days were destroyed.'

Apart from that, *was* can appear together with superlatives and with the antecedent words *das*, *dasjenige*, *dasselbe*, *alles*, *einiges*, *nichts*, *vieles*, and *weniges*. One can assume that the class of elements that can be modified by a relative clause with *wer* is even further restricted. It contains just one element: the empty head. The restrictions for the possible antecedents of a relative word have to be contained in the lexical entry of the relative word. They are percolated through the tree via REL. How this works in detail is described in (Koch, 1996).

6 Case Assignment and Feature Projection

In (64), the relative phrase *was* (*what*) is an NP and the relative clause *was noch übrig war* functions as an NP complement in the matrix clause.

(64) Ich habe gegessen, [was noch übrig war].
I have eaten what still left was
'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 clause shown in (64), the verb in the matrix clause needs an accusative complement, and *war* (*was*) 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 clause, a unification failure would be the result. See figure 4 for illustration.

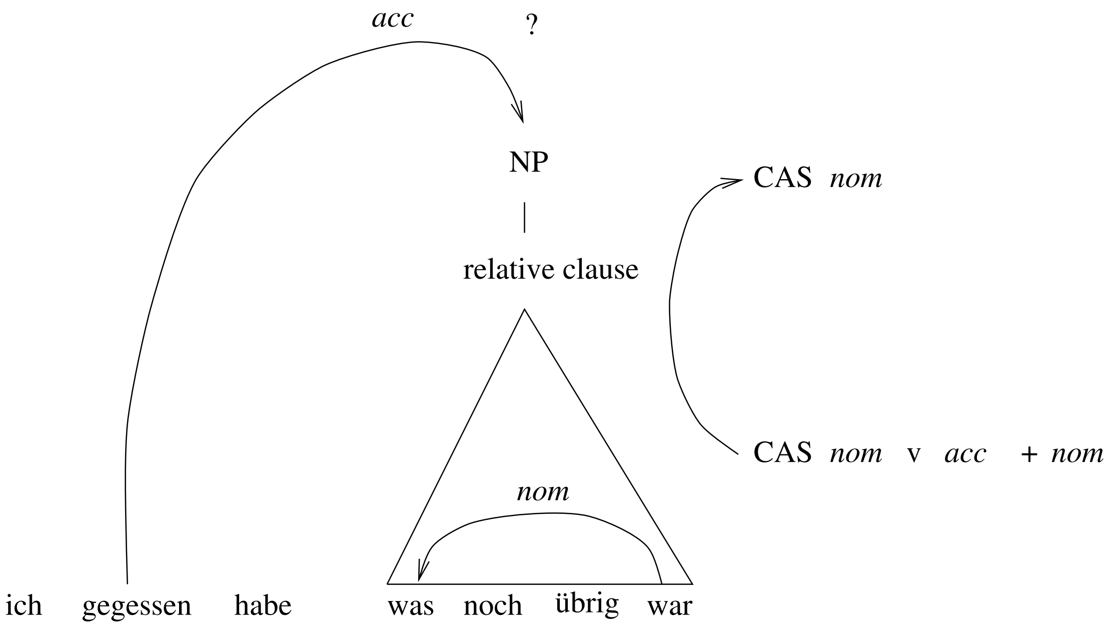

Figure 4: Analysis for *, weil ich gegessen habe, was noch übrig war.*

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.

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

If saturation does not instantiate case values, then the case values of the NPs in (65) will remain $nom \vee acc$. In this case it is impossible to use Linear Precedence Constraints (LP-constraints) under the standard assumptions (see (Uszkoreit, 1987)) to determine the preferred reading of (65), i.e. the one where the nominative NP precedes the accusative one.

If one states an LP rule like (66), then either sentences like (65) are ruled out, or the rule is never applied to those sentences:[56] If one assumes that a description in an LP rule has to unify with the linearized element, then the rule would exclude (65). 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 (65).

(66) NP[*nom*] < NP[*acc*]

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

(67) , 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 (67) 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 to relative clauses. Relative clauses are generally analyzed as clauses from which a relative phrase is extracted via a nonlocal dependency construction (see Section 3). When a nonlocal dependency is introduced the subcategorization requirements will 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 (68) would be admitted by the grammar.

(68) 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

[56] Of course nobody would use LP rules like (66) in an actual German grammar. Instead one would use a disjunction of LP statements. See (Uszkoreit, 1987) for 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 (66) would be violated and the sentence would be regarded as marked, which it is not.

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.

Dalrymple and Kaplan (1997) suggested an interesting alternative for analyzing the matching effects in an LFG framework. Instead of using a subsumption test on types, they assume that the value of the CAS feature is a set and case requirements are checked with a membership test. The pronoun *wer* has the case value $\{nom\}$ and the case of *was* is $\{nom, acc\}$. In an HPSG theory the case requirements of a verb like *liebt* (*loves*) would be formulated as in (69).

