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Editors' Note

This year's conference was held as part of a larger Berkeley Formal Grammar Conference, which included a day of workshops and the annual HPSG conference.

The program committee for LFG'00 were Rachel Nordlinger and Chris Manning. We would like to thank them for putting together the program that gave rise to this collection of papers.

We would also like to thank all those who contributed to this conference, especially the local organizing committee, namely Andreas Kathol, and our reviewers, without whom the conference would not have been possible.

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Functional Identity and Resource-Sensitivity in Control

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1 Introduction[1]

Glue semantics provides a semantics for Lexical Functional Grammar (LFG) that is expressed using linear logic (Girard, 1987; Dalrymple, 1999) and provides an interpretation for the f(unctional)-structure level of syntactic representation, connecting it to the level of s(emantic)-structure in LFG's parallel projection architecture (Kaplan, 1987, 1995). Due to its use of linear logic for meaning assembly, Glue is resource-sensitive: semantic resources contributed by lexical entries and resulting f-structures must each be used in a successful proof *exactly once*. In this paper, I will examine the tension between a resource-sensitive semantics which interprets f-structures and structure-sharing in f-structures as expressed by functional control resulting from lexical functional identity equations. The empirical phenomenon I concentrate on is equi, also known as obligatory control.[2] Although at first blush it seems that structure-sharing poses a serious problem for Glue semantics, I will show that this is not so. In fact, this tension leads to a very restrictive theory, and the analysis I present here solves several long-standing problems in the semantics of equi, by exploiting LFG's grammatical architecture.

In this paper I will:

1. Give a Glue semantics for equi.
2. Show how the analysis can yield either a propositional or property denotation for the clausal complement of an equi verb. This flexibility arises naturally from the architecture of the theory.
3. Adopt the property theory of equi complements, which has been argued for independently by Chierchia (1984).
4. Counter previous objections to the property theory from anaphoric binding and typological data by exploiting LFG's architecture.
5. Argue that a previous solution to the structure-sharing/resource-sensitivity problem (Kehler et al., 1999) can only yield a propositional denotation. The Kehler et al. proposal is rejected for empirical and theoretical reasons.
6. Show several empirical predictions of the analysis.

2 Glue Semantics

2.1 Motivation

There are two basic conceptual motivations for Glue, beside the empirical motivation provided by successful Glue analyses of semantic phenomena (Dalrymple, 1999). First, the resource-sensitivity of Glue semantics

[1] I owe a great debt to Dick Crouch and Mary Dalrymple at PARC for a lot of feedback, free exchange of ideas, and a great working environment. They should accept much of the credit for this work, but none of the blame. I'd also like to thank the following people for their comments: David Beaver, Joan Bresnan, Daniel Büring, Ron Kaplan, Tracy Holloway King, Hanjung Lee, John Maxwell, Dave McKercher, Line Hove Mikkelsen, Yukiko Morimoto, Ivan Sag, Peter Sells, Ida Toivonen, and audiences at Stanford's Semantics Fest and LFG 2000. I accept full responsibility for any remaining errors. A special thanks to Jim McCloskey for getting me access to facilities at UCSC. This research was supported partly by SSHRC Doctoral Fellowship 752-98-0424.

[2] Throughout this paper I will use the term 'equi', even though the term 'control' is more common in the literature. I do this to avoid confusion between the data being described and the theoretial construct — functional control — that models it.

directly models the resource-sensitivity of natural languages. The words and sentences in a natural language utterance do not make multiple contributions to the utterance's meaning unless they are used multiple times.

Second, the resource-sensitivity of Glue means that completeness and coherence follow from the formalism and do not need to be stipulated as separate principles (Dalrymple et al., 1999a).[3]

- **Completeness**: If any of the Glue resources a predicate needs for its semantics are not present, *there is no successful Glue proof*.
  (Instead of: "every function designated by a PRED [must] be present in the f-structure of that PRED." (Bresnan, 2000: 72))

- **Coherence**: If a GF is present and contributing a resource which no predicate's meaning will consume, *there is no successful Glue proof*.
  (Instead of: "every argument function in an f-structure [must] be designated by a PRED." (Bresnan, 2000: 73))

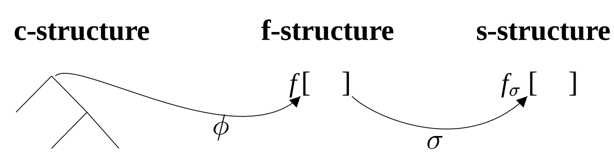
Note that by "successful Glue proof" I mean one that consumes the semantics of the lexical items making up a sentence to provide the sentential meaning. Thus, PRED values in f-structures do not need to be of the form 'pred-name$\langle \ldots \rangle \ldots$' and are instead of the form 'pred-name'. Although completeness and coherence were originally proposed as purely syntactic constraints (Kaplan and Bresnan, 1982) and continue to be formulated as such (Bresnan, 2000), if they can be derived from the formal architecture of the theory, they clearly do not need to be stated as theoretical primitives.

2.2 Glue and the Parallel Projection Architecture of LFG

LFG has a grammatical architecture in which various levels of grammatical representations are simultaneously present, but each level is governed by its own rules and representations. The various levels are then related to each other by mapping functions, which map representations at one level to those in another (Kaplan, 1987, 1995).

Just as the level of c(onstituent)-structure is mapped to f-structure by the ϕ function, f-structure is mapped to s-structure by the σ function. Glue semantics is a theory of the σ-mapping and of s-structure.

(1)



This separation of levels allows one to make simple theoretical statements about the aspet of grammar that the level in question models. Phrase structure, constituency, domination and linear order are represented at c-structure using trees, while grammatical functions, subcategorization, binding, control, and various other aspects of syntax are represented at f-structure using attribute-value matrices. Semantics and the relationship between syntax and meaning are represented at s-structure using Glue: a combination of linear logic and a chosen meaning language.

[3]Expletives do not contribute resources and present a potential complication for this reduction of completeness and coherence.

An important feature of this architecture is that there can be systematic mismatches between grammatical levels. For example, null pronoun subjects in pro-drop languages are not present at c-structure, because they are unmotivated by the syntactic phenomena represented at that level. Rather, null pronouns are present at f-structure, where they can participate in agreement, binding, and other syntactic processes best represented at that level. Similarly, there can be systematic mismatches between f-structure and s-structure, and it is this aspect of the architecture that allows for an adequate semantics of equi that nevertheless does not conflict with structure-sharing in the syntax and in fact uses the syntax to give solutions to certain problems in previous analyses of equi semantics.

2.3 Overview of Glue Semantics

Glue uses two logics: a meaning logic for representing meaning terms, and linear logic (Girard, 1987) for assembling meanings Dalrymple (1999). As already stated, linear logic is resource-sensitive: a linear logic proof is valid only if all premises are used exactly once. This is best exemplified by comparing propositional logic to propositional linear logic and observing the differences in certain entailment patterns.

1. **A premise can only be used once**

(2) Propositional logic implication ($\rightarrow$)

a. $p, p \rightarrow q \vdash q$

b. $p, p \rightarrow q \vdash p \wedge q$ — p used to derive q and can be conjoined with q

(3) Propositional linear logic implication ($\multimap$)

a. $p, p \multimap q \vdash q$

b. $p, p \multimap q \nvdash p \otimes q$ — p was used up to derive q

2. **Each premise must be used**

(4) Propositional logic conjunction ($\wedge$)

a. $p \wedge q \vdash p$ — q ignored

(5) Propositional linear logic conjunction ($\otimes$)

a. $p \otimes q \nvdash p$ — must use q

In principle, we can choose any logic for the meaning logic, so long as a systematic relationship can be established between operations in the meaning language and those in the Glue language (linear logic).

2.4 New Glue

Recent work in Glue semantics has used the Curry-Howard (C-H) isomorphism to directly relate the Glue and meaning languages (Dalrymple et al., 1999b). According to the C-H isomorphism, introduction of implication in the Glue language corresponds to lambda abstraction in the meaning language and elimination of implication corresponds to function application. I will use only the implication fragment of linear logic in this analysis, and will present my Glue proofs in the natural deduction (ND) style. The ND proof rules for introduction and elimination of implication are as follows:

(6) **Implication Elimination** **Implication Introduction**

$$\frac{A \multimap B \qquad A}{B} \multimap_{\mathcal{E}} \qquad\qquad \frac{\begin{array}{c}[A]^i \\ \vdots \\ B\end{array}}{A \multimap B} \multimap_{\mathcal{I}}, i$$

The elimination rule is just modus ponens. The implication rule involves flagging an assumption in square brackets, and subsequently discharging this assumption if it has been used to prove another premise. In this case $[A]^i$ is used to derive B, and we can discharge the assumption using implication introduction to get A $\multimap$ B.

The following simple example shows the natural deduction rules and Curry-Howard isomorphism working together to prove that $a \multimap b \vdash a \multimap b$. The meaning language appears on the left of the uninterpreted symbol ':' and the linear logic is on the right.

(7)

$$\cfrac{\cfrac{[x:a]^i \qquad P : a \multimap b}{P(x) : b}\, function\ application : \multimap_{\mathcal{E}}}{\lambda x.P(x) : a \multimap b}\, lambda\ abstraction : \multimap_{\mathcal{I},i}$$

In the first step, $x : a$ is assumed (indicated by square brackets) and the assumption is flagged with the superscript i. We take this assumption and combine it with our one premise $a \multimap b$ by elimination, which corresponds to function application in the meaning language.

Glue with the C-H isomorphism has advantages over previous Glue formalizations:

1. It eliminates the need for higher-order unification.
2. The meaning and Glue languages are kept completely separate, such that a proof cannot fail simply due to failure in the meaning language, only due to failure in the Glue language.
3. By examining operations in the Glue language, we automatically know the corresponding operation in the meaning language.

To stay within the implicational fragment, Glue conjunction ($\otimes$) in the antecedent of an implication will be cashed out as implication, by the following equivalence (which also holds for ordinary (non-linear) propositional logic):

(8) $(a \otimes b) \multimap c \equiv b \multimap (a \multimap c)$

For example, the Glue semantics for a transitive verb can be written using a conjunction, such that the verb consumes the resources of its subject and object to give its meaning, or it can be written such that the verb consumes its object's resource and then its subject's resource to give its meaning:

(9) An example: transitive verbs
$((\uparrow \text{SUBJ})_\sigma \otimes (\uparrow \text{OBJ})_\sigma) \multimap \uparrow_\sigma \equiv (\uparrow \text{OBJ})_\sigma \multimap ((\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma)$

Using the equivalence in (8) with the equivalence in (10), the subject can be consumed first, as in (11).

(10) $(\mathrm{a} \otimes \mathrm{b}) \equiv (\mathrm{b} \otimes \mathrm{a})$

(11)
$$\begin{aligned} & (\uparrow \text{OBJ})_\sigma \multimap ((\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma) \\ \equiv\ & ((\uparrow \text{SUBJ})_\sigma \otimes (\uparrow \text{OBJ})_\sigma) \multimap \uparrow_\sigma \\ \equiv\ & ((\uparrow \text{OBJ})_\sigma \otimes (\uparrow \text{SUBJ})_\sigma) \multimap \uparrow_\sigma \\ \equiv\ & (\uparrow \text{SUBJ})_\sigma \multimap ((\uparrow \text{OBJ})_\sigma \multimap \uparrow_\sigma) \end{aligned}$$

Although this introduction to Glue semantics has been necessarily short, I have presented everything that I use in my analysis (sections 5 and 6). But first let us consider the problem that functional control presents for a resource-sensitive semantics.

3 The Problem

Despite its advantages in modelling natural language meaning, the resource-sensitivity of Glue initially seems to be at odds with functional control in f-structures, which is expressed by functional identity equations[4] in lexical f-descriptions. These equations result in structure-sharing (i.e. token identity) of f-structures. The σ mapping function is must map this one stucture-shared f-structure to one node in s-structure, or else the mapping function is not a function by definition. In other words, the problem is that if an f-structure is structure-shared, then it can only produce one semantic-resource.

Consider the following equi example:

(12) Gonzo tried to go.

I am assuming a functional control analysis of English obligatory control, whereby the equi verb's SUBJ or OBJ functionally controls and is therefore token identical to its XCOMP SUBJ.[5] Simplifying somewhat, we get the following f-structure for (12).

(13)
$$f\begin{bmatrix} \text{PRED} & \text{`try'} \\ \text{SUBJ} & g\begin{bmatrix}\text{PRED} & \text{`Gonzo'}\end{bmatrix} \\ \text{XCOMP} & h\begin{bmatrix}\text{PRED} & \text{`go'} \\ \text{SUBJ} & \end{bmatrix}\end{bmatrix}$$

So the attribute paths (f SUBJ) and (f XCOMP SUBJ) share as their value the f-structure g. This f-structure contributes one semantic resource that we must use in the Glue proof of the sentence's meaning. The embedded verb is an ordinary intransitive verb that needs to consume its subject's resource and the matrix equi verb also takes its subject as a semantic argument. Thus it seems that both verbs need to consume the one subject resource. But, if we use this subject resource as a premise in deriving the meaning of the matrix verb, the resource is consumed and is not available for the embedded verb. Likewise, if the embedded verb consumes the subject resource, it is unavailable for the matrix verb.

[4]These are also known as functional control equations.

[5]For motivation of such an analysis, see Bresnan (1982a) and Falk (to appear).

One possible solution to this problem is to treat *paths* in f-structures as contributing resources (Kehler et al., 1999), rather than the standard Glue treatment, whereby *nodes* (i.e. the f-structures values of paths) contribute resources. Consider this proposal with respect to (13). There are two subject paths, (*f* SUBJ *g*) and (*f* XCOMP SUBJ *g*). Each of these contributes a resource and as a result both the matrix and embedded verbs have a subject resource to consume.

The are two major problems with this proposal. First, it involves a non-trivial extension of Glue theory. It needs an additional axiom and the repercussions of the extension are not clear. Essentially, this modification results in a weakening of the notion of resource-sensitivity, because there can always be multiple paths leading to the same value. Second, by providing both the matrix equi verb and the embedded verb with a subject resource, this solution would force the clausal equi complement to denote a proposition. The embedded verb denotes a property and this would combine withe denotation of the subject, an individual or generalized quantifier, to yield a proposition. There would be no principled way to get a property denotation for the clausal complement instead. However, there is a long-standing literature in theoretical semantics that argues precisely for a property denotation of clausal equi complements (Chierchia, 1984, 1985; Chierchia and Jacobson, 1986). I now turn to a brief summary of these arguments.

4 The Denotation of Clausal Equi Complements

Chierchia and various other semanticists have long argued that the denotation of the clausal complement of an equi verb is a property (14a) and not a proposition (14b) (Chierchia, 1984, 1985; Chierchia and Jacobson, 1986).

(14) a. try(gonzo, λx.go(x))

b. try(gonzo, go(gonzo))

The fundamental motivation for this comes from certain entailments/inference patterns that are very robust.[6]

(15) **Property inference patterns:**

Quantification	**Ellipsis**
Gonzo tried to go.	Gonzo tried to go.
Andrew tried everything that Gonzo tried.	Andrew did too.
Andrew tried to go.	Andrew tried to go.
try(gonzo, λx.go(x))	try(gonzo, λx.go(x))
$\forall$P.[try(gonzo, P) $\rightarrow$ try(andrew, P)]	$\exists$P$\exists$Q.[Q(gonzo, P) $\wedge$ Q(andrew, P)]
try(andrew, λx.go(x))	try(andrew, λx.go(x))

[6]Chierchia (1984) discusses the quantificational inference patterns on the left. The ellipsis patterns were suggested to me by Mary Dalrymple (p.c.). The treatment of ellipsis given here is based very roughly on Dalrymple et al. (1991). None of the logical forms given in this section are intended as real analyses, but are rather presented as suggestive sketches which highlight the problems being discussed.

(16) **Propositional inference patterns:**

Quantification	**Ellipsis**
Gonzo tried to go.	Gonzo tried to go.
Andrew tried everything that Gonzo tried.	Andrew did too.
??	**??**
[* Andrew tried for Gonzo to go.]	[* Andrew tried for Gonzo to go.]
try(gonzo, go(gonzo))	try(gonzo, λx.go(x))
$\forall$P.[try(gonzo, P) $\rightarrow$ try(andrew, P)]	$\exists$P$\exists$Q.[Q(gonzo, P) $\wedge$ Q(andrew, P)]
try(andrew, go(gonzo))	try(andrew, go(gonzo))

The property theory gets the correct entailments, while the propositional theory does not. In fact there are no English sentences corresponding to the conclusions of the propositional inference patterns. For this reason, Chierchia treats the complement of equi as denoting a property. Semantics is ultimately grounded in providing meanings for natural language that capture our intuitions about entailments. Thus, we must reject a semantics that results in denotations with missing or false entailments, as is the case with the propositional denotation of clausal equi complements.

There have been objections to the property theory, which I turn to in the next section, and it may be that the empirical problems with the propositional theory that have been outlined here can be overcome. But in the absence of proposals to this effect, the Kehler et al. (1999) treatment of structure-sharing and its relationship to Glue semantics is unsatisfactory, because it can *only* give a propositional denotation to the equi complements, as discussed above.

4.1 Two Problems for the Property Theory

4.1.1 Locality of Anaphoric Binding

Pollard and Sag (Pollard and Sag, 1994; Sag and Pollard, 1991) have noted that the property theory has trouble with reflexives in clausal complements of equi verbs. Consider:

(17) Gonzo tried to pinch himself/*herself.

This case is problematic for the property theory of equi, because it has been developed in frameworks which are strictly compositional (Montague Grammar, Categorial Grammar). Accordingly, there is no local antecedent for the reflexive in (14). In the syntax, the clausal equi complement is a VP, which has no subject. There *must not* be a syntactic subject, because the theory is strictly compositional and needs a property denotation for the complement in the semantics. If a subject were present in the semantics, it would combine with the property to give a proposition. Thus, there is also no subject in the semantics, where the subject is represented as a variable bound by a lambda.

The result is that in giving a property denotation to the clausal equi complement, there is no local antecedent for the reflexive, and an extremely robust generalization from binding theory is lost. The parallel projection architecture of LFG offers a solution to this apparent dilemma, which I give in section 6.1.

4.1.2 Sentential Complements with Property Denotations

Zec (1987) notes that Serbo-Croatian[7] sentences like the following pose a problem for the property theory of equi semantics (Zec, 1987: 142).

(18) Petar je pokušao da dodje
Petar Aux tried Comp come(Pres)
Peter tried to come.

The complement to the matrix verb *pokušao* is clearly not a subjectless VP for two reasons. First, there is an overt complementizer, indicating that this is a CP, not a VP. Second, Zec argues that there is actually a null pronominal subject in the embedded clause, so there is an f-structure SUBJ. *Pokušao* is nevertheless an equi verb and there is a relationship of obligatory control between its subject and the subject of its complement. Furthermore, Serbo-Croatian control verbs participate in inferences like (15), indicating that the clausal equi complement denotes a property despite initial appearances. This is a problem for Chierchia, because his theory predicts that the sentential complement in (18) should denote a proposition, as it has a subject. Again, the present analysis uses LFG's parallel projection architecture to overcome this problem, as show in section 6.2.

5 A Glue Analysis of Equi

Let us consider the following sentence;

(19) Gonzo tried to go.

I assume the following (partial) lexical entries for this sentence:[8]

(20)

Gonzo	N	$(\uparrow \text{PRED}) = \text{`Gonzo'}$
		gonzo : $\uparrow_\sigma$
		$= g_\sigma$
tried	V	$(\uparrow \text{PRED}) = \text{`try'}$
		$\lambda x \lambda P.\text{try}(x, P) : (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma)$
		$= g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)$
go	V	$(\uparrow \text{PRED}) = \text{`go'}$
		$\lambda y.\text{go}(y) : (\uparrow \text{SUBJ}) \multimap \uparrow_\sigma$
		$= g_\sigma \multimap h_\sigma$

These entries are clearly simplified, and many syntactic details have been suppressed. For simplicity's sake, I've also presented a simple extensional predicate calculus as the meaning language, which is to the left of the colons in the Glue formulas.[9]

The Glue formulas have been presented first in their general form, as they are listed in the lexicon, and secondly with the ↑ metavariables instantiated to nodes in the following f-structure for (19).

[7] This is the term that Zec uses.

[8] I have assumed a co-head analysis of infinitival *to*. If a raising analysis is preferred, then the derivation would essentially be like the one presented for raising embedded under equi in section 6.4.2.

[9] For a presentation of an intensional version of the meaning language see Asudeh (to appear).

(21) $$f\begin{bmatrix} \textsc{pred} & \text{`try'} \\ \textsc{subj} & g\begin{bmatrix} \textsc{pred} & \text{`Gonzo'} \end{bmatrix} \\ \textsc{xcomp} & h\begin{bmatrix} \textsc{pred} & \text{`go'} \\ \textsc{subj} & \end{bmatrix} \end{bmatrix}$$

Using the instantiated glue premises, we can construct the following proof.

(22) **Glue proof, with meanings**

$$\dfrac{\dfrac{\text{gonzo} : g_\sigma \qquad \lambda x \lambda P.\text{try}(x, P) : g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{\lambda P.\text{try}(\text{gonzo}, P) : (g_\sigma \multimap h_\sigma) \multimap f_\sigma} \multimap_{\mathcal{E}} \qquad \lambda y.\text{go}(y) : g_\sigma \multimap h_\sigma}{\text{try}(\text{gonzo}, \lambda y.\text{go}(y)) : f_\sigma} \multimap_{\mathcal{E}}$$

In the first step of the proof, we take the Glue resource provided by the subject, *Gonzo*, and combine it with the Glue resource provided by the equi matrix verb, *tried*, using implication elimination (modus ponens; see (6)). This corresponds to function application in the meaning language, and the first argument of try is the denotation of the subject, $gonzo$. The result of the first step is then combined with the resource provided by the embedded verb, again using implication elimination. This results in a semantics for the f-structure corresponding to the sentence which is the try relation between $gonzo$ and the property of going.

The very same Glue entry for the equi verb can yield the propositional denotation for the clausal complement. The only difference is in the meaning language, where the controllee is given as an argument to the property:

(23) tried V $(\uparrow \textsc{pred}) = \text{`try'}$
λxλP.try(x, P(x)) : $(\uparrow \textsc{subj})_\sigma \multimap (((\uparrow \textsc{xcomp subj})_\sigma \multimap (\uparrow \textsc{xcomp})_\sigma) \multimap \uparrow_\sigma)$
$= g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)$

Combining this with the same meaning for *go*, the last line of the Glue proof would instead be $try(gonzo, \lambda y.go(y)(gonzo)) : f_\sigma$, which reduces to $try(gonzo, go(gonzo)) : f_\sigma$ after function application.

6 Empirical Results

6.1 Anaphoric Binding in Equi Complements

Let us consider again (17), which I noted as a potential problem for the property theory:

(17) Gonzo tried to pinch himself.

At c-structure, the clausal complement (IP) does not have a subject, but at f-structure, there is a subject, which is structure-shared with its controller, the matrix subject. The projection architecture allows this kind of mismatch and the equi verb lexically specifies the functional control equation which identifies its SUBJ and its XCOMP SUBJ.

Anaphoric binding in LFG is defined at the level of f-structure (Dalrymple, 1993; Bresnan, 2000), as indicated by the binding equation in the lexical entry for the reflexive in (24a). For sentence (17), we get the f-structure in (24b).

(24) a. himself N $(\uparrow \text{PERS}) = 3$
$(\uparrow \text{NUM}) = \text{SG}$
$(\uparrow \text{GEND}) = \text{MASC}$
$\mathbf{(((}\text{GF } \alpha\mathbf{)} \uparrow \mathbf{)} \text{ GF}' \text{ INDEX}\mathbf{)} = \mathbf{(}\uparrow \text{INDEX}\mathbf{)}$

b.

$$f\left[\begin{array}{lll} \text{PRED} & & \text{'try'} \\ \text{SUBJ} & g & \left[\begin{array}{ll} \text{PRED} & \text{'Gonzo'} \\ \text{INDEX} & j \end{array}\right] \\ \text{XCOMP} & h & \left[\begin{array}{lll} \text{PRED} & & \text{'pinch'} \\ \text{SUBJ} & & [\;] \\ \text{OBJ} & i & \left[\begin{array}{ll} \text{PRED} & \text{'pro'} \\ \text{NUCLEAR} & + \\ \text{INDEX} & j \end{array}\right] \end{array}\right] \end{array}\right]$$

Instantiating the binding equation in (24a):

(25) $(((\text{GF } \alpha) \uparrow) \text{ GF}' \text{ INDEX}) = (\uparrow \text{INDEX})$
$(((\text{OBJ } e)\ i) \text{ SUBJ INDEX}) = (i \text{ INDEX})$
$(h \text{ SUBJ INDEX}) = j$
$(g \text{ INDEX}) = j$
$j = j$

Thus, there is a local antecedent for the reflexive at f-structure, the appropriate level for binding theory.

The relationship between levels of representation in LFG is not isomorphic, but it is systematic, as defined by projection functions. Although the subject is present in f-structure, the *denotation* of the clausal equi complement can be a property, as we've seen. This analysis exploits the parallel projection architecture and the modular nature of information contribution in LFG to capture the correct syntax for constituency and binding (c-structure and f-structure) as well as the right semantics for equi.

6.2 Obligatory Anaphoric Control

Recall the Serbo-Croatian sentence (18):

(18) Petar je pokušao da dodje
Petar Aux tried Comp come(Pres)
Peter tried to come.

Zec (1987) noted this as a problem for the property theory because the clausal equi complement is clearly a CP with a null subject, yet it seems to denote a property. This is only a problem if we assume strict compositionality, and the solution here relies on using normal Glue semantics and exploiting the capacity for systematic mismatches between levels of representation in LFG's grammatical architecture.

I assume the following lexical entries for (18).

(26)

Petar	N	$(\uparrow \text{PRED}) = \text{'Petar'}$
		petar : $\uparrow_\sigma$
		$= g_\sigma$
je	I	$(\uparrow \text{TENSE}) = \text{PAST}$
pokušao	V	$(\uparrow \text{PRED}) = \text{'try'}$
		$(\uparrow \text{COMP SUBJ INDEX}) = (\uparrow \text{SUBJ INDEX})$
		$\lambda w \lambda P.try(w, P) : \; (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{COMP SUBJ})_\sigma \multimap (\uparrow \text{COMP})_\sigma) \multimap \uparrow_\sigma)$
		$= g_\sigma \multimap ((i_\sigma \multimap h_\sigma) \multimap f_\sigma)$
		$\lambda x \lambda y.x : \; (\uparrow \text{SUBJ})_\sigma \multimap ((\uparrow \text{COMP SUBJ})_\sigma \multimap (\uparrow \text{SUBJ})_\sigma)$
		$= g_\sigma \multimap (i_\sigma \multimap g_\sigma)$
da	C	$(\uparrow \text{MOOD}) = \text{DECL}$
dodje	V	$(\uparrow \text{PRED}) = \text{'come'}$
		$(\uparrow \text{TENSE}) = \text{PRES}$
		$\left(\begin{array}{l} (\uparrow \text{SUBJ PRED}) = \text{'pro'} \\ X : \; (\uparrow \text{SUBJ})_\sigma \\ \quad\quad = i_\sigma \end{array} \right)$
		$\lambda z.come(z) : \; (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma$
		$= i_\sigma \multimap h_\sigma$

The second line in each Glue formula has instantiated node descriptions with the node names from the following f-structure for (18):

(27)
$$f\begin{bmatrix} \text{PRED} & \text{'try'} \\ \text{SUBJ} & g\begin{bmatrix} \text{PRED} & \text{'Petar'} \\ \text{INDEX} & j \end{bmatrix} \\ \text{COMP} & h\begin{bmatrix} \text{PRED} & \text{'come'} \\ \text{SUBJ} & i\begin{bmatrix} \text{PRED} & \text{'pro'} \\ \text{INDEX} & j \end{bmatrix} \\ \text{MOOD} & \text{DECL} \end{bmatrix} \\ \text{TENSE} & \text{PAST} \end{bmatrix}$$

I have made the simplifying assumption that the auxiliary verb simply contributes TENSE to the f-structure and that the complementizer contributes MOOD. The entry for the embedded verb *dodje* is general, and not just for its occurrence in complements of equi verbs. This verb optionally specifies its SUBJ PRED as 'pro', since Serbo-Croatian is a pro-drop language. When the null subject is contributed by the verb, the semantics of the null pronominal is also contributed, as indicated by the Glue formula X : $(\uparrow \text{SUBJ})_\sigma$.[10]

[10]Clearly this is a not a satisfactory treatment of anaphora, but discussion of the treatment of anaphora in a dynamic Glue, which is being developed at PARC, would take us too far afield.

The entry for the subject equi verb *pokušao* is different from the entry for the English verb *try* in (20) above. Its clausal complement is a COMP, not an XCOMP, because the complement has its own subject rather than the subject being structure-shared with another GF by functional control. Instead, the control relationship is anaphoric as indicated by the equation requiring that *pokušao*'s COMP SUBJ and SUBJ be coindexed. Corresponding to the anaphoric control specified by the coindexation equation, the second Glue formula in the entry consumes the pronoun's meaning. This is motivated because the pronoun can only be bound by the controlling subject. In effect, it is not contributing a normal pronominal meaning, but is rather a device that is employed in certain languages (like Serbo-Croatian) to establish an equi relation. Thus, we can think of this Glue formula as going hand in hand with the anaphoric control equation, just as the embedded verb's contribution of its null subject goes hand in hand with a Glue formula for that subject.

This leaves the final and most important detail of the present analysis of anaphoric control: the first Glue formula, which gives the semantics of the equi verb, is the same as the Glue for the equi verb *try* in English, a language that uses functional control in the syntax. In both cases, the matrix subject is consumed to yield an implication that consumes the *entire* clausal complement to yield the semantics of the outer f-structure and thus the sentence. The following proof demonstrates the parallelism. Notice that once the Glue premises dealing with the anaphoric control relation and embedded subject have been consumed, the remainder of the proof (starting at the third line) is identical to the proof in (22) for the English sentence *Gonzo tried to go*.

