Subsumption and Equality:
German Partial Fronting in LFG

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Subsumption and Equality: German Partial Fronting in LFG*

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1. Introduction

In a previous paper (Zaenen and Kaplan, 1995; henceforth ZK) we developed a general LFG account of West Germanic sentence structure, concentrating on the order of nominal arguments in the Vorfeld and Mittelfeld. The account was based on the interactions between functional uncertainty equations, functional precedence constraints, and phrase structure rules. In Kaplan and Zaenen (forthcoming) we develop our account of the verbal complex. In the present paper we concentrate on another specific problem, partial VP topicalization in German. We extend our previous accounts by showing how subsumption relations rather than equality can model some important properties of partial VP fronting and also the differences in behavior of equi and raising complements in fronted and extraposed environments. We observe more generally that the subsumption relation in LFG and perhaps also in other constraint-based frameworks can provide insightful characterizations of asymmetrical phenomena in natural language that are otherwise difficult to describe.

2. Partial fronting phenomena

As has often been observed, German sentences like the following are grammatical:[1]

(1) a. Das Buch zu geben schien Hans dem Mädchen.
The book to give seemed Hans the girl.

b. Dem Mädchen zu geben schien Hans das Buch.
The girl to give seemed Hans the book.

c. Zu geben schien Hans dem Mädchen das Buch.
to give seemed Hans the girl the book.

* We gratefully acknowledge Stefan Riezler and Anette Frank for providing some of the data we discuss in this paper. We also thank Miriam Butt, Mary Dalrymple, and Detmar Meurers for helpful comments on an earlier draft. The usual disclaimers apply.

[1] The acceptability of this type of sentence varies and depends heavily on discourse factors, which we ignore here.

d. Dem Mädchen das Buch zu geben schien Hans.
The girl the book to give seemed Hans.

'Hans seemed to give the girl the book.'

In (1a) the verb is topicalized together with one of its non-subject arguments, *Das Buch*, in (1b) the other argument is chosen. (1c) gives a version in which only the verb is topicalized. The fourth version exemplifies the fronting of the complete VP. Following the literature, we will refer to versions (1a) to (1c) as instances of partial VP fronting (henceforth PVPF).

Early discussions of PVPF focused mainly on examples in which the verb was fronted together with one or more of its non-nominative dependents, as in (1). But it has long been observed (Uszkoreit, 1987) that the subjects of unaccusative verbs can also be fronted. More recent literature starting with Haider (1990) has also drawn attention to PVPF sentences with unergative subjects. Both cases are exemplified in (2):

(2) a. Ein Fehler unterlaufen ist ihr noch nie.
An error happened-to is her still never
'Until now she has never made a mistake.'

b. Ein Aussenseiter gewonnen hat hier noch nie.
An outsider won has here still never.
'Until now no outsider has won here.'

PVPF has mainly attracted attention because the Vorfeld is occupied by material that cannot always be a constituent in the Mittelfeld. In some theories, for instance, in transformational ones, this presents a problem. In the next section (Section 3) we will extend to German the traditional LFG approach to topicalization and show that that particular problem does not arise. In HPSG, the phenomenon has attracted attention because it bears on the way the Mittelfeld is structured (see e.g. Nerbonne, 1995) and the way argument saturation works (see e.g. Müller, 1999). The assumptions we have made in earlier papers about West Germanic word order have as a consequence that the structure of the Mittelfeld is irrelevant for our analysis, but the issue of how to state the constraints on argument saturation do arise. In Section 4 we lay out a subsumption-based analysis of partial verb phrase fronting and show how it improves on a traditional LFG account. In Section 5 we discuss the interaction between PVPF and raising and control constructions. We conclude with a short discussion of the different roles of subsumption and equality in linguistic modeling.

3. Topicalization in LFG

Topicalization, like other long distance phenomena, is modeled in LFG through functional uncertainty (Kaplan & Zaenen, 1989). Functional uncertainty is a straightforward extension to the basic mechanism for describing simple functional relationships in LFG. A basic equation such as (↑ XCOMP) = □ appearing in a phrase-structure rule is satisfied just in case the f-structure corresponding to the mother node of the c-structure expansion (the f-structure denoted by ↑) has

an XCOMP attribute whose value is the f-structure corresponding to the daughter node of the expansion (the □ f-structure).

The problem with long distance dependencies is that the relationship between two f-structures is not determined uniquely by the positions of the phrasal constituents to which they correspond. Consider the topicalized sentences in (3):

(3) a. Mary John likes.
b. Mary John says that Bill likes.
c. Mary John says that Bill believes that Henry likes.
d. Mary John says that …

In the first one *Mary* is understood both as the TOP(ic) of the sentence and also as the OBJ of *likes*. An equation (↑ OBJ) = □ associated with the fronted *Mary* NP would properly characterize this within-clause relationship. In the second sentence *Mary* is still understood as the object of *likes*, but *likes* is now the predicate of a complement of the higher verb *says*, and the appropriate annotation for defining *Mary*'s within-clause function would be (↑ COMP OBJ) = □. For the third sentence the equation would be (↑ COMP COMP OBJ) = □, and in general for every additional level of embedding that might happen to be in the main clause, the path of functions appropriate for *Mary* would be lengthened with an additional COMP. The uncertainty in how to annotate the fronted NP comes from the fact that there is no information available at its surface position to determine exactly which of these possible equations correctly captures its functional relationship to the embedded clause.