(69) $$\begin{bmatrix} \text{SUBCAT} \left\langle \text{NP[CAS } \boxed{1} \text{], NP[CAS } \boxed{2} \text{]} \right\rangle \\ \textit{cat} \end{bmatrix} \wedge nom \in \boxed{1} \wedge acc \in \boxed{2}$$

Interestingly, this approach makes the right predictions for sentences like (68), assuming that the grammar is processed in a certain way. If one assumes lazy evaluation for constraints like, for instance, van Noord and Bouma (1994) suggested for the treatment of adjuncts, constraints can be blocked if there is not sufficient information for them to be applied. So if *liebt* is combined with a trace, the constraint $acc \in \boxed{2}$ is not applied as there is no information about the case value present. However, the constraint is applied when the filler is bound off, and then (68) violates the constraint, and the sentence is rejected by the grammar.

The problem Ingria's approach had with uninstantiated case features carries over to the set-based approach of Dalrymple and Kaplan. The case of the complements is just checked. This checking does not effect the case values of the complements. So in (70) the case value of both complements is still $\{nom, acc\}$.

(70) a. , weil das Krokodil$_{\{nom,acc\}}$ das Mädchen$_{\{nom,acc\}}$ beißt.
because the crocodile the girl bites
'because the crocodile bites the girl.'

b. , weil das Mädchen$_{\{nom,acc\}}$ das Krokodil$_{\{nom,acc\}}$ beißt.
because the girl the crocodile bites
unmarked: ', because the girl bites the crocodile.'
marked: ', because the crocodile bites the girl.'

Linearization rules could not change the case values either. So the only thing that could be done within the linearization component is a test for set membership. If (66) means that all sentences where an accusative complement appears in front of a nominative complement are to be ruled out, then both sentences in (70) are ruled out. If the order based account of Kasper, Kathol, and Pollard (1995) is adopted the constraint would say nothing about sentences like (70), and it would remain unclear why the ordering of the subject and the object in (70b) is marked.[57]

Another problem for both the subsumption and the set based approach is certain adverbial phrases that have to agree in gender and case with an argument of the verb. Höhle (1983, Chapter 6) gives the following examples:

(71) a. [Die Türen]$_i$ sind [eine nach der anderen]$_i$
the doors$_{nom,fem}$ are one$_{nom,fem}$ after the$_{fem}$ other
kaputt gegangen.
broke gone
'The doors broke one after another.'

b. [Einer nach dem anderen]$_i$ haben wir$_i$ die
one$_{nom,mas}$ after the$_{mas}$ other have we$_{nom}$ the
Burschen runtergeputzt.
lads down.cleaned
'We took turns in bringing the lads down a peg or two.'

c. [Einen nach dem anderen]$_i$ haben wir [die
one$_{acc,mas}$ after the$_{mas}$ other have we the
Burschen]$_i$ runtergeputzt.
lads$_{acc,mas}$ down.cleaned
'One after the other, we brought the lads down a peg or two.'

d. Ich ließ [die Burschen]$_i$ [einen nach dem anderen]$_i$
I let the lads$_{acc,mas}$ one$_{acc,mas}$ after the$_{mas}$ other
einsteigen.
in.get
'I let the lads get in (get started) one after the other.'

[57] It could, of course, be the case that the linearization component does not need to refer to case values. For instance, the verb could instantiate the feature THEMATIC ROLE (TR) of its arguments. Cf. (Uszkoreit, 1986). The LP-rules can then refer to the value of TR. The problem with this approach is that there are constructions like control and causative constructions where complements would get assigned more than one role.

e. Uns$_i$ wurde [einer nach der anderen]$_i$ der Stuhl
us$_{dat}$ were one$_{dat,fem}$ after the$_{fem}$ other the chair
vor die Tür gesetzt.
in.front.of the door set
'We were given the sack one after the other.'

If case requirements are checked by a membership test only, sentences like (72b) are not ruled out.

(72) a. , weil Kasparow [seine Gegner]$_i$
because Kasparow his opponents$_{\{nom,acc\}}$
[einen nach dem anderen]$_i$ geschlagen hat.
one$_{acc,mas}$ after the$_{mas}$ other beaten has
'because Kasparow beat his opponents one after the other.'

b. * , weil Kasparow seine Gegner
because Kasparow his opponents$_{\{nom,acc\}}$
einer nach dem anderen geschlagen hat.
one$_{nom,mas}$ after the$_{mas}$ other beaten has

If one follows the approach of Dalrymple and Kaplan, the requirement of *einer nach dem anderen* to have a nominative antecedent has to be checked with a membership test as well since these adverbial phrases can appear in free relative clauses, as the example (73) shows.