(28)

$$\dfrac{\lambda z.\text{come}(z) : i_\sigma \multimap h_\sigma \qquad \dfrac{\dfrac{\dfrac{\text{petar} : g_\sigma \qquad \lambda x \lambda y.x : g_\sigma \multimap (i_\sigma \multimap g_\sigma)}{\lambda y.\text{petar} : i_\sigma \multimap g_\sigma} \qquad \text{X} : i_\sigma}{\text{petar} : g_\sigma} \qquad \lambda w \lambda P.\text{try}(w, P) : g_\sigma \multimap ((i_\sigma \multimap h_\sigma) \multimap f_\sigma)}{\lambda P.\text{try}(\text{petar}, P) : (i_\sigma \multimap h_\sigma) \multimap f_\sigma}}{\text{try}(\text{petar},\ \lambda z.\text{come}(z)) : f_\sigma}$$

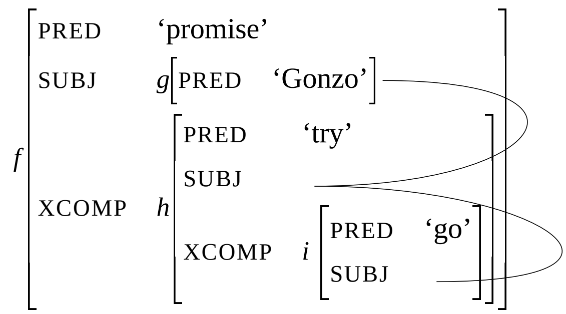
Again we see that LFG's architecture has been exploited to solve a previous problem in the semantics of equi. Although there is a null pronominal subject in the clausal equi complement, I am essentially proposing here that it is only there to maintain the obligatory syntactic relationship between the controller and the controllee. Thus, there is typological variation in the syntactic mechanisms used to maintain control relationships. English uses functional control, while other languages, such as Serbo-Croation or Icelandic (Andrews, 1982) use anaphoric control. The differences in the syntactic mechanisms are reflected in the Glue semantics, but it is still possible for the controlled clausal complements to have the same denotation, no matter which syntactic mechanism the grammar of a language employs. Therefore, there is a separation of syntax and semantics, but there is a systematic relationship between the two, and there can be typological differences in one, without there *necessarily* being differences in the other.

6.3 Equi Embedded under Equi

At this point the reader may well be wondering if this analysis can handle an equi verb embedded under another equi verb, which will result in three-way structure-sharing. In fact, this is not a problem as the following example and its Glue proof show.

(29) a. Gonzo promised to try to go.

b.



c.

$$
\begin{array}{rcl}
\text{gonzo :} & & \uparrow_\sigma \\
& = & g_\sigma \\
\lambda\text{x}\lambda\text{P.promise(x, P) :} & & (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma) \\
& = & g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma) \\
\lambda\text{y}\lambda\text{Q.try(y, Q) :} & & (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma) \\
& = & g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma) \\
\lambda\text{w.go :} & & (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma \\
& = & g_\sigma \multimap i_\sigma
\end{array}
$$

d. **Glue proof, without meanings**[11]

$$
\dfrac{\dfrac{g_\sigma \quad g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{(g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}} \qquad \dfrac{\dfrac{\dfrac{[g_\sigma]^1 \quad g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma)}{(g_\sigma \multimap i_\sigma) \multimap h_\sigma}\multimap_{\mathcal{E}} \quad g_\sigma \multimap i_\sigma}{h_\sigma}\multimap_{\mathcal{E}}}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{I},1}}{\text{promise(gonzo, } \lambda z.\text{try}(z,\ \lambda w.\text{go}(w))) : f_\sigma}\multimap_{\mathcal{E}}
$$

The lefthand side of the proof shows that the Glue resource for the matrix subject is consumed to prove the consequent of the matrix equi verb, as already demonstrated in section 5. The righthand side of the proof shows the first use of linear implication introduction (see (6) in section 2.4). We assume a Glue resource, g_σ, and flag the assumption. We then use this resource to get the meaning for the outer XCOMP, h. Since we have used the assumed g_σ in proving h_σ, we can discharge the assumption and get the implication $g_\sigma \multimap h_\sigma$. We then combine this resource with the resource from the lefthand side of the proof to get the meaning for the sentence, which is a relation of promising between an individual, $gonzo$, and the property of trying to go. Thus, once again in our semantics we have the property denotation for the clausal equi complement and the Glue proof goes through despite the three-way structure-sharing.

6.4 The Interaction of Equi and Raising

In this section I will demonstrate that the analysis of equi presented thus far interacts nicely with a Glue analysis of raising, which I present first.

[11] Glue proofs with meanings for this example and for examples (31) and (32) are given in the appendix.

6.4.1 Raising

At the syntactic level of f-structure, raising looks very much like equi, because the raising verb's SUBJ (or OBJ) functionally controls its XCOMP SUBJ, as illustrated in (30b) below. The crucial difference between equi and raising is a semantic one. In equi, the controlling GF is simultaneously a semantic argument of the equi verb and of its XCOMP, but in raising the "raised" GF is not a semantic argument of the raising verb, only of its XCOMP. Evidence for this comes from expletives. Raising verbs can take expletive subjects or objects in lieu of a raised one, but equi verbs can never take an expletive instead of the equi controller.

Furthermore, the denotation of a raising verb's clausal complement is a proposition, not a property (Montague, 1974). The verb *seem*, for example, is a one-place predicate, taking a propositional argument, as its subject is not a semantic argument. This is why the Glue entry for the verb *seem* in (30c) is $\lambda\mathcal{P}.seem(\mathcal{P})$: $(\uparrow \text{XCOMP})_\sigma \multimap \uparrow_\sigma$. *Seem* only needs its XCOMP's meaning, which is a proposition,[12] to provide its own meaning.

(30) a. Gonzo seemed to vanish.

b.

$$f\begin{bmatrix} \text{PRED} & \text{`seem'} \\ \text{SUBJ} & \\ \text{XCOMP} & h\begin{bmatrix} \text{PRED} & \text{`vanish'} \\ \text{SUBJ} & g\begin{bmatrix} \text{PRED} & \text{`Gonzo'} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

c.

$$\begin{array}{rcl} \text{gonzo} : & & \uparrow_\sigma \\ & = & g_\sigma \\ \lambda\mathcal{P}.\text{seem}(\mathcal{P}) : & & (\uparrow \text{XCOMP})_\sigma \multimap \uparrow_\sigma \\ & = & h_\sigma \multimap f_\sigma \\ \lambda\text{x.vanish(x)} : & & (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma \\ & = & g_\sigma \multimap h_\sigma \end{array}$$

d. **Glue proof, without meanings**

$$\dfrac{\dfrac{g_\sigma \qquad g_\sigma \multimap h_\sigma}{h_\sigma}\multimap_\mathcal{E} \qquad h_\sigma \multimap f_\sigma}{\text{seem}(\text{vanish}(\text{gonzo})) : f_\sigma}\multimap_\mathcal{E}$$

e. **Glue proof, with meanings**

$$\dfrac{\dfrac{\text{gonzo} : g_\sigma \qquad \lambda x.\text{vanish}(x) : g_\sigma \multimap h_\sigma}{\text{vanish}(\text{gonzo}) : h_\sigma}\multimap_\mathcal{E} \qquad \lambda\mathcal{P}.\text{seem}(\mathcal{P}) : h_\sigma \multimap f_\sigma}{\text{seem}(\text{vanish}(\text{gonzo})) : f_\sigma}\multimap_\mathcal{E}$$

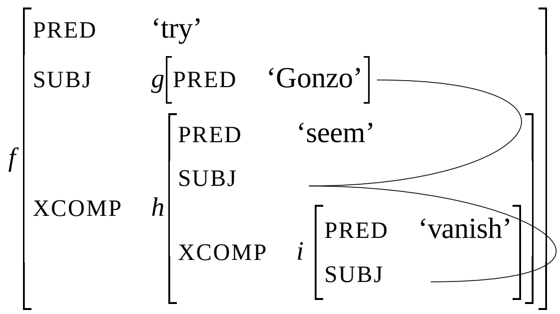
We end up with the sentence *Gonzo seemed to vanish* meaning $seem(vanish(gonzo))$. This is a one place predicate with a propositional argument, just as desired.

[12]The variable $\mathcal{P}$ ranges over propositions, unlike the previously encountered P, which ranges over properties.

6.4.2 Raising under Equi

With the analysis of raising in hand, we can derive a meaning for a sentence that has a matrix equi verb and an embedded raising complement. Again, this results in three-way structure-sharing, but the analysis developed here is fully general and the structure-sharing once again poses no problem.

(31) a. Gonzo tried to seem to vanish.

b. 

c.

$$\begin{aligned}
\text{gonzo} :\quad & \uparrow_\sigma \\
= \quad & g_\sigma \\
\lambda\text{y}\lambda\text{Q.try(y, Q)} :\quad & (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma) \\
= \quad & g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma) \\
\lambda\mathcal{P}.\text{seem}(\mathcal{P}) :\quad & (\uparrow \text{XCOMP})_\sigma \multimap \uparrow_\sigma \\
= \quad & i_\sigma \multimap h_\sigma \\
\lambda\text{w.vanish(w)} :\quad & (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma \\
= \quad & g_\sigma \multimap i_\sigma
\end{aligned}$$

d. **Glue proof, without meanings**

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{[g_\sigma]^1 \quad g_\sigma \multimap i_\sigma}{i_\sigma}\multimap_{\mathcal{E}} \quad i_\sigma \multimap h_\sigma}{h_\sigma}\multimap_{\mathcal{E}}}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{I},1} \qquad \dfrac{g_\sigma \quad g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{(g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}}}{\text{try}(\text{gonzo},\ \lambda z.\text{seem}(\text{vanish}(z))) : f_\sigma}\multimap_{\mathcal{E}}$$

Using simply the equi and raising entries we have already encountered so far, the meaning for the sentence is given as $try(gonzo, \lambda z.seem(vanish(z)))$, which is a relation between the individual $gonzo$ and the property of seeming to vanish. Once again, the denotation of the clausal equi complement is a property, although the complement is headed by a raising verb.

6.4.3 Equi under Raising

The semantics for an equi verb embedded as the complement of a raising verb is equally unproblematic:

(32) a. Gonzo seemed to try to go.

b. $$f\left[\begin{array}{ll} \text{PRED} & \text{‘seem’} \\ \text{SUBJ} & g\left[\begin{array}{ll}\text{PRED} & \text{‘Gonzo’}\end{array}\right] \\ \text{XCOMP} & h\left[\begin{array}{ll} \text{PRED} & \text{‘try’} \\ \text{SUBJ} & \\ \text{XCOMP} & i\left[\begin{array}{ll}\text{PRED} & \text{‘go’} \\ \text{SUBJ} & \end{array}\right] \end{array}\right] \end{array}\right]$$

c.
$$\begin{array}{rcl}
\text{gonzo}: & & \uparrow_\sigma \\
& = & g_\sigma \\
\lambda\mathcal{P}.\text{seem}(\mathcal{P}): & & (\uparrow \text{XCOMP})_\sigma \multimap \uparrow_\sigma \\
& = & h_\sigma \multimap f_\sigma \\
\lambda y\lambda Q.\text{try}(y, Q): & & (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma) \\
& = & g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma) \\
\lambda w.\text{go}(w): & & (\uparrow \text{SUBJ})_\sigma \multimap \uparrow_\sigma \\
& = & g_\sigma \multimap i_\sigma
\end{array}$$

d. **Glue proof, without meanings**

$$\dfrac{\dfrac{\dfrac{g_\sigma \quad g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma)}{(g_\sigma \multimap i_\sigma) \multimap h_\sigma}\multimap_\mathcal{E} \quad g_\sigma \multimap i_\sigma}{h_\sigma}\multimap_\mathcal{E} \quad h_\sigma \multimap f_\sigma}{\text{seem}(\text{try}(\text{gonzo},\ \lambda w.\text{go}(w))) : f_\sigma}\multimap_\mathcal{E}$$

The meaning we end up with is a one place predicate, $seem$, which takes a propostional argument, $try(gonzo, \lambda w.go(w))$. And the meaning of the embedded equi verb is the usual relation between an individual and property.

6.5 De Re and De Dicto Scope

Lastly, it can be shown that the semantics for equi and raising developed here naturally yield the de re/de dicto differences between equi and raising verbs (Dowty et al., 1981; Montague, 1974). In particular, a quantified subject of a raising verb can take either wide scope (de re reading) or narrow scope (de dicto reading) with respect to the verb. However, the subject of an equi verb cannot take narrow scope with respect to the equi verb, and the de dicto reading is unavailable.

6.5.1 Raising: Both De Re and De Dicto Readings Available

Consider the example in (33a) below. The de re reading entails the existence of a goblin, whereas the de dicto reading does not. On the de dicto reading, something that *seems* to be a goblin tried to pinch Gonzo, but the thing in question could (for example) be a child in a Halloween costume. Let us assume an existentially quantified denotation of indefinite noun phrases, represented as a generalized quantifier (Barwise and Cooper, 1981). We can then write the Glue for *a goblin* as in (33c), following the Glue treatment of generalized quantifiers in Dalrymple et al. (1999b). There are two ways to instantiate the variable X in the indefinite noun phrase's Glue. To get the de re reading in (33d), we first prove f_σ (i.e. the sentence's semantics) and then instantiate X to f_σ, giving the quantified noun phrase wide scope. For the de dicto reading, we combine the quantifier with the XCOMP's Glue, and then combine the result with the matrix raising verb. This gives the quantifier narrow scope.

(33) a. A goblin seemed to pinch Gonzo.

b.

$$f\begin{bmatrix} \text{PRED} & \text{'seem'} \\ \text{SUBJ} & g\begin{bmatrix}\text{PRED} & \text{'goblin'}\end{bmatrix} \\ \text{XCOMP} & h\begin{bmatrix} \text{PRED} & \text{'pinch'} \\ \text{SUBJ} & \_\_ \\ \text{OBJ} & i\begin{bmatrix}\text{PRED} & \text{'Gonzo'}\end{bmatrix} \end{bmatrix} \end{bmatrix}$$

c.

$$\begin{array}{rcl} \lambda Q\exists z.[\text{goblin}(z) \wedge Q(z)] : & & (\uparrow_\sigma \multimap X) \multimap X \\ & = & (g_\sigma \multimap X) \multimap X \\ \lambda \mathcal{P}.\text{seem}(\mathcal{P}) : & & (\uparrow \text{XCOMP})_\sigma \multimap \uparrow_\sigma \\ & = & h_\sigma \multimap f_\sigma \\ \lambda y\lambda x.\text{pinch}(x, y) : & & (\uparrow \text{OBJ})_\sigma \multimap ((\uparrow \text{SUBJ}) \multimap \uparrow_\sigma) \\ & = & i \multimap (g \multimap h_\sigma) \\ \text{gonzo} : & & \uparrow_\sigma \\ & = & i_\sigma \end{array}$$

d. **De re**[13]

$$\dfrac{(g_\sigma \multimap X) \multimap X \qquad \dfrac{\dfrac{\dfrac{\dfrac{i_\sigma \quad i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}} \quad [g_\sigma]^1}{h_\sigma}\multimap_{\mathcal{E}} \quad h_\sigma \multimap f_\sigma}{f_\sigma}\multimap_{\mathcal{E}}}{g_\sigma \multimap f_\sigma}\multimap_{\mathcal{I},1}}{\exists z.[\text{goblin}(z) \wedge \text{seem}(\text{pinch}(z,\ \text{gonzo}))] : f_\sigma}\multimap_{\mathcal{E}}, X = f_\sigma$$

e. **De dicto**

$$\dfrac{h_\sigma \multimap f_\sigma \qquad \dfrac{\dfrac{i_\sigma \quad i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}} \quad (g_\sigma \multimap X) \multimap X}{h_\sigma}\multimap_{\mathcal{E}}, X = h_\sigma}{\text{seem}(\exists z.[\text{goblin}(z) \wedge \text{pinch}(z,\ \text{gonzo})]) : f_\sigma}\multimap_{\mathcal{E}}$$

[13] See the appendix for Glue proofs with meanings of (33d), (33e), and (34d).

6.5.2 Equi: Only De Re Reading Available

Now let us consider the same sentence with the equi verb *try* replacing the raising verb *seem*. The resulting sentence only has a de re reading for the quantified subject: the goblin is entailed to exist. It is easy to understand why this should be so. If a goblin tried to pinch Gonzo, then there must be some goblin or other that did this. The de re reading is derived in the same manner as for (33). The sentence's semantics is first derived and then combined with the quantifier, which gets wide scope. However, there is no way to give the quantifier narrow scope. If we attempt to do this, the subject resource (g_σ) is lost and the Glue proof fails.

(34) a. A goblin tried to pinch Gonzo.

b.

$$f\left[\begin{array}{ll} \text{PRED} & \text{'try'} \\ \text{SUBJ} & g\left[\begin{array}{ll}\text{PRED} & \text{'goblin'}\end{array}\right] \\ \text{XCOMP} & h\left[\begin{array}{ll} \text{PRED} & \text{'pinch'} \\ \text{SUBJ} & \\ \text{OBJ} & i\left[\begin{array}{ll}\text{PRED} & \text{'Gonzo'}\end{array}\right] \end{array}\right] \end{array}\right]$$

c.

$$\begin{array}{rcl} \lambda Q\exists z.[\text{goblin}(z) \wedge Q(z)] : & & (\uparrow_\sigma \multimap X) \multimap X \\ & = & (g_\sigma \multimap X) \multimap X \\ \lambda w\lambda P.\text{try}(w, P) : & & (\uparrow \text{SUBJ})_\sigma \multimap (((\uparrow \text{XCOMP SUBJ})_\sigma \multimap (\uparrow \text{XCOMP})_\sigma) \multimap \uparrow_\sigma) \\ & = & g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma) \\ \lambda y\lambda x.\text{pinch}(x, y) : & & (\uparrow \text{OBJ})_\sigma \multimap ((\uparrow \text{SUBJ}) \multimap \uparrow_\sigma) \\ & = & i \multimap (g \multimap h_\sigma) \\ \text{gonzo} : & & \uparrow_\sigma \\ & = & i_\sigma \end{array}$$

d. **De re**

$$\dfrac{(g_\sigma \multimap X) \multimap X \qquad \dfrac{\dfrac{\dfrac{[g_\sigma]^1 \quad g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{(g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}} \qquad \dfrac{i_\sigma \qquad i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}}}{f_\sigma}\multimap_{\mathcal{E}}}{g_\sigma \multimap f_\sigma}\multimap_{\mathcal{I},1}}{\exists z.[\text{goblin}(z) \wedge \text{try}(z,\ \lambda x.\text{pinch}(x,\ \text{gonzo}))] : f_\sigma}\multimap_{\mathcal{E}}, X = f_\sigma$$

e. **De dicto - no proof**

$$\dfrac{\dfrac{g_\sigma \quad g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{(g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}} \qquad \dfrac{\dfrac{i_\sigma \multimap (g_\sigma \multimap h_\sigma) \quad i_\sigma}{g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}} \qquad (g_\sigma \multimap X) \multimap X}{h_\sigma}\multimap_{\mathcal{E}}, X = h_\sigma}{}$$

7 Conclusion

The analysis of equi developed here has shown that the resource-sensitivity of Glue semantics is not necessarily at odds with functional control and structure-sharing at f-structure. In fact, the tension between these features of the architecture leads to a restrictive semantics for equi which has several advantages. First, the semantics naturally yields a property denotation for the clausal equi complement, which has been argued for by Chierchia (1984) and others. At the same time, a propositional denotation is possible, without changing the linear logic portion of the Glue semantics for equi verbs. The only change is in the meaning language. This analysis therefore offers a better solution than Kehler et al.'s (1999) proposal that paths in f-structures contribute resoures, because it involves no modification of Glue theory and it has the empirical advantage of allowing the property denotation for clausal equi complements, which the Kehler et al. analyis does not allow.

Second, the analysis in this paper exploits LFG's parallel projection architecture to capture the anaphoric binding facts and typological facts which have been a problem for other formulations of the property theory of equi semantics. Binding is handled at f-structure as usual, with the structure-shared controlled subject providing a local antecedent for a reflexive in the embedded clause. But, the projection architecture and Glue language allow for a semantics in which the resource for the controlled subject does not have to be contributed, which also naturally leads to the right analysis in the meaning language. The second problem, that of anaphoric control, can also be handled naturally. Languages that use anaphoric control for equi simply need an additional Glue premise which consumes the controllee pronominal and relates it to the controller.

Third, this semantics is robust and can handle a range of empirical phenomena, including embedded equi verbs, the interaction with the semantics for raising verbs, and de dicto/de re differences between equi and raising verbs. As a final aside, the analysis suggests a general program for dealing with structure-sharing, which has preliminarily been extended to the analysis of VP conjunction and right node raising in our implementation at PARC.

References

Andrews, Avery (1982). The representation of case in Modern Icelandic. In Bresnan (1982b), (pp. 427–503).

Asudeh, Ash (to appear). A resource-sensitive semantics for equi and raising. In David Beaver and Stefan Kaufmann (eds.), *Proceedings of the Stanford Semantics Fest*. Stanford, CA: CSLI Publications.

Barwise, Jon, and Robin Cooper (1981). Generalized quantifiers and natural language. *Linguistics and Philosophy*, *4*, 159–219.

Bresnan, Joan (1982a). Control and complementation. *Linguistic Inquiry*, *13*, 343–434.

Bresnan, Joan (ed.) (1982b). *The mental representation of grammatical relations*. Cambridge, MA: MIT Press.

Bresnan, Joan (2000). *Lexical-Functional Syntax*. Cambridge, MA: Blackwell.

Chierchia, Gennaro (1984). Anaphoric properties of infinitives and gerunds. In Mark Cobler, Susannah MacKaye, and Michael Wescoat (eds.), *Proceedings of the third West Coast Conference on Formal Linguistics*, (pp. 28–39), Stanford, CA. Stanford Linguistics Association.

Chierchia, Gennaro (1985). Formal semantics and the grammar of predication. *Linguistic Inquiry*, *16*, 417–443.

Chierchia, Gennaro, and Pauline Jacobson (1986). Local and long distance control. In *Proceedings of NELS 16*.

Dalrymple, Mary (1993). *The syntax of anaphoric binding*. Stanford, CA: CSLI Publications.

Dalrymple, Mary (ed.) (1999). *Semantics and syntax in Lexical Functional Grammar: The resource logic approach*. Cambridge, MA: MIT Press.

Dalrymple, Mary, John Lamping, Fernando Pereira, and Vijay Saraswat (1999a). Overview and introduction. In Dalrymple (1999), (pp. 1–38).

Dalrymple, Mary, John Lamping, Fernando Pereira, and Vijay Saraswat (1999b). Quantification, anaphora, and intensionality. In Dalrymple (1999), (pp. 39–89).

Dalrymple, Mary, Stuart M. Schieber, and Fernando C. N. Pereira (1991). Ellipsis and higher-order unification. *Linguistics and Philosophy*, *14*, 399–452.

Dowty, David R., Robert E. Wall, and Stanley Peters (1981). *Introduction to montague semantics*. Dordrecht: Kluwer Academic Publishers.

Falk, Yehuda (to appear). *Lexical-Functional Grammar: An introduction to parllel constraint-based syntax*. Stanford, CA: CSLI Publications.

Girard, Jean-Yves (1987). Linear logic. *Theoretical Computer Science*, *50*, 1–102.

Kaplan, Ronald M. (1987). Three seductions of computational psycholinguistics. In P. Whitelock, M. M. Wood, H. L. Somers, R. Johnson, and P. Bennett (eds.), *Linguistic theory and computer applications*, (pp. 149–181). London: Academic Press. Reprinted in Dalrymple et al. (1995), 339–367.

Kaplan, Ronald M. (1995). The formal architecture of Lexical-Functional Grammar. In Mary Dalrymple, Ronald M. Kaplan, John T. Maxwell, and Annie Zaenen (eds.), *Formal issues in Lexical-Functional Grammar*, (pp. 7–27). Stanford, CA: CSLI.

Kaplan, Ronald M., and Joan Bresnan (1982). Lexical-Functional Grammar: A formal system for grammatical representation. In Bresnan (1982b), (pp. 173–281).

Kehler, Andrew, Mary Dalrymple, John Lamping, and Vijay Saraswat (1999). Resource sharing in glue language semantics. In Dalrymple (1999), (pp. 191–208).

Montague, Richard (1974). The proper treatment of quantification in ordinary English. In *Formal philosophy: Selected papers of Richard Montague*. New Haven: Yale University Press. Edited and with an introduction by Richmond H. Thomason.

Pollard, Carl, and Ivan A. Sag (1994). *Head-Driven Phrase Structure Grammar*. Chicago, IL and Stanford, CA: The University of Chicago Press and CSLI Publications.

Sag, Ivan A., and Carl Pollard (1991). An integrated theory of complement control. *Language*, *67*, 63–113.

Zec, Draga (1987). On obligatory control in clausal complements. In Masayo Iida, Stephen Wechsler, and Draga Zec (eds.), *Workng papers in grammatical theory and discourse structure, vol. I: Interactions of morphology, syntax, and discourse*, (pp. 139–168). CSLI Publications.

Appendix: Glue Proofs with Meanings

(29d′)

$$\dfrac{\dfrac{\text{gonzo} : g_\sigma \quad \lambda x \lambda P.\text{promise}(x, P) : g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{\lambda P.\text{promise}(\text{gonzo}, P) : (g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}} \quad \dfrac{\dfrac{\dfrac{[z : g_\sigma]^1 \quad \lambda y \lambda Q.\text{try}(y, Q) : g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma)}{\lambda Q.\text{try}(z, Q) : (g_\sigma \multimap i_\sigma) \multimap h_\sigma}\multimap_{\mathcal{E}} \quad \lambda w.\text{go}(w) : g_\sigma \multimap i_\sigma}{\text{try}(z, \lambda w.\text{go}(w)) : h_\sigma}\multimap_{\mathcal{E}}}{\lambda z.\,\text{try}(z, \lambda w.\text{go}(w)) : g_\sigma \multimap h_\sigma}\multimap_{\mathcal{I},1}}{\text{promise}(\text{gonzo}, \lambda z.\,\text{try}(z, \lambda w.\text{go}(w))) : f_\sigma}\multimap_{\mathcal{E}}$$

(31d′)

$$\dfrac{\dfrac{\dfrac{\dfrac{[z : g_\sigma]^1 \quad \lambda w.\text{vanish}(w) : g_\sigma \multimap i_\sigma}{\text{vanish}(z) : i_\sigma}\multimap_{\mathcal{E}} \quad \lambda \mathcal{P}.\text{seem}(\mathcal{P}) : i_\sigma \multimap h_\sigma}{\text{seem}(\text{vanish}(z)) : h_\sigma}\multimap_{\mathcal{E}}}{\lambda z.\,\text{seem}(\text{vanish}(z)) : g_\sigma \multimap h_\sigma}\multimap_{\mathcal{I},1} \quad \dfrac{\text{gonzo} : g_\sigma \quad \lambda y \lambda Q.\text{try}(y,\ Q) : g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{\lambda Q.\text{try}(\text{gonzo},\ Q) : (g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}}}{\text{try}(\text{gonzo},\ \lambda z.\,\text{seem}(\text{vanish}(z))) : f_\sigma}\multimap_{\mathcal{E}}$$

(32d′)

$$\dfrac{\dfrac{\dfrac{\text{gonzo} : g_\sigma \quad \lambda y \lambda Q.\text{try}(y,\ Q) : g_\sigma \multimap ((g_\sigma \multimap i_\sigma) \multimap h_\sigma)}{\lambda Q.\text{try}(\text{gonzo},\ Q) : (g_\sigma \multimap i_\sigma) \multimap h_\sigma}\multimap_{\mathcal{E}} \quad \lambda w.\text{go}(w) : g_\sigma \multimap i_\sigma}{\text{try}(\text{gonzo},\ \lambda w.\text{go}(w)) h_\sigma}\multimap_{\mathcal{E}} \quad \lambda \mathcal{P}.\text{seem}(\mathcal{P}) : h_\sigma \multimap f_\sigma}{\text{seem}(\text{try}(\text{gonzo},\ \lambda w.\text{go}(w))) : f_\sigma}\multimap_{\mathcal{E}}$$

(33d′)

$$\dfrac{\dfrac{\lambda Q \exists z.[\text{goblin}(z) \wedge Q(z)] : (g_\sigma \multimap X) \multimap X \quad \dfrac{\dfrac{\dfrac{\dfrac{\text{gonzo} : i_\sigma \quad \lambda y \lambda x.\text{pinch}(x, y) : i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{\lambda x.\text{pinch}(x, \text{gonzo}) : g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}} \quad [w : g_\sigma]^1}{\text{pinch}(w, \text{gonzo}) : h_\sigma}\multimap_{\mathcal{E}} \quad \lambda \mathcal{P}.\text{seem}(\mathcal{P}) : h_\sigma \multimap f_\sigma}{\text{seem}(\text{pinch}(w, \text{gonzo})) : f_\sigma}\multimap_{\mathcal{E}}}{\lambda w.\text{seem}(\text{pinch}(w, \text{gonzo})) : g_\sigma \multimap f_\sigma}\multimap_{\mathcal{I},1}}{\exists z.[\text{goblin}(z) \wedge \lambda w.\text{seem}(\text{pinch}(w,\ \text{gonzo}))(z)] : f_\sigma}\multimap_{\mathcal{E}}, X = f_\sigma}{\exists z.[\text{goblin}(z) \wedge \text{seem}(\text{pinch}(z,\ \text{gonzo}))] : f_\sigma}$$

(33e′)

$$\dfrac{\lambda\mathcal{P}.\text{seem}(\mathcal{P}) : h_\sigma \multimap f_\sigma \qquad \dfrac{\dfrac{\text{gonzo} : i_\sigma \qquad \lambda y\lambda x.\text{pinch}(x,y) : i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{\lambda x.\text{pinch}(x,\text{gonzo}) : g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}} \qquad \lambda Q\exists z.[\text{goblin}(z) \wedge Q(z)] : (g_\sigma \multimap X) \multimap X}{\exists z.[\text{goblin}(z) \wedge \lambda x.\text{pinch}(x,\text{gonzo})(z)] : h_\sigma}\multimap_{\mathcal{E}}, X = h_\sigma}{\text{seem}(\exists z.[\text{goblin}(z) \wedge \text{pinch}(z,\ \text{gonzo})]) : f_\sigma}\multimap_{\mathcal{E}}$$

(34d′)

$$\dfrac{\dfrac{\lambda Q\exists z.[\text{goblin}(z) \wedge Q(z)] : (g_\sigma \multimap X) \multimap X \qquad \dfrac{\dfrac{\dfrac{[u : g_\sigma]^1 \quad \lambda w\lambda P.\text{try}(w,\ P) : g_\sigma \multimap ((g_\sigma \multimap h_\sigma) \multimap f_\sigma)}{\lambda P.\text{try}(u,\ P) : (g_\sigma \multimap h_\sigma) \multimap f_\sigma}\multimap_{\mathcal{E}} \qquad \dfrac{\text{gonzo} : i_\sigma \qquad \lambda y\lambda x.\text{pinch}(x,y) : i_\sigma \multimap (g_\sigma \multimap h_\sigma)}{\lambda x.\text{pinch}(x,\text{gonzo}) : g_\sigma \multimap h_\sigma}\multimap_{\mathcal{E}}}{\text{try}(u, \lambda x.\text{pinch}(x,\text{gonzo})) : f_\sigma}\multimap_{\mathcal{E}}}{\lambda u.\text{try}(u, \lambda x.\text{pinch}(x,\text{gonzo})) : g_\sigma \multimap f_\sigma}\multimap_{\mathcal{I},1}}{\exists z.[\text{goblin}(z) \wedge \lambda u.\text{try}(u,\ \lambda x.\text{pinch}(x,\ \text{gonzo}))(z)] : f_\sigma}\multimap_{\mathcal{E}}, X = f_\sigma}{\exists z.[\text{goblin}(z) \wedge \text{try}(z,\ \lambda x.\text{pinch}(x,\ \text{gonzo}))] : f_\sigma}$$

The morphosyntactic correlates of finiteness

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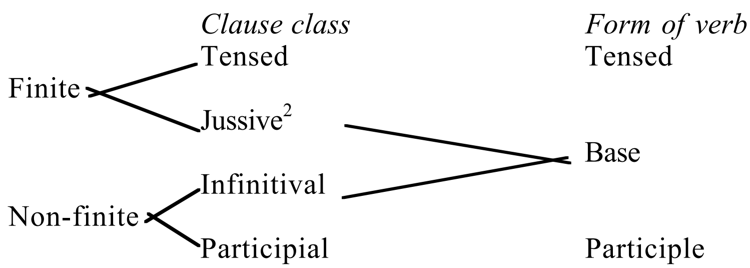
Abstract
In this paper I question the traditional view of the notion 'finiteness'. Rather than being a morphosyntactic feature, I argue that if anything it is a semantic category related to time, reference and definiteness. Furthermore I attempt to abandon the rather misleading labels of 'finite' and 'non-finite' verb forms by offering evidence from English, Romance and Japanese which reveal that verb forms may have morphological tense despite having no independent time reference. I propose a realisational theory of morphology in the spirit of Anderson (1992) and Stump (forthcoming) in which the shapes of verb forms are the expression of particular configurations of features at f-structure involving tense, aspect, modality and subordination. For example I show that *to*-infinitives like subjunctives and modal verbs are prototypical expressions of irrealis modality while a tensed form in an Italian perception verb complement may be used to unambiguously express imperfective aspect.