Functional uncertainty provides a simple way of defining a family of equations while still leaving open the choice of exactly which member of the family will turn out to be consistent with an embedded f-structure. For this particular construction, the equations in the family all have functional paths that belong to the regular language COMP* OBJ, and the infinite family of appropriate equations can be specified in the single equation (↑ COMP* OBJ) = □. In the general case, suppose that *f* and *g* are f-structures and that □ is an expression denoting a regular language of functional paths. Then we assert that

(4) $(f\ \square) = g$ holds if and only if $(f\ x) = g$ holds for some string x in the language □.

Kaplan and Zaenen (1989) give a somewhat more precise definition and discuss an initial set of linguistic applications for this device; Kaplan and Maxwell (1988) show that it has attractive mathematical and computational properties.

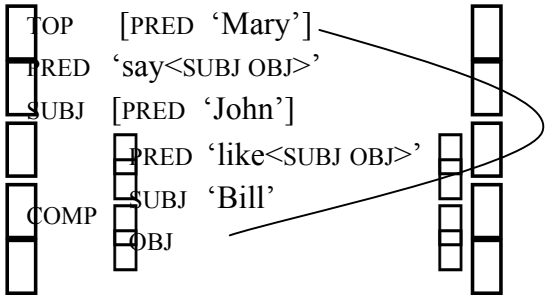
Within this framework we see that the English topicalization patterns in (3) can all be derived by means of the c-structure expansion and the uncertainty equation in the following rule:[2]

[2] It is customary in LFG rules not to specify the ↑ = □ equations that identify the heads and coheads of a construction, letting those be the unmarked relations between mother and daughter f-structures. In this paper we do not follow that abbreviatory convention and instead explicitly mark all f-structure connections so that the flow of information is easier to discern.

(5) S' → NP S
(↑ TOP) = ↓ ↑ = ↓
(↑ COMPS* NGF) = ↓

Here we use COMPS as an abbreviatory symbol that ranges over COMP and XCOMP, and NGF ranges over the usual set of nominal grammatical functions (SUBJ, OBJ, OBJ2,…). This rule provides the appropriate f-structure for sentence (3b), for example, as shown in (6):

(6)



The linking line in this diagram indicates that the values of the TOP and COMP OBJ functions have exactly the same attributes and values, including the same instantiations of the semantic-form PRED values (Kaplan & Bresnan, 1982).

The S' rule for German topicalization is an elaboration of the rule in (5) and also of the S' rule we previously proposed for Dutch, rule (29) of Zaenen and Kaplan (1995). There is little basis in German for making a categorial distinction between S and VP, since in German nominative subjects can appear interspersed with non-nominative NP's. For German we therefore conflate S and VP into a single category which, for want of a better name, we will call S|VP. S|VP has expansions that permit all possible grammatical functions. Our German rule (7) specifies this category for the Mittelfeld position and also includes this as one of the possible expansions in the fronted Vorfeld position. Also, the Vorfeld and Mittelfeld are separated by a tensed verb in second position.

(7) S' → XP V (S|VP)
↑ = ↓ ↑ = ↓
(↑ TENSE)

where XP = { NP | S|VP | …}
(↑ TOP) =↓ (↑ TOP) =↓
(↑ COMPS* NGF) = ↓ (↑ XCOMP* XCOMP) = ↓

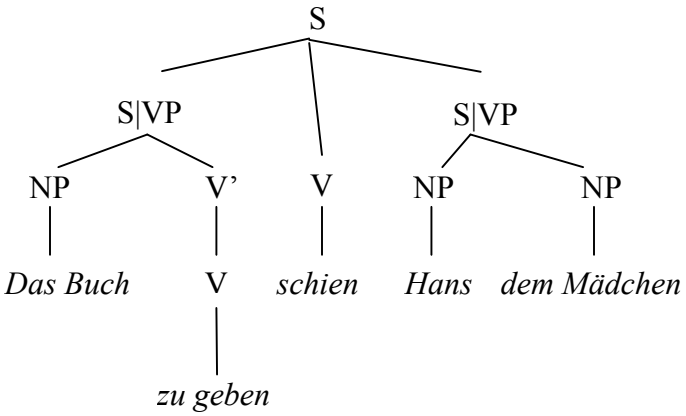
The S|VP realization of the XP is of course what allows for the topicalization of (S|)VP's in the Germanic languages. The partial fronting found in (1) and (2) arises from the optionality of the constituents in the S|VP, as we have also discussed in previous papers. In those papers the phrase structure rules we proposed were for Dutch; we repeat them here with some trivial adaptations for German. Rule (8a) corresponds to (27) in Zaenen and Kaplan (1995) and (8b) is a German variant of their (13).