(73) Die da einer neben dem anderen
those$_{\{nom,acc\}}$ there one$_{nom,mas}$ beside the$_{mas}$ other
stehen haben wir einen nach dem anderen gesehen.
stand have we one$_{acc,mas}$ after the$_{mas}$ other seen
'We saw those who are standing there one beside the other one after the other.'

In the embedded relative clause *einer neben dem anderen* is nominative and in the matrix clause *einen nach dem anderen* that refers to the accusative complement—i.e. the embedded free relative clause—is accusative. So, if case agreement is checked by a membership test, this test succeeds both for (72a) and (72b) since the case of *seine Gegner* is $\{nom, acc\}$.

So accounts that are based on subsumptions make wrong predictions and set-based accounts need additional machinery for the interpretation of the grammar constraints and do not allow other components of the grammar to refer to case values of complements.

Therefore I will now propose a different account that uses an additional feature for the morphological realization of case to describe the case phenomena. With such a feature it is then possible to use unification for functor argument combination.

If one looks at sentences like (64)—repeated here as (74)—and (75), one can see that the general pattern for free relative clauses is as follows: A free relative clause 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 relative clauses share certain syntactic and semantic properties with their relative phrase.

(74) Ich habe gegessen, [was noch übrig war].
I have eaten what still left was
'I ate what was left over.'

(75) Ihr könnt beginnen, [mit wem ihr (beginnen) wollt].
you can start with whom you start want
'You can start with whoever you like.'

In (74) *was noch übrig war* fulfills the function of an NP complement in the matrix clause, whereas in (75) *mit wem ihr (beginnen) wollt* has the function of a PP just as the relative phrase *mit wem* does. If the relative phrase is a complement PP, the head features are identical, and if it is an NP, all head features but the CASE feature are identical. Instead of projecting the case of the NP, which would lead to unification clashes in certain cases, the morphological case is projected.[58] The morphological case is the value of a separate feature MORPH-CASE, which is not changed if heads and complements are combined. To be able to project morphological case without being affected by subcategorization requirements I assume a complex structure for the case value.[59]

(76) $\begin{bmatrix} \text{MORPH-CASE} & nom \vee gen \vee dat \vee acc \\ \text{SYN-CASE} & nom \vee gen \vee dat \vee acc \\ case & \end{bmatrix}$

[58]Note that it is not possible to leave the projected case value unconstrained, as sentences like (13) and (14) might suggest. This would lead to overgeneration, as the free relative clause in (i) could be interpreted as a dative argument of *kaufen*.

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

[59]In ((Müller, 1998); (Müller, 1999a, Ch. 15)), I use an additional feature CASE-TYPE for the distinction of structural and lexical case. The feature is omitted here since it is irrelevant for the present discussion.

In subcat lists only SYN-CASE values of complements are specified. The value for MORPH-CASE for *was* is $nom \vee acc$.[60] This value gets projected, so that the projection of the relative clause *was noch übrig war* becomes an NP $nom \vee acc$. As figure 5 shows,