1.0 Introduction[1]

'Finiteness' is traditionally defined as a property which relates to verb forms such that a *finite verb* is one that is 'limited by properties of person, number and tense.' Huddleston (1988:44). Huddleston, however, goes on to make a distinction between verb level and clause level notions of finiteness, and gives the following classification for English:

1.


Lyons on the other hand considers tense to be a sentential category: 'In any case, independently of the way in which tense is expressed in languages of various morphological types, considered from a semantic point of view, tense (in tensed languages) is always a sentential (or clausal) category." (1995:314).

From the perspective of English, non-finite verbal forms are assumed to be the infinitive, the gerund, the participles, while finite forms are those which inflect for tense (*walk* vs. *walked*) and person (*walk* vs. *walks*). Of undetermined category are thus the modal verbs, which do not inflect for person, and may not inflect for tense (see below) and the so-called subjunctive, which does not inflect for person and whilst it has morphological tense, does not in fact have referential tense.

2.0 The morphosyntactic correlates of finiteness

At this point, given the importance traditionally attached to finiteness of the terms tense and agreement, it is perhaps worth examining these concepts in more detail, rather than assuming that they are well-defined primitives of grammatical theory.

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[1] This paper is based on issues arising from my PhD Thesis (Barron 1999), however its development into this paper is due in part to ESRC Research Grant No. R000238228.
[2] Jussives are of two kinds, imperative and non-imperative (occurring in subordinate clauses):
a. Be careful (Imperative jussive)
b. [It is essential] (that) they be present. (Non-imperative jussive)
Huddleston would therefore appear to argue that *be* in the above examples is a base form in a finite clause.

2.1 Finiteness as tense and agreement

Person and number agreement in English is only found on 3rd person singular present tense forms, unlike languages like Italian with rich agreement morphology. Its contribution therefore to the discussion of finiteness in English is often more covert than apparent. Any examination of tense (e.g. Palmer 1986) reveals that at best the relationship between tense and time is indirect. Tense is said to be the grammaticalization of time, or a deictic system which relates the time of a situation to the time of the utterance (Lyons 1995). This is apparent in the contrast between the following:

2. a. Clio is walking to the station.
   b. Clio was walking to the station.

(2a and b) are simple main clauses. The time of the event in (2a) is simultaneous or subsequent, and in (2b) prior, to the time of utterance. The present/past tense distinction on the verb *be* reflects this difference. In addition there is clearly person and number agreement on the verb. (3) illustrates that the infinitive form, *walk*, which does not express the tense contrast, has no relation to the time of utterance.

3. a. Clio hopes to walk to the station.
   b. Clio hoped to walk to the station.

The infinitive form *walk* has no person or number agreement either. In addition the infinitive verb form cannot be found as the sole verb in main clauses:

4. *Clio (to) walk to the station.

It is this kind of canonical relationship between tense and agreement which has lead to the analysis of finiteness as described above and could be represented as follows:

5. a. [+ finite] = [+ Tense] [+ AGR]
   b. [− finite] = [− Tense] [− AGR]

2.1.1. <u>The arguments against a binary distinction</u>.
Evidence against a simple binary distinction between [+ finite] and [− finite] comes however from a number of sources[3]:

2.1.1.1. Languages without agreement features
The existence of languages like Japanese which do not have agreement features (and in some analyses have the verbal category aspect rather than tense), but which nonetheless are claimed to have a finite/non finite distinction. This casts doubt upon the requirement for [AGR] in any description of finiteness.[4]

2.1.1.2. Languages with agreeing 'non-finite' forms.
There are instances of so-called non finite forms, infinitives (Portuguese, Southern Italian), see Raposo (1987) and Ledgeway (1998a); gerunds and participles (Old Neopolitan) see Vincent (1997, 1998 and references therein) which inflect for person and number, and of infinitives which inflect for tense (eg. Latin *portare* vs. *portavisse*). These facts give us grounds for two further correlations:

6. [− finite] = [−Tense] [+AGR] (Portuguese)
   [− finite] = [+Tense] [−AGR] (Latin)

[3] See also Koptjevsakaja-Tamm (1994) for a discussion of the problem of defining finiteness.
[4] Unless one assumes that AGR is covert in such languages.

2.2 Finiteness as tense and modality

2.2.1. The modal verbs of English

The relationship between the English modal verbs and tense is notoriously complicated. Quirk and Greenbaum (1973), and all subsequent descriptions of English, note that modal verbs are excluded from non-finite clauses and yet it appears that modal verbs (which may not have deictic tense) may be found in clauses traditionally described as 'finite'. So could we speculate that there is a relationship between finiteness and the presence/absence of modal verbs? The only modal verb which clearly expresses a past/non past distinction is *can/could*. Nonetheless, *could* also clearly has non-past uses (8), so is not unambiguously a past tense form:

7. I *could* speak French as a child, but since moving to England I've forgotten it all.
8. I *could* go tomorrow, if you want.

In addition, consider (9a) which describes habitual action in the past versus (9b) which describes potential/hypothentical action in the future.

9. a. I *would* go to the shops every Saturday when I was a teenager.
   b. I *would* go to the shops every Saturday if I lived in Oxford Street.

The existence of morphological present/past pairs for the modal verbs *will/would*; *can/could*; *may/*might; *shall/should* has little to do with a present/past temporal distinction as noted by Coates (1983), Quirk et al (1985),[5] Palmer (1986), Warner (1993), and Bybee (1995). Lyons notes "the grammatical categories of mood and tense are interdependent in all natural languages that have both categories; and mood is more widespread than tense throughout the languages of the world." (1995:327) It is thus surprising, that except for a recent paper by Vincent, so little attention has been paid to the relationship between finiteness and modality. Fleishman (1995:519) notes the connection between imperfective aspect (particularly in the past tense) and irrealis modality due to the shared semantic feature of non-completion. Bybee (1995:505) notes that modal verbs 'whether they express desire, obligation, necessity, intention or ability, have in common the semantic property that they do not imply the completion of the action or event expressed by the infinitive with which they occur.' Traditional mood categories include indicative, subjunctive and imperative.

2.2.2. The subjunctive

The 'subjunctive' mood in English is realized by the use of the base form of the verb or the morphological past tense[6]:

10. If he **came** tomorrow, he could meet your sister.
11. The officer asked that the suspect **be** detained for questioning.

The use of morphological past tense in (10) clearly has nothing directly to do with past time, in the same way that the use of the modal verb *could* in the same sentence has nothing to do with past time, despite being a morphological past tense. The use of past tense as a secondary deictic device, where the notion of distal time is extended to express subjective distancing from commitment to a proposition is discussed in James (1982), Frawley (1992) and Lyons (1995). The subjunctive then is further evidence that there needs to be a division between morphological tense and referential or primary deictic tense.

---

[5] Where they do appear to have a temporal distinction is in reported speech: (i) *I will go tomorrow*. (ii) *She said she would go tomorrow.* However, here the morphological form of *would* in (ii) is determined by *said* and is not independent.

[6] The absence of distinct specific verbal inflections to signal these modal meanings is often cited as evidence that English does not have a syntactic category of 'subjunctive' mood. I shall therefore use the term 'subjunctive' in English to refer to the non-canonical use of base and past tense forms which carry the modal meaning.

Huddleston's schema in (1) does in part reflect this, by claiming that base forms of verbs may be found in both finite and non-finite clauses. His position is that clauses with morphological tense and those with base forms, when jussive (imperative or subjunctive) are finite. However, this does not advance our understanding of what finiteness is. Palmer (1986:162) also makes the point that finite and non-finite may not be discrete categories: 'It could be argued that there is no clear distinction between finite and non-finite forms, rather a gradation of finiteness. If the declarative form is considered to be the maximally finite form…., other forms can be considered to be less finite in relation to the degree to which they do not mark the other categories (tense, aspect, number, gender, person) that may be marked on declarative forms. The infinitive may well be maximally non-finite (unless it marks tense), but the subjunctive, if it does not have full tense marking….is less finite than the declarative.' However, with respect to that status of the subjunctive in relation to subordinate clauses, he concedes that it (the subjunctive) may be partially non-finite, but that it contrasts with other non-finite forms in that it is clearly marked for the relevant category of mood (presumably by this he means irrealis). He concludes that "Non-finiteness and mood are thus very different indicators of subordination, and are not to be handled in a single parameter." However, it seems to me that there are fairly good grounds for suggesting that the to-infinitive and the subjunctive encode precisely the same type of irrealis modality.

2.2.3. <u>To-infinitives and modality</u>.

Frahzyngier (1995:476) claims that complementizers constitute a part of the system of modality markers, encoding deontic, epistemic and other types of modality. 'The absence of complementizers in indicative main clauses in some languages is explained by the fact that such clauses are inherently marked as conveying a speaker's belief in the truth of the proposition.' (1995:499)

2.2.3.1. The semantics of the *to* infinitive marker.

Several commentators have pointed out that the preposition *to*, which is polysemous in nature, having both directional and recipient meanings (Croft 1990:166), has been reanalyzed as a complementizer preceding the infinitive, (Noonan 1985:47-8), (Hopper and Traugott 1993:71, 181-184), (Warner 1993:135-140). The origins of the 'to infinitive' were as a preposition (meaning *towards*) plus nominalized verb. This phenomenon is apparently common cross-linguistically, for example French *à* < Latin *ad*. The allative-dative marker is associated semantically with notions of 'goals' and consequently it is used as a complementizer precisely with those verbs whose semantics involve some form of 'goal' (Wierzbicka 1988), be it an intended or desired action, notably for example with the verb *want*, where it can express the intended future action of the *wanter* or of some other individual:

12. a. Clio wanted to go to the party
    b. Clio wanted Leo to go to the party.

In (12a) and (12b) the action in the complement clause is understood to be subsequent to the action of the matrix verb. Indeed, this is the conclusion of Van Valin & La Polla (1997:472) who analyse *to* as a clause linker which appears whenever the condition [−temporal overlap] is present between the action in each part of the clause.

13. a. Leo persuaded Clio to leave the party
    b. Leo saw Clio leave party.

In (13a) the action of leaving the party is subsequent to the act of persuasion and we find the *to* infinitive as expected. In (13b) the action of leaving the party does not follow the act of seeing, hence the presence of ‘to’ would be unexpected and is not found.[7]

2.2.3.2. The *to*-infinitive and the subjunctive

Evidence for the premise that *to*-infinitives and the subjunctive encode the same semantic element comes from a number of sources, as outlined in what follows. The infinitive form is used in the subordinate clause introduced by *want* type verbs in English both when the subject of the subordinate clause is identical with the matrix and when it is different. However the subjunctive is not normally permitted:

14. a. Leo wanted to leave the party.
    b. Leo wanted Clio to leave the party
    c. *Leo wanted that Clio leave the party.

In Italian, the infinitive is required when the subjects are identical, but the subjunctive is required when they are different as noted previously:

15. a. Leo vuole partire (INF). (‘Leo wants to leave’)
    b. Leo vuole che Clio parta (SUBJ) (‘Leo wants that Clio leave’)
    c. *Leo vuole Clio partire (INF). (‘Leo wants Clio to leave’)

In Romanian the subjunctive, introduced by the modal particle *s≤* is required both when the subjects are identical and when they are different:

16. a. Leo vrea s≤ plece (SUBJ) (‘Leo$_i$ wants that he$_i$ go’)
    b. Leo vrea c≤ Clio s≤ plece (SUBJ) (‘Leo wants that Clio go’)
    c. *Leo vrea plecat^{j} (INF) (‘Leo wants to leave’)

The different forms of the complement verb, subjunctive or infinitive, used in the subordinate clause can be presented in tabular form for the different languages:

	Same subject in comp	*Different subject in comp.*
Romanian	subjunctive	subjunctive
Italian	infinitive	subjunctive
English	to-infinitive	to-infinitive

Table 1 Verbal forms of complements of *want*

It would seem implausible to argue that there is any meaning difference between the subjunctive and infinitive forms. Both express some desired future action, which is necessarily irrealis. It might be thought that the inflectional ending of the subjunctive would be useful to identify a different subordinate subject in pro-drop languages, (such as Italian and Romanian), however the fact that the subjunctive is also found in French, which is not pro-drop and would therefore be redundant as far as identification in concerned, coupled with the fact that the Romanian subjunctive has syncretism of 3rd person singular and plural forms in the subjunctive, suggests that the subjunctive is required simply to provide the same modal information as the infinitive.

17. a. El cite_te (he reads-3s). El vrea s≤ citeasc≤ (SUBJ) ‘he wants to read’
    b. Ei citesc (they read-3pl). Ei vor s≤ citeasc≤ (SUBJ) ‘they want to read’

This may lead us to speculate upon an implicature to the effect that:

[7] The fact that we do not find a *to* infinitive after *make*, e.g. (i) Leo made Clio leave the party, may be due to the exceptional nature of this verb in that as noted by Mittwoch (1990:125) it appears to take small clause complements, and of course is typically associated with complex predicate formation in other languages.

18. If a language has an infinitive form which is used to express the predicate of a subordinate clause when the subject of that clause is different from the matrix clause subject, then the infinitive form is preferred when the subject is identical.[8]

Vincent (1998) too speculates that the subjunctive is an intermediate category between the indicative and the infinitive, citing the fact that in Romanian[9] subjects can be extracted out of a subjunctive clause introduced by *seem* or *must*:

19. a. Trebuia c≤ studenÔii s≤ plece
must-3SG that students.DEF.PL. that leave.SUBJ
'It must be that the students have left'
b. StudenÔii trebuiau s≤ plece
students.DEF.PL. must-3PL that leave.SUBJ
'The students must have left.'

This behavior, among others, leads Vincent to the conclusion that "finiteness and mood are different sub-parts of the same overall grammatical category."

2.2.3.3. Modals and infinitives

The link between modal forms and the infinitive can clearly be seen in the following close paraphrases, where we see that modal verbs and infinitive forms are associated with similar meanings:

20. a. He wondered whether to go. (infinitive)
b. He wondered whether he should go. (modal verb)
21. a. She agreed to sell the house (infinitive)
b. She agreed that the house could/should be sold (modal verb)
c. She agreed that the house be sold (subjunctive)

2.2.4. The imperative 'mood'.

In (1) we saw that Huddleston claims that the imperative in English uses the base form of the verb to form a finite clause, however he nowhere defines what he means by finiteness. The closest he comes is to say that apart from some odd exceptions (eg. *Why bother*?) all main clauses are finite, which in the absence of other defining criteria, appears to equate finiteness with absence of subordination. Matthews conversely defines *finite verb* as the following: 'Traditionally a verb, e.g. in Latin or Greek, inflected for person and number. Now more generally of any verb whose form is such that it can stand in a simple declarative sentence.' (1997:129). For Matthews, it is the presence of the finite verb which appears to define the finite clause. For Huddleston the fact that an imperative is not a subordinate clause makes it a finite clause, irrespective of the verb form. For Matthews the absence of a finite verb form would certainly qualify it as a non-declarative clause, though we do not know whether it would therefore be non-finite. Japanese for example uses 'non-finite' forms, gerunds, for the imperative:

22. Kite kudasai!
Come-GER please

Italian (Romance) on the other hand, uses the bare stem form to signal the singular imperative in the positive (in most conjugations) and the second person plural present indicative form to signal the

[8] However the Romanian data, along with that provided by other languages which do not use infinitive constructions in these instances but which nonetheless have an infinitive, illustrate that this is a tendency rather than a universal.
[9] The data is from Rivero (1989).

plural imperative.

23. Vieni qua (SG) Venite qua (PLURAL).
'Come here'

But we note that the infinitive form is found with the negative 2nd person singular (*non venire*) and with more formal commands:

24. a. Accendere i fari i galleria (Switch on headlights in tunnel)
b. Spegnere il motore in caso di sosta. (Switch off engines when stationary)

Romanian follows approximately the same pattern as Italian, with the 2nd person singular negative form being the infinitive, without the infinitive marker *a*, with the 2nd singular positive equivalent to the 2nd or 3rd person indicative:

25. a. Vorbe_te! (Speak.2SG) VorbiÔi! (Speak.2PL) 'Speak!'
b. Nu vorbi! (Neg speak.INF) Nu vorbiÔi (Neg speak.2PL) 'Don't speak!'

However, Romanian also employs the strategy of the subjunctive marker *s≤* to issue commands[10] (in the same way as French *Que tu t'en ailles!* 'That you would go away').

26. S≤ nu pleci (SUBJ not leave-2SG.IND) 'Don't leave'.

Thus if imperative is indeed a mood, then it also closely associated with both 'finite' and 'non-finite' verbal forms. The imperative is thus a good example of the difficulty of determining clausal finiteness by reference to verbal morphology.

2.2.5. Summary

The claim was made above that the *to*-infinitive in English could be associated with irrealis modality, be it volitional or epistemic.
The conflict between semantic and syntactic definitions of the concept of tense/finiteness was recognized by McCawley (1988:228): "This distinction between finite and non-finite Ss [sentences - JB] is independent of the distinction between semantically tensed and semantically tenseless Ss…all four combinations of deep and surface tensed and tenseless are attested." He gives the following examples in Table 2:

The underlined elements are the Ss in question. McCawley notes that the combination "surface tensed, deep tenseless" does not occur in English, however it is found in languages such as Japanese. The construction *koto ga dekiru* ('is a thing X is able to do') demands the plain tensed form of the verb, here *hiku* 'to play', in its complement. However no tense opposition is permitted in the complement, hence the past form *hiita* is not allowed. Thus, just as the English counterpart 'play the piano', the structure is taken to be semantically or 'deep' tenseless. McCawley's term 'deep tenseless' may correlate therefore with a semantic category of non-finite, while 'deep tensed' may correlate with a semantic category of finite. Again these are sentential properties, while 'surface tensed and tenseless' are syntactic categories related to the verb and the clause.

	DEEP TENSED	DEEP TENSELESS
SURFACE TENSED	John said that he was tired	John wa piano o hiku koto ga dekiru John TOP piano ACC play-PRES thing NOM can do-PRES

[10] However unlike French the verb following s≤ is in the indicative rather than the subjunctive

		'John can play the piano'
SURFACE TENSELESS	We believe John to have stolen the money	John can play the piano

Table 2 Deep and surface tensed/tenseless complements

3.0. Other 'non-finite' forms.

An example of the use of the English 'non-finite' forms of the bare infinitive and the *ing* participle is found in the complementation of the perception predicate *see*.

3.1. English perception verb complements

3.1.1. Infinitival Perception Verb Complements

A verb of direct perception may take a complement with a verb in the base form:

27. Leo saw his friend get off the train

I shall label this type the Infinitival Perception Verb Complement (IPVC). The following constraints apply to this type (Mittwoch (1990); Dik and Hengeveld (1991); Guasti (1993) and Felser (1998))

(i) The event in the complement is simultaneous with the perception event.[11] Hence the incongruity of an independent time reference in each clause:

28. a. *Today Leo saw his friend get off the train yesterday[12].
    b. * Leo saw his friend have got off the train.

From the fact that there can be no independent time reference in the complement clause it is assumed that there is no TENSE operator in the complement.

(ii) The event in the complement is generally required to be physically perceivable:

29. *Leo saw his friend miss his evening class.

As the whole event is the object of perception, it is not necessarily the case that the subject of the IPVC be perceivable, as is evident in the following examples adapted from Declerck (1982:12):

30. a. The children watched Tom move the puppets
    b. We heard the farmer kill the pig.

In (30a) the children would not normally see Tom, and in (30b) the farmer himself would not normally be heard, unless he was grunting with the effort of his actions.

(iii) As a result of the restriction in (i), it is not possible to independently negate the complement clause, given that it is normally not possible to see an event not taking place:

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[11] Felser (1998:361) labels this requirement as the Simultaneity Condition formulated as $t_{event} \geq t_{event*}$ (that is, the time interval taken up by the event described by a Perception Verb Complement includes the time interval taken up by the matrix event.)

[12] I admit that there may be some scenarios where the two events need not be simultaneous, for example:
(i) At 10.00 am the police saw the suspect enter the building at 6.00 am (on the security guard's video tape) however as Mittwoch (1990) points out it is still the case that the time of perceiving the event is simultaneous with the perceptibility of the event, even if the perception is indirect.

31. a. Leo didn't see his friend get off the train.
b. ?*Leo saw his friend not get off the train

It might appear that this constraint is contravened in such cases as (32):

32. Leo saw Clio not walk, but stumble across the room.

However, the interpretation of this sentence has to be that an event was seen, but that that event was of one kind rather than of another kind, not that there was an event which was not seen.

(iv) Again, as a result of (i) the complement clause cannot be a stative verb. Hence the ungrammaticality of the following:

33. a. *The hostess saw Leo own a new tuxedo.
b. *Leo saw Clio resemble her mother.

Complement clauses containing normally stative verbs would require an event or temporary state reading[13] as in:

34. a. Clio saw the hostess smile (≠ Clio saw the smiling hostess)
b. The teacher saw the children sit on the grass (= perform the action of sitting)

This last restriction, and indeed the first restriction, are presumably related to the underlying temporal structure of the IPVC complement with a bare infinitive. It has been observed that the bare infinitival complement is indicative of a perfective aspect or bounded state of affairs (Comrie (1976); Kirsner and Thompson (1976); Barwise and Perry (1983); Dik and Hengeveld (1991); Guasti (1993)). It is understood that the action in the embedded predicate is complete, hence the oddity of the following extension to (27):

35. ?Leo saw his friend get off the train, but he didn't see him leave the train.

The intuition is that the perceiver sees an event including its completion to a resultant state. The perfective aspect of the complement can be seen quite clearly if we try and apply a synonym of the inceptive use of *see*:

36. a. *Leo caught sight of his friend leave the train
b. Leo caught sight of his friend leaving the train

The ungrammaticality of (36a) contrasts sharply with the grammaticality of (36b) which is of the Participial Perception Verb Complement (PPVC) type. Clearly it is not possible to catch sight of an event which is completed. In other words the logical structure of the IPVC contains an aspectual operator specified for perfect aspect.

Many of these constraints are linked to the absence of the *to* infinitive marker in the complement. The impossibility of any notion of futurity or volition in the complement, which must be simultaneous, precludes the presence of *to*. Perception verbs differ from causation verbs in this respect. This rules out any use of *to* which might be related to intention, volition or purpose.

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[13] Dowty (1979:177-86) makes a distinction between two types of stative verbs, those that range over objects and entities, like *know* (individual-level predicates) and those that range over stages, like *lie* (stage-level predicates). The examples in (38) refer here to the first of these types, the coerced examples in (39) refer to the second. Carlson (1980) and Felser (1998) note that it is a requirement for the IPVC to have a stage-level predicate in the complement, not an individual-level predicate.

3.1.2. The Participial Perception Verb Complement

The use of the *ing* participle in complementation is exemplified in the following PPVC.[14, 15]

37. Leo saw his friend getting off the train.

The relationship between the *ing* form of the verb and the simultaneity of the action is discussed by Wierzbicka (1988:60) who concludes that the formal similarity between the present participle form and the gerund is not coincidental in that both indicate simultaneity of time. Specifically she claims that gerundive complements imply sameness of time "whenever they combine with temporal semantic types such as actions, processes and states; when, however they combine with atemporal semantic types such as facts and possibilities they are free of the 'sameness of time' constraint, because under those circumstances, time is irrelevant." (1988:69). The same point is made by Stowell (1982:563): "the understood tense of the gerund is completely malleable to the semantics of the governing verb."

3.1.2.1. Properties of the PPVC

The constraints (i) to (v) above which relate to the IPVC construction all equally apply to the PPVC type. The PPVC type presupposes simultaneity with the event of the main clause. The action of the seeing and the action of getting off the train are co-extensive. In addition as seen above, it is possible to use *catch sight of* with the *ing* complement as it specifies an action in process, rather than a completed action.

The difference between the two types is to do with an ongoing 'progressive' aspect internal to the perceived event. In (27) it is understood that the perceiver perceives the completion of an event, in (38) it is understood that the perceiver perceives an event in progress but not necessarily its completion. This is evident from the possibility of the continuation in the following example where the view may have been obscured, or his friend may have changed his mind and reboarded the train:

38. Leo saw his friend getting off the train, but didn't see him leave the train.

The PPVC will have the same structure as the IPVC except that the value for aspect is specified as progressive. The IPVC and the PPVC are thus nearly identical in semantic properties. Neither of them have a tense operator, but they differ in the type of aspectual operator present. The fact that they are of the same syntactic type means they may be conjoined as in:

39. Leo saw his friend get off the train and the guard waving the flag.

3.1.3. Summary

We have been examining finiteness in terms of a number of factors:

- Syntactic categories of tense and agreement were seen to have little correlation with finite vs. non-finite clauses.
- We have seen that 'finite' and 'non-finite' forms can occur in both main and subordinate clauses.
- We have seen that certain 'non-finite' forms (the *to*-infinitive, the English modals and the subjunctive) are associated with irrealis modality while the bare infinitive and the *ing* participle are associated with factive or realis complements.

[14] I intentionally avoid using such traditional labels as the present or progressive participle in the light of the following analysis.
[15] There are at least three types of PPVC. This claim was first made by Declerck 1982, and subsequently adopted by Felser (1998) and noted by Gisborne (1996), but appears to have been largely ignored or unnoticed by other commentators, notably Guasti (1993) and Dik and Hengeveld (1993). We shall however consider only one type here.

We now turn to an examination of constructions equivalent to the perception complements in Italian to further inform our goal of examining the morphological realization of syntactic and semantic categories.

3.2. Perception complements in Italian

We shall examine two different perception verb complements in Italian, the so-called Accusativus cum infinitivo (AcI), and the 'pseudo-relative.'

3.2.1. The AcI construction

The AcI construction in Italian is very similar to the IPVC construction in English.

40. Leo ha visto il cameriere rovesciare la bottiglia.
L. PERF PRES 3S see-PP the waiter knock over-INF the bottle
'Leo saw the waiter knock/knocking the bottle over.'

In (40) the perception verb complement is in infinitive form. However, the event seen by the perceiver is neutral with respect to imperfect versus perfect aspect. This is exemplified by Guasti (1993:150) who points out that while (41) contains an apparent contradiction in that English perception verb complements with bare infinitive are understood to be perfective, the Italian example (42) is not contradictory as it can be interpreted as semantically equivalent to the English PPVC which has imperfective aspect.

41. ? I saw John cross the street, but not reach the other side.
42. Ho visto Gianni attraversare la strada, ma non raggiungere l'altro lato.
I saw G. cross-INF the street, but not reach- INF the other side

The lack of a distinction in Italian between perfect and imperfect aspect is of course also reflected in the simple present finite form of verbs, where English uses a distinct form to express imperfect aspect while Italian is neutral with respect to the distinction, viz. (43). This suggests that the semantic structure of the AcI differs from English in that there is no aspect operator in the complement.

43. Gianni attraversa la strada
G. cross-PRES-3S the street
'Gianni crosses/is crossing the street.'

Nonetheless as Strudsholm (1996:66) shows, the infinitive is dispreferred over the pseudorelative construction discussed in the next section, when the duration of the action is specifically in focus.
Taking these factors together we might propose that the logical structure of the AcI is rather like the IPVC/PPVC without an aspect or tense operator in the complement:

3.2.2. The pseudorelative

The second construction under consideration is known as the pseudo-relative (see Radford 1977; Burzio 1986; Guasti 1993; Cinque 1995 and for a recent survey Strudsholm 1996). This construction is illustrated in the following sentence.