(8) a. S|VP → NP* (V') (S|VP)
(↑ COMPS* NGF) = ↓ ↑ = ↓ (↑ XCOMP* COMP) = ↓

b. V' → (V') (V)
(↑ XCOMP) = ↓ ↑ = ↓
(↑ XCOMP^{+} NGF) $\prec_f$ (↑ NGF)

Rule (8a) allows for any number (including zero) of NP's coming before the optional V' cluster of verbs, and it permits an optional post-verbal complement. The functional role of individual NP's is expressed by the associated uncertainty equation; this allows each NP to be a nominal function of a verb at any depth of COMPS (XCOMP or COMP) complement embedding. Arguments for a verb cluster in German are given in Hinrichs and Nakazawa (1995). The verb cluster is optional in this rule because the f-structure head may also be realized as the tensed second-position verb of rule (7).[3] Rule (8b) provides a left-branching expansion for German verb clusters, with each verb serving as the XCOMP head of the verb immediately to its right.[4] The c-structure that these rules provide for sentence (1a) is sketched in (9), and the associated f-structure is shown in(10):

(9)

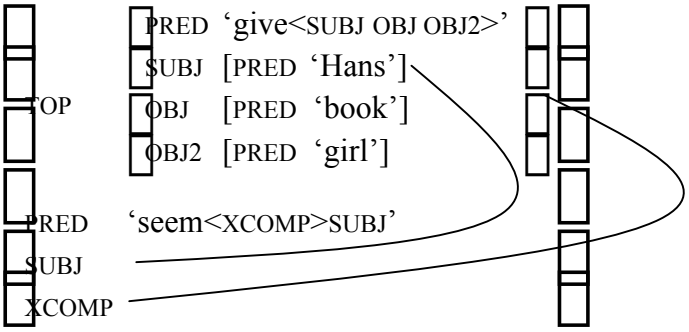


[3] Note that even though all the constituents in (8a) are optional, the LFG prohibition against any empty nodes (Kaplan & Zaenen, 1989) means that at least one daughter must appear in any expansion of S|VP. Thus the optionality of the Mittelfeld S|VP in (7) is necessary to allow for sentences with no post-verbal constituents, such as (i):

(i) Hans läuft.
Hans runs.

[4] The f-precedence constraint in (8b) imposes appropriate ordering constraints on the NP arguments for all the verbs in an XCOMP hierarchy. Nominal word order and order within the verb cluster were the major foci of earlier papers (Zaenen & Kaplan (1995); Kaplan & Zaenen (in press), but they are not relevant to the present discussion. We do not comment on word-order constraints in the remainder of the present paper.

(10)



For this sentence the uncertainty path chosen for the Vorfeld in the S' rule (7) consists of a single XCOMP, and the outer linking-line indicates that the TOP and XCOMP have identical internal functions and features. The uncertainties for the NP's in the fronted S|NP expansion resolve to the singleton paths OBJ and OBJ2, and the uncertainty for *Hans* in the Mittelfeld S|VP resolves to SUBJ. The inner linking-line marks the fact that *scheinen* 'to seem' is a raising verb, and thus its lexical entry includes a standard functional-control equation that identifies its SUBJ with the SUBJ of its XCOMP, as shown in (11):

(11) scheinen V (↑ PRED) = 'seem<(↑ XCOMP)>(↑ SUBJ)'[5]
(↑ SUBJ) = (↑ XCOMP SUBJ)

Because of the equality relations on the topicalized S|VP, the functional information in the fronted constituent combines with the information in the Mittelfeld S|VP and the lexical equation of functional control, and the result is an f-structure that satisfies the Completeness and Coherence requirements of *geben*.

These are relatively simple rules, but they account for a surprising amount of the syntactic data. The subcategorization requirements for all the sentences in (1) are satisfied, even though those sentences receive quite different c-structures. And because they do not incorporate a distinguished and obligatory position for the German subject, allowing the subject to appear among any of the nominals in the S|VP, these rules also provide appropriate analyses for the examples in (2). The only kind of partially fronted VP's that these rules systematically exclude are examples that are in fact ungrammatical. One such example is shown in (12).

(12) *Müssen wird er ihr ein Märchen erzählen.
must will he her a story tell.
'He will have to tell her a story.'

In this example *erzählen* must be assigned as the head of the XCOMP of the matrix verb *wird*, because the V' cluster has no internal uncertainty equations. Resolving the uncertainty COMPS* to the empty sequence causes *müssen* also to be assigned as the XCOMP head, and the result is an

[5] Recall that, according to standard LFG conventions, the angled brackets around the XCOMP indicate that it is a semantic argument whereas the fact that the SUBJ is outside the brackets means that it is a non-semantic grammatical function. The Semantic Completeness condition (Kaplan & Bresnan, 1982) requires the f-structure of a semantic argument to have its own semantic-form PRED value.

inconsistency with *erzählen*. But if the uncertainty is resolved to any longer sequence of XCOMP's or COMP's the resulting f-structure will be incoherent, since *erzählen* does not subcategorize for either of those functions. Other ungrammatical sentences are illustrated in (13) and (14). These are disallowed because they violate the Coherence and Completeness conditions respectively.