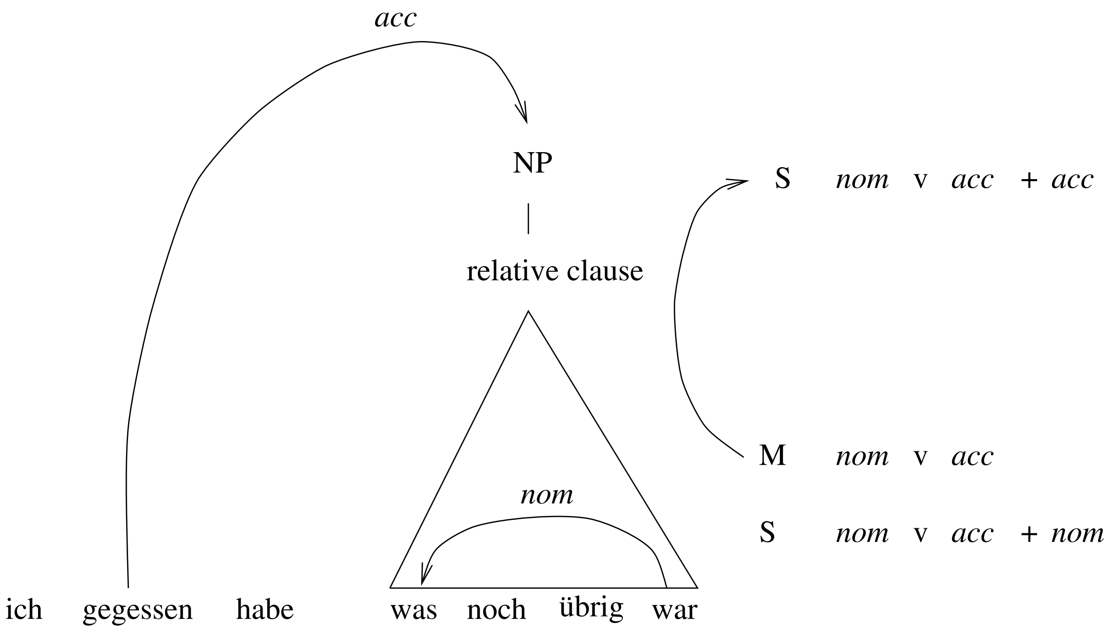

Figure 5: Analysis for *, weil ich gegessen habe, was noch übrig war.*

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

7 The Analysis

As was explained in Section 4, it is reasonable to assume that free relative clauses are a projection of a relative clause that inherits the syntactic properties of its relative phrase. (3a) therefore gets the structure shown in (77).

(77) $[_{\text{NP}}$ $[_{\text{RC}}$ 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.[61]

[60]Note that $nom \vee acc$ stands for a type. So if the disjunctive normal form for the description of *was* is computed, the values of MORPH-CASE and SYN-CASE are still $nom \vee acc$. Otherwise one would get four entries for pronouns like *was*. This would not be a problem for the analysis of free relative clauses, but one would get spurious ambiguities for sentences with normal relative clauses.

[61]See (Bausewein, 1990, p. 149) for remarks on the gender of *wer* (*who*). Syntactically *wer* behaves like a masculine pronoun but can nevertheless refer to a female person. The SEXUS value of *wer* is $fem \vee$

(78)
$$\left[\begin{array}{ll} \text{IND} & \boxed{1}\left[\begin{array}{ll} \text{PER} & \mathit{3} \\ \text{NUM} & \mathit{sg} \\ \text{GEN} & \mathit{mas} \end{array}\right] \\ \text{RESTR} & \left\{ \left[\begin{array}{ll} \text{THEMA} & \boxed{1} \\ \mathit{schlafen} & \end{array}\right] \right\} \\ \mathit{nom\text{-}obj} & \end{array}\right]$$

The index is identical to the index of the relative word. The set of restrictions is a set that contains the semantic content of the relative clause. This shows that free relatives behave like modifying relatives that modify an empty head with an empty restriction

---

mas.

(i) Wer hat seinen Lippenstift liegen lassen? (Bausewein, 1990, p. 149)
who has his lipstick lie let
'Who left their lipstick?'

The SEXUS value of the relative pronoun *der* is *mas*. The sentence in (ii.a) is not ungrammatical as is claimed by Bausewein.

(ii) a. Der da kommt, ist schwanger.
the$_{mas}$ there comes is pregnant
'The man who is coming there is pregnant.'

b. Die da kommt, ist schwanger.
the$_{fem}$ there comes is pregnant
'The woman who is coming there is pregnant.'

c. Wer da kommt, ist schwanger.
who there comes is pregnant
'The one who is coming there is pregnant.'

It is odd because the presupposition that the referent is female is violated. But with an appropriate context such sentences are possible.

(iii) Der da kommt, ist nicht schwanger, denn es ist Peter und Männer werden nicht schwanger.
'The man who's coming isn't pregnant, because it's Peter, and men don't get pregnant.'

But it is certainly true that *der* refers to a male discourse referent.

set.

(79)
$$\left[\begin{array}{ll} \text{CAT} & \left[\begin{array}{ll} \text{HEAD} & \left[\begin{array}{l} \text{MOD}\ \overline{\text{N}}\text{:} \left[\begin{array}{ll} \text{IND} & \boxed{1} \\ \text{RESTR} & \boxed{2} \end{array}\right] \\ \textit{relativizer} \end{array}\right] \\ \text{SUBCAT} & \langle\rangle \end{array}\right] \\ \text{CONT} & \left[\begin{array}{ll} \text{IND} & \boxed{1} \left[\begin{array}{ll} \text{PER} & \textit{3} \\ \text{NUM} & \textit{sg} \\ \text{GEN} & \textit{mas} \end{array}\right] \\ \text{RESTR} & \boxed{2} \cup \left\{ \left[\begin{array}{ll} \text{THEMA} & \boxed{1} \\ \textit{schlafen} & \end{array}\right] \right\} \end{array}\right] \\ \textit{loc} & \end{array}\right]$$

(79) shows what the LOCAL value of the relative clause *wer schläft* looks like according to the analysis described in Section 3. If $\boxed{2}$ is instantiated as $\{\}$ we get (78).