44. Leo ha visto Clio che mangiava la pizza
Leo have-PRES.3SG see-PP Clio that eat-PAST.IMPERF.3SG. the pizza
'Leo saw Clio eating the pizza'

As the translation implies, the pseudorelative is apparent equivalent to (one of) the PPVC constructions in English. The pseudorelative has the appearance of a straightforward relative clause, however it differs from both the restrictive and non-restrictive relative clauses in the following ways. For detailed exemplification see Barron (1999):

- In a pseudorelative, the initial NP may be a proper noun, as in (44) above. In a restrictive relative clause, only a common noun is permitted.
- The initial NP in a pseudorelative may only relate to the subject of the embedded predicate, whereas in a restrictive relative clause the initial NP may correspond to either the subject or the object.
- The initial NP in a pseudorelative may be expressed by a clitic pronoun on the matrix verb, whereas this is not possible in a relative clause.[16]
- The complementizer *che* may be substituted by *il/la quale* in a normal relative clause (restrictive or non-restrictive), however this is not possible in the pseudo-relative:[17]

These restrictions appear to illustrate that the pseudorelative is a different type of construction from the relative clause. There are in addition other semantic constraints which as expected are identical to those of the English IPVC and PPVC constructions and the Italian AcI:

- The pseudorelative may only predicate an event, hence stative verbs are disallowed.
- As expected, negation may not occur in the pseudorelative for the reason that it is not possible to see an event not taking place.
- The verb in the pseudorelative may appear to be tensed, but as with other PVC types, it may not have its own referential tense. In fact if the main perception verb is the in present tense, then the verb of the pseudorelative is in the present tense; if the main clause is in the past, then the verb of the pseudorelative is in the imperfect tense.[18]

These facts illustrate two things: firstly, that the action perceived must be simultaneous with the act of perception; and secondly, that the action perceived is not a complete action but is aspectually incomplete. Semantically then, the pseudorelative corresponds most directly to an English PPVC.[19] The key properties of the pseudorelative complement appear to be imperfectivity of an event described by the complement; lack of referential tense; visibility of the participant who is the logical subject of the complement clause; the possibility of representing this participant as an object clitic pronoun on the matrix perception predicate contrasting with the status of the whole complement as a constituent. This particular set of criteria suggest to me that we are again dealing with a structure in which the pseudorelative appears to function as a constituent as it has the structure of a complex NP.[20] [21]

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[16] Note that this restriction is essentially the same as the restriction on the postmodification of pronouns in English: (i) *Leo hated her who was pouring the wine, and applies similarly to perception verb complements: (ii) *Leo saw her who was pouring the wine.

[17] It is of particular interest, as noted by Strudsholm (1996:57), that in Romanian the equivalent to the pseudo-relative is introduced by the complementizer *c≤* which is never used to introduce relative clauses.

[18] It is beyond the scope of this work to enter into a long analysis of the relationship between tense and aspect in Italian, however I follow the line that there is a close association between the *-va* imperfect tense forms and imperfect (or progressive) aspect. See for example Bertinetto (1996:119) for a detailed analysis.

[19] It is interesting to speculate why Italian does not make use of a gerund or participle to express tenseless imperfect aspect in the embedded clause rather than the rather elaborate mechanism of the pseudorelative. As noted by Noonan (1985:64) and Strudsholm (1996:53-58) some other Romance languages make far greater use than Italian of the gerund or present participle as alternatives to the pseudorelative.

[20] Guasti (1993:146) dismisses the complex NP analysis suggested by both Kayne and Burzio, by claiming that it is not possible to modify the pseudorelative with an appositive relative clause. She claims for example that (i) (which is a normal relative clause) is fine, but that (ii) is not. (i) Ugo, che qui tutti conoscono, è partito senza dir nulla. 'Ugo, whom everybody here knows, left without saying anything.' (ii) *Ho visto Maria che usciva dal cinema, che tu conosci bene. 'I have seen Maria coming out of the cinema, whom you know well.' It appears to me, however, that this is not a particularly convincing example. In (ii) it is not the head noun of the complex NP, Maria, which is being postmodified whereas it is in (i) (Ugo). Also, the placing of the relative clause *che tu conosci bene* could also relate to the noun *cinema*. Interestingly, Strudsholm seems to draw the opposite conclusion

3.2.3. The pseudorelative and finiteness

We have noticed that the only functional operator present in the semantic structure of the pseudorelative complement is that of aspect and have suggested that the imperfect form is used to unambiguously indicate progressive aspect. The imperfect form does superficially appear to carry both tense and agreement information. However recalling the discussion of finiteness in §2.2.5. I would like to suggest that the logical combination of deep tenseless/surface tensed found in some languages, is found in Italian in the pseudorelative construction. In other words that the pseudo-relative appears to have both tense and agreement features, i.e. is [+TENSE] [+ AGR] but it nonetheless semantically non finite. This, then, would be the strongest case against the argument that finiteness is to do with a positive specification of tense and agreement features. For if [– finite] can = [+TENSE] [+ AGR] also, then there can be no correlation between these categories and finiteness.

4.0 The morphological realization of syntactic and semantic features.

At this point we might want to speculate that finiteness is both a semantic property to do with time, in the temporal anchoring of events, and that it is also to do with reality, in that in order for events to have a temporal anchoring, they must be real events. This approach allies finiteness with properties like definiteness. This observation has been made by Lyons (1995:317) "Standard definitions of tense usually fail to make explicit the fact that the reference of natural language tenses…is characteristically definite, rather than indefinite." Tense then is a syntactic category which is the grammaticalization of time.

The relationship between semantic finiteness, syntactic tense and morphological verb forms depends the interaction of two parameters, subordination and realis/irrealis modality. In other words, the canonical realization of the verb in a realis main clause in English will be with a tensed verb form, whereas the canonical realization of the verb in an irrealis subordinate clause will be with a *to*-infinitive verb form. However, there are many cross-cutting and intermediate categories, such that a modal verb expressing irrealis modality may appear in a main clause. This idea can be expressed in Table 3 where the two axes are realis/irrealis and main clause/subordinate clause.

	Realis ◄──────────►		*Irrealis*
Main Clause	Tensed verbs		Modal verbs Base forms
▲▼		Subjunctives	
Subordinate Clause	Bare infinitives /participles		To-infinitives

Table 3 Cross-cutting parameters involved in the morphology of verb forms.

The key question is how do we account for the morphological realization of this disparate set of properties.

4.1. Morphology as the spell out of f-structures.

Morphological words are understood here to be the spell-out of f-structures. The implications of this approach are the following:

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to Guasti citing (iii) as grammatical: (iii) Ho visto Maria, che di solito sta sempre a casa, che usciva dal cinema. 'I saw Maria, who is usually always at home, coming out of the cinema.'

[21] In Barron (1999) I argue for two different constructions, however I shall restrict myself to describing the most common here.

- Morphological forms (in languages like English/Italian) do not provide us with sufficient information to build f-structures, for example the infinitive cannot tell you whether it is active or passive, outside of a syntactic context. They provide us with a partial lexical semantics.
- Formal features such as VPART PAST PARTICIPLE or VCOMP TO+ are not part of f-structures which is where semantically interpretable properties are given. (see Spencer and Sadler (1999) etc.), they are part of morphological structure.

4.1.1. The semantics of the clause

Barron (1999) partially adopts an approach to clause structure developed by Valin and LaPolla (1997) and develops it within an LFG framework. There is not space to explain VV&LP's approach in any detail, however of particular interest here is the insight that operators such as, ASPECT and NEGATION have scope over different levels of the clause, such that TENSE is a clause-level operator, while aspect has scope over the predicate.[22] In examining complementation it is important to recognize in a clause with two predicates we may have two aspectual operators but only one tense operator. This is apparent in perception verb complements such as (45). The f-structure for which is given in (46).

45. Leo has seen his friend getting off the train.

46.

PRED	‘ *see* < –, – >’	
SUBJ	‘Leo’	
TENSE	PRES	
ASP	PERF	
COMP	PRED	‘*get off* < –, –>’
	SUBJ	‘his friend’
	OBJ	‘the train’
	ASP	PROG

Note that the f-structure contains no information about the morphological form of the element which will realize the particular syntactic configuration. F-structure attribute value matrices, particularly their internal structure, are realized in different ways by different languages. The potential realization of an f-structure is a form from the paradigm of forms supplied by the morphology.

4.1.2. F-structures and paradigms in English

Table 5 gives an example set of paradigms of English verb forms. Each verb form has a base form which I have called the default form (the infinitive in English) and a number of other forms, to which I have assigned arbitrary names (the top row). The bottom row (in italics) gives the typical f-structure feature values which provide the context for these forms.

DEFAULT	ING FORM	- S FORM	AM FORM	WENT FORM	WAS FORM	-ED FORM
cross	crossing	crosses		crossed		crossed
eat	eating	eats		ate		eaten
go	going	goes		went		gone
be	being	is	am	were	was	been
	ASP PROG	*TENSE PRES MOD REALIS PERS 3RD NUM SG*	*TENSE PRES PERS 1ST NUM SG MOD REAL*	*TENSE PAST*	*TENSE PAST MOD REALIS PERS 3RD NUM SG*	*ASP PERF*

Table 5. Paradigm of some English verb forms.

[22] In VV&LP's terms ASPECT is a nuclear-level operator.

Mappings between f-structures and verb forms are of the type:

47. *f* [ASP PROGRESSIVE] → VFORM ING

As the paradigm lists many forms, choice is restricted to that which matches most closely the set of f-
structure features, i.e. this is an approach which lends itself to an optimality theory type of resolution.

48.				
	TENSE	PRES		
	MODALITY	REALIS	→	some paradigmatic value
f	ASPECT	PROG		
	NUM	SG		
	PERS	3		

Thus for (48) the requirements of aspect are such that it is best expressed by the *ing* form, while tense (in English) requires expression by a separate tense form of the verb *be*, hence here *is* is the appropriately matching form.

So that for example when in a perception verb complement we have an embedded complement which has no tense, but has progressive aspect the *ing* form in sufficient.
On the other hand, when the complement has perfect aspect, the default form is found as there is no more highly specified form.

49.				
	TENSE	….		
	MOOD	REALIS		
	: :	ASP PERF	→	COMP VFORM = DEFAULT form (cross)
		PRED 'cross'		

With an irrealis mood in the matrix f-structure, e.g. with a volition or epistemic predicate as in '*Leo wants to cross the road'*, the mapping is:

50.				
	TENSE	….		
	MOOD	IRREALIS		
	: :	PRED 'cross'	→	COMP VFORM = *to* + DEFAULT form (to cross)

In addition, the morphology allows us to handle the combination of deep tensed, surface tenseless: as in '*I believe John to have crossed the road.'*

51.				
	TENSE	PRES		
	MOOD	IRREALIS		
	:	TENSE PRES		
	:	ASP PERF	→	COMP VFORM = TO +HAVE+ ED form (to have crossed)
		PRED 'cross'		

4.1.3 <u>F-structures and paradigms in Italian</u>
The situation in Italian is similar, except that the paradigms have a larger set of forms as we can see in Table 6 which is part of the paradigm of *traversare* 'to cross'. Certain forms of the paradigm are associated invariantly with f-structure person and number values, but the other f-structure properties such as tense and mood only typically interact with each form. (52) is a possible f-structure.

52. PRED ‘cross’
f TENSE PRES
MODALITY REALIS → some paradigmatic value of *traversare* (= traversa)
ASPECT PROG
NUM SG
PERS 3

Its formal realisation will be taken from the paradigm of forms for *traversare*:

PERSON NUMBER ↓	FORM 1	FORM 2	FORM 3	DEFAULT
1st sing	traverso	traversai	traversavo	traversare
2nd sing	traversi	traversasti	traversavi	
3rd sing	traversa	traversò	traversava	
1st plural	traversiamo	traversammo	traversavamo	
2nd plural	traversate	traversaste	traversavate	
3rd plural	traversano	traversarono	traversavano	
F-STRUCTURE VALUES	*TENSE PRES MOD REALIS ASP PROG*	*TENSE PAST MOD REALIS*	*TENSE PAST MOD REALIS ASP PROG*	

Table 6. Partial paradigm of *traversare* ‘to cross’.

If we return to our perception verb complements, we can see that the default form is found in those complements where there is no tense or aspect specified in the complement:

53. PRED *see* < –, – >
TENSE
(ASP) → COMP VFORM = DEFAULT
COMP [PRED ‘*traversare* < –, –>’]

The interesting thing is what happens when progressive aspect of the complement has to be expressed. The forms which are associated with progressive aspect are those forms which we have called FORM 1 and FORM 3. However these are also associated with TENSE and PERSON and NUMBER features. In order to use an appropriate form without clashing features, the person and number features are provided by the RELADJ subject, while the tense form appropriate to the matrix tense form is used. (55) is the f-structure given above for (54).

54. Leo ha visto Clio che mangiava la pizza
Leo have-PRES.3SG see-PP Clio that eat-PAST.IMPERF.3SG. the pizza
‘Leo saw Clio eating the pizza’

55. PRED ‘vedere <–, – >’
SUBJ [‘Leo’]
TENSE PAST
OBJ SUBJ$_a$ [‘Clio’]
RELADJ PRED ‘mangiare <–,–>’
ASP PROG → RELADJ VFORM = *che* + FORM 3
SUBJ$_a$
OBJ [‘la pizza’]

5.0. Summary

I have argued here that finiteness may be a semantic property to do with definite referential time, but that it is not a morphosyntactic feature. Rather the particular combinations of tense, modality and aspect in matrix and embedded f-structures make use of parts of the morphological paradigm to realize their properties.

References

Anderson, Stephen (1992) *A-morphous Morphology*. Cambridge: Cambridge University Press

Aronoff, Mark (1994) *Morphology by Itself*. Cambridge, MA: The MIT Press

Barron, Julia (1999) *Perception, volition and reduced clausal complementation.* PhD Thesis. University of Manchester.

Barwise, Jon and Perry John (1983) *Situations and Attitudes*. Cambridge, MA: The MIT Press

Bertinetto, Pier Marco (1986) *Tempo, aspetto e azione nel verbo italiano - il sistema dell'indicativo*. Florence: L'accademia della Crusca.

Bresnan Joan and Jonni Kanerva (1989) Locative Inversion in Chicheœa: a Case Study of Factorization in Grammar in *Linguistic Inquiry,* 20(1) 1-50

Burzio, Luigi (1986) *Italian Syntax - A Government-Binding Approach* Dordrecht: Reidel

Bybee, Joan (1995) The Semantic Development of Past Tense Modals in English. In Joan Bybee and Suzanne Fleischman (eds.) *Modality in Grammar and Discourse.* Amsterdam: John Benjamins Publishing Company pp 503-517

Centineo, Guilia (1996 [1986]) A lexical theory of auxiliary selection in Italian, in Probus 8 223-271.

Cinque, Guiglielmo (1995) *Italian syntax and universal grammar* Cambridge: Cambridge University Press

Coates, Jennifer (1983) *The Semantics of the Modal Auxiliaries* London: Croom Helm

Comrie, Bernard (1976) *Aspect* Cambridge: Cambridge University Press

Croft, William (1990) Possible verbs and the structure of events in Savas L. Tsohatzidis (ed.) *Meanings and Prototypes: Studies in Linguistic Categorization* London: Routledge

Declerck, Renaat (1982) The triple origin of participial perception verb complements. *Linguistic Analysis* 10. 1-26.

Dik Simon C and Kees Hengeveld (1991) The hierarchical structure of the clause and the typology of perception-verb complements. *Linguistics* 29, 231-259

Dixon, R.M.W (1991) *A new approach to English grammar, on semantic principles*. Oxford: Clarendon Press.

Dowty David (1979) *Word Meaning and Montague Grammar* Dordrecht: Reidel

Felser, Claudia (1998) Perception and control: a Minimalist analysis of English direct perception complements. *Journal of Linguistics*. 34: 351-385.

Fillmore, Charles .J. (1971) Types of lexical information. In D.D. Steinberg and L.A. Jakoboovits, eds. Se*mantics: an interdisciplinary reader in philosophy, linguistics and psychology.* Cambridge: Cambridge University Press

Fleishman, Suzanne (1995) Imperfective and Irrealis. In Joan Bybee and Suzanne Fleischman (eds.) *Modality in Grammar and Discourse.* Amsterdam: John Benjamins Publishing Company pp 519-551eferences

Frahzyngier (1995). In Joan Bybee and Suzanne Fleischman (eds.) *Modality in Grammar and Discourse.* Amsterdam: John Benjamins Publishing Company.

Frawley, William (1992) *Linguistic Semantics* Hillsdale, N.J.: Lawrence Erlbaum Associates

Gisborne, Nikolas S. (1996) *English Perception Verbs*. Unpublished PhD thesis. University College London.

Guasti, Maria Teresa (1993) *Causative and Perception verbs. A Comparative Study*. Torino: Rosenberg & Sellier

Hopper, Paul J. and Elizabeth Closs Traugott (1993) *Grammaticalization* Cambridge: Cambridge University Press.

Huddleston, Rodney D. (1976) Some theoretical issues in the description of the English verb. *Lingua* 40. 331-383.

James, Deborah (1982) Past tense and the hypothetical: A cross-linguistic study. *Studies in Language*

6, 375-403.
Kirsner, Robert S. and Thompson, Sandra A. (1976). The role of pragmatic inference in semantics: a study of sensory verb complements in English. *Glossa* 10, 200-240.
Koptjevskaja-Tamm, M. (1994) Finiteness. In R.E.Asher (ed.) *The encyclopedia of language and linguistics.* Oxford: Pergamon Press, pp. 1245-1248.
Ledgeway, Adam (1998a) Variation in the Romance Infinitive: The case of the southern Calabrian inflected infinitive. In *Transactions of the Philological Society* Vol 96:1, 1-61. London: Routledge.
Lyons, John (1995) *Linguistic Semantics An Introduction* Cambridge: Cambridge University Press
Matthews, P. H. (1997) *The concise Oxford dictionary of linguistics.* Oxford & New York: Oxford University Press
McCawley, James D. (1988) *The syntactic phenomena of English.* Chicago: University of Chicago Press
Miller, George A. & Philip N. Johnson-Laird (1976) *Language and Perception* Cambridge: Cambridge University Press
Mithun, Marianne (1995) In Joan Bybee and Suzanne Fleischman (eds.) *Modality in Grammar and Discourse.* Amsterdam: John Benjamins Publishing Company.
Mittwoch, Anita (1990) On the distribution of bare infinitive complements in English *Journal of Linguistics* 26 103-131
Noonan, Michael (1985) Complementation. In *Language Typology and Syntactic Description*, Vol. 2, T. Shopen (ed.), 42-140. Cambridge: Cambridge University Press
Palmer, Frank (1986) *Mood and Modality* Cambridge: Cambridge University Press
Quirk, Randolph, Sydney Greenbaum, Geoffrey Leech and Jan Svartvik (1985) *A comprehensive grammar of the English language.* London: Longman.
Radford, Andrew (1977) Italian Syntax: Transformational and Relational Grammar. Cambridge: Cambridge University Press
Raposo, Eduardo (1987) Case theory and Infl-to-Comp: the inflected infinitive in European Portuguese. *Linguistic Inquiry* 18.85-109
Rivero, Maria-Luisa (1989) Barriers and Rumanian. In Carl Kirschner & Janeet De Cesaris, eds. *Studies in Romance Linguistics*, Amsterdam and Philadelphia: John Benjamins, 298-312.
Smith, Carlotta S. (1991) *The parameter of aspect* Dordrecht: Kluwer
Spencer, Andrew and Louisa Sadler (1999). Syntax as an exponent of morphological features. Ms. University of Essex.
Stowell, Timothy (1982) The tense of infinitives *Linguistic Inquiry* 13, 561-70
Strudsholm, Erling (1996) *Relative situazionali in italiano moderno*. PhD Thesis. University of Copenhagen.
Stump, Gregory T. (forthcoming) *Inflectional morphology : A Theory of Paradigm Structure*, Cambridge: Cambridge University Press.
Van Valin, Jr. Robert D and Randy J. LaPolla (1997) *Syntax: Structure, meaning and function* Cambridge: Cambridge University Press
Vincent, Nigel (1997) Complementation. In Martin Maiden and Mair Parry (eds), *The dialects of Italy*, London: Routledge, 171-178
Vincent, Nigel (1998) On the grammar of inflected non-finite forms (with special reference to Old Neopolitan). In Korzen, Iørn and Mechael Herslund (eds.) *Clause combining and text structure* Copenhagen Studies in Language 22. Samfundslitteratur, 135-158..
Warner, Anthony (1993) *English auxiliaries: structure and history.* Cambridge: Cambridge University Press.
Wierzbicka, Anna (1988) *The semantics of grammar.* Amsterdam: John Benjamins.

WORD ORDER AND MARKEDNESS IN KAQCHIKEL

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1 Introduction[1]

Most Kaqchikel sentences show the possibility of two word orders; one in which the subject is initial, and another in which the verb is initial:

[1] Kaqchikel is a Mayan language spoken by about half a million people in Guatemala. This paper reports on the dialect of Patzicía as spoken by Alberto Esquit Choy. The paper largely uses the conventions of the national orthography, in which <x> = a voiceless alveopalatal sibilant (English *sh)*, <tz> = a voiceless dental affricate , <ä> = schwa, <q> is a uvular stop and apostrophe = glottal stop (following a vowel) or glottalization (following a consonant). Kaqchikel dialects differ in the number of phonemic vowels. Although the national orthography represents ten distinct vowels, the Patzicía dialect has six (*a, ä, e, i, o, u*) and I write only those vowels here.

Glosses use the following abbreviations: abs = absolutive, af = actor focus, cl = personal classifier (markers of the age and sex of human referents), com = completive aspect, erg = ergative, inc = incompletive aspect, p = plural, pass = passive, s = singular. The tableaux use the following additional abbreviations: def = definite, indef = indefinite, neg = negative, non-su = non-subject, obv =obviative, prox = proximate, psor = possessor, psum = possessum, subj = subject.

I thank Judith Aissen, David Mora Marín, and Timothy Smith for their suggestions on the analysis of Kaqchikel. Special thanks to Alberto Esquit Choy, who not only provided all the Kaqchikel data, but also contributed cogent suggestions for this analysis.

1) X-u-b'a ri tz'i' ri me's.
com-3sErg-bite the dog the cat

'The dog bit the cat.'

2) Ri tz'i' x-u-b'a ri me's.
the dog com-3sErg-bite the cat

'The dog bit the cat.'

The claim of this paper is that SVO order is a signal of *markedness* in Kaqchikel, and that this descriptive generalization can be captured in a theoretical framework that represents markedness through optimality theory (Aissen 1999).

2 Unmarked orders

The unmarked order for a Kaqchikel sentence is verb-initial, but the ordering principles for the noun phrases that follow are somewhat surprising. If a transitive verb is followed by two NPs with equal degrees of definiteness, then either order is grammatical and the sentence is ambiguous.

3) X-r-oqotaj ri tz'i' ri me's.
com-3sErg-chase the dog the cat

'The dog chased the cat.'
'The cat chased the dog.'

4) X-r-oqotaj ri me's ri tz'i' .
com-3sErg-chase the cat the dog

'The dog chased the cat.'
'The cat chased the dog.'

If one of the NPs is definite and the other is indefinite, then a.) the definite NP must follow the indefinite (a strong preference) and b.) the definite is interpreted as the subject (an inviolable rule).

5) X-r-oqotaj jun me's ri tz'i'.
com-3sErg-chase a cat the dog

'The dog chased a cat.' 1:68
* 'A cat chased the dog.'

6) ?*X-r-oqotaj ri tz'i' jun me's.
com-3sErg-chase the dog a cat

There is also a clear but violable preference for proper nouns to follow common nouns:

7) X-u-loq' ri wä'y Maria.
com-3sErg-buy the tortilla Maria

'Maria bought the tortillas.'

? X-u-loq' Maria ri wä'y.
com-3sErg-buy Maria the tortilla

If two proper nouns follow the verb, the sentence is ambiguous:

8) X-r-oqotaj ri xta Maria ri a Juan
com-3sErg-chase the cl Maria the cl Juan

'Maria chased Juan.'
'Juan chased Maria.'

The focus of this paper, however, is not the principles that determine order in verb-initial sentences, but the alternation between V-initial and SVO.

3 Obligatory SVO order

There are two contexts in which SVO order is obligatory: 1) with indefinite subjects, and 2) when the possessor of the subject is antecedent to a following pronoun.

It is important to qualify this claim, however, so that it applies only to subjects of transitive clauses with 3rd person objects. Subject-initial order in these cases is not obligatory for intransitive clauses, or for transitive clauses with 1st or 2nd person objects.

3.1 Indefinite subjects

Indefinite subjects of transitive verbs cannot be postverbal.

9) X-u-b'a jun tz'i' ri a Juan.
   com-3sErg-bite a dog the cl Juan

   *'A dog bit John'/ 'John bit a dog.'

Instead, they must appear in preverbal position. When they do, they trigger ACTOR FOCUS morphology on the verb.[2]

10) Jun tz'i' x-b'a'-o ri a Juan.
    a dog com-bite-AF the cl Juan

    'A dog bit Juan.'

11) *? Jun tz'i' x-u-b'a' ri a Juan.
    a dog com-3sErg-bite the cl Juan

(11) is ungrammatical because the actor focus morpheme has not been used.

However, this restriction on indefinite subjects only holds for transitive clauses with third person objects. If the clause is intransitive or transitive with a local object, then a postverbal indefinite subject is grammatical.

12) Ni-b'a'on jun tz'i'.
    inc-bark a dog

    'A dog is barking.'

13) X-i-ru-b'a' jun tz'i' (rin).
    com-1sAbs-3sErg-bite a dog (me)

    'A dog bit me.'

Preverbal subjects are also possible in this situation. When the clause is transitive, fronting the subject results in actor focus morphology.

[2] There is an established Mayanist tradition of calling this morpheme the (agentive) antipassive. However, Smith-Stark (1978), Aissen (1999) and others have shown that this is not an appropriate analysis in many Mayan languages. Therefore I follow Aissen (1999) in calling this morphology 'actor focus'

14) Jun tz'i' ni-b'a'on.
a dog con-bark

'A dog is barking.'

15) Jun tz'i' x-i-b'a'-o (rin).
a dog com-1sAbs-bite-AF (me)

'A dog bit me.'

3.2 Possessor antecedents

If the possessor of a transitive subject is the antecedent of some following pronoun, then it cannot appear postverbally.

16) N-u-kanoj r-ixjayil a Manuel rija'.
con-3sErg-look:for 3sErg-wife cl Manuel s/he

*'Manuel's$_i$ wife is looking for him$_i$.'[3]

But the same sentence is grammatical if the subject is preverbal:

17) R-ixjayil a Manuel n-u-kanoj rija'.
3sErg-wife cl Manuel inc-3sErg-look:for s/he

'Manuel's$_i$ wife is looking for him$_{i, j}$.'

These two rather disparate conditions – indefinite transitive subjects and transitive subjects whose possessors are antecedents of a following pronoun both induce a shift from V-initial to SVO order. In the following sections, I will outline an approach under which this effect can be captured.

4 S and IP in Kaqchikel

I will assume that the verb-initial and SVO orders in Kaqchikel correspond to syntactic structures like the ones shown in figures (1) and (2). (1) shows a flat, non-endocentric S, while

[3] However, this string is grammatical with possible readings as 'S/he is looking for Manuel's wife.' *or* 'Manuel's$_i$ wife is looking for him$_j$.' *or* 'S/he (e.g. his mother/father) is looking for a wife for Manuel.'

(2) shows a phrase headed by Infl.

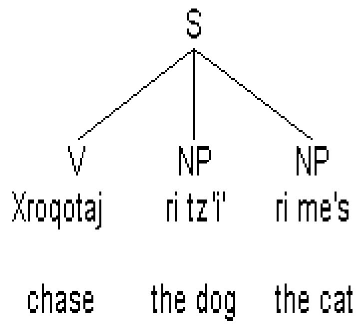

Figure 1 Non-endocentric structure

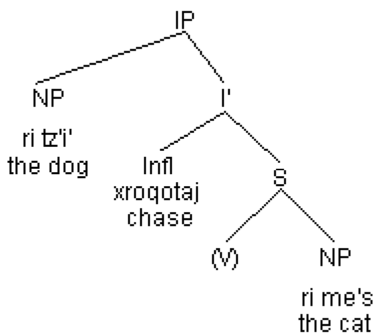

Figure 2 Endocentric clause structure

The difference between these two structures is supported by data from adverb placement.

For the verb-initial structure, a temporal adverb like *iwir* 'yesterday' may appear at the beginning or end of the S, but not in other places:[4]

[4] My consultant finds final adverbs to be somewhat odd, but possibly acceptable in some contexts.

18) Iwir x-r-oqotaj ri tz'i' ri me's. Adv V S O
yesterday com-3sErg-chase the dog the cat

'Yesterday the dog chased the cat.'[5]

*X-r-oqotaj iwir ri tz'i' ri me's. *V Adv S O
*X-r-oqotaj ri tz'i' iwir ri me's. *V S Adv O
?X-r-oqotaj ri tz'i' ri me's iwir ?V S O Adv

However, possibilities for adverb placement are notably different in the SVO order:

19) Iwir ri tz'i' x-r-oqotaj ri me's. Adv S V O
yesterday the dog com-3sErg-chase the cat

Ri tz'i' iwir x-r-oqotaj ri me's. S Adv V O
Ri tz'i' x-r-oqotaj iwir ri me's. S V Adv O
? Ri tz'i' x-r-oqotaj ri me's iwir. ? S V O Adv

We can account for the distribution of temporal adverbs with the following statement:

20) Adverb placement

Temporal adverbs are (left-)adjoined to S or an extended projection of S.

Thus Kaqchikel has two options for the syntactic structure of a clause: it may project a minimal, non-endocentric S or a more elaborated, endocentric IP. Since the IP involves more structure, it is the more marked of the two.

5 Towards an explanation

We can understand the obligatory nature of SVO order in these two cases by appealing to notions of markedness, following work by Aissen (1999), Donahue (1999), Lee (2000) and others.

5.1 Indefinite subjects

In the case of indefinite subjects, we would like to posit a constraint which penalizes indefinite subjects. However, recall that SVO is only obligatory for subjects of transitive clauses with third person objects. So a constraint like *Subj/Indef is too broad. One possible move is to

[5] Also available is the reading 'The cat chased the dog', which I will ignore for the moment.

conjoin *Subj/Indef and *Obj/3. However, the problem with this solution is that *Subj/Indef & *Obj/3 will need to dominate *Subj/Indef & *Obj/Local in order for this to work. But Aissen (1999) has shown that there is good reason to think that *Obj/Local universally outranks *Obj/3. So a solution along these lines would require rejecting the well-documented tendency of local person to be more marked as objects than third persons.

Instead I will rely on an approach using the notion of obviation (Aissen 1997). I will assume that within an obviation span containing two third person nominals, one nominal (the proximate) is ranked higher and the other (the obviative) is ranked lower.[6] In Algonquian languages where the notion of obviation is explicitly marked in the morphology, the proximate nominal is generally the one that is more central and topical, though notions of speaker empathy play a role as well. I will assume that there is no obligatory assignment of proximate and obviative in an intransitive main clause, since obviation measures the relative centrality of third person nominals.

There are two alignments with obviation that are relevant to the account here: 1) the alignment of obviation and grammatical relation and 2) the alignment of obviation and definiteness.