(13) * Dem Mädchen ein Märchen wird er ihr erzählen.
The girl a story will he her tell
'He will tell the girl her a story.'

(14) * Dem Mädchen gegeben hat er.
The girl (Dat) given has he
'He has given the girl.'

We note that under our analysis there are no problems with differences in the content of constituents in the Vorfeld and the Mittelfeld, since all S|VP elements are optional. Our proposal, however, does have two drawbacks. First, it allows for sentences such as (15), where two arguments of a verb have been fronted without their verb. This is allowed because the same c-structure expansions are possible for S|VP in both the Vorfeld and the Mittelfeld, and thus the V', and hence the V, is not required in the fronted constituent.

(15) * Ihr ein Märchen wird er erzählen.
Her a story will he tell
'He will tell her a story.'

Second, the proposal does not record at the f-structure level which parts of the S|VP are topicalized and which ones are not.[6] Whether this is important or not depends on one's view of the interaction between the f-structure and other modules of linguistic information: for argument structure and purely syntactic wellformedness conditions, this information is not important. But if we assume that there is a discourse-structural difference between the various versions of (1) and that the discourse structure is read off the f-structure without separate input from the c-structure (and even without covert c-structure information via inverse correspondence relations), the account given is inadequate. In the next section we revise our account so that it does distinguish the topicalized from the untopicalized grammatical functions. This revision also solves the verb-less fronting problem illustrated in sentence (15).

4. A Subsumption Analysis of Topicalization

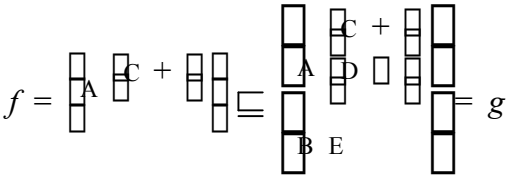
Most current constraint-based theories of syntax use an equality relation (or its unification equivalent) as the main device for combining information from various surface locations via path specifications. Equality is a symmetric relation and thus can provide no account for the often remarked-upon asymmetry, or even anti-symmetry, of syntactic relations. Our theoretical framework makes available a subsumption relation in addition to equality, and subsumption permits us to model asymmetric syntactic dependencies. In this section we review the difference

[6] Other cases of the same and related problems of representation are discussed by King (1997).

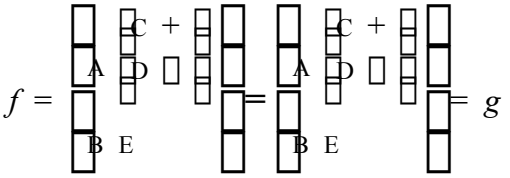
between subsumption and equality and then show how subsumption constraints can be used to solve the two residual problems we have just described.

Informally, subsumption establishes an ordering relation between two units of information, stating that the one subsuming the other contains less information (or is less specific or more general) than the one that is subsumed. A formal definition of the subsumption relation between two functional entitites *f* and *g*, notated as $f \sqsubseteq g$, is given in (16), along with an illustration of two f-structures that satisfy the relation. For comparison we show in (17) a parallel formal definition of equality. Dom(*f*) in these definitions denotes the domain of the f-structure *f*, the set of all its attribute-symbols.

(16) Definition of Subsumption: $f \sqsubseteq g$ iff
f and *g* are the same symbol or semantic form, or
f and *g* are both f-structures, Dom(*f*) $\subseteq$ Dom(*g*), and $(f\ a) \sqsubseteq (g\ a)$ for all $a \in$ Dom(*f*), or
f and *g* are both sets and every element of *f* $\sqsubseteq$ some element of *g*



(17) Definition of Equality: $f = g$ iff
f and *g* are the same symbol or semantic form, or
f and *g* are both f-structures, Dom(*f*) = Dom(*g*), and $(f\ a) = (g\ a)$ for all $a \in$ Dom(*f*), or
f and *g* are both sets, every element of *f* = some element of *g* and every element of *g* = some element of *f*.



We note in passing that subsumption is the more primitive relation, since equality can also be defined as the symmetric combination of a subsumption with its inverse:

(18) $f = g$ iff $f \sqsubseteq g$ and $g \sqsubseteq f$ (symmetry)

Returning to the analysis of partial VP fronting, let us examine the rules and simplified representations for the variant given in (1a), repeated here for convenience:

(1)	a.	Das	Buch	zu	geben	schien	Hans	dem	Mädchen.
		The	book	to	give	seemed	Hans	the	girl.

'Hans seemed to give the girl the book.'

We revise the fronted S|VP expansion of the S' rule given in (7) by replacing its uncertainty equation with a subsumption relation, as shown in (19). For the sake of concreteness, we give in (20a) the particular instance of this uncertainty necessary for example (1a). In (20b) we show the expansion of rule (8a) that derives the Vorfeld S|VP, and (20c) derives the Mittelfeld S|VP for this example.