Note what happens if two instances of (79) are coordinated. According to the standard assumptions the CAT values of both conjuncts are structure shared. This leads to the unification of the MOD values, i.e. the indices ($\boxed{1}$) of both relative clauses get unified. In a structure like (41) the two relatives therefore refer to the same discourse referent. This is the only reading available for the lexical rule based approach.[62]

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 head value of the relative phrase.

The first option would violate the Locality Principle[63] 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 (42). In (79) the relative phrase daughters are not directly accessible. Therefore only the last two options remain. The second option is not to bind off the REL value and 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.[64] However, this approach

[62] It could, however, be assumed that free relatives do not have a MOD value. Then, of course, it remains a pure coincidence that in some constructions the coordinated relative clauses refer to the same referent.

[63] (Pollard and Sag, 1987, p. 142–143)

[64] In her paper on Bulgarian relative clause constructions, Avgustinova (1996) suggests the projection of the REL value to the next level. A lexical rule changes the subcategorization frame of the governing

is not compatible with the treatment of extraposition as a nonlocal dependency, as was suggested by Keller (1995) and Bouma (1996) (see also (Müller, 1999a, Ch. 13.2) for some discussion). Relative clauses can be extraposed, but the projected SLASH element can not be bound off if the extraposed relative clause becomes bound as a daughter of a verbal projection. If the example sentence in (80) is analyzed in terms of a nonlocal dependency the sentence gets the structure in figure 6.

(80) , weil ich gegessen habe, was noch übrig war.
because I eaten have what still left was
'because I ate what was left over.'

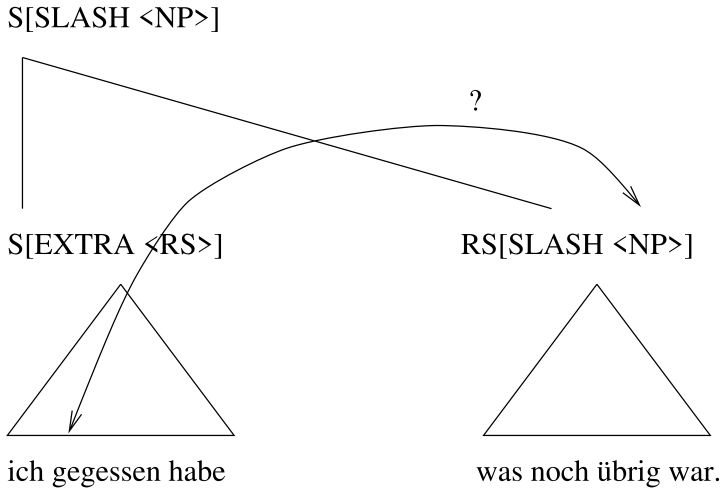

Figure 6: Analysis for *, weil ich gegessen habe, was noch übrig war.*

The elements in SLASH and EXTRA are *local*-objects. A lexical rule or trace for the introduction of the SLASH element has to specify that a complement has a nonempty

verb. The matrix verb selects for a relative clause with an appropriate REL value and binds off the inherited REL value. As is clear from looking at the data presented in Section 2 the REL value is not restrictive enough. Avgustinova's analysis would admit ungrammatical sentences like (i) if it were integrated in a grammar for German.

(i) * Ihr könnt beginnen, wem ihr helft.
you can start whom you help

As prepositional phrases in complement function introduce an index that is indistinguishable from indexes of nominal phrases, the matrix verb's subcategorization requirements can be satisfied by *wem ihr helft* and by *mit wem ihr wollt* (see sentence (3h)). The REL value that is projected from *mit wem* is identical to the one projected from *wem*. This shows that information about syntactic properties of the relative phrase like the syntactic category and the case value have to be projected to the level where subcategorization requirements of the matrix verb are checked.

SLASH value (see (Müller, 1994; Müller, 1997a)).

(81)
$$\left[\begin{array}{ll} \text{SYNSEM} & \left[\begin{array}{ll}\text{LOC} & \left[\text{CAT}|\text{COMPS}\ \boxed{1} \oplus \left\langle \boxed{2} \right\rangle \oplus \boxed{3}\right] \\ \text{NONLOC} & \left[\text{INHER}|\text{SLASH}\ \boxed{4}\right]\end{array}\right] \\ \textit{lexical-sign} & \end{array}\right] \rightarrow$$
$$\left[\begin{array}{ll} \text{SYNSEM} & \left[\begin{array}{ll}\text{LOC} & \left[\text{CAT}|\text{COMPS}\ \boxed{1} \oplus \boxed{3}\right] \\ \text{NONLOC} & \left[\text{INHER}|\text{SLASH}\ \boxed{4} \oplus \left\langle \boxed{5} \right\rangle\right]\end{array}\right] \\ \textit{lexical-sign} & \end{array}\right]$$

Where $\boxed{2}$ corresponds to the structure in (82).