The scales involved are as follows:

21) Subj > Non-Su

Prox > Obv

Def > Indef

The harmonic alignments, and the corresponding constraints are shown below:

Harmonic Alignment	Constraints
Subj/Prox > Subj/Obv	*Subj/Obv >> *Subj/Prox
Non-Su/Obv > Non-Su/Prox	*Non-Su/Prox >> *Non-Su/Obv
Prox/Def > Prox/Indef	*Prox/Indef >> *Prox/Def
Obv/Indef > Obv/Def	*Obv/Def >> *Obv/Indef

The two constraints that will play the most important role in the account here are *Non-Su/Prox and *Prox/Indef. Both make sense from the viewpoint of discourse. It is well known that

[6] An obviation span contains at most one proximate, but any number of obviatives. So if the span contains three third person nominals, one will be proximate and the other two will be obviatives.

subjects are an important locus of topic continuity cross-linguistically, and the constraint *Non-Su/Prox says that a sentence with a topical/central non-subject is marked. Similarly, definiteness correlates highly with topicality. All things being equal, definite NPs are more topical than indefinite NPs.[7]

As Aissen (1999) shows, conjunction with a constraint *Ø, which penalizes zero exponence, gives us a way to model the fact that marked combinations of features typically require some special solution. In the Kaqchikel case, the special solution is to characterize the verb as an INFL and build extra syntactic structure. To differentiate this solution from others (such as case marking), we can call this constraint $*Ø_{Infl}$.

We want to rank the constraint *Prox/Indef & $*Ø_{Infl}$ and the constraint *Non-Su/Prox & $*Ø_{Infl}$ higher than the constraint * STRUC, which penalizes additional structure. For indefinite subjects of transitive verbs with third person objects, this yields a tableau like the following:

$\begin{bmatrix} \textbf{PRED} & \textbf{'chase(x,y)'} \\ \textbf{GF} & \begin{bmatrix} \textbf{PRED} & \textbf{'dog'} \\ \textbf{DEF} & - \end{bmatrix} \textbf{x} \\ \textbf{GF} & \begin{bmatrix} \textbf{PRED} & \textbf{'John'} \end{bmatrix} \textbf{y} \end{bmatrix}$	[Spec, FP] = DF	*Prox/Indef & $*Ø_{Infl}$	*Non-Su /Prox & $*Ø_{Infl}$	*STRUC
a. [$_s$Chased a dog (PROX) John (OBV)]		*!		
b. [$_s$Chased a dog (OBV) John (PROX)]			*!	
--> c. [$_{IP}$A dog (PROX) chased John (OBV)]				*
–> d. [$_{IP}$A dog (OBV) chased John (PROX)]				*
e. [$_{IP}$John (PROX) chased a dog (OBV)]	*!			
f. [$_{IP}$John (OBV) chased a dog (PROX)]	*!			

[7] Du Bois (1987) has shown that indefinite transitive subjects are quite rare in free discourse in a number of languages. He proposes the Given A constraint, which favors sentences in which a transitive subject (an A, using the terminology of Dixon), has previously introduced in discourse. The approach pursued here draws on Du Bois's essential insight, but does not state the constraint directly between grammatical relations and definiteness for the reasons explained in the text.

The constraint [Spec, FP] = DF comes from Bresnan (1998:21), and is a general constraint on c-structure to f-structure correspondence. Since SUBJ is one of the discourse functions, it may appear in the specifier position of a phrase headed by a functional category. An OBJ may not appear in this position (unless it bears some additional DF).

I assume that in the SVO order, the initial subject may be either proximate or obviative, depending on the larger discourse context.

5.2 Possessor antecedents

Recall the following contrast:

22) N-u-kanoj r-ixjayil a Manuel rija'.
inc-3sErg-look:for 3sErg-wife cl Manuel s/he

*'Manuel's$_i$ wife is looking for him$_i$.'

22) R-ixjayil a Manuel n-u-kanoj rija'.
3sErg-wife cl Manuel inc-3sErg-look:for s/he

'Manuel's$_i$ wife is looking for him$_{i, j}$.'

I will follow Aissen's (1997) approach to the problem of possessor antecedents, though I will formulate it in a slightly different manner. The relevant scale for possessors is Possessor > Possessum.[8] When aligned with the Proximate > Obviative scale this leads to the harmonic alignments Psor/Prox > Psor/Obv and Psum/Obv > Psum/Prox. Inverted, these give us the constraints *Psor/Obv >> *Psor/Prox and *Psum/Prox >> *Psum/Obv.

Assuming that pronouns must have the same obviation value as their antecedents, then we have the following tableau:

[8] For the sake of clarity, I abbreviate possessor as Psor and possessum as Psum

	*Psor/Obv & *$Ø_{Infl}$	*Non-Su/Prox & *$Ø_{Infl}$	*STRUC
[$_S$Seeks Manuel$_i$'s (Prox) wife (Obv) him$_i$ (Prox)].		!*	
[$_S$Seeks Manuel$_i$'s (Obv) wife (Prox) him$_i$ (Obv)].	!*		
–> [$_{IP}$Manuel$_i$'s (Prox) wife (Obv) seeks him$_i$ (Prox)].			*
–> [$_{IP}$Manuel$_i$'s (Obv) wife (Prox) seeks him$_i$ (Obv)].			*

Once again, we end up with a situation in which the initial subject may be either proximate or obviative depending on the larger discourse context. In Kaqchikel, this seems compatible with the evidence, since there is no overt marking of obviation.

In Algonquian languages, the possessum is never proximate. It is not obvious how to achieve this result for Kaqchikel. We could, of course, add a constraint *Psum/Prox & $Ø_{Infl}$. But the last candidate in this tableau will not violate this constraint, since it does signal its markedness through characterizing the main verb as Infl.[9]

6 The passive

Aissen (1997) has shown that in Tzotzil possessor antecedents are also regarded as marked. However, in that language, the markedness is resolved by use of the passive, rather than a distinctive word order.

24) *Ta s-sa' *pro*$_i$ y-ajnil li Manvel-e$_i$.
icp A3-seek him A3-wife the Manuel-enc

'Manuel$_i$'s wife is looking for him$_{i.}$.'

---

[9] This may signal a larger conceptual problem: How many violations of markedness constraints can one structure license? Will characterizing the verb as INFL be enough to overcome a whole series of markedness violations?

Furthermore, if a language has more than one signal of markedness (e.g. passive in some cases; word order in other cases; morphology in still other cases) then the conjunction of markedness constraints with *Ø becomes increasing complex, and would seem to require *$STRUC_{Voice,}$ *$STRUC_{Infl}$, *$STRUC_{Case,}$ and so on.

25) Ta sa'-at yu'un y-ajnil li Manvel-e.
icp seek-PASS by A3-wife the Manuel-ENC

'Manuel$_i$ was sought by his$_i$ wife.' (Aissen 1997:771-2)

In Kaqchikel, the passive is in fact available as a solution to both the indefinite subject and the possessor antecedent problems. Kaqchikel has two passives, which I will call the ROOT PASSIVE and the SECOND PASSIVE.[10] The root passive is formed by adding /-x/ to end of the verb root and/or changing the tenseness of last vowel of the root.

26) X-kanox a Manuel r-oma' ri r-ixjayil. root passive
com-seek:PASS cl Manuel 3sErg-by det 3sErg-wife

'Manuel$_i$ was sought by his$_i$ wife.'

The second passive is formed by using third person plural ergative agreement with the active verb stem:[11]

27) X-ki-kanoj a Manuel r-oma' ri r-ixjayil. second passive
com-3pErg-seek cl Manuel 3sErg-by the 3sErg-wife

'Manuel$_i$ was sought by his$_i$ wife.'

The following sentences show that both are also available as solutions to the problem of indefinite subjects:

---

[10] My consultant finds these two passives to be synonymous, and both passives are available for the entire range of transitive verbs I have checked so far. Nevertheless, I suspect there are some differences in their use, which I hope to clarify in future work. For current purposes, however, both are available as a solution to the problem raised by possessor antecedents.

[11] The second passive seems to have originated historically with impersonal subject clauses, such as 'They were looking for John', accounting for the third person plural agreement on the verb. However, in modern Kaqchikel, neither the passive subject nor the agent in the by-phrase need be plural. This gives the appearance of an agreement mismatch, so that an example like (29) seems to say literally 'They were looking for Manuel by his wife.'

28) X-oqotäx ri achin r-oma' jun tz'i'. root passive
com-chase:PASS the man 3sErg-by a dog

'The man was chased by a dog.'

29) X-k-oqotaj ri achin r-oma' jun tz'i'. second passive
com-3pErg-chase the man 3sErg-by a dog

'The man was chased by a dog.'

Despite the availability of a passive solution to the markedness problems, my consultant almost never volunteers passive translations for these sentences.

The reason, I believe, lies in the discourse function of the passive in Kaqchikel. A detailed examination of the use of voice in Kaqchikel has not yet been carried out, but my initial impression is that both Kaqchikel passives are used in a manner somewhat like the English passive – they occur when the patient is highly topical and the agent is largely detopicalized. (Cf. Zavala (1997) for a similar account of the Akateko passive.)

We can capture the restricted nature of the passive in Kaqchikel along the same lines suggested by Aissen (1999). That is, we employ the constraints *Su/x, which penalizes subjects which are not discourse prominent, and *Su/Pat, which penalizes patient subjects, with the ranking *Su/x >> *Su/Pat. This will result in a situation where passive only occurs when the patient is more discourse prominent than the agent.

7 Non-obligatory SVO

The evidence considered so far indicates that SVO is a marked word order for Kaqchikel. But what about the alternation between V-initial and SVO order in sentences like the following?

30) X-u-b'a ri tz'i' ri me's.
com-3sErg-bite the dog the cat

'The dog bit the cat.'

31) Ri tz'i' x-u-b'a ri me's.
the dog com-3sErg-bite the cat

'The dog bit the cat.'

Since the constraint *STRUC will penalize the SVO order, why is it possible in the lack of markedness?

The answer seems to involve the larger discourse structure of Kaqchikel. A study of topicality and word order in Kaqchikel is still in progress, but a preliminary generalization is the following:

32) Subjects that function as continuing topics appear preverbally.
Subjects that do not function as continuing topics appear postverbally.

This would suggest that the [Spec, IP] position may be associated with a discourse function like [-new, +prom] (cf. Choi 1999). This discourse function should not be obligatory, however, since indefinite subjects and subjects with possessor antecedents obligatorily appear in this position, regardless of their function.

8 References

Aissen, Judith. 1992. Topic and focus in Mayan. *Language* 68:43-80.
Aissen, Judith. 1997. On the syntax of obviation. *Language* 73:705-750.
Aissen, Judith. 1999. Agent choice and inverse in Tzotzil. *Language* 75:451-485.
Aissen, Judith. 1999. Markedness and subject choice in optimality theory. *Natural language and linguistic theory* 17:673-711.
Bresnan, Joan. 1998. Optimal syntax. to appear in Joost Dekkers, Frank van der Leeuw, and Jeroen van de Weijer. *Optimality theory: Phonology, syntax and acquisition.* Oxford: Oxford University Press.
Choi, Hye-Won. 1999. *Optimizing structure in context: Scrambling and information structure.* Stanford: CSLI Publications.
Chomsky, Noam. 1981. *Lectures on government and binding*. Dordrecht: Foris.
Donahue, Cathryn. 1999. Optimizing Fore case and word order. ms. Stanford University. (Available at http://www-csli.stanford.edu/~donohue/)
Du Bois, John. 1987. The discourse basis of ergativity. *Language* 63:805-855.
Lee, Hanjung. 2000. Markedness and word order freezing. ms. Stanford University. (Available at http://www-ot.stanford.edu/ot/)
Smith-Stark, Thomas. 1978. The Mayan antipassive: Some facts and fictions. *Papers in Mayan linguistics*, ed. by Nora England, pp 169-87. Columbia, MO: University of Missouri.
Woolford, Ellen. 1991. VP-internal subjects in VSO and nonconfigurational languages. *Linguistic Inquiry* 22:503-540.
Zavala, Roberto. 1997. Functional analysis of Akatek voice constructions. *International Journal of American Linguistics* 63:439-74.

9 Appendix 1 — Other preverbal positions

There are several preverbal positions in Kaqchikel, in addition to the [Spec, IP] position..

The following figure shows the overall clause structure that I posit for Kaqchikel:

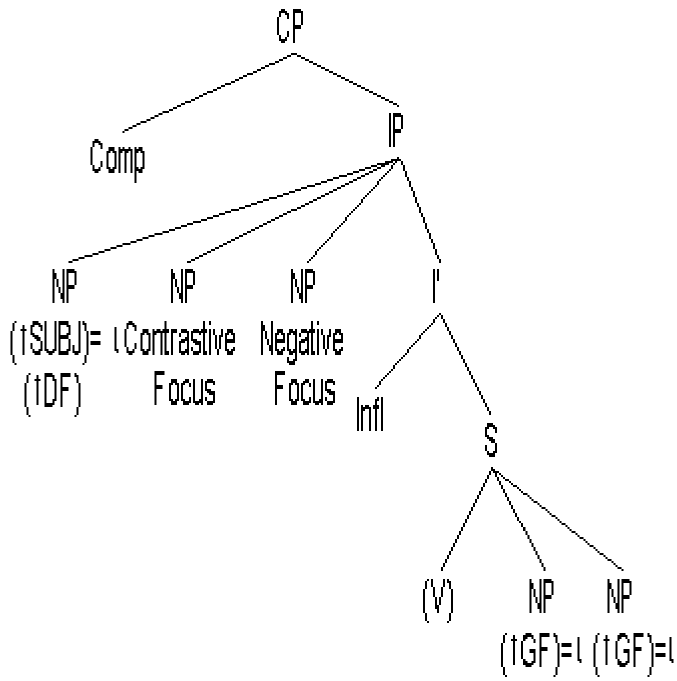

Figure 3 Kaqchikel clause structure

9.1 Topic and Comp

The preverbal position for subjects found in Kaqchikel is comparable to what has been called topic position in other Mayan languages. Aissen (1992) has argued that topics in Tzotzil occupy a position which is adjoined to CP, while topics in Tzutujil are in [Spec, CP].

It is not clear to me whether it is correct to call this position Topic in Kaqchikel, since certain kinds of subjects must appear here, whether they are topical in discourse or not. However, it is clear that the Kaqchikel preverbal subject position is lower than Comp, since it follows the complementizer:

33) Rin man w-etaman ta [$_{CP}$ wä [$_{IP}$ ri tz'i' x-roqotaj ri achin]].
I neg 1sErg-know neg if the dog com-3sErg-chase the man

'I don't know if the dog chased the man.'

34) A Manuel x-u-b'ij chwe' [$_{CP}$ chi [$_{IP}$ ri tz'i' x-u-b'a' ri a Ramon]].
cl Manuel com-3sErg-tell to:me that the dog com-3sErg-bite the cl Ramon

'Manuel told me that the dog bit the man.'

The fact that preverbal subject follows the complementizer, shows that such subjects must be in a position like [Spec, IP].

9.2 Negative foci

Negated noun phrases (which are marked by *man*) must appear in the NegFoc position. When the negated NP is a transitive subject, the verb must appear in the actor focus form.

35) Man jun wä'y x-u-tij ri a Juan. [negation of object]
not one tortilla com-3sErg-eat the cl Juan

'Juan ate no tortillas.'

36) *X-u-tij man jun wä'y ri a Juan. [object in situ]
com-3sErg-eat not one tortilla the cl Juan

(Juan ate no tortillas.)

37) Man jun ni-xajo'. [negation of intransitive subject]
not one con-dance

'Nobody is dancing.'

38) *Ni-xajo' man jun. [intransitive subject in situ]
con-dance not one

39) Man jun x-tij-o' ri wä'y. [negation of transitive subject]
not one com-eat-af the tortilla.

'Nobody ate the tortilla.' 1:78

40) *X-tij-o' man jun ri wä'y. /* X-u-tij man jun ri wä'y.
com-eat-AF neg one the tortilla com-3sErg-eat not one the tortilla

(Nobody ate the tortilla.) [transitive subject in situ]

9.3 Contrastive focus

Preceding the negative focus position is the contrastive focus position, generally used in a context where some other alternative is denied. If the contrastively focussed item is a transitive subject, the actor focus verb form is used.

41) Ja ri wä'y x-u-loq' Maria. [contrastive object]
foc the tortilla com-3sErg-buy Maria

'It was the tortillas that Mary bought.'

42) Ja ri a Juan x-tij-o/*x-u-tij wä'y. [contrastive transitive subject]
foc the cl Juan com-eat-af tortilla

'It was Juan who ate the tortilla.'

43) Ja ri tetata' x-wär. [contrastive intransitive subject]
foc the old:man com-sleep

'It was the old man who slept.' (RKC 91)

We can tell the relative order from sentences that contain both sorts of foci.

44) Ja ri a Ramón man jun wä'y x-u-tij.
con the cl Ramon neg one tortilla com-3sErg-eat

'It was Ramón who ate no tortillas.' 1:82

The opposite order is ungrammatical.

45) *Man jun wä'y ja ri a Ramón x-u-tij.
neg one tortilla con the cl Ramon com-3sErg-eat

*(It was Ramón who ate no tortillas.)

In sentences with multiple foci, it is the closest focus that determines whether the actor focus form is used. For example, in (41), the plain form of the verb is used because the negative focus is an object. In a sentence with multiple foci, if the negative focus is a transitive subject then the actor focus form will be used:

46) Ja ri wä'y man jun achi x-tij-o.
con the tortilla not one person com-eat-AF

'It's the tortillas that nobody ate.'

9.4 Preverbal subjects

Preverbal subjects appear before both kinds of foci:

47) Ri nu-tz'i' ja ri a Juan x-u-b'a.
the 1sErg-dog foc the cl Juan com-3sErg-bite

'It was Juan that my dog bit.'

48) Ri a Juan man jun wä'y x-u-tij.
the cl Juan not one tortilla com-3sErg-eat

'Juan didn't eat any tortillas.'

Note that when transitive subjects appear in topic position they do not trigger actor focus morphology:

49) Ri xta Maria x-u-loq' ri q'or.
the cl Maria com-3sErg-buy the atole

'Maria bought the atole.'

9.5 Ordering principles

On the assumption that the two kinds of foci represent new information, it is possible to describe the order of the various elements in [Spec, IP] position with two simple ordering constraints: [-new] < [+new] and [-neg] < [+neg]. The first of these constraints is familiar as NEW from Choi (1999:97). The second is novel to this account.

10 Appendix 2 – Inanimate subjects

Aissen (1997) showed that in Tzotzil, inanimate transitive subjects are also marked and require the passive. In Kaqchikel, however, SVO order is not obligatory in such cases.

50) Ri kä'r x-u-yawa'risaj ri w-ixjayil.
the fish com-3sErg-make:sick the 1sErg-wife

'The fish made my wife sick.' 1:42

51) X-u-yawa'risaj ri kä'r ri w-ixjayil.
com-3sErg-make:sick the fish the 1sErg-wife

'My wife made the fish sick.'
'The fish made my wife sick.'

52) Ri aq'on x-u-k'achojrisaj ri a Juan.
the medicine com-3sErg-make:well the cl Juan

'The medicine made John well.'

53) X-u-k'achojrisaj ri aq'on ri a Juan.
com-3sErg-make:well the medicine the cl Juan

'Juan fixed the medicine.'
'The medicine cured Juan.'

This seems to show that a constraint like *Subj/Inan & $Ø_{Infl}$ must be ranked lower than *STRUC in Kaqchikel.

An incorporated topic marker in Takelma

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Abstract

This paper concerns the distribution of Takelma -*k*^{h}*wa* and its consquences for linguistic theory. First, it is argued that -*k*^{h}*wa* is an incorporated object topic marker. Second, the work of Aissen 1997, 1999a on syntactic obviation will be applied to Takelma -*k*^{h}*wa*, and the framework will be extended to shed new light on the notions of proximate and obviative. Finally,the beginnings of a typology of topic anaphora is suggested, in which -*k*^{h}*wa* is simply one type in a broader spectrum.

1 Introduction

Takelma (possibly Oregon Penutian) has two third person object markers (OMs) which occur with verbs.[1] One OM, by far the more common one, is usually morphologically null and unrestricted in its reference. The second OM (-*kʰwa*), the one of interest here, is restricted in reference to humans or anthropomorphized animals, and is only used in situations where the subject is also third person (Sapir 1922:168). Sapir also notes (p. 169) two other interesting properties of -*kʰwa*: it cannot occur with an overt object and it is used to disambiguate clauses (1).[2]

1. Disambiguation by -*kʰwa* (Sapir 1922:169)

a. t'ipisi:	t'ayákʰ	b. t'ipisi:	t'ayá:<u>kʰwa</u>
ants	found	ants	found-OM
'He found the ants'		'The ants found him'	

This paper concerns the distribution of -*kʰwa* and its consquences for linguistic theory. What follows can be divided into three parts. The first part is devoted to the Takelma language and -*kʰwa* in particular. I will argue, among other things, that -*kʰwa* is an incorporated object topic marker.

The second part of the paper examines the generalizations about -*kʰwa* through the lens of Aissen's work on syntactic obviation (Aissen 1997, 1999a). I will extend Aissen's work to shed new light on the notions of proximate and obviative.

After taking this clausal perspective, the third and final part of the paper returns to -*kʰwa* itself and its properties. From this perspective, it is the fact that -*kʰwa* is a topic marker which leads to the obviation analysis, and not simply a ranking of constraints. Furthermore, I also suggest the beginnings of a typology of topic anaphora, in which -*kʰwa* is simply one type in a broader spectrum.

2 Basic facts

2.1 Background on Takelma

Sapir spent six weeks in the summer of 1906 working with Frances Johnson, one of the last speakers of Takelma. Takelma was spoken in southern Oregon along the Rogue River, but by 1906 all of the Takelma speakers were on the Siletz and Grand Ronde reservations in northwest Oregon, which is where Sapir worked with Frances Johnson.

Sapir's fieldwork resulted in "no less than the first modern description of an American Indian language" (Golla 1990:15). In addition to the grammar (Sapir 1922), Sapir also published a book of Takelma texts (Sapir 1909, henceforth TT), from which the bulk of

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[1]Part of this work was done while I was on leave from The Univeristy of Iowa. I am grateful to the Linguistics Department there as well as the Linguistics Department at Stanford University, where I was a visiting scholar, and to SRI, International, for their support. Thanks to for helpful comments from David Beaver, Jennifer Bradshaw, Joan Bresnan, Sarah Fagan, Mark Gawron, Linda L. McIntyre, Peter Sells, Linda Uyechi, Michael Wescoat, and the audience at LFG00 Conference. I remain responsible for any errors, of course.

[2]Examples are given in an IPA-based orthography rather than Sapir's original orthography. cf. Culy 1999, Kendal 1977. There are various phonological processes which affect the surface shape of -*kʰwa*.

the examples in this paper are taken. There are on the order of 3000 clauses in the texts with an estimated 700 or so transitive clauses, of which 56 contain -$k^{h}wa$.

Takelma has no clear genetic affiliation, though it does seem to be most closely related to Kalapuya, and it is often grouped with other Oregon Penutian languages. Takelma had numerous Athabaskan neighbors, and many of the other languages spoken at Siletz were/are Athabaskan, a point to which we will return in the third section.

2.2 Some facts

2.2.1 Ø OM

The Takelma object markers other than -$k^{h}wa$ are given in (2). As can be seen, the third person is otherwise Ø, for both singular and plural.

2. Takelma object markers (cf. Sapir 1922:167,284)

Person	Singular	Plural
1	-xi	-am
2	-pi	-anp^{h}
3	Ø	Ø

The Ø third person can be used with the full range of NP objects, from human to inanimate, as seen in (3a,b). Furthermore, the object need not be overt (3c) (nor, for that matter, need the subject be overt).

3. Human, inanimate and covert objects with the -Ø object marker

a. Human object (TT 158:3)

ani:ˀ	ki:	t'omomàˀn	hamìˀt^{h}pan
neg	1sg	kill-1sg	father-2pl

'I did not kill your father'

b. Inanimate object (TT 56:9)

K^{h}ài	nakaí:t^{h}
something	do/say-2sg

'What did you say?'

c. Covert object (TT 24:12)

alsinlò:k^{h}

face/to-nose-stick

'They met him'

2.2.2 -$k^{h}wa$ with an overt subject

Turning now to -$k^{h}wa$, we can start with Sapir's observation that -$k^{h}wa$ can be used to disambiguate clauses:

> "whenever the third personal object refers to a human being and the subject is expressed as a noun, suffixed -$k^{h}wa$ must be used to indicate the object; if it is not used the expressed noun will most naturally be construed as the object of the verb." (Sapir 1922:169)

This type of disambiguation is illustrated in the examples in (1) given previously. As it turns out, 48 of the 56 -$k^{h}wa$ clauses have an overt subject. An example from the texts is given in (4).

4. -*k^h^wa* with overt subject (TT 28:10)

Mi: kasà:lhi ma:l sa:nsàn<u>k</u><u>h</u><u>wa</u>

now then salmon-spear_shaft fight-k^hwa
'Now the salmon-spear shaft fought with him'

However, there are two questions which immediately arise with respect to Sapir's generalization that -*k^hwa* must be used with an overt subject. First, what about the other eight -*k^hwa* clauses without an overt subject? While they do not fall under the purview of Sapir's generalization, we should look at what factors govern the use of -*k^hwa* in those clauses.

The second quesion is, is it really true that -*k^hwa* "must" be used to when there is an overt subject? To answer the second question first, it turns out that -*k^hwa* is not in fact obligatory when there is an overt subject. One such sentence is given in (5).

5. Overt subject without -*k^hwa* (TT 118:5)

<u>nakàhiˀ</u> nihwík^hw^

say-3sg.tr Black_Bear
'"…" said Black Bear to them'

To be fair to Sapir, these sentences are not common. In a detailed analysis I did of one of the stories ("The Four Otter Brothers and Chicken-Hawk"), out of 38 transitive clauses, there were 10 with human/animate objects, and no clear examples of an overt subject without -*k^hwa*.[3]

2.2.3 -*k^hwa* as topic

Turning now to the eight -*k^hwa* clauses without an overt subject, we find that in all eight instances the object is the main character (the topic) of the story. In fact, in 51 of the 56 -*k^hwa* clauses the object is (one of) the main characters of the story, i.e. the discourse topic. An example is given in (6). In this story Daldal is the main character, and Sinew-man is a character he encounters.

6. -*k^hwa* without overt subject; -*k^hwa* as discourse topic (TT 27:16)

Há:xan<u>k</u><u>h</u><u>wa</u>hì:s

burn-k^hwa-almost
'He [Sinew-man] almost burned him [Daldal]'

When we look at the remaining five -*k^hwa* clauses, the object is always a local topic. For example in (7) from the same story as (6), the preceding section talks about how the women (referenced by -*k^hwa*) were quarreling after Daldal tied their hair together.

7. -*k^hwa* as local topic TT 27:5

Mi: taltàl tak^{h}wilì:tat^h uyù:ˀski<u>kwa</u>

now Taltal over-house-3sg laugh-k^hwa
'And Daldal from on top of the house laughed at them'

---

[3]Of the four candidates for an overt subject without -*k^hwa*, two involve an object which is not portrayed as human at that point in the story, while the other two involve an overt emphatic subject pronoun, which is not what Sapir was considering.

Furthermore, in the detailed analysis of the story, the only example of a main character (the Otter brothers) as an object with the -Ø OM is when the subject is another main character (Chicken-Hawk), as seen in (8).

8. -Ø OM with (co-)topic (TT 152:4)

"…" nakàhiʔ

say-3sg.tr

'"…", he [Chicken-Hawk] said to them [the Otter brothers]'

A further pair of contrasting examples is given in (9). In (9a), the object referenced by -$k^{h}wa$, Grizzly Bear, is one of the topics of the story, while in (9b), the object, Frog, is not one of the topics of that story.

9. -$k^{h}wa$ as topic marker, -Ø OM with non-topic

a. -$k^{h}wa$ as topic marker (TT 122:13)

xamkwitìk^{hw}takwa mé:x

threw_into_water-OM crane

'Crane threw her [Grizzly bear] into the water'

b. -Ø OM with non-topic (TT 108:5)

Skìsi lap^{h}á:m xamkiwitík^{hw}

coyote frog threw_into_water

'Coyote threw Frog into the water.'

Thus, the topic status of the object is a significantly better predictor of whether -$k^{h}wa$ will be used than is an overt subject.

Finally, this analysis of -$k^{h}wa$ as a topic marker helps us understand the two examples in which -$k^{h}wa$ occurs with an overt object, contrary to Sapir's generalization. The two examples are given in (10). [4] In both cases the overt object is not in its canonical preverbal position[5] but rather follows the verb. This suggests that the overt NP is acting as something in addition to being the notional object, namely the topic.

10. -$k^{h}wa$ with overt object: non-canonical SVO order

a. TT 63:4

àni:ʔ nek^{h} alxì:k^{h}wa k^{h}a-ilà:p^{h}a hà:p^{h}ti

not person see-k^{h}wa woman small

'No one did see the little woman'

b. TT 110:11

mi: yap'a kà:ʔm t'ayá:k^{h}wa ho:ú:

now person two found-OM jack_rabbit

'now two persons had found Jack-Rabbit'

---

[4]There are another two examples in Sapir's grammar (Sapir 1922:158) with SOV order. However, they seem to be invented, since they are not from any of the texts.

[5]cf. Kendall 1977 for Takelma as an SOV language

2.2.4 Summary

Given that -*k*^{h}*wa* occurs without an overt object, it is an incorporated pronoun. That is not uncommon (cf. Bresnan and Mchombo 1987, Jelinek 1984). What is less common is that -*k*^{h}*wa* is used only for topics. This point will be the topic (pun intended) of the third section.

Even though topicality of the object and overtness of the subject combine to account for all the -*k*^{h}*wa* clauses, there is one more property of -*k*^{h}*wa* which is worth mentioning, and which will be the point of departure for the next section. In the texts, -*k*^{h}*wa* is always used when the object is more animate than the subject. The example in (10) with "ants" as the subject illustrates this point. Another example is given in (11) (see also (25) below).

11. -*k*^{h}*wa* with an object more animate than the subject

mi: p'owó:k^{h}wa

now sting-k^{h}wa
'now they [the yellowjackets] stung him [Coyote]'

To sum up, we have seen three properties of -*k*^{h}*wa* which contribute to its distribution (12). Two of these properties (a,c) are new generalizations. The next two sections will discuss these properties in more detail.

12. Three properties of -*k*^{h}*wa*
a. The object is a topic
b. The subject is overt
c. The object is more animate than the subject

2.3 What -*k*^{h}*wa* is and isn't: OM vs. Switch Reference and Voice

Since -*k*^{h}*wa* is used being used to track entity references, I will now briefly discuss two reference tracking systems, switch reference and voice, and show that -*k*^{h}*wa* does not fit either of them. Obviation, another type of reference tracking system, will be the subject of the next section, when we return to the properties of -*k*^{h}*wa*.

First, we can show that -*k*^{h}*wa* occurs in the same position as the other overt object markers, immediately preceding the subject marker.