(19) S' → S|VP V S|VP
(↑ TOP) = ↓ ↑ = ↓ ↑ = ↓
↓ ⊑ (↑ XCOMP* XCOMP) (↑ TENSE)

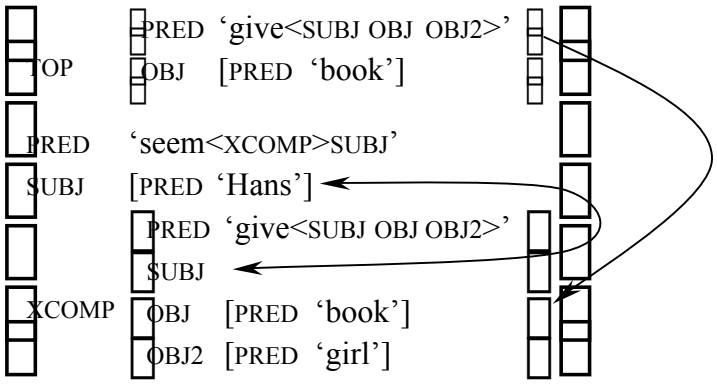
(20) a. S' → S|VP V S|VP
(↑ TOP) = ↓ ↑ = ↓ ↑ = ↓
↓ ⊑ (↑ XCOMP) (↑ TENSE)

b. S|VP → NP V'
(↑ OBJ) = ↓ ↑ = ↓

c. S|VP → NP NP
(↑ SUBJ) = ↓ (↑ OBJ2) = ↓

With the subsumption constraint instead of equality in rule (19), the f-structure in (21) instead of the one in (10) is assigned to sentence (1a).

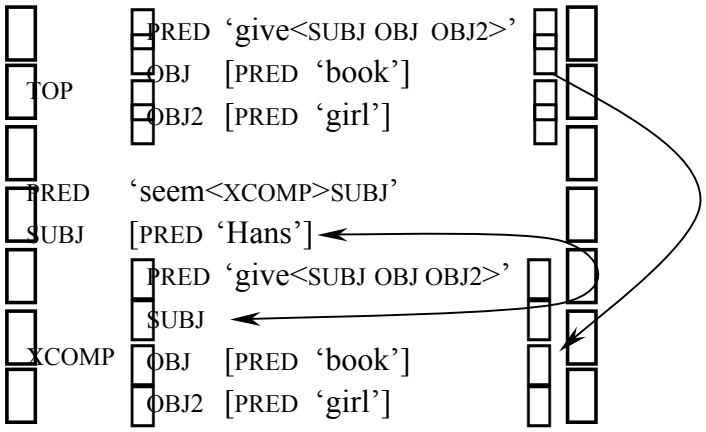
(21)



Here we have placed an arrow on the linking line between the TOP and XCOMP f-structures to indicate the asymmetric flow of information specified by the subsumption constraint: all properties of the TOP f-structure (including the particular instantiation of the semantic form) follow the arrow and appear in the XCOMP, but not vice versa. In constrast, the two arrows on the line linking the SUBJ and XCOMP SUBJ represent the symmetric flow of information between these equated f-structures, and in this case we continue the abbreviatory convention of not displaying the identical properties of the two f-structures (Kaplan & Bresnan, 1982). As can be seen from this diagram, the subsumption relation insures that the information from the topicalized position combines with additional Mittelfeld information to form the XCOMP f-structure, just as in our initial equality-based proposal. But now the TOP and XCOMP values are kept distinct, and f-structures produced under the subsumption analysis thus clearly show which properties of the

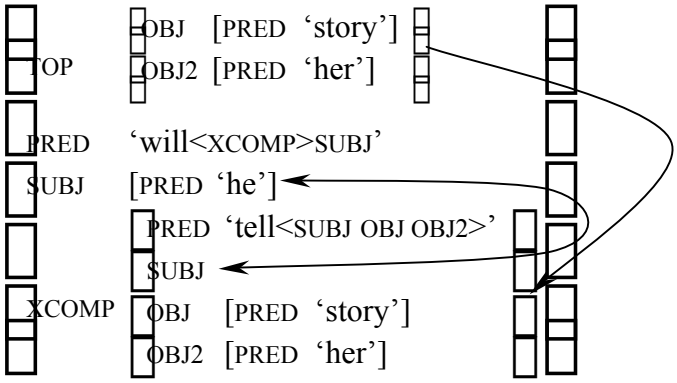
XCOMP have been topicalized. This can be seen by comparing (21) with (22), the f-structure for (1d):

(22)



The subsumption relation also has the effect of ruling out sentences such as (15), where two nominals appear without a verb in the fronted S|VP position, as shown in (23):

(23)



Without the verb the TOP f-structure for this example contains two governable but ungoverned functions and the Coherence condition is therefore not satisfied.

Subsumption does have one undesirable consequence, however: the TOP f-structures for grammatical PVPF sentences such as those in (1) now do not contain all the functions required by their PREDs and thus would be incomplete. This is a technical difficulty that we remedy by extending the definition of Completeness of Kaplan and Bresnan (1982) to one that it is sensitive to subsumption relations:

(24) An f-structure *g* is complete if and only if each of its subsidiary f-structures is either locally complete *or subsumes a subsidiary f-structure of g that is locally complete*.