(82)
$$\left[\begin{array}{ll} \text{LOC} & \boxed{5} \\ \text{NONLOC} & \left[\begin{array}{ll}\text{INHER} & \left[\begin{array}{ll}\text{QUE} & \langle\rangle \\ \text{REL} & \langle\rangle \\ \text{SLASH} & \left\langle \boxed{5} \right\rangle \\ \text{EXTRA} & \langle\rangle\end{array}\right]\end{array}\right] \\ \textit{synsem} & \end{array}\right]$$

Without the restriction in (82) it were possible to analyze (83).

(83) * [To talk to John] Max is easy.

For *easy*-adjectives Pollard and Sag (1994, p. 167) assume the following entry.[65]

(84)
$$\left[\begin{array}{l} \text{LOC}|\text{CAT} \left[\begin{array}{l}\text{HEAD}\ \textit{adjective} \\ \text{SC} \left\langle \text{NP}_{\boxed{1}},\ \text{VP}[\textit{inf},\ \text{SLASH} \left\langle \boxed{2}\ \text{NP}[\textit{acc}]{:}\textit{ppro}_{\boxed{1}} \right\rangle] \right\rangle\end{array}\right] \\ \text{NONLOCAL}|\text{TO-BIND}|\text{SLASH} \left\langle \boxed{2} \right\rangle \end{array}\right]$$

So if the lexical rule could be applied to *easy*-adjectives, just the LOCAL value of the infinitive VP would be introduced into SLASH. This SLASH value would then have to

[65]See also (Flickinger and Nerbonne, 1992).

be bound off by a fully saturated VP with an empty SLASH list. The ungrammatical sentence (83) would be the result. The same holds for the extraposition lexical rule.

(85)
$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT}|\text{COMPS} & \boxed{1} \oplus \left\langle \boxed{2} \right\rangle \oplus \boxed{3} \end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER}|\text{EXTRA} & \boxed{4} \end{bmatrix} \end{bmatrix} \\ \textit{lexical-sign} & \end{bmatrix} \rightarrow$$
$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT}|\text{COMPS} & \boxed{1} \oplus \boxed{3} \end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER}|\text{EXTRA} & \boxed{4} \oplus \left\langle \boxed{5} \right\rangle \end{bmatrix} \end{bmatrix} \\ \textit{lexical-sign} & \end{bmatrix}$$

Where $\boxed{2}$ corresponds to the structure in (86).

(86)
$$\begin{bmatrix} \text{LOC} & \boxed{5} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER} & \begin{bmatrix} \text{QUE} & \langle\rangle \\ \text{REL} & \langle\rangle \\ \text{SLASH} & \langle\rangle \\ \text{EXTRA} & \left\langle \boxed{5} \right\rangle \end{bmatrix} \end{bmatrix} \\ \textit{synsem} & \end{bmatrix}$$

In the case of relative clause complements, the extraposition lexical rule or a schema for the introduction of the extraposition dependency could wrongly ignore the SLASH value in (86).

However, there is still a problem, as there is nothing that binds off the SLASH value of the extraposed relative clause. As figure 6 shows, there is no connection between the SLASH values at the introduction of the extraposition dependency and the landing site.[66]

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[66]Note that an analoguous problem arises for the analysis of embedded *w*-questions.

(i) a. Ich$_i$ möchte $\_{i}$ $\_{j}$ wissen, [wer das gestohlen hat]$_j$.
I would.like.to know who that stolen has
'I would like to know who stole it.'

The third option to present the information about the relative phrase does not have this problem. I will introduce a feature RP-HEAD that contains information about the categorial properties of the relative phrase. It is sufficient to project just the information about head features since the constraints on the relative phrase in relative clauses allow only maximal projections to function as relative phrases. Therefore the valence information under CAT does not need to be projected.

The identity of the HEAD value of the relative phrase and the RP-HEAD value ($\boxed{3}$) is enforced by structure sharing in the final version of the schema 4 which licenses the relative clause.

---

b. [Wer das gestohlen hat]$_i$ möchte ich _$_i$ wissen.
   who that stolen has would.like.to I know

If *wissen* is analyzed as a verb that subcategorizes for a sentential complement with a non-empty QUE feature, the sentences in (i) cannot be explained. In (i.a) the *w*-question is extraposed and if extraposition is modelled via the nonlocal mechanism, the connection between matrix verb and QUE feature of the embedded question is lost. In (i.b) the *w*-question is fronted. As explained in Section 3.4, the fronting of the sentential complement is analyzed as extraction from the finite clause (*möchte ich _$_i$ wissen*). And such extractions are described with the SLASH mechanism.