13. -*k*^{h}*wa* in position of OM
a. 2sg OM (Sapir 1922:167)

tó:mxpink^h

kill-2sg-3sg.fut.tr
'he will kill you'

b. -*k*^{h}*wa* (TT 94:2)

t^{h}a:n ka ná:k^{h}wak^h

Squirrel that say-k ^{h}wa-3sg.infer.tr
'Squirrel it was that said that to him'

Switch reference tracks whether the subject is the same or different from an adjacent clause, usually the preceding one. It is clear that -*k*^{h}*wa* is not a switch reference marker, since it does not show either a same subject or a different subject effect with adjacent clauses (14).

14. -k^{h}*wa* is not a switch-reference marker
-k^{h}*wa* when preceding subject = current subject (SS_p) a.ii, b.ii
-k^{h}*wa* when preceding subject ≠ current subject (DS_p) a.iii
-k^{h}*wa* when following subject = current subject (SS_f) b.i
-k^{h}*wa* when following subject ≠ current subject (DS_f) a.ii

a. (TT:180,24)
i. Background
ka xepèʔn
that does
'That one$_i$ does so'

ii. SS_p, DS_f
ka c'olx okoí:k^{h}wa
that dentalia give-k ^{h}wa
'that one$_i$ gives him$_j$ [the go-between] dentailia'

iii. DS_p
Yap'a to:màʔs àni:ʔ k^{h}ai okoí:k^{h}wa
person killer not something give-k ^{h}wa
'The slayer of the person$_k$ does not give him$_j$ [the go-between] anything.'

b. (TT 142:4)
i. SS_f
ka malá:k^{h}wa
that tell-k^{h}wa
'that one$_i$ [the mouse] had told him$_j$'

ii. SS_p
nakaí:k^{h}wanaʔ
tell-k^{h}wa-sub
'she$_i$ telling him$_j$'

It also seems clear that -k^{h}*wa* is not a voice marker. -k^{h}*wa* clauses are active, but the Ø-OM also occurs with active clauses. Takelma does have a passive voice marker which replaces the subject marker on the verb, leaving the OM in place. No examples have been found with -k^{h}*wa* and the passive.

3 Obviation

3.1 *k'wa* and characterizations of obviation
Traditionally, the term obviation has been used to describe a system of nominal morphology in which one noun in a clause is marked as proximate and the others are marked as obviative. Takelma clearly does not fit this description. Nouns have the same shape regardless of their grammatical or functional status.

However, Aissen 1997, 1999a extends the notion of obviation to *syntactic* obviation, and shows how this view can provide a unified account of phenomena in a range of languages. The rest of this section will consider -*kʰwa* from the point of view of syntactic obviation.

Aissen gives two different characterizations of obviation. The first is as a system

> "which obligatorily rank[s] third person nominals according to a complex function which includes grammatical function, inherent semantic properties, and discouse salience" Aissen 1997:705

This characterization is quite broad and Takelma does seem to satisfy it, given the animacy and topicality factors governing -*kʰwa*.

The second characterization that Aissen gives of obviation has to do with syntactic "gaps" which she associates with obviation. There are three types of such gaps. The first type of gap is animacy gaps. By this Aissen means roughly that the combination of more animate agent and less animate patient is not permitted in all relevant constructions, and similarly for less animate agent and more animate patient. As Aissen discusses, in Algonkian, the instances of the more animate agent are restricted to direct clauses, and the instances of the less animate agent are restricted to inverse clauses. In Tzotzil, the instances of the more animate agent are restricted to active clauses, while the instances of the less animate agent are restricted to passive and Actor Focus clauses. Takelma clearly has something like this type of animacy gap, since -*kʰwa* is obligatory with a less animate subject and more animate object, as discussed earlier. We can summarize the animacy gaps in the different languages as in (15).

15. Animacy gaps in Takelma (here), Algonkian, and Tzotzil (Aissen 1997)

	Ø OM/direct/active/	-*kʰwa*/inverse/passive
S more animate than O	√	(*)
S less animate than O	*	√

The second type of gap Aissen associates with obviation is genitive gaps. By this Aissen means that a possessor of the subject may be coreferential with the non-subject only in certain constructions, while the subject may be coreferential with the possessor of the non-subject only in the complementary constructions. The situations in Algonkian and Tzotil are summarized in (16).

16. Genitive gaps in Algonkian and Tzotzil (cf. Aissen 1997)

	direct/active	inverse/passive
Psr of S = O/OBL	*	√
S = Psr of O	√	*

Takelma also seems to have the same types of genitive gaps. The facts in Takelma can be summed up as in (17), with supporting examples in (18).

17. Pattern of Takelma genitives

	-Ø OM	-*kʰwa*
Psr of S = O	Not attested	√
S = Psr of O	√	Not attested

18. Takelma genitives
a. Psr of S = O, with -*k^h^wa* (TT 31:16)

hantat^h ó:pxa alxì:k^{h}wa
across-there elder_brother-3sg see-k ^{h}wa
'From across there [the river] his$_i$ elder brother saw him$_i$'

b. S = Psr of O, with -Ø OM (TT 88:13)

mi: òpxa i:kì:na
now elder_brother-3sg throw_aside
'Now his$_i$ elder brother he$_i$ threw to one side'

The third type of gap Aissen associates with obviation is complement object gaps. By this Aissen means that a subject cannot corefer with the object in the complement clause. This constraint is not surface-true in all languages that Aissen considers to have obviation, so it is the least reliable indicator of obviation. Takelma does not have this type of gap, as seen in (19).

19. Subject coreferential with complement object
a. With -Ø OM (TT 150:22)

yok'^{w}oí: tó:mkulukwàn
know kill-intend-pas
'he$_i$ knew that it was intended to kill him$_i$'

b. With -*k^{h}wa* (TT 116:18)

yokoí: tó:mk^{h}wakulúk^h
know kill-k^{h}wa-intend
'she knew that (Grizzly Bear) was intending to kill her'

It is worth noting that Takelma also does not have any alternative means to express this situation, since its passive does not promote the patient, but merely demotes the subject. This may lead to an explanation for why Takelma does not have this gap.

We can summarize the situation in Takelma with respect to evidence for obviation from noun morphology and the three types of obviation gaps as in (20).

20. Takelma and obviation evidence

Noun morphology	No
Animacy gaps	Yes
Genitive gaps	Yes
Complement object gaps	No

Takelma is thus very similar to some of the other languages that Aissen considers as having syntactic obviation (e.g. Algonkian, Kutenai), and I conclude that Takelma too has syntactic obviation.

3.2 Consequences for syntactic obviation

3.2.1 Aissen's OT account of obviation

Aissen's Optimality Theory account of obviation makes use of four hierarchies and four alignments of those hierarchies. The relevant portions of the four hierarchies are given in (21).

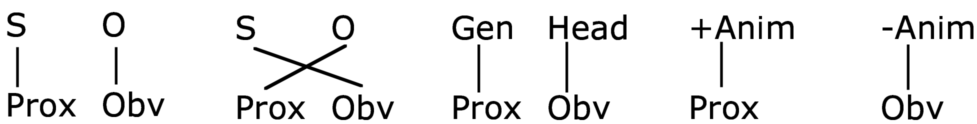
21. Hierarchies relevant to obviation

Participant Hierarchy	proximate > obviative
Relational Hierarchy	subject > primary object
Nominal-Relational Hierarchy	genitive > possessum
Animacy Hierarcy	animate > inanimate

The four alignments of these hierarchies are given in (22). All four involve a relationship between the Relational Hierarchy and one of the other hierarchies.

22. Alignments of the hierarchies for obviation as constraints
a. Direct Alignment of Relational and Participant = Direct Rel[ational]
b. Indirect Alignment of Relational and Participant = Indirect Rel[ational]
c. Direct Alignment of Nominal-Relational and Participant = Direct Nom[inal]
d. Direct Alignment of Animacy and Participant = Direct Anim[acy]

e. Comparison of alignments
Direct Rel Indirect Rel Direct Nom Direct Anim



Direct Rel means that subjects are proximate and objects are obviative. Indirect Rel means that subjects are obviative while objects are proximate. Direct Rel and Indirect Rel are each associated with particular clause types. Direct Rel is associated with active/direct clauses, while Indirect Rel is associated with inverse clauses.

Direct Nom means that the genitive is proximate and the possessum is obviative. Direct Nom is not restricted to any clause or nominal type.

Direct Anim means that when there is a difference in animacy between the agent and the patient, the more animate one will be proximate and the less animate will be obviative. Direct animacy is not restricted to any particular clause type. The final piece of information is that Direct Rel and Indirect Rel are ranked higher than Direct Nom and Direct Anim. There is no available evidence in Takelma for the relative ranking of Direct Nom and Direct Anim.

Let's see how these alignments might apply to Takelma. Direct Rel will be associated with -Ø OM clauses, while Indirect Rel will be associated with -k^hwa. (Note that that means that -k^hwa clauses are parallel to inverse clauses in Algonkian, a point to which we will return in the next section.) Let's consider the clause in (23), and the tableau of candidates with the -Ø OM and -k^hwa in (24). (Direct Nom is omitted from these and future tableaux where it is not relevant.)

23. Hunger was killing him.

24.

hunger killed him	Direct Rel	Indirect Rel	Direct Anim
a. hunger killed-Ø him Prox Obv			!*
b. hunger killed-Ø him Obv Prox	!*		
c. hunger killed-k^hwa him Prox Obv		!*	*
d. ☞ hunger killed-k^hwa him Obv Prox			

In (24a) and (24c), Direct Anim is violated since "hunger" is less animate than "him", but it is given as proximate in these candidates when it should be obviative. (24b) violates Direct Rel, since the subject is not proximate, while (24c) vioates Indirect Rel, since the subject is not obviative. That leaves (24d) as the winning candidate, which is borne out by the Takelma sentence in (25).

25. (TT 15:16)

Pá:nx t’omó:$\underline{k^{h}wa}$

hunger kill-k^hwa
'He was hungry' (lit. 'Hunger was killing him')

3.2.2 Proximate/obviative status as emergent

This discussion shows how the animacy restriction on -k^hwa can be accounted for, but we have not said anything yet about the other two factors governing the distribution of -k^hwa, namely that it is a topic marker and that it often occurs when there is an overt subject. Consider for example the tableau in (26) for "they told him", where animacy does not play a role. Without knowing the proximate/obviative status of the arguments, we cannot decide on a single winning candidate. While both candidates (a) and (d) correspond to potential Takelma sentences, in a given context only one candidate is possible. Clearly, we would like to be able to determine the correct candidate in context.

26. Preliminary tableau

they told him	Direct Rel	Indirect Rel	Direct Anim
a. ☞ they told-Ø him Prox Obv			
b. they told-Ø him Obv Prox	!*		
c. they told-k^hwa him Prox Obv		!*	
d. ☞ they told-k^hwa him Obv Prox			

The key to both of the factors governing -*k^h wa* (topic and overt subject) has to do with what determines proximate and obviative status. In particular, topicality is one thing that determines these, with topics being proximate and non-topics being obviative. Going a step further, overt arguments are generally very unlikely to be topics, and this is true in Takelma as well.[6] So overt arguments will be (or are more likely to be) obviative.

Implicit in the tableaux in (24) and (26) is the idea that the proximate/obviative status of the arguments is a property of the candidates that is subject to constraints. This view is different from that assumed by Aissen 1997,1999b and others (e.g. Sells to appear) who assume that the discourse prominence of the arguments is part of the input.

However, given that there is a range of factors which determine proximate/obviative status, it seems natural to treat those factors as constraints determining the optimal candidate rather than treating proximate/obviative stauts as an unanalyzable, immutable given. So far as I can tell, the position taken by Aissen, Sells and others is really a matter of convenience for their discussions[7] and not one that is crucial theoretically for their arguments.

In particular, if the constraints determining proximate/obviative status are necessarily ranked higher than the other constraints under discussion (here, Direct Rel, Indirect Rel, Direct Nom, and Direct Anim) then we will see exactly the same effects as if proximate/obviative information were part of the input. For example, if we add to the tableau in (26) a high ranking constraint whose effect is that topics are proximate, we get the tableau in (27) (omitting the irrelevant Direct Anim) for the Takelma sentence in (28).

27. Revised (not final) tableau

they told him(TOP)	Prox=Topic	Direct Rel	Indirect Rel
a. they told-Ø him(TOP) Prox Obv	!*		
b. they told-Ø him(TOP) Obv Prox		!*	
c. they told-*k^h wa* him(TOP) Prox Obv	!*		*
d. ☞ they told-*k^h wa* him(TOP) Obv Prox			

[6]In the story that was analyzed, the distance between an argument and its most recent mention (Referential Distance, cf. Givón 1983) is a very good predictor ($p < 0.05$) of whether that argument will be overt.
[7]In this regard, it is like the glossing over of the choice of grammatical function in the tableau in (24). While the assignment of grammatical function to arguments is not part of the input, Takelma does not have any construction in which the patient/experiencer is the subject and the cause is a non-subject, so the grammatical function assignment is essentially fixed in this example.

28. (TT 60:7)

nakaí:k^{h}waʔ

say-k^{h}wa

'they had told him'

Determining the full range of factors which determine proximate/obviative status is beyond the scope of this paper, and in any case it has received much discussion in the Algonkian literature. However, we can sketch how some of the factors might work for Takelma.

We can treat the factors that determine proximate/obviative status as hierarchies entirely parallel to the Participant, Relational, Nominal, and Animacy hierarchies, as in (29). In addition to topicality and overtness, another factor which may be relevant to proximate/obviative status in Takelma is individuation, since both of the examples (10) with an overt object have less individuated subjects (cf. Aissen 1999a for individuation as a factor in Tzotzil). The three hierarchies are given in (29).

29. Three (partial) prominence hierarchies for proximate/obviative status
a. Topicality: TOPIC > non-TOPIC
b. Overtness: OVERT > COVERT
c. Individuation: More Indivduated > Less Individuated

We can then align these hierarchies with the Participant hierarchies, just as we did the other Relational and Animacy hierarchies, as in (30). Direct Topic is then the replacement for the Prox=Topic constraint in tableau (27).

30. Three alignments with the Participant hierarchy
a. Direct Alignment of Topicality and Participant = Direct Topic
b. Indirect Alignment of Overtness and Participant = Indirect Overt
c. Direct Alignment of Individuation and Participant = Direct Indiv
d. Comparison of Alignments

TOPIC non-TOPIC Overt Covert More individ. Less individ.

Prox Obv Prox Obv Prox Obv

Given that the topicality of *-k^{h}wa* seems more important than the overtness of the subject, we can tentatively say that at least for Takelma Direct Topic > Indirect Overt. There is not enough information to rank Direct Indiv. We can reformulate the tableau in (27) as in (31). I leave open the possibility that the choice of overtness for the arguments may be determined by (higher-ranking) constaints as well.

31. Final tableau

they(Ø) told him(Ø,TOP)	DirTop	IndirOvert	DirRel	IndirRel
a. they(Ø) told-Ø him(Ø,TOP) Prox Obv	!*	*		
b. they(Ø) told-Ø him(Ø,TOP) Obv Prox		*	!*	
c. they(Ø) told-*k^h^wa* him(Ø,TOP) Prox Obv	!*	*		*
d. ☞ they(Ø) told-*k^h^wa* him(Ø,TOP) Obv Prox		*		

To sum up this section, Takelma seems similar to other languages with syntactic obviation, so Aissen's OT analysis can be applied. We also saw that it is possible to extend that analysis to treat proximate/obviative status as an emergent property rather than as part of the input.

4 Typology: topic markers

4.1 -*k^{h}wa* as paragraph topic marker

When we step back and look at the languages in which obviation plays an important role, there are two broad types, depending on whether Indirect Rel is active or not. In the Algonkian languages and Takelma, Indirect Rel is active, while in Tzotzil and Chamorro it is not. It is striking as well that in the languages with Indirect Rel, there is special morphology associated with it. In the Algonkian languages it is the inverse marker on the verb, while in Takelma it is -*k^{h}wa*.[8] The question naturally arises as to whether there are properties of these morphemes which lead to their association with Indirect Rel. At least for -*k^{h}wa*, I think the answer is pretty clearly affirmative. -*k^{h}wa* is a topic marker for objects, which are not usually topics — subjects are usually topics. While I won't explore *how* these morphemes are associated with Indirect Rel, I will take a look at the properties of -*k^{h}wa* that lead it to be associated with Indirect Rel.

We have seen that -*k^{h}wa* is a topic marker, but we can refine that a bit. -*k^{h}wa* usually corresponds to a story topic, but as the example in (7), repeated here in (32), shows, -*k^{h}wa* can correspond to a smaller, paragraph-level topic. I would suggest that -*k^{h}wa*'s specification is as a marker of the paragraph topic. Of course, the story topic is often the paragraph topic, which explains why -*k^{h}wa* so often corresponds to the story topic.

32. (=7) -*k^{h}wa* as paragraph-level topic

Mi: taltàl tak^{h}wilì:tat^h uyù:ʔski<u>kwa</u>

now Taltal over-house-3sg laugh-k^{h}wa
'And Daldal from on top of the house laughed at them'

[8] It is peraps worth noting that -*k^{h}wa* is much more uncommon than the Algonkian inverse marker. The reason for that awaits further research.

Further evidence that -$k^{h}wa$ is a paragraph topic marker (as opposed to a story topic) comes from stories in which it occurs with different referents. Some figures are given in (33).

33. -$k^{h}wa$ with multiple referents in a story

Story	Referents of -$k^{h}wa$	n
Daldal the Transformer		7
	Daldal (unspecified as to which one)	3
	Daldal the younger	3
	The two blind women (= (7/32))	1
Grizzly Bear and Black Bear		6
	Black Bear	2
	Grizzly Bear	2
	Black Bear's daughters	2
Eagle and the Grizzly Bears		5
	Eagle	4
	Grizzly Bear brothers	1

The story of Grizzly Bear and Black Bear is particularly interesting in that the use of -$k^{h}wa$ follows the story action. The first part of the story is about Black Bear and the events leading up to her murder by Grizzly Bear, and the two instances of -$k^{h}wa$ referring to Black Bear occur in that section. The second part of the story is about Black Bear's daughters and the revenge they take by killing Grizzly Bear's daughters, and the two instances of -$k^{h}wa$ referring to Black Bear's daughters occur in that middle section. The final part of the story is about Grizzly Bear's futile pursuit of Black Bear's daughters, and the two instances of -$k^{h}wa$ referring to Grizzly Bear occur in this final section.

This evidence points strongly towards -$k^{h}wa$ being a paragraph level topic marker. There is also evidence that -$k^{h}wa$ is used to refer to the paragraph topic even when there is a more local topic. In the example in (34), at the local level, the Crows and their speech are what the sentences are about. However, the paragraph, and indeed the story as a whole, are about Chicken-Hawk.

34. -$k^{h}wa$ is not sentence topic marker (TT 146:11)

tà:le:lák^{hw}, me:l t^{h}ka: mìˀs texepèˀn, ka c'ipìnk^{h}wa

listen_to crows land one say_so that address_to-k^{h}wa

'He$_i$ listened to them$_j$, the Crows$_j$ covering the land said so, that speech they$_j$ addressed to him$_i$.'

4.2 Other levels of topic marking

So far, I have talked about three levels of discourse, the sentence, the paragraph, and the story, and argued that -$k^{h}wa$ indicates a paragraph topic. If the level of discourse structure is relevant to the definition of -$k^{h}wa$, then we might expect to find other topic markers which refer to the other levels of discourse structure. In fact, this does seem to be the case, as evidence from Athabaskan shows.

The Athabaskan *bi-* verbal prefix has received a lot of attention in the literature, most notably in Navajo, starting with Hale 1973. There are a variety of analyses, but a series of recent analyses of Navajo (Speas 1990, Uyechi 1996) argue that *bi-* is a sentence-level topic marker. In other words, *bi-* indicates what the sentence is about (cf. Platero 1974 on Navajo, Sandoval and Jelinek 1989 on Jicarilla Apache, and Thompson 1996 on a variety of Athabaskan languages). Uyechi analyzes Navajo *bi-* in LFG as an incorporated pronoun which refers to sentence topics. An example is given in (35).

35. Navajo *bi-* as sentence-level topic marker (Uyechi 1996:123, citing Hale 1973)

łį́į́ dzaanééz biztał
horse mule BI-kicked
'The horse, the mule kicked it'

A further interesting aspect of Athabaskan *bi-* is that it has been connected with syntactic obviation. Thompson 1989 argues that Koyoukon *bi-* is an inverse marker and Aissen 1997 connects the Navajo animacy and genitive gaps with syntactic obviation.

One final aspect of Athabaskan *bi-* is that it existed, at least in some form, in at least two of the Athabaskan languages neighboring Takelma, namely Galice Athabaskan (Hoijer 1966) and Tututni (Golla 1976). We might speculate wildly that Takelma borrowed the function of topic-anaphora from Athabaskan. Of course, much, much more work would have to be done to substantiate this speculation.

We have now seen pronominal topic markers for sentence-level (Athabaskan) and paragraph-level (Takelma) topics. A third level of discourse organization is the story or episode (often the whole text), and there is some evidence, again from Navajo, that there may be pronominals which refer to story-level topics. So-called fourth person pronominals in Navajo have not been the subject of much analysis, but at least one of the uses of them seems to be as a story level topic marker (Young and Morgan 1987, Willie 1991). However, unlike *bi-* and -k^h*wa*, the fourth person pronominals have other uses, e.g. to indicate politeness, and they are not restricted to objects but can be subjects as well.

4.3 The beginnings of a typology of topic marking

We've seen that Takelma -k^h*wa* and Navajo *bi-* only refer to topics. Furthermore, when the prior conditios on their use is satisfied (e.g. there is a third person subject, and in the case of -k^h*wa*, the humanness of the referent), only they can be used to refer to topics. For example, the Takelma Ø OM does not refer to paragraph topics; nor is Navajo *yi-* (also used when there is a third person subject) apparently used for sentence topics. We thus have forms (Takelma Ø OM, Navajo *yi-*) which we might call "anti-topic" markers.[9] Interestingly enough, Bresnan and Mchombo 1987 show that the independent pronoun cannot refer to a topic that is an object, making the Chichewa independent pronoun an anti-topic pronoun in this situation.

In addition to topic markers and anti-topic markers, there are also pronouns which may or may not refer to topics. English pronouns are one example. The Chichewa OM may also be neutral with respect to the topicality the object. Bresnan and Mchombo provide ample evidence that when the OM is used with an overt object, it is a topic. However, they also give in example in the second clause of (36) in which the OM is not used with an overt object and it does not seem to be a topic in any sense: Hyena seems to be the topic.

[9] David Beaver (p.c. 7/00) suggests that the notion of "anti-topic" may not be needed. On this view, anti-topic markers are simply the elsewhere forms and need not be specified specifically as anti-topic. It is hard to see how this approach would account for the three-way distinction in Navajo, though, among *bi-*, *yi-* and fourth person.

36. Chichewa OM not referring to topic (Bresnan and Mchombo 1987)
Fîsi a-na-dyá chí-manga.
1A.hyena 1ASu-PST-eat 7-corn

Á-tá-chí-dya, a-na-pítá ku San Francisco
1A.s-serial-7.O-eat 1A.s-past-go to San Francisco
'The hyena ate the corn. Having eaten it, he went to San Francisco.'

Putting together the information about the different pronouns, we have the beginnings of a typology of what we might call topic-anaphora. A summary of this information is given in (37).

37. The beginnings of a topic-anaphora typology
(o) = the form has other uses

Discourse Level	Topic-marker	Anti-topic marker	Neutral
Sentence	Navajo *bi-*	Navajo *yi-* Chichewa independent pronoun (o)	English pronouns Chichewa OM
Paragraph	Takelma -k^h*wa*	Takelma Ø OM (o)	" " (?)
Story/episode	Navajo 4th person (o)	?	" " (?)

The existence of this range of topic anaphora also addresses a question that may have been nagging the reader: why couldn't we simply say that -k^h*wa* is an incorporated pronoun and be done with it? The answer is that topic anaphoricity is a separate dimension along which pronominals in general (not just incorporated pronouns) are classified. In particular, for Takelma, the Ø OM would also be treated as an incorporated pronoun, since it occurs without overt objects, just as -k^h*wa* does. What distinguishes -k^h*wa* from the Ø OM is their topic anaphoricity: -k^h*wa* is a topic maker while the Ø OM is an anti-topic marker.

What I have attemped to show in this section is that -k^h*wa* as a topic marker is not an aberration. Rather, it is one point in a larger typology of topic-anaphora. I have suggested that the level of discourse organization is one dimension of the typology of topic-anaphora. It remains to be seen if other aspects of topicality (e.g. continuing vs shift) are relevant to topic anaphora. For example, Givón 1990:913 lists a variety of constructions in English which correspond to different aspects of topicality.

5 Conclusion
In this paper, I have looked at Takelma -k^h*wa* from a variety of points of view, from a language internal perspective, from the perspective of obviation, and from the perspective of topic-anaphora. From the language internal perspective, I showed new generalizations about -k^h*wa*, namely that it indicates an inverse animacy relationship between subject and object, and it is a paragraph topic marker. From the perspective of obviation, I showed that proximate/obviative status can and should be treated as emergent rather than as part of the input. And finally, from the perspective of topic-anaphora, I suggested that -k^h*wa*fits into a of typology of topic-anaphora, the beginnings of which were explored here.

References
Aissen, Judith. 1997. On the syntax of obviation. Language. 73:4. 705-750.
Aissen, Judith. 1999a. Agent focus and inverse in Tzotzil. Language. 75:3. 451-483.

Aissen, Judith. 1999b. Markedness and subject choice in Optimality Theory. Natural Language and Linguistic Theory. 17. 673-711.
Bresnan, Joan and Sam A. Mchombo. 1987. Topic, pronoun, and agreement in Chichewa. Language. 63:4. 741-782.
Culy, Christopher. 1999. Questions in Takelma. International Journal of American Linguistics. 65.3, 251-274.
Givón, Talmy. 1983. Topic continuity in discourse: An introduction. Topic Continuity in Discourse: A Quantitative Cross-Language Study, ed. by Talmy Givón. 1-41. Philadelphia: John Benjamins Publishing Company.
Givón, Talmy. 1990. Syntax: A Functional-Typological Introduction, vol. II. Philadelphia: John Benjamins Publishing Company.
Golla, Victor. 1976. Tututni (Oregon Athapaskan). International Journal of American Linguistics. 42:3. 217-227.
Golla, Victor. 1990. The Collected Works of Edward Sapir VIII: Takelma Texts and Grammar. New York: Mouton de Gruyter.
Hale, Kenneth. 1973. A note on subject-object inversion in Navajo. Issues in Linguistics: Papers in Honor of Henry and Renée Kahane, ed. by Braj B. Kachru, Robert B. Lees, Yakov Malkiel, Angelina Pietrangeli, Sol Saporta,. 300-309. Urbana: University of Illinois Press.
Hoijer, Harry. 1966. Galice Athapaskan: A Grammatical Sketch. International Journal of American Linguistics. 32:4. 320-327.
Jelinek, Eloise. 1984. Empty Categories, Case and Configurationality.. Natural Language and Linguistic Theory. 2:1. 39-76.
Kendall, Daythal Lee. 1977. A Syntactic Analysis of Takelma Texts. Philadelphia: Ph.D. dissertation, University of Pennsylvania.
Platero, Paul R. 1974. The Navaho Relative Clause. International Journal of American Linguistics. 40:3. 202-246.
Sandoval, M and E Jelinek. 1989. The Bi-construction and Pronominal Arguments in Apachean. Athapaskan Linguistics: Current Perspectives, ed. by Eung-Do Cook, Keren D. Rice,. 335-377. New York: Mouton de Gruyter.
Sapir, Edward. 1909. Takelma Texts. University of Pennsylvania Anthropological Publications. 2:1. 1-263.
Sapir, Edward. 1922. The Takelma language of southwestern Oregon. Bulletin of American Ethnology: Handbook of American Indian Languages, ed. by Franz Boas. 40:2. 1-296. Washington, DC: Government Printing Office.
Speas, Margaret J. 1990. Phrase Structure in Natural Language. Dordrecht: Kluwer Academic Publishers.
Thompson, Chad. 1989. Pronouns and voice in Koyukon Athapaskan: A text-based study. Internation Journal of American Linguistics. 55:1. 1-24.
Thompson, Chad. 1996. The history and function of the yi-/bi- alternation in Athabaskan. Athabaskan Language Studies: Essays in Honor of Robert W. Young, ed. by Eloise Jelinek, Sally Midgette, Keren Rice, Leslie Saxon,. Albuquerque: University of New Mexico Press.
Uyechi, Linda. 1996. The Navajo third person alternation and the pronoun incorporation analysis. Athabaskan Language Studies: Essays in Honor of Robert W. Young, ed. by Eloise Jelinek, Sally Midgette, Keren Rice, Leslie Saxon,. 123-135. Albuquerque: University of New Mexico Press.
Willie, MaryAnn. 1991. Navajo pronouns and obviation.
Young, Robert W. and William Sr. Morgan. 1987. The Navajo Language: A Grammar and Colloquial Dictionary (revised edition). Albuquerque: University of New Mexico Press.

MISSING-OBJECT CONSTRUCTIONS:
LEXICAL AND CONSTRUCTIONAL VARIATION*

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1 Introduction

In missing object constructions, the subject of the matrix clause is construed as coreferent with a missing complement — a "gap" — in the complement to the predicate:

(1) a. This book is tough to finish ___. (TOUGH-type)

b. This car needs washing ___. (NEED-type)

Cross-linguistically, missing object constructions are sometimes analyzed as involving long-distance dependencies, similar to the dependencies found in wh-question or relative clause constructions. Other missing object constructions have been analyzed as involving complex predicate formation. We propose that both classes of missing object constructions are found in English, exemplified by the canonical long-distance *tough* predicate and the short-distance *need* predicate. This difference in the syntactic structure of the two types of missing object constructions explains their very different syntactic behavior.

This paper is organized as follows. First we discuss *need*-type missing object constructions, arguing that they are complex predicates. We then contrast these

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with *tough*-type missing object constructions which involve a long-distance dependency. Finally, we compare the *tough* constructions to other long-distance dependencies both within English and cross-linguistically.

2 English *need* and other short-distance MOCs

The predicates in (2), which we call *need*-type predicates, involve an apparent object "gap" and have previously been analyzed as a type of *tough* predicate like the ones to be analyzed in Section 3 (Nanni 1978, 1980).[1]

(2) Sample predicates: need, could do with, want, require, warrant, deserve, merit

However, *need*-type MOCs turn out to be better analyzed as complex predicates and hence as monoclausal, with no long-distance dependency, as proposed by Barron (1999). Evidence for the complex predicate analysis includes the fact that the path in *need* constructions is always short, and parasitic gaps are not allowed. That the construction does not involve nominalization of the complement verb is shown by the fact that the complement does not have nominal characteristics and that it must be a predicate of arity greater than one. Further, the construction can be shown to contain only one subject, not two, as characteristic of a monoclausal construction. Finally, string adjacency between the *need* predicate and the complement verb is required, a common characteristic of complex predicates.