As specified by Kaplan and Bresnan, an f-structure is locally complete if it contains all the governable functions that its predicate governs.

5. The interaction between PVPF and raising and equi

Whereas the account above replaces equality with subsumption to model the basic patterns of partial verb phrase fronting, it is interesting to look at the way PVPF interacts with equi and raising, other phenomena that are also traditionally modeled with equality relations. Meurers and de Kuthy (2001) discuss the following contrast:

(25) a. * Ein Aussenseiter zu gewinnen versuchte hier noch nie.
An outsider to win tried here still never
'An outsider never tried to win here.'

b. Ein Aussenseiter zu gewinnen schien hier eigentlich nie.
an outsider to win seemed here actually never
'An outsider never actually seemed to win here.'

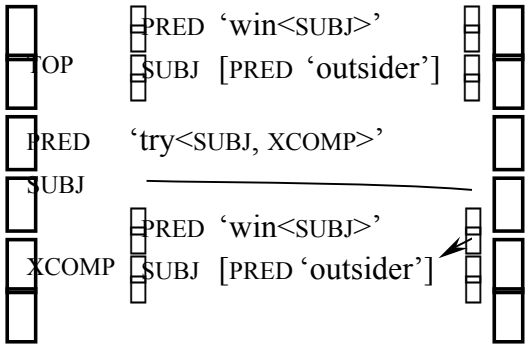
Meurers and de Kuthy attribute this contrast to the difference between equi (25a) and raising (25b) constructions.

In traditional LFG accounts the lexical entries of both equi and raising predicates contain an equation of functional control (such as (↑ SUBJ) = (↑ XCOMP SUBJ) in (11)) that identifies the controller's matrix grammatical function (SUBJ in the case of subject-raising or subject-equi verbs such as *scheinen* and *versuchen* 'to try') with the subject of the complement. The main difference between equi and raising predicates is that for an equi verb the matrix controller is a semantic argument, indicated by the appearance of its grammatical function inside the brackets of the semantic form, while the controller of a raising verb is non-semantic, indicated by its appearance outside the brackets (cf. (11). This difference is not enough to explain the contrast in (25). But we can account for this contrast quite easily by using subsumption instead of equality for the control relation of equi but not raising verbs, as shown in the following lexical entry for *versuchen*:

(26) versuchen V (↑ PRED) = 'try <(↑ SUBJ) (↑ XCOMP)>'
(↑ SUBJ) $\sqsubseteq$ (↑ XCOMP SUBJ)

For sentence (25a) this gives rise to the information dependencies diagrammed in (27):

(27)



This shows that any information defined by the matrix subj will also appear in the xcomp subj, in accordance with the subsumption constraint. But information does not flow in the opposite direction, so for this sentence the matrix subj in fact has no information at all. The top-level f-structure is therefore incomplete, and the sentence is ungrammatical. On the other hand a sentence like (28), in which the subj is fronted as an NP and not part of an xcomp, will receive the coherent and complete f-structure (29) because the properties of the matrix subj do flow down to the xcomp.7

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[7] Note that the use of subsumption does not solve the well-known problem with case agreement in equi constructions exemplified in (i) (adapted from Berman, 1999):

(i) Ich habe den Burschen geraten, einer nach dem anderen zu kündigen.
I have the boys(D) advised one(N) after another to quit.
'I have advised the boys that they one after the other quit.'

This is an example of a second-object equi construction, and we see that although the controller of the embedded subject is in the dative, the adverbial phrase *einer nach dem anderen* that presumably agrees with the embedded subject is in the nominative. The controller and the embedded subject thus do not share their case values in equi constructions. The proper behavior is characterized by the following lexical entry:

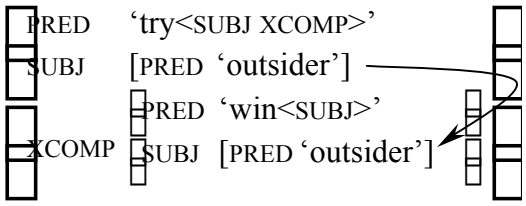
(ii) raten V (↑ PRED) = 'advise< (↑ SUBJ) (↑ OBJ2) (↑ XCOMP)>'
(↑ OBJ2)/CASE ⊑ (↑ XCOMP SUBJ)/CASE
NOM ∈ (↑ XCOMP SUBJ CASE)

Here we have used the restriction operator of Kaplan and Wedekind (1993) to amend the subsumption relation. The effect is that the CASE of the controller, unlike all other features and functions, does not flow down to the embedded subject. Instead the embedded subject is specified explicitly as being nominative by the last constraint; we treat CASE as a set-valued feature in accordance with the Dalrymple and Kaplan (2000) account of feature indeterminacy. This constraint most likely follows from a general convention that identifies nominative as an unmarked or default value for German case.