Schema 5 (Relative Clause Schema, final version)

$$
\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix}
\text{LOC} & \begin{bmatrix}
\text{CAT} & \begin{bmatrix}
\text{HEAD} & \begin{bmatrix} \text{MOD } \overline{\text{N}}\text{:} & \begin{bmatrix} \text{IND} & \boxed{1} \\ \text{RESTR} & \boxed{2}\end{bmatrix} \\ \text{RP-HEAD} & \boxed{3} \\ \textit{relativizer} & \end{bmatrix} \\
\text{SUBCAT} & \langle\rangle
\end{bmatrix} \\
\text{CONT} & \begin{bmatrix}\text{IND} & \boxed{1} \\ \text{RESTR} & \boxed{2} \cup \{\ \boxed{4}\ \}\end{bmatrix}
\end{bmatrix}\\
\text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \langle\rangle \\ \text{SLASH} & \langle\rangle\end{bmatrix}\end{bmatrix}
\end{bmatrix} \\
\text{DTRS} & \begin{bmatrix}
\text{RP-DTR} & \begin{bmatrix}\text{SYNSEM} & \begin{bmatrix}\text{LOC} & \boxed{5}\ \text{CAT}|\text{HEAD}\ \boxed{3} \\ \text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \left\langle \boxed{1} \right\rangle \\ \text{SLASH} & \langle\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix} \\
\text{S-DTR} & \begin{bmatrix}\text{SYNSEM} & \begin{bmatrix}\text{LOC} & \begin{bmatrix}\text{CAT} & \begin{bmatrix}\text{HEAD} & \begin{bmatrix}\text{INITIAL} & - \\ \text{VFORM} & \textit{fin} \\ \textit{verb} & \end{bmatrix} \\ \text{SUBCAT} & \langle\rangle\end{bmatrix} \\ \text{CONT} & \boxed{4}\end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix}\text{INHER} & \begin{bmatrix}\text{REL} & \langle\rangle \\ \text{SLASH} & \left\langle \boxed{5} \right\rangle\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix} \\
\textit{relativizer-structure} &
\end{bmatrix} \\
\textit{phrasal-sign} &
\end{bmatrix}
$$

The unary schema 6 can then access the RP-HEAD value and the appropriate values that are dependent on RP-HEAD can be projected.

Schema 6 (Relative Clause Projection Schema)

$$\begin{bmatrix}
\text{SYNSEM} & \begin{bmatrix} \text{LOC} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \textit{free_rc_head}(\boxed{1}) \\ \text{SUBCAT} & \langle\rangle \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix} \\ \text{NONLOC} & \begin{bmatrix} \text{INHER} & \begin{bmatrix} \text{REL} & \langle\rangle \\ \text{SLASH} & \langle\rangle \end{bmatrix} \end{bmatrix} \end{bmatrix} \\
\text{DTRS} & \begin{bmatrix} \text{RC-DTR} & \begin{bmatrix} \text{SYNSEM}|\text{LOC} & \begin{bmatrix} \text{CAT}|\text{HEAD} & \begin{bmatrix} \text{MOD N:[RESTR } \{\}] \\ \text{RP-HEAD } \boxed{1} \\ \textit{relativizer} \end{bmatrix} \\ \text{CONT} & \boxed{2} \end{bmatrix} \end{bmatrix} \\ \multicolumn{2}{l}{\textit{relativizer-projection-structure}} \end{bmatrix} \\
\multicolumn{2}{l}{\textit{phrasal-sign}}
\end{bmatrix}$$

Structures of type *relativizer-projection-structure* are, of course, not subtypes of *headed-structure*. The instantiation of the RESTRICTIONS value under MOD in the RC-DTR has already been discussed on page 46. It corresponds to the intuition that the free relative clause modifies an empty head with an empty restriction set.

free_rc_head relates the projected HEAD value to the HEAD value of the relative phrase in a way that is shown in (87) and (89). The relational constraint is equivalent to a (distributed) disjunction.

(87)
$$\textit{free\_rc\_head}(\text{N}[\text{MORPH-CASE } \boxed{1}]) = \begin{bmatrix} \text{CAS}|\text{SYN-CASE} & \boxed{1} \\ \textit{noun} & \end{bmatrix}$$

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. Let us take the sentence (12a), repeated here as (88), as an example.

(88) Die da stehen, kennen wir nicht.
those$_{nom \vee acc}$ there stand know we not
'We don't know the ones that are standing over there.'

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*.

Sentences like (9b) and (11c) can be ruled out easily if the case value in (87) is specified as distinct from genitive.