2.1 *Need*-type MOCs do not involve a long-distance dependency

Two types of evidence show that *need* predicates do not involve long-distance dependencies. First, the dependency is bounded: the SUBJ of *need* is interpreted as an argument of the complement verb, and nonlocal dependencies are not allowed:

(3) a. The clothes need/require/deserve/merit washing.

b. *The clothes need/require/deserve/merit trying to wash.

c. *The book needs/requires/deserves/merits getting her to read.

Second, parasitic gaps, which are licensed by long-distance dependencies, are not allowed:

(4) a. *This report needs filing ___ without trying to read ___.

[1] We are grateful to Paul Kay for providing this list.

b. *This food needs cooking ___ before you eat ___.

There are some acceptable examples which seem to involve parasitic gaps, as seen in (5).

(5) a. The report needs filing ___ without reading ___.

b. The chest needs varnishing ___ after sanding down ___.

However, we believe that these examples involve a type of coordination within the *need*-type complex predicate, and do not exemplify parasitic gap formation. This analysis is consonant with the observations of Butt (1996: pp. 49 ff.), who provides evidence that coordinate verbs can be involved in complex predicate formation in Urdu. The unacceptability of more complex parasitic gap examples like (4), as well as the strictly local nature of the relation between the SUBJ of the *need* predicate and the missing argument of the complement verb, provide strong evidence against an analysis of *need* predicates as involving a long-distance dependency.

2.2 *Need*-type MOCs do not involve a nominalization

It is also clear that the complements of *need*-type complex predicates are not nominalizations.[2] First, Grover (1995) points out that *need* predicates occur with adverbs[3] and not adjectives, as seen in (6), and they disallow initial determiners, as seen in (7).

(6) The carpet needs shaking well.

(7) The child needs (*a) taking to the doctors.

In addition, the complement verb is required to be a predicate with at least two arguments. Even unaccusative intransitive complements are not allowed, as seen in (8):

(8) *The patient needs bleeding/yawning.

[2]We will not discuss the alternative transitive subcategorization frame of *need* in examples like:

(i) I need a stiff drink.

Examples such as these involve nominal objects, but do not exemplify *need*-type complex predicates.

[3]Note that this does not rule out a gerund analysis.

It is not clear how such a requirement could be imposed on a nominalization: the requirement would be for a nominalized transitive verb and not a nominalized intransitive verb, and such requirements are generally disallowed by the Lexicalist Hypothesis. However, requirements referring to the argument structure of the complement of a light verb in a complex predicate construction are common (Butt 1996).

2.3 *Need*-type MOCs are monoclausal

In this section we show that there is no accessible subject of the complement verb.

2.3.1 Subject-oriented adverbials

If *need* predicates are complex predicates, then they are monoclausal and have only one syntactic subject. One way to verify whether *need* predicates are monoclausal is to combine the predicate with subject-oriented adverbs; in a complex predicate, a subject-oriented adverb will pick out only the matrix subject, since there is no subordinate subject. This test must be used with caution, however, since many so-called subject oriented adverbs like *deliberately* are often oriented not towards the grammatical subject but towards the logical subject, as in (9) (Quirk et al. 1985: 8.93). The same is true for adverbial phrases, like those in (10).

(9) a. Bill examined the book deliberately/willingly.

b. The book was examined deliberately/willingly.

(10) a. Bill washed the car without asking permission.

b. The book was examined without asking permission.

c. Bill killed the cockroach without stopping to think about it.

Nevertheless, the behavior of *need* predicates in combination with these adverbial phrases is telling: when these adverbial phrases are combined with *need* predicates, as in (11), they cannot refer to the subject of the complement verb, but only to the subject of the *need* predicate. That is, a sentence like (11a) has only the nonsensical reading on which the clothes must ask permission:

(11) a. *The car needs washing without asking permission.

b. *Cockroaches need killing/The car needs washing without stopping to think about it.

This is because the adverbials cannot refer to the logical subject of the complex predicate, since it is suppressed. Thus, subject oriented adverbials support the idea that *need* predicates have a single syntactic subject, with the subject of the complement verb suppressed.

2.3.2 For-phrase

An interesting argument for complex predicatehood comes from the fact that MOCs do not permit a *for*-phrase to act as the overt controller of the subject of the complement verb, as seen in (12).[4]

(12) a. *The car needs/requires/deserves for him washing.

b. *For him, the car needs/requires/deserves washing.

For-phrases are licensed with the biclausal missing object constructions but not with the monoclausal complex predicates, since there is no complement involved in this complex predicate construction.[5]

2.4 Phrase structure characteristics

Besides demonstrating the impossibility of *for*-phrases with *need* predicates, the examples in (12) provide evidence for a string adjacency requirement: *need* predicates must appear adjacent to their complement verb. This requirement is also shown by the ungrammaticality of examples like (13):[6]

(13) *The car needs thoroughly washing.

[4] Grover (1995: Chapter 4) claims that *worth* belongs to the class of *need* predicates and yet allows a *for*-phrase. However, in Section 3 we analyze *worth* as a long-distance *tough* predicate, which does not involve complex predicate formation.

[5] Given the passive-like meaning of the *need* complex predicate, we might expect *by*-phrases as a plausible alternative expression of the subject of the complement verb; see Barron (1999) for discussion of the passive origin of the *-ing* participle in this construction. Some examples with *by*-phrases are in fact acceptable (thanks to Joan Bresnan for pointing this out):

(i) This coat needs washing by me.

However, even with an overt agent, subject-oriented adverbials are not possible:

(ii) a. *This coat needs washing by me without asking permission.

b. *These cockroaches need killing by exterminators without stopping to think about it.

[6] The one item which can marginally intervene is contrastive negation, as in (i). Butt (1996) cites similar intervention of negation in Urdu complex predicates.

(i) The car needs not WASHING, but POLISHING.

Though some complex predicate constructions do not require string adjacency (Butt 1996), such a requirement is commonly found in complex predicate constructions.

2.5 Syntax of *need*-type MOCs

The basic functional structure of a *need* predicate is shown in (14), as previously proposed by Barron (1999):

(14) The clothes need washing.

$$\begin{bmatrix} \text{PRED} & \text{`NEED-WASHING}\langle\text{SUBJ}\rangle\text{'} \\ \text{SUBJ} & \begin{bmatrix}\text{PRED} & \text{`CLOTHES'}\end{bmatrix} \end{bmatrix}$$

The complement of the light verb *need* must take (at least) two arguments: the argument higher on the hierarchy is suppressed, and the second argument surfaces as the SUBJ of the *need* predicate. At argument structure, the complement verb cannot be monovalent. However, the complex predicate can inherit additional arguments from the complement verb:

(15) Chris needs convincing ___that this is a good idea.

3 English *tough* and other long-distance MOCs

Long-distance missing object constructions in English can be roughly divided into the following categories:

(16) a. Adjective + infinitival complement: tough, easy, hard, difficult, simple, impossible, etc.

b. Adjective + participial complement: worth, worthwhile

c. Modified adjective: too + ADJ, ADJ + enough

d. Time phrases: take 3 years, take 1 month, etc.

In this section, we argue that *tough* predicates involve long-distance dependencies with anaphoric control of the complement object by the matrix subject.

3.1 *Tough*-type MOCs involve a long-distance dependency

Tough-type missing object constructions have often been analyzed in terms of a long-distance dependency similar to the long-distance dependencies in interrogative and relative clause formation. This proposal has been adapted in work by, among others, Kaplan and Bresnan (1982), Gazdar et al. (1985), and Pollard and Sag (1994), with a dissenting view presented by Grover (1995). Arguments for this type of analysis are that *tough* predicates can license parasitic gaps and obey island constraints. After reviewing the relevant data and past analyses, we also propose a version of the long-distance dependency analysis for the *tough* construction.

3.1.1 Unbounded dependencies

The dependency path in a *tough* construction can be arbitrarily long. That is, not only can objects of the predicate's complement be gapped, but complements of the complement can have gapped objects. (17) shows the shortest paths, using examples from different subtypes of *tough* predicates, and (18) shows longer paths for the same types of predicates. Additional long-distance paths are given in (19), taken from Hukari and Levine (1987).

(17) a. This book is easy to read.

b. This book is too valuable to throw away.

c. This book is worth reading.

d. This book takes six months to read.

(18) a. This book is hard to get her to avoid reading.

b. This house is too old to get anyone to try to renovate.

c. This book is worth trying to get her to read.

d. This book takes six months to try to read.

(19) a. Kim would be difficult to persuade Robin to attempt to reason with.

b. Robin is too nice for us to try to persuade Kim to tease.

Consider example (19a), where *Kim* is coreferent with the gapped object of *reason with*, passing through the domains of three other predicates (*difficult, persuade, attempt*). Such long paths are the mark of an unbounded dependency: the subject-gap relation can span arbitrarily many predicates.

3.1.2 Island phenomena

Hukari and Levine (1987) claim that the long-distance path in *tough* constructions obeys island constraints (see also Cinque 1990; Grover 1995). This fact has been cited as evidence for analyzing *tough* constructions similarly to other long-distance dependencies. For example, as Hukari and Levine (1987) show, the gap cannot appear in an NP-island, as seen in (20b) for a simple NP and in (20c) for a relative clause within an NP. As seen in (20d), they also obey wh-islands.

(20) a. Kim would be difficult to imagine kissing.

b. *Kim would be difficult to imagine [the likelihood of kissing]$_{NP}$.

c. *Kim would be difficult to imagine a person [who likes]$_{REL-CL}$.

d. *Kim would be difficult to wonder [whether to kiss]$_{WH}$.

In Section 4, we show that there are various differences between other long-distance dependencies and long-distance missing object constructions. Nevertheless, all long-distance dependencies seem to obey island constraints.

3.1.3 Parasitic gaps

An additional similarity between long-distance dependencies in interrogative and relative clause formation and in *tough* constructions comes from *tough*'s ability to license parasitic gaps (Montalbetti et al. 1982; Grover 1995). In (21), from Grover (1995), the subject *these papers* is coreferent not only with the object of *file*, but also with the object of *reading.* Further examples are shown in (22) for a variety of *tough* predicates.

(21) These papers are easy to file ___ without reading ___.

(22) a. This book is hard to throw away without trying to read.

b. This book is too interesting to read without really trying to understand.

c. This book is not worth reading without attempting to analyze deeply.

d. This book would take three years to read without even trying to analyze.

3.2 *Tough*-type MOCS are biclausal

Unlike *need*-type complex predicates, *tough* constructions are biclausal. As such, a *for*-phrase is possible, as in (23) (see Levine 2000 on the status of the *for*-phrase):

(23) a. The clothes are easy for George to wash.

b. The clothes are too dirty for me to wear.

In addition, subject oriented adverbials can refer to the understood subject of the lower predicate, as seen in (24). This was not possible with the *need*-type complex predicates.

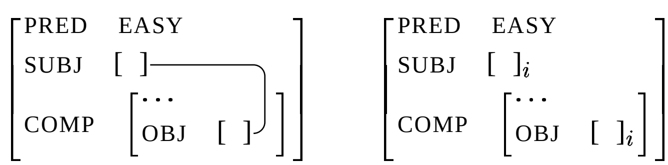
(24) a. The clothes are too clean to wash without asking permission.

b. Cockroaches are easy to kill without stopping to think about it.

3.3 Connectivity: Functional vs. anaphoric control

We have shown that the *tough* construction involves a long-distance dependency between the matrix subject and the gapped object of a potentially long-distance complement of the *tough* predicate. The question then arises as to whether this dependency involves functional control, in which the subject and gapped object are identical, or anaphoric control, in which they are co-referent but syntactically distinct. This question is sometimes referred to as "connectivity".

(25) Functional: Anaphoric:



This issue has been addressed by Kaplan and Bresnan (1982), Hukari and Levine (1987), Bayer (1990), Grover (1995), and Calcagno (1999), among others. Within LFG, Kaplan and Bresnan (1982), Saiki (1991), and Yamamoto (1996) analyze *tough* constructions as involving functional control of a topic.

However, evidence from casemarking indicates that anaphoric control, and not functional control, is involved. In particular, there is a case mismatch between the nominative case subject and the accusative case object (Hukari and Levine 1987, 1991; Bayer 1990; Calcagno 1999). This is seen in (26).

(26) He/*Him is tough to kill ___.

It is easy to handle this case discrepancy if these constructions are analyzed as involving anaphoric control, with an anaphoric relation between the matrix subject and the gapped argument in the subordinate clause. In an anaphoric control construction, there are two different f-structures involved, one which is nominatively case marked and one which is accusatively marked. In contrast, functional control constructions involve identity between the controller and the controllee, and thus require case preservation.

Some arguments that have previously been made for and against connectivity (i.e., functional vs. anaphoric control) are flawed in that they are actually orthogonal to the issue, at least within LFG. Calcagno (1999), citing Pollard and Sag (1994), considers phrase structure category mismatches such as that in (27), arguing that there is no syntactic connectivity between the matrix argument and the lower clause.

(27) a. [For Robin to be a spy] would be hard to get over ___.

b. *It would be hard to get over [for Robin to be a spy].

However, this is not an argument for or against f-structure connectivity in LFG, since LFG defines subcategorization in functional terms, not in terms of phrase structure configuration. Indeed, such category mismatches are common in a variety of constructions, as shown by Kaplan and Bresnan (1982) and Kaplan and Zaenen (1989) in their discussion of topicalization of sentential complements:

(28) a. That Chris yawned he wasn't aware of. (= *of* + *that*)

b. *That Chris yawned he wasn't aware. (= no *of* + *that*)

c. *He wasn't aware of that Chris yawned. (= *of* + *that*)

d. He wasn't aware that Chris yawned. (= no *of* + *that*)

Hukari and Levine (1991) present several arguments for connectivity. First, they show that verbs which require subjunctive complements also impose this requirement when these complements occur in *tough* constructions, as in (29).

(29) a. It would have been difficult for Robin to demand of us that we be/*were there on time.

b. That we be/*were there on time would have been difficult for Robin to demand of us.

However, Jacobson (1992) shows that this is a semantic requirement, not a syntactic one, since it holds even across sentences:

(30) I demanded something. It was that we be/*were there on time.

Second, Hukari and Levine (1991) claim that phrase structure category restrictions must be met both in *tough* constructions and their non-*tough* counterparts (judgements are those of Hukari and Levine (1991)):

(31) a. I pretended that I was sick.

b. ?? I pretended my sickness.

c. [That I was sick] would have been difficult for me to pretend when I really wasn't.

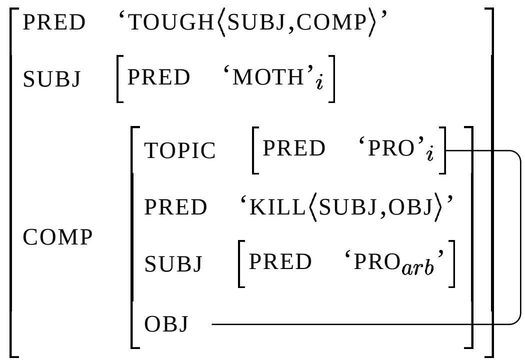
d. ?? My sickness would have been difficult for me to pretend.

However, we believe that the contrast between (31a) and (31b) is better explained in terms of grammatical function rather than phrase structure category; the verb *pretend* requires a sentential complement with grammatical function COMP, and noun phrases are not associated with the COMP role. Our judgements differ from those of Hukari and Levine (1991) on the status of (31c): we do not believe this sentence is fully grammatical, since (as example (31b) shows) *pretend* does not take an object and thus cannot participate in the *tough* construction.

3.4 Syntax of *tough*-type MOCs

The structure given in (32) for the sentence *tough to kill* captures the facts described earlier in this section. The *tough* predicate subcategorizes for a thematic subject and a COMP. The subject anaphorically controls the TOPIC of the COMP, as indicated by the coindexation, and the TOPIC fills an OBJ role within the subordinate clause via functional control. Note that the arbitrary control of the PRO SUBJ means that this construction must involve a COMP and not an XCOMP complement.

(32) Moths are tough to kill.



3.5 Argument structure of *tough*-type MOCs

A closer look at the argument structure and semantic requirements of *tough* predicates explains some otherwise mysterious constraints. In particular, we adopt the proposal that the subject of the *tough* predicate is thematic. In addition, we discuss some semantic constraints on the complement of *tough* predicates.

3.5.1 Subject of *tough* is thematic

There has been extensive controversy over whether or not the subject in *tough* constructions is a thematic argument of the *tough* predicate. The primary reason that the subject of *tough* has been considered to be nonthematic is that many *tough* predicates also participate in a construction in which the subject is an expletive, as in (33).[7]

(33) a. This book is hard to read.

b. It is hard to read this book.

In some transformational theories the gapped object is assumed to move from its original (thematic) object position to the matrix subject position; a violation ensues if both positions are assigned thematic roles, as discussed by Chomsky (1981). The analysis we present does not rely on movement transformations, and so this is not a problem for LFG.

We claim that the subject is in fact a thematic argument of the *tough* predicate, following Lasnik and Fiengo (1989), Jacobson (1992), Pollard and Sag (1994), Kim (1995), and Clark (2000). Note that if the subject of *tough* were nonthematic,

[7] However, not all *tough* predicates do this:

(i) This book is too long to read.

(ii) *It is too long to read this book.

as is sometimes argued, *tough* predicates would be like raising verbs and would necessarily involve functional control. However, there is substantial evidence that the subject of *tough* is thematic, consistent with the anaphoric control analysis that we assume.

First, it is impossible for an expletive pronoun to appear as the subject of a *tough* predicate, even if it leaves an object gap, as in (34).

(34) a. *There is hard for me to imagine ___ ever being enough snow in New England. (Jacobson 1992)

b. *There would be tough to believe ___ to be a party in our back yard tonight. (Bayer 1990; Jacobson 1990)

On our view, the semantically empty matrix subject would be required to enter into an anaphoric relation with the subordinate clause TOPIC/OBJ, a relation which is not semantically possible. Comrie and Matthews (1990) provide an additional explanation for the ungrammaticality of these examples based on discourse functions: they are ungrammatical because the *tough* construction serves to topicalize the subject, and dummy arguments cannot be topics.

Postal (1974) cites the examples in (35) and discusses the difference in meaning, a difference which is unexpected if the subject of *tough* predicates is non-thematic.

(35) a. Nothing is hard for Melvin to lift. (only wide scope)

b. It is hard for Melvin to lift nothing. (narrow scope)

Jones (1983) notes a similar difference in interpretation related to the possibility for a non-specific interpretation of *someone* in *tough* constructions, as in (36).

(36) a. It is easy to fool someone.

b. ?? Someone is easy to fool.

Finally, consider evidence from idioms. Past reasoning on this issue has been as follows (Berman 1973; Bayer 1990; Jacobson 1990). Idioms are allowed with subject raising verbs, whose subject is nonthematic, but not with equi verbs. Idioms are also acceptable with *tough* predicates. Therefore, the subject of *tough* predicates must be non-thematic. Examples are shown in (37).

(37) a. Tabs seem to have been kept on my brother. (raising)

b. *Tabs are eager to be kept on my brother. (equi)

c. Tabs are difficult to keep on my brother. (tough)

However, in a detailed study of idiomatic expressions, Nunberg et al. (1994) show that the examples in (37) involve what they call “idiomatically combining expressions”, not true idioms. Many idiomatically combining expressions are acceptable with equi as well as *tough* predicates, depending on the meanings of the parts of the expression:

(38) An old dog never wants to be taught new tricks. (equi)

(39) a. Some strings are harder to pull than others. (tough)

b. The law can be hard to lay down. (tough)

As Nunberg et al. show, true idioms are not possible with *tough* predicates because, like equi verbs, they are semantically incompatible with a thematic subject position:

(40) *The bucket is easy to kick in wartime. (tough)

This evidence indicates that the subject of *tough* predicates in missing object constructions is thematic; as Bayer (1990) notes, this necessitates positing two different argument structure frames for some *tough* predicates.

3.5.2 Semantic constraints on the complement of *tough*

In addition to constraints on their subject, *tough* predicates also impose semantic constraints on their complement, originally explored by Nanni (1978) (see also Lasnik and Fiengo 1989; Clark 2000): the complement of a *tough* predicate is required to be volitional or intentional with respect to its subject. Examples from Berman (1973) and Nanni (1978) in (41) support this view:

(41) a. *The park was tough for there to be men sitting in.

b. *The money was tough for John to lack.

c. *That expensive dress was easy for Mary to want.

d. *The hardcover edition was hard for the teacher to prefer.

e. The man was hard for Mary to find attractive/*sick.

f. The children were difficult for us to return unharmed/*exhausted.

Nanni (1978) shows that stativity is not the relevant factor in determining the felicity of the examples in (41). That is, although most of the ungrammatical complements in (41) involve stative predicates, grammatical examples of *tough* predicate complements with stative predicates are also found:

(42) a. The lecture is hard for me to understand.

b. Your cousin is difficult for me to like.

c. Her transgressions are easy for us to forgive.

This restriction to intentionality solves a long-standing puzzle in the ungrammaticality of examples in which the object of a raising verb is the subject of a *tough* predicate. The example in (43a) is originally due to Chomsky (1973), discussed in Postal (1974); another example from Berman (1973) is seen in (43b) (see also Zwicky 1987).

(43) a. Smith was easy for Jones to force ___ to recover. (equi)

b. *Smith was easy for Jones to expect ___ to recover. (raising)

c. *John is impossible to expect ___ to understand that book. (raising)

The explanation for the ungrammaticality of the examples in (43) is that raising verbs are generally not volitional with respect to their subjects. In fact, it is possible for the *tough* construction to involve a raising verb of the appropriate semantic type; Nanni (1978) provides example (44), attributed to Partee.

(44) This analysis was hard for us to prove ___ to be correct. (raising)

In sum, we conclude that *tough* predicates are semantically two-place predicates in the missing-object *tough* construction. The subject of *tough* predicates is a thematic argument of that predicate, as was shown in the f-structure in (32); there are also semantic restrictions on the complement of the *tough* predicate in that it must be intentional with respect to the subject.

4 *Tough* and other long-distance dependencies

We have shown that there are two types of missing object constructions in English: *need*-type predicates are complex predicates, while *tough* predicates involve long-distance dependencies. In this section, we examine constraints on the long-distance dependency in *tough* predicates, concentrating primarily on the canonical examples involving an adjective like *tough* with an infinitival complement. Our basic question is: What paths are possible in long-distance dependency constructions in English and cross-linguistically?

4.1 Constraints on *tough*-type dependencies

Besides the nominal island constraints mentioned in Section 3, *tough* constructions obey constraints forbidding adjunct gaps, subject gaps, and extraction from tensed clauses.

First, it is impossible to extract an ADJUNCT with a *tough* predicate, even if it is an NP, as in (45) (Bayer 1990).

(45) *Tuesday would be difficult to take the exam.

However, it is possible to extract the OBJ of an ADJUNCT, as in (46) (Grover 1995: Chapter 5). The long-distance path in a *tough* construction cannot end in an ADJUNCT; it must end in an OBJ.

(46) a. This violin is easy to play the sonata on.

b. Kim is difficult to sit next to.

Second, subject gaps are not allowed, as in (47) (Hukari and Levine 1987; Gazdar et al. 1985). Once again, the path must end in OBJ, not a SUBJ.

(47) *Mary is hard for me to believe ___ kissed John.

Third, extraction from tensed clauses is forbidden or at best marginal (Postal 1971; Bresnan 1971; Nanni 1978; Hukari and Levine 1987), although Kaplan and Bresnan (1982) and Calcagno (1999) present similar examples which they claim are grammatical. This is shown in (48).[8]

(48) %Mary is hard for me to believe Leslie kissed.

A puzzle remains with regard to the *tough* path: Double object constructions are questionable in the *tough* construction, no matter which object participates in the construction. We do not examine this problem further here.

(49) a. *Kim would be easy to make a cake.

b. *A cake would be easy to make Kim.

[8] Kaplan and Bresnan classify (i) as grammatical and Calcagno (1999) presents (ii) as grammatical.

(i) Mary is tough for me to believe that John would ever marry ___.

(ii) That kind of mistake is hard to realize you're making ___.

Here we outline the precise nature of the path for *tough* predicates. The first grammatical function in the body of the path is always COMP, since this is the grammatical function of the complement of the *tough* predicate. The bottom of the path is always OBJ.[9] This leaves us with determining the rest of the body of the path. Based on the paths found in the examples in the papers cited and then extrapolating for the unbounded dependency, we get the hypothesized path in (50):

(50) $(\uparrow \text{ COMP TOPIC}) = (\uparrow \text{ COMP XCOMP}^{*} (\{\text{OBL}_{\theta}|\text{ADJ}\}) \text{ OBJ})$

In (50), the body of the functional uncertainty is COMP XCOMP* ($\{\text{OBL}_{\theta}|\text{ADJ}\}$), while the bottom is OBJ. We require an additional constraint on the body of the path, that it cannot contain a tensed element. In English, this falls out from the definition of XCOMP, since English XCOMPs are always non-finite. This proposal is similar to the proposal of Yamamoto (1996), but differs in several respects. Yamamoto (1996) assumes that the relation between the SUBJ of the *tough* predicate and the complement OBJ is one of functional control, not anaphoric control of a topic as we assume. Also, Yamamoto's proposal does not account for OBJ gaps inside adjunct or oblique phrases, which we have shown to be possible.

As mentioned above, some speakers allow a more unconstrained path; for example, Kaplan and Bresnan (1982) classify (51) as grammatical, where the path passes through the finite complement of *believe*:

(51) %Mary is tough for me to believe that John would ever marry ___.

This kind of variation is expected, since the long-distance path may vary within universally set parameters.

4.2 Variations in long-distance dependencies

Although long-distance dependencies are involved in both question and relative clause formation and in the *tough* construction, they do not involve the same path (Grover 1995; Hukari and Levine 1987, 1991). This can be easily seen by comparing the range of possible wh-questions with possible *tough* constructions. Question formation involves a much greater range of possibilities for the long-distance path. The basic English long-distance dependency path from Kaplan and Zaenen (1989) is seen in (52).

(52) $(\uparrow \text{ TOPIC}) = (\uparrow \{\text{COMP, XCOMP}\}^{*} (\text{GF}-\text{COMP}))$

[9]Pollard and Sag (1994) capture these constraints by requiring the gapped constituent to be an accusative NP. That is, their generalization involves case and not grammatical function.

First, consider the bottom of the functional uncertainty. As seen in section 4, only OBJ is allowed as the bottom for the *tough* construction, SUBJ and other grammatical relations are impossible. However, question formation allows a large range of grammatical functions as bottom, including SUBJ, as in (53a), and ADJUNCT, as in (53b).

(53) a. Who do you think saw Bill? (SUBJ)

b. When do you need to leave? (ADJUNCT)

Next, consider the body of the functional uncertainty involved in the two constructions. This is also different and, once again, more possibilities are available for question formation. As discussed earlier, the gap in the *tough* construction cannot appear in a finite clause. In contrast, question formation can involve certain finite clauses, as in (54).

(54) a. Which question did Bill think we asked the teacher?

b. Who did you say that Mary saw?

This variability in long-distance dependencies can also be seen cross-linguistically. For example, the long-distance path for question formation and topicalization in Icelandic is much less restricted than that in English, as seen in (55a) (Kaplan and Zaenen 1989) in which the bottom of the path can be any grammatical function and the body can be any grammatical function except ADJUNCT. In contrast, the path in Tagalog is much more restricted, as seen in (56) (Kroeger 1993), in which only SUBJ or SUBJ of SUBJ, etc. can occur.

(55) a. Icelandic: $(\uparrow \text{TOPIC}) = (\uparrow (\text{GF-ADJ})^{*}\ \text{GF})$

b. Tagalog: $(\uparrow \text{TOPIC}) = (\uparrow \text{SUBJ}^{+})$

5 Conclusion

We have shown the existence of two types of MOC in English. *Need*-type MOCs are complex predicates, and *tough*-type MOCs are long-distance dependencies. Cross-linguistically, complex predicate formation in missing object constructions is quite common. In particular, Huang (1997) shows in detail that missing object constructions in Chinese and Japanese are complex predicates. Huang (1997) provides four pieces of evidence that Chinese lexical *tough* constructions involve complex predicate formation: the constructions respect lexical integrity, they behave like a disyllabic verb in question formation, they are demonstrably intransitive and stative, and they show idiosyncratic gaps and suppletive semantic shifts. Huang also goes on to demonstrate that the Japanese *tough* construction involves complex predicate formation.

Missing object constructions in other languages have often been noted to allow only short-distance paths: Grover (1995) discusses missing object constructions in Dutch, Italian, and Spanish, noting that in all of these languages the relation between the subject of the *tough* predicate and the argument of the complement verb is very strictly bounded, suggestive of complex predicate formation. Further investigation may reveal the prevalence of *need*-type "missing object constructions" involving complex predicate formation.

In contrast, *tough* predicates involve anaphoric control between the subject of the *tough* predicate and the TOPIC of the *tough* complement. The relation between the TOPIC and the "missing object" is a long-distance dependency, though the properties of this dependency differ from the dependency in question formation. Thus, long-distance dependencies can vary within a language and cross-linguistically; this work constitutes a first step toward a universal typology of long-distance dependencies both within and across languages.

References

Barron, Julia, 1999. *Perception, Volition, and Reduced Clausal Complementation.* Ph.D. thesis, University of Manchester.

Bayer, Samuel, 1990. Tough movement as function composition. In Aaron Halpern (editor), *Proceedings of the Ninth West Coast Conference on Formal Linguistics*, pp. 29–42.

Berman, Arlene, 1973. A constraint on tough movement. In Claudia Corum, T. Cedric Smith-Stark, and Ann Weiser (editors), *Papers from the Ninth Regional Meeting of the Chicago Linguistic Society*, pp. 34–43. University of Chicago: Chicago Linguistic Society.

Bresnan, Joan, 1971. Sentence stress and syntactic transformations. *Language* 47, pp. 257–281.

Butt, Miriam, 1996. *The Structure of Complex Predicates in Urdu*. Ph.D. thesis, Stanford University. *Dissertations in Linguistics* series, CSLI Publications, Stanford University. Revised and corrected version of 1993 Stanford University dissertation.

Calcagno, Mike, 1999. Some thoughts on tough movement. MS, University of Tübingen.

Chomsky, Noam, 1973. Conditions on transformations. In Stephen Anderson and Paul Kiparsky (editors), *A Festschrift for Morris Halle*. New York: Holt, Reinhart, and Winston.

Chomsky, Noam, 1981. *Lectures on Government and Binding.* Dordrecht: Foris Publications.