An alternative solution is to apply the subsumption relation to (↑ OBJ2 PRED) and (↑ XCOMP SUBJ PRED) and thereby enforce sharing only of the semantic form. This would also eliminate the matching requirement on the case feature, as well as the sharing of all other features and values. Presumably the instantiation of the semantic form provides sufficient information for proper semantic interpretation. Which solution is most plausible therefore depends in part on on the treatment of contrasts such as the following:

(iii) Ich versuche mich/*sich zu waschen.
I tried myself/*oneself to wash
'I tried to wash myself.'

(28) Ein Aussenseiter versuchte hier zu gewinnen.
An outsider tried here to win.
'An outsider tried to win here.'

(29) 

This solution locates the ungrammaticality of (25a) precisely in the relation for equi between the SUBJ and XCOMP SUBJ, without appealing directly to any special characteristics of the PVPF construction. The ungrammaticality follows because fronting the subject along with the verb puts it unmistakably in a c-structure position within the complement clause. Its within-clause grammatical function is assigned by virtue of its position in the embedded clause, but this does not establish any connection to the matrix predicate. This solution accounts for a wider range of data, as shown in (30). These examples involve the two-place complement verb *gefallen* 'to please' so that we can observe the difference in behavior between subject and non-subject complement functions.

(30) a. Ein Student versuchte dem Professor noch nie zu gefallen.
A (N) student tried the (D) professor still never to please

b. Dem Professor versuchte ein Student noch nie zu gefallen.
The (D) professor tried a (N) student still never to please.

c. * Ein Student zu gefallen versuchte dem Professor noch nie.
A (N) student to please tried the (D) professor still never

The PRED-subsumption solution will work if we consider the person agreement here to be semantic; if we see it as syntactic, the restriction solution seems more appropriate.

An anaphoric-control account of equi, as proposed by Andrews (1982) for Icelandic and commonly used in other LFG analyses, is also a way of avoiding the case mismatch. We can see this as similar to the PRED-subsumption solution except that the equi verb provides a 'PRO' value as the PRED of the embedded subject rather than the controller's semantic form. The instantiation of the explicitly specified 'PRO' rules out sentences such as (iv), but additional principles are necessary to insure that this particular 'PRO' is anaphorically linked to the matrix controller (cf. Chapter 12 of Dalrymple, 2001).

(iv) * Ich habe den Burschen geraten, sie zu kündigen.
I have the boys advised they to quit.
'I advised the boys to quit.'

Berman (2001) and Dalrymple and Kaplan (2000) suggest that the nominative case of the adverbial in (i) is due to the strong correlation in German between case and grammatical function. On this view the adverbial does not agree with the case value in the subject's f-structure; instead, it appears as nominative because that is the case associated with the grammatical function (SUBJ) that it modifies. This solution will not work for instances of quirky case in Icelandic, and it also fails in German raising examples, as discussed below in footnote 10.

d. Dem Professor zu gefallen versuchte ein Student noch nie.
The (A) professor to please tried a (N) student still never

e. * Noch nie hat dem Professor versucht, ein Student zu gefallen.
Still never has the (D) professor tried a (N) student to please

f. Noch nie hat ein Student versucht, dem Professor zu gefallen.
Still never has a (N) student tried the (D) professor to please

'Until now a student never tried to please the professor.

Our subsumption solution does not predict ungrammaticality when either subjects or non-subjects are fronted as NP constituents unaccompanied by the verb, as seen in (30a-b) (and also (28) above). These are accounted for by the NP realization of the XP in rule (7), where the uncertainty there is resolved to either SUBJ (30a) or XCOMP OBJ (30b). Sentence (30c) resembles (25a) in that the complement subject is fronted along with the complement verb, and it is also ungrammatical. In contrast, when the object and verb are fronted together, as in (30d), the sentence is quite acceptable. This is because the complement object does not need to bear any particular relation to the matrix verb. Sentences (30e-f) are instances of extraposition, not topicalization, but they show a similar pattern. Here also the postposed NP's belong to S|VP of the embedded clause and their overt position assigns them the within-clause function. For the postposed subject the subsumption relation does not allow satisfaction the Completeness condition for the matrix, but there is no violation for postposted nonsubjects.

We now turn to the grammatical raising example (25b). In raising constructions the subject of the complement clause bears no semantic relation to the matrix verb, but an array of standard arguments shows that it does bear a syntactic relationship to the matrix. For example, one well-known argument is based on subject-verb agreement facts as illustrated in the contrast between (2a-b), repeated here, and (31a-b).[8] In spite of the fact that the subject appears overtly with the verb in the embedded clause, the higher verb agrees with it. This shows that it functions also as the matrix subject.

(2) a. Ein Fehler unterlaufen ist ihr noch nie.
An error-sg happened-to is-sg her still never
'Until now she has never made a mistake.'

b. Ein Aussenseiter gewonnen hat hier noch nie.
An outsider-sg won has-sg here still never.
'Until now no outsider has won here.'