The compatibility hierarchy can be implemented by projecting NPs with MORPH-CASE *dat* to NPs with SYN-CASE $nom \vee dat \vee acc$ and NPs with MORPH-CASE *acc* to NPs with SYN-CASE $nom \vee acc$.

If the relative phrase is a complement PP, then its head features are identical to the projected features.

(89) $free\_rc\_head(\boxed{1}\ \mathrm{P}[\textsc{mod}\ none]) = \boxed{1}$

If the compatibility hierarchy is included, the constraint for the LOCAL value of the projection looks like (90).

(90)
$$free\_rc\_head(\boxed{1}\ \mathrm{P}[\textsc{mod}\ none]) = \\ \boxed{1} \vee \begin{bmatrix} \textsc{cas}|\textsc{syn-case}\ \ nom \vee acc \\ noun \end{bmatrix}$$

8 Alternatives

As was shown in Section 4.4 the Jackendoff proposal cannot explain the extraposition data and the lexical rule based approach fails to explain the linearization of free relatives in the *Mittelfeld*. So, the only alternative that remains to be explored is an empty head.

If one uses an empty head to analyze modifying relative clauses like Pollard and Sag (1994) do, it seems reasonable to use empty heads to analyze free relative clauses as well.

The intuition that a free relative is a modifying relative clause that modifies an empty head cannot be encoded directly. The empty head would be a maximal projection. It could thus function as a complement without modification by a relative clause since modification is optional. Therefore all arguments of a verb could be saturated by empty elements and we would end up with ungrammatical structures like (91).

(91) Gibt $\_{NP[nom]}$ $\_{NP[dat]}$ $\_{NP[acc]}$
gives

But the single ditransitive verb is not a complete sentence in German. The only way to make the presence of the relative clause obligatory is to subcategorize for it. (92) shows the entry for free relatives.

(92) empty category changing head:

$$\left[\begin{array}{ll} \text{LOC} & \left[\begin{array}{ll} \text{C} & \left[\begin{array}{ll} \text{HEAD} & \textit{free\_rc\_head}(\boxed{1}) \\ \text{SUBCAT} & \left\langle \left[\begin{array}{ll} \text{LOC} & \left[\begin{array}{ll} \text{C} & \left[\begin{array}{ll} \text{H} & \left[\begin{array}{l} \text{RP-HEAD } \boxed{1} \\ \text{MOD N:[RESTR } \{\}] \\ \textit{relativizer}\end{array}\right] \\ \text{SUBCAT} & \langle\rangle \end{array}\right] \\ \text{CONT} & \boxed{2} \end{array}\right] \\ \text{NONLOC|INHER|REL} & \langle \boxed{3} \rangle \end{array}\right] \right\rangle \end{array}\right] \\ \text{CONT} & \boxed{2}\end{array}\right] \\ \text{NONLOC} & \left[\text{TO-BIND|REL } \langle \boxed{3}\rangle\right] \\ \textit{synsem} & \end{array}\right]$$

Again the head features are computed from the RP-HEAD value of the relative clause by the relation *free_rc_head* as defined in the last section.

One drawback of empty elements is that one has to explain why they cannot be coordinated. Elements with equal syntactic structure can usually be coordinated regardless of their saturation.

(93) Kennt und achtet Karl Maria?
knows and respects Karl Maria
'Does Karl know and respect Maria?'

In (93) the two transitive verbs *kennen* and *achten* are coordinated. Their subcategorization lists get unified. The resulting phrase *kennt und achtet* is a verbal projection that has the same subcategorization requirements as the two coordinated verbs have. This phrase functions as the head of the complete sentence and is combined with its two dependent elements *Karl* and *Maria*.

Similar structures are possible with two of the empty category changing heads. They could be coordinated resulting in a phrase like (94).

(94) $\_e$ und $\_e$

This structure could then be combined with the missing complement (the saturated relativizer) which would result in ungrammatical sentences like (95).

(95)	*	Sie	hat,	[[$_e$ und $_e$]	was	sie	geschenkt	bekommen	hat,]
		she	has	and	what	she	given	got	has

sofort in den Schrank gestellt.
immediately in the cupboard put

9 Conclusion

Investigating the properties of free relative clauses in German, I suggested using a unary schema to analyze them within the framework of HPSG. This avoids empty elements and fits nicely in an implemented fragment of German (Müller, 1996) 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, 1997d).

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

How this approach can be extended to cover morphological effects in coordinated structures as have been discussed by several authors (Eisenberg, 1976; Zaenen and Karttunen, 1984; Pullum and Zwicky, 1986; Ingria, 1990; Bayer and Johnson, 1995; Bayer, 1996) remains to be seen.

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