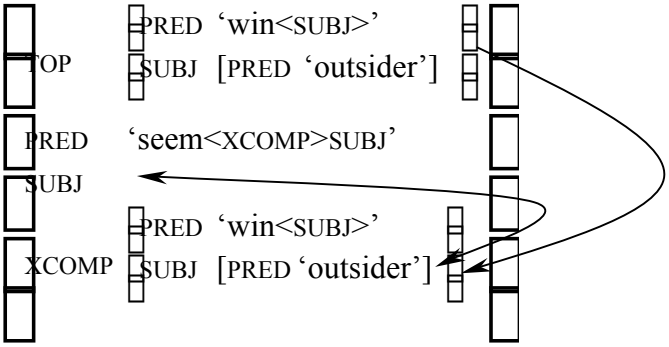
(31) a. * Manche Fehler unterlaufen ist ihr noch nie.
Many error-pl happened-to is-sg her still never
'Until now she has never made many mistakes.'

[8] We assume here that *sein* 'to be' and *haben* 'to have' are raising verbs.

b. * Ein Aussenseiter gewonnen haben hier noch nie.
An outsider-sg won have-pl here still never.
'Until now no outsider have won here.'

The way the raising construction works in traditional LFG analyses was sketched above in the lexical entry, rules and diagrams (11) to (21). Under this analysis the relation between a raised subject and an XCOMP subject is one of equality. This equality insures that *ein Aussenseiter* 'an outsider' is interpreted as the subject of *scheinen* 'to seem' as well as that of *gewinnen* 'to win', as shown in (32):

(32)



Unlike our formalization of equi, in our account of raising we retain the equality in the functional control relation. Equality predicts the grammaticality of (25b) and the sentences in (2), and it predicts the ungrammaticality of the sentences in (31).

Our analysis allows a raising subject to occur overtly within the c-structure constituent that is annotated as an XCOMP and thus not to be raised at all in the c-structure. The raising effect is entirely due to the equality relation (see Zaenen, 1989, for an early version of this analysis for Dutch). This makes the prediction that with raising verbs we can find overt subjects in extraposed complements, as illustrated by the example in (33) (from Meurers and De Kuthy, 2001):[9]

(33) Obwohl damals anfing, der Mond zu scheinen.
Even though back then begun the moon (N) to shine.
'Even though the moon had begun to shine back then.'

This example contrasts with the ungrammatical equi sentence (30e).

[9] Another potential example, taken from the web, is the following.

(i) Es scheint sich aber allgemein die Form Bergfried durchgesetzt zu haben.
It seems refl however generally the form Bergfried imposed to have.
'The form Bergfried seems, however, to have imposed itself.'

Here the analysis depends on exactly how the conditions on so-called there-insertion (*es* in German) are stated for German. We will not go into this.

Our account of raising also extends properly to the cases of German object raising, the so-called AcI constructions. As has been discussed recently in Meurers and De Kuthy (2001), in AcI constructions the subject of the complement verb appears as an accusative, as illustrated with the PVPF example in (34):

(34) Den Kanzler tanzen sah der Oskar.
The (A) chancellor dance saw the Oskar.
'Oskar saw the chancellor dance.'

This kind of sentence is accounted for straightforwardly by our proposal under the assumptions that the raising verb *sehen* 'to see' takes an accusative object, that its object and the subject of the embedded verb are related by equality, and that nominative case is not obligatorily assigned in the infinitive clause.[10]

6. Conclusions

In this paper we propose a new analysis of German partial VP fronting and show how it interacts with raising and equi. The main new ingredient is the use of subsumption in addition to equality in modeling the flow of information. Subsumption combines with the optionality of most c-structure constituents within the S|VP and previously proposed uncertainty equations to give the right results. Unlike the previous account, it explicitly records in the f-structure which parts of the complement clause appear in topic position. We also use subsumption to model the relation between the subject of an equi-verb complement and the grammatical function it serves in the matrix.

For the interaction between raising and fronting we crucially rely on the fact that equality relations allow information to be realized in either of the c-structure positions between which a functional equality holds. This allows us to have (f-structure) raising without (c-structure) raising as was first pointed out in Zaenen (1989). Our account of the interaction of VP fronting with raising is in this respect similar to the one proposed by Meurers and De Kuthy (2001) who rediscovered the 'raising without raising' solution in an HPSG framework.

The German raising and equi facts handled here are similar but not identical to those found in French Stylistic Inversion. As discussed in Zaenen and Kaplan (2002), in French both subject to subject raising and subject-controlled equi are best handled with equality relations whereas both object raising and object-controlled equi require subsumption.

[10] Here the understood subject also imposes accusative case on the adjuncts that agree with it, as shown by the following example (from Müller, 1999).

(i) Der Wächter sah die Männer einen nach dem anderen weglaufen
The guard saw the men (A) one (A) after the other run-away

This is to be expected: because of the equality relation, the case of the object is also the case of the embedded subject, and the adjunct agrees with it.

The use of subsumption addresses fundamental questions about the nature of information flow in syntax. Most transformational theories promote an asymmetric or even anti-symmetric view. Constraint-based formalisms have tended to stress the non-directionality of information flow. The subsumption relation permits a characterization of asymmetric syntactic dependencies that cannot be easily encoded in phrase structure constraints and thus allows for simple models of phenomena that otherwise are difficult to describe.

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