Cinque, Guglielmo, 1990. *Types of $\bar{A}$-Dependencies.* Linguistic Inquiry Monographs. Cambridge, MA: The MIT Press.

Clark, Brady, 2000. *Some things are not susceptible to thinking about*: The historical development of *tough* complementation. MS, Stanford University.

Comrie, Bernard and Stephen Matthews, 1990. Prolegomena to a typology of Tough Movement. In William Croft, Keith Denning, and Suzanne Kemmer (editors), *Studies in Typology and Diachrony: Papers presented to Joseph H. Greenberg on his 75th Birthday*. Amsterdam: John Benjamins.

Dalrymple, Mary, Ronald M. Kaplan, John T. Maxwell, III, and Annie Zaenen (editors), 1995. *Formal Issues in Lexical-Functional Grammar*. Stanford University: CSLI Publications.

Gazdar, Gerald, Ewan Klein, Geoffrey K. Pullum, and Ivan A. Sag, 1985. *Generalized Phrase Structure Grammar*. Cambridge, MA: Harvard University Press.

Grover, Claire, 1995. *Rethinking some Empty Categories: Missing Objects and Parasitic Gaps in HPSG*. Ph.D. thesis, University of Essex.

Huang, Chu-Ren, 1997. Morphological transparency and autonomous morphology: A comparative study of tough constructions and nominalization. In *Chinese Languages and Linguistics III: Morphology and Lexicon*, pp. 369–399. Academia Sinica.

Hukari, Thomas E. and Robert D. Levine, 1987. Rethinking connectivity in unbounded dependency constructions. In Megan Crowhurst (editor), *Proceedings of the Sixth West Coast Conference on Formal Linguistics*, pp. 91–102. Stanford University: Stanford Linguistics Association.

Hukari, Thomas E. and Robert D. Levine, 1991. On the disunity of unbounded dependency constructions. *Natural Language and Linguistic Theory* 9(1), pp. 97–144.

Jacobson, Pauline, 1990. Raising as function composition. *Linguistics and Philosophy* 13, pp. 423–475.

Jacobson, Pauline, 1992. The lexical entailment theory of control and the *tough* construction. In Ivan A. Sag and Anna Szabolcsi (editors), *Lexical Matters*, pp. 269–297. Stanford University: CSLI Publications.

Jones, Michael A., 1983. Getting 'tough' with WH-movement. *Journal of Linguistics* 19, pp. 129–159.

Kaplan, Ronald M. and Joan Bresnan, 1982. Lexical-Functional Grammar: A formal system for grammatical representation. In Joan Bresnan (editor), *The Mental Representation of Grammatical Relations*, pp. 173–281. Cambridge, MA: The MIT Press. Reprinted in Dalrymple et al. (1995: pp. 29–130).

Kaplan, Ronald M. and Annie Zaenen, 1989. Long-distance dependencies, constituent structure, and functional uncertainty. In Mark Baltin and Anthony Kroch (editors), *Alternative Conceptions of Phrase Structure*, pp. 17–42. Chicago University Press. Reprinted in Dalrymple et al. (1995: pp. 137–165).

Kim, Boomee, 1995. Predication in *tough* constructions. In José Camacho, Lina Choueri, and Maki Watanabe (editors), *Proceedings of the Fourteenth West Coast Conference on Formal Linguistics*, pp. 271–285.

Kroeger, Paul, 1993. *Phrase Structure and Grammatical Relations in Tagalog*. Ph.D. thesis, Stanford University. *Dissertations in Linguistics* series, CSLI Publications, Stanford University, 1993. Revised and corrected version of 1991 Stanford University dissertation.

Lasnik, Howard and Robert Fiengo, 1989. Complement object deletion. In Howard Lasnik (editor), *Essays on Anaphora*. Dordrecht: Kluwer Academic Publishers. Originally in *Linguistic Inquiry* 5 (1974), 535–571.

Levine, Robert D., 2000. *Tough* complementation and the extraclausal propagation of argument descriptions. Paper presented at the 7th International Conference on Head-Driven Phrase Structure Grammar, Berkeley, July 2000.

Montalbetti, Mario, Mamoru Saito, and Lisa Travis, 1982. Three ways to get tough. In Kevin Tuite, Robinson Schneider, and Robert Chametzky (editors), *Papers from the Eighteenth Regional Meeting of the Chicago Linguistic Society*, pp. 348–366. University of Chicago: Chicago Linguistic Society.

Nanni, Debbie, 1978. *The* EASY *class of adjectives in English*. Ph.D. thesis, University of Massachusetts at Amherst.

Nanni, Debbie, 1980. On the surface syntax of constructions with *easy*-type adjectives. *Language* 56(3), pp. 568–591.

Nunberg, Geoffrey, Ivan A. Sag, and Thomas Wasow, 1994. Idioms. *Language* 70(3), pp. 491–538.

Pollard, Carl and Ivan A. Sag, 1994. *Head-Driven Phrase Structure Grammar*. Chicago: The University of Chicago Press.

Postal, Paul M., 1971. *Cross-Over Phenomena.* New York: Holt, Rinehart, and Winston.

Postal, Paul M., 1974. *On Raising.* Cambridge, MA: The MIT Press.

Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech, and Jan Svartvik, 1985. *A Comprehensive Grammar of the English Language*. New York: Longman.

Saiki, Mariko, 1991. The tough construction in Japanese. *Studies in Humanities* 28(2), pp. 91–115.

Yamamoto, Kazuyuki, 1996. The *tough* constructions in English and Japanese: A Lexical Functional Grammar approach. In Akira Ikeya (editor), Tough *Constructions in English and Japanese*, pp. 43–61. Tokyo: Kuroiso.

Zwicky, Arnold M., 1987. Slashes in the passive. *Linguistics* 25(4), pp. 639–669.

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THE GRAMMATICAL FUNCTIONS OF COMPLEMENT CLAUSES*

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1 Introduction

Current syntactic theories differ greatly in how abstract syntactic structure is represented. In theories in which grammatical functions are defined in terms of phrase structure configuration (for example, Speas 1990), the subject or external argument is distinguished from the nonsubject arguments on the basis of phrase structural criteria, and differences among nonsubject arguments are ascribed to differences in their phrasal position. In HPSG (Pollard and Sag 1994) and some versions of categorial grammar (Dowty 1982), grammatical functions are defined in terms of a functional hierarchy, usually taken to represent relative syntactic obliqueness. In such theories, syntactic distinctions among arguments follow from their relative position on the functional hierarchy. In more recent versions of HPSG (Manning and Sag 1999), the subject is given a special status, different from other grammatical functions, but any differences among nonsubject grammatical functions are assumed to follow from the functional hierarchy.

Still other theories assume a much more informationally rich representation of grammatical functions; each argument of a predicate is identified as bearing a particular grammatical function such as subject, object, complement, or oblique, each with different grammatical properties. Lexical Functional Grammar (Bresnan 1982; Dalrymple et al. 1995) is an exemplar of such a theory, as are the theories of Relational Grammar (Perlmutter 1983) and Construction Grammar (Kay 1998). It is reasonable

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to ask whether this more elaborate representation is in fact warranted, or whether a simpler theory of grammatical functions would suffice.

We will show that the fine distinctions among different grammatical functions provided by a theory like LFG are necessary in the description of the syntax of clausal complementation. A clausal complement can bear one of two grammatical functions to a predicate: some clausal complements bear the OBJ function, while others bear the COMP function, the grammatical function traditionally assumed for clausal complements in LFG. In some languages, all clausal complements bear the same grammatical function. More interestingly, clausal complements in what we call *mixed languages* can bear either grammatical function: some clausal complements are COMP and some are OBJ, depending on the requirements of the matrix predicate.

Evidence from mixed languages shows that a binary distinction between subject and nonsubject arguments of a predicate is insufficient to capture the syntactic behavior of clausal complements. Even a hierarchically-defined distinction among grammatical functions cannot predict the different behavior of clausal complements in mixed languages. Consider, for example, a two-argument predicate subcategorizing for a SUBJ and a clausal complement in a mixed language: the distinction between OBJ and COMP clausal complements does not follow from their position on the functional hierarchy, since both arguments occupy the same hierarchical position relative to the SUBJ argument. Some additional abstract syntactic distinction is also necessary.

In the following, we will provide a sketch of several languages that demonstrate that clausal complements are not restricted to realizing a single grammatical function. We will focus primarily upon finite declarative clausal complements, the clearest cases illustrating a COMP/OBJ distinction. An interesting further question, which we will not address here, concerns the status of infinitival clauses. Since, as we will show, some clausal arguments bear the OBJ function, it is natural to suppose that at least some infinitival complements (those that are anaphorically controlled) can also be OBJ: see Lødrup (1991) for discussion.

We will also focus on sentences with no nonthematic or pleonastic arguments, and thus we will not discuss examples involving ‘extraposed’ clauses such as:

(1) It surprised me that it snowed.

Under some analyses, extraposed clauses are analyzed as a kind of apposition to the nonthematic argument (Berman 1998), while other approaches analyze extraposed clauses as bearing the same grammatical function as the nonthematic argument (Berman et al. 1998). In fact, however, extraposed clauses seem to have the same grammatical properties that we expect a COMP to have (Culy 1994), so that a crosslinguistic examination of the syntactic behavior of extraposed arguments could provide further evidence for the existence of mixed languages.

2 The grammatical functions of complement clauses

In some languages, all clausal complements bear a uniform grammatical function. For example, all complement clauses bear the grammatical function OBJ in Icelandic, Norwegian and Spanish, as described by Thráinsson (1979), Lødrup (1991), and Plann (1986).[1]

Alsina et al. (1996b) propose that all clausal complements bear the grammatical function OBJ, and that any differences in syntactic behavior between NP objects and clausal complements should be accounted for only in terms of the difference in their phrase structure category. They argue that this leads to a generally more parsimonious theory, and further that the grammatical function COMP has no place in Lexical Mapping Theory and should therefore be eliminated. Indeed, Alsina et al. (1996a) hint at an analysis in which a language with no syntactic differences between NP objects and clausal complements is assumed to have clausal complements of the category NP.

We believe that there are several difficulties with this proposal. Most importantly, we will show that mixed languages exhibit no distinction in phrase structure category between OBJ and COMP clausal complements. In these languages, there is no basis for an appeal to phrase structure distinctions to explain the differing syntactic behavior of complement clauses.

We also do not believe that the limitations in linking analyses of clausal arguments constitute a serious argument against the existence of COMP. There is general agreement that LMT in its classical version is too limited, and current research on linking seeks to extend it in various directions. One way of integrating COMP into LMT is outlined by Zaenen and Engdahl (1994), who propose that COMP and XCOMP bear the thematic role PROPOSITION. They claim that this role is intrinsically associated with a restricted grammatical function and bears the feature +R. This is a welcome step towards a complete theory of linking and clausal arguments, but it has a serious drawback: it does not allow for clausal complements to bear the OBJ function. We will not discuss an alternative LMT treatment of clausal complements here, but the idea that COMP is +R will be important to our approach as well.

In what follows, we will discuss the grammatical properties we expect COMP and OBJ clausal complements to have, and show how these expectations are borne out by data from English, German, Swedish, and Slave.

3 Mixed languages: English, German, Swedish

Clausal complementation in English, German and Swedish is fundamentally similar. In all three languages, a clause with the complementizer *that/dass/att* can be either COMP or OBJ: all three are mixed languages. This similarity has not been systematically recognized in traditional or generative grammar. German grammar has always made a distinction between what we take to be COMP and OBJ clausal complements (see, for example, Duden 1984:668; Breindl 1989; Webelhuth 1992; Zifonun et al. 1997:1097). English grammar, on the other hand, usually assumes a single type of clausal complement. Traditional grammar assumed that they are objects (Jespersen 1924:103; Quirk et al. 1985:1049), while generative grammar since Emonds (1970) has assumed that they are (what we take to be) COMPs. An interesting exception is Foley and Valin (1984:252–254), who assume that English has two kinds of clausal

[1]Lødrup (1991) points out a handful of exceptional predicates in Norwegian that seem to take COMP complement clauses; one example is the adjective *glad* ‘happy’.

complements, along the lines proposed here. Swedish grammar has never really focused upon this question (but see Ralph 1975; Teleman et al. 1999:533–534).

An objective clausal complement in English, German, and Swedish can also appear as the second of two objects, as in (2):

(2) He told us [that it is raining].

In example (2), the OBJ of *told* is *us*, and the complement clause *that it is raining* bears the grammatical function OBJ_θ. In such cases, we expect the complement clause to share grammatical properties with nominal OBJ_θs. However, we will not focus upon verbs that take double objects, to avoid the complications raised by variation in double object systems.

In the following, we will show that verbs such as English *believe*, German *glauben* 'believe', and Swedish *tro* 'believe' take either NP or CP OBJs. These verbs contrast with verbs that take COMP clausal complements, such as English *hope*, German *sich freuen* 'be happy', and Swedish *yrka* 'insist'.

Alternation with NP object We expect a verb that takes a clausal OBJ to take a nominal OBJ as an alternative; if subcategorization requirements are stated purely in terms of grammatical functions, and no semantic factors preclude a nominal OBJ, either type of OBJ should be possible.[2]

In English, German and Swedish, verbs that take OBJ clausal complements also allow NP objects:

(3) Eng: I believe [that the earth is round] / it

Ger: Ich glaube [dass die Erde rund ist] / es
I believe [that the earth round is] / it
'I believe [that the earth is round]/it.'

Swe: Jag tror [att jorden är rund] / det
I believe [that the.earth is round] / it
'I believe [that the earth is round]/it.'

In contrast, verbs that take COMP clausal complements do not allow nominal proforms:

(4) Eng: I hope [that it will rain] / *it

Ger: Ich freue mich [dass Hans krank is] / *das / *es (Webelhuth 1992:104–105)
I am.happy Refl that Hans sick is / it
'I am happy [that Hans is sick]/it.'

Swe: Kassören yrkade [att avgiften skulle höjas] / *det
the.cashier insisted that the.tax should be.increased / it
'The cashier insisted [that the tax should be increased]/it'

[2]To be more exact, our claim concerns alternation with a thematic OBJ. Non-thematic OBJs are possible with a much larger set of verbs, as shown by a sentence like:

(i) He complained himself hoarse about the bad coffee. (Pesetsky 1993)

Coordination In some languages, an NP object can be coordinated with a clause. In these cases, the clause also bears the OBJ function:

(5) Pat remembered [the appointment] and [that it was important to be on time].
(Sag et al. 1985:165)

All three languages allow, to some extent, an NP object to be coordinated with a clause. Sag et al. (1985:164–165) claim that such coordinations are permitted by 'many speakers ... in certain environments' in English, and they seem to have roughly the same status in German and Swedish.

(6) Ger: Er vergass [die Verabredung] und [dass es wichtig war, pünktlich zu sein].
he forgot the appointment and that it important was on.time to be
'He forgot the appointment and that it was important to be on time.'

(7) Swe: Han glömde [mötet] och [att det var viktigt att vara precis]
he forgot the.appointment and that it was important to be on.time
'He forgot the appointment and that it was important to be on time.'

It has also been noted that not all examples of this structure are acceptable:

(8) *He proposed [a 20% reduction for the elderly] and [that the office be moved to the suburbs].
(Emonds 1970:85)

We do not believe that the unacceptability of example (8) constitutes clear evidence against our analysis, however, since a number of poorly-understood grammatical and extragrammatical factors influence the acceptability of coordination.[3] Examples like (8) show that the acceptability of coordinating with an NP OBJ cannot be a necessary property for a clausal complement to be an OBJ.

Passive We follow Zaenen and Engdahl (1994) in assuming that COMP is a restricted grammatical function, thus differing from OBJ, which is unrestricted. At the level of a-structure, the semantic argument which is realized as OBJ is classified as −R, while the semantic argument which is realized as COMP is (possibly lexically) classified as +R. We predict, then, that the −R argument can be realized as a SUBJ if the external argument is demoted, as in the passive, while the +R argument cannot be realized as a SUBJ. This prediction is borne out in English, German and Swedish:

(9) Eng: That the earth is round was not believed

[3] For example, even though examples (i) and (ii) are syntactically very similar, (ii) is much less acceptable than (i):

(i) Pat is a Republican and proud of it.

(ii) ??Pat is a Republican and stupid.

Ger: Dass die Erde rund ist, wurde nicht geglaubt
that the earth round is was not believed
'That the earth is round was not believed.'

Swe: Att sosserna vinner valet antas allmänt
that the.social.democrats win the.election is.assumed generally
'That the Social Democrats win the election is generally assumed.'

(10) Eng: *That it would rain was hoped

Ger: * Dass Hans krank ist wurde ihn nicht informiert
that Hans sick is was him not informed
'That Hans was sick was not informed him.'

Swe: *Att avgiften skulle höjas yrkades
That the.tax should be.increased was.insisted
'That the tax should be increased was insisted'.

Of course, a verb that takes a COMP is not precluded from appearing in passive voice; passivization is possible if another argument besides the COMP becomes the subject of the passivized verb:

(11) John was informed that it would rain.

(12) It was hoped that it would rain.

Unbounded dependencies OBJ arguments can enter into an unbounded dependency; for example, a topicalized argument can fill the OBJ function. In contrast, most languages do not allow a COMP to enter into an unbounded dependency. This is true of English, German and Swedish, as shown by the following examples.

(13) Eng: That it would rain, everybody believed

Ger: Dass Hans krank ist glaube ich (Webelhuth 1992:103)
that Hans sick is believe I
'That Hans is sick, I believe.'

Swe: Att sosserna vinner valet antar man
that the.social.democrats win the.election assumes one
'That the Social Democrats win the election, one assumes.'

(14) Eng: *That it would rain, everybody hoped.

Ger: *Dass Hans krank ist freue ich mich (Webelhuth 1992:105)
that Hans sick is am.happy I Refl
'That Hans is sick, I am happy'

Swe: *Att avgiften skulle höjas yrkade kassören
that the.tax should be.increased insisted the.cashier
'That the tax should be increased, the cashier insisted.'

The data in (13–14) is usually discussed in terms of Higgins's Generalization (Higgins 1973), expressible as in (15):

(15) A clausal argument can enter into an unbounded dependency only if it is in an NP position, i.e. a position in which an NP is possible as an alternative to the clausal argument.

How this insight should be implemented has often been discussed (Stowell 1981; Kaplan and Bresnan 1982; Emonds 1985; Kaplan and Zaenen 1989; Webelhuth 1992; Postal 1994; Bošković 1995; Büring 1995; Berman 1996; Odijk 1998; Bresnan 2000). In our framework, all that is needed is a stipulation that a COMP cannot enter into an unbounded dependency (or that a COMP cannot be identified with a TOPIC). This was originally proposed by Kaplan and Zaenen (1989). However, Kaplan and Zaenen assume that a clausal complement is always a COMP when it is not a part of an unbounded dependency. In their analysis, a verb like *believe* takes either a COMP or an OBJ, and the grammaticality of an example like (13) is due to the fact that the topicalized clause is associated with the OBJ function rather than COMP (see also Bresnan 2000:215). Our analysis is different in that the clausal complement of a verb like *believe* always bears the OBJ function; Lødrup (2000) provides further discussion.

The prohibition against topicalizing COMP does not seem to hold for all languages. Languages allowing topicalized COMP include older German (Breindl 1989:181, 206) and Slave (see Section 4).

Complementation of nouns, adjectives and prepositions Nouns and adjectives are intransitive categories, and we expect them not to take OBJ clauses. There is no reason they should not take COMP clauses, however, and nouns and adjectives do take COMP clauses in English, German and Swedish.[4]

(16) Eng: certain that we will win.
the certainty that we would win

(17) Ger: froh, dass es alle geschafft haben
happy that it everyone made has
'happy that everybody has made it'

die Sorge, dass ihrem Sohn etwas zustossen könnte
the fear that their son something happen could
'the fear that something could happen to their son'

(18) Swe: stolt att han skall befordras (Ralph 1975)
proud that he should be.promoted
'proud that he will be promoted'

hoppet att han skall befordras
the.hope that he should be.promoted
'the hope that he will be promoted'

[4]It might be claimed that German adjectives are transitive, since some adjectives can take a nominal complement. These NPs are dative or genitive, however, and should probably be considered oblique phrases; see, for example, Riemsdijk (1983).

A language that has only OBJ clausal complements is predicted not to have clausal complements with nouns and adjectives; this is the situation in Spanish, Icelandic, and Norwegian.[5] We assume that a complement to a noun such as *belief* is an apposition (*the belief that we will win*), and that these complements can appear even in a language with no COMPs; see Stowell (1981) and Lødrup (1991) for discussion.

In contrast, prepositions are a transitive category, and we expect them to take OBJ clauses. This is a point that is not without its problems, and it is clear that English, German and Swedish behave in different ways. Swedish prepositions take OBJ clauses without any special restrictions:

(19) Swe: Jag väntade på [att hon skulle komma] (Andersson 1974:7)
I waited for that she should come
'I waited for her to come.'

English is a more complicated case, since a clause cannot appear in the complement position of a PP. However, an English preposition can take a displaced clausal OBJ:

(20) That he might be wrong he didn't think of. (Kaplan and Bresnan 1982:242)

A clausal OBJ is also (to some extent) possible if it is coordinated with an NP OBJ, as in (21), originally discussed by Sag et al. (1985):

(21) We talked about Mr. Colson and that he had worked in the White House.

The unavailability of in-situ clausal objects of prepositions in English must be due to constraints on constituent structure configurations, not functional syntactic factors; see Section 5 for further discussion of this point.

German is an even more complicated case. A couple of prepositions (*anstatt* 'instead of', *ohne* 'without') can take finite clausal complements, while the majority cannot.[6] German sentences like (20) are unavailable for independent reasons: German does not allow preposition stranding. Sentences like (21) seem to be marginally possible, and thus give meager evidence for the possibility of OBJ clausal complements of prepositions. The fact that only a few German prepositions take clausal complements represents a problem for our theory — and probably for most other theories as well. We return to this problem in Section 5.

We have shown that there is solid evidence that English, German and Swedish are mixed languages with both COMP and OBJ clausal complements. Some problems remain, however; for instance, Bresnan (1995) argues that the reason for the unacceptability of example (21) is that, contra our assumptions, clausal OBJs are not possible in English:

(22) *On the roof was written that enemies are coming.

[5]As noted in footnote 1, there are a few exceptional Norwegian adjectives which take COMP arguments.

[6]As pointed out by Jane Simpson (p.c.), the preposition *without* can take a clausal complement in some nonstandard dialects of English: *You don't know about me without you have read a book by the name of The Adventures of Tom Sawyer* (Mark Twain, *Huckleberry Finn*). See Dubinsky and Williams (1995) for more discussion.

We do not have an alternative explanation of why (22) is unacceptable. One might want to base an explanation upon the function of the clausal argument as a presentational focus, but this seems to be difficult. Bresnan notes that the Chicheŵa counterpart of (22) is fully grammatical, and the same is true of its corresponding presentational focus sentence in Norwegian. (Norwegian does have a restriction that is similar to the English one; the difference is that it only concerns active sentences.) A more general point is that presentational focus sentences are subject to a number of restrictions that are not fully understood; for example, they often disallow manner adverbs, agent phrases, and so on. This makes the evidence from presentational focus sentences somewhat delicate.

4 Another mixed language: Slave

Rice (1989) shows that Slave, an Athapaskan language spoken in western Canada, has both OBJ and COMP clausal complements. Rice represents this difference in grammatical function in phrase structure terms, proposing that the clausal complements that behave as OBJ are dominated by an NP, while those that behave as COMP are not dominated by NP. Thus, according to her analysis, the difference between OBJ and COMP in Slave is mirrored by a difference in phrase structure category. However, there is no morphological or phrase structural evidence for this distinction. Rather, we take her evidence as supporting a functional distinction between OBJ and COMP clausal complements.

Slave verbs are morphologically complex, including incorporated pronominal affixes, adverbs, and derivational affixes. A Slave sentence may consist of a single verb:[7]

(23) káseyį̀hkw'i — Rice (1989:634)
's/he pinched me'

Slave has an object pronominal affix *go*-, which Rice refers to as an 'areal' affix, observing that it 'mark[s] that the object indicates time, place, or situation' (p. 634). It appears with an object like 'house' but not an object like 'snowshoes':

(24) **go**htsį — (Rice 1989:635)
's/he builds it (a house)'

(25) yehtsį — (Rice 1989:635)
's/he makes it (e.g. snowshoes)'

Rice further observes that the areal object marker *go*- is unlike the other Slave pronominal affixes in that it functions as an agreement marker, present whether or not there is a full nominal object:

(26) kǫ́é **go**dįtl'é — (Rice 1989:635)
house 2sg.paint.area
'you (sg.) paint the house'

[7] Rice (1989) does not indicate morpheme boundaries and often does not give word-by-word glosses of the examples she presents, and we will not attempt to add them.

Morphological marking Rice (1989:1230) shows that the OBJ affix *go-* is used for agreement with OBJ clausal complements, as with the verb 'be surprised':

(27) [lą́ ráse] begha gudeyídli (Rice 1989:1230)
really 3.is.strong 3.for 1pl.was.surprised
'we were surprised that he was so strong'

In contrast, with other verbs whose clausal complement is COMP such as 'say', using the areal pronominal affix *go-* results in ungrammaticality:

(28) metá [ʔekǫ́ ʔahndeh gha] ndi (Rice 1989:1224)
3.father there 1sg.go FUT 3.say
'His dad said that he is going there'

(29) *metá [ʔekǫ́ ʔahndeh gha] ʔagodi (Rice 1989:1224)
3.father there 1sg.go FUT 3.say.**area**
'His dad said that he is going there'

Alternation with NP object Example (27) shows that the verb 'be surprised' takes a clausal object. According to Rice, the verb 'be surprised' also takes nominal objects, although she gives only an example with a pronominal object:

(30) sudeyį̨li (Rice 1989:1231)
'I surprised him/He was surprised by me'

This is expected; since the verb subcategorizes for an object, either a nominal or a clausal object can appear. In contrast, the verb 'say' does not appear with a nominal object or object affix. Rice provides the following ungrammatical example of the use of a pronominal 'fourth person' object affix with the verb 'say':[8]

(31) *ʔayedi (Rice 1989:1224)
3 say 4

Unbounded dependencies Rice shows that in a clause with a third person subject and a topicalized object, a pronominal object affix must appear on the verb:

(32) lį ʔehkee kayį̨hshu (Rice 1989:1197)
dog boy 3.bit
'the dog bit the boy'

(33) [ʔehkee] lį kayeyį̨hshu (Rice 1989:1197)
boy dog 3.bit.**4**
'the boy, a dog bit him'

When the COMP of the verb 'say' is topicalized, no affix appears on the verb:

[8]Rice (1989) observes that the 'fourth person' nonreflexive object pronoun is used when the subject is a third person form.

(34) [ʔekǫ́ ʔahndeh gha] metá ndi (Rice 1989:1224)
there 1sg.go FUT 3.father 3.say
'His dad said that he is going there'

Unfortunately, Rice provides no example of a topicalized clausal object of a verb such as 'be surprised', but our analysis predicts that an object pronominal affix would appear in such a case.

Complementation of P Clausal arguments can appear as the object of an oblique phrase, as with a verb like 'help':

(35) [dene k'ę́ gudee] goghǫ bets'ę́ ráhídí (Rice 1989:1230)
Dene like 3.opt.talk area.about 3.to 1pl.help
'We are helping him to talk Dene'

In this example, the clausal complement is the object of the postposition *gogho* 'about', which is marked with the areal agreement affix *go*-.

These tests show that Slave is also a mixed language: clausal OBJs behave like nominal objects, and clausal COMPs behave differently.

5 C-structure and f- structure constraints

The architecture of LFG reflects the fact that the syntax of clausal complements is two-faceted. What is an OBJ in f-structure can have different realizations in c-structure: as an NP, a clitic, an affix, or a clause. Constituent structure constraints make reference to phrasal category information, while functional constraints depend on more abstract functional syntactic organization. Thus, we would expect that CPs, whether COMP or OBJ, would obey similar constituent structure constraints despite their difference in grammatical function, and that NP and CP arguments might behave differently, even when they both bear the OBJ function. Connections between the two syntactic levels can also be exploited to impose constraints on the c-structure form of f-structure arguments.

5.1 C-structure generalizations

It is an old insight that there are restrictions on the distribution of clauses in c-structure (see, for example, Kuno 1973, Dryer 1980). A CP may not appear in the canonical subject position in English. Instead, a CP subject must appear in topic position. Functionally, it is interpreted as both subject and topic (Bresnan 1994, 1995, 2000):

(36) *Does that he left bother them?
(cf. Does it bother them that he left?)
That he left bothers them.

In the same way, the canonical object position is not a possible position for a CP in English. Instead, a CP complement must appear closer to the end of the sentence, as Emonds (1970:74–75) observed:

(37) *She won't tell she is sick to the doctor.
She won't tell the doctor she is sick.

This is true of all clausal complements, whether they are COMP or OBJ. We assume that there is a position at the end of the VP for both COMP and OBJ clausal complements. (The clausal complement can also be "extraposed" to the end of the sentence, but this is a general possibility for heavy constituents.) The descriptive generalization for English is that the canonical subject and object positions can only contain NP/DP, the prototypical category for realizing subjects and objects.[9] Within a theory like LFG, with its insistence on c-structure and f-structure as different levels of representation, this situation is expected: arguments that have the same grammatical function do not necessarily have the same behavior at c-structure.

Other languages allow CP in the canonical subject and object positions to a varying extent. German and Swedish are like English concerning subjects, but Spanish allows CP in the canonical subject position (Plann 1986). German allows CP in the canonical object position of verbs (to some extent, cf. 5.2 below), and Swedish allows CP in the canonical object position of prepositions (cf. example (19) above). Such generalizations concerning what categories can appear in what positions in c-structure must be part of a syntactic description of any configurational language.

There is an interesting interaction between the functional and the structural parts of our theory. The functional part predicts that a language that allows OBJ clausal complements should allow clausal complements with prepositions. The structural part says that a language can forbid a preposition to have a clause in object position in c-structure. Taken together, this gives a perfect account of the situation in English. It also gives an account of at least the main rule in German, if we allow ourselves to put aside the two exceptional prepositions discussed in Section 3 above. The functional part predicts that German prepositions should allow clausal complements, but the structural part says that these clausal complements cannot be in object position in c-structure. This leaves them with no place to go, since preposition stranding is not possible in German.

5.2 Functional constraints on c-structure configuration

Functional information can also influence phrasal organization. For example, German COMP and OBJ clausal complements can appear in different phrase structure positions. The unmarked position for a clausal complement is at the end of the sentence, but there is one position where an OBJ clausal complement can occur (at least for some speakers; see Webelhuth 1992, Büring 1995), but not a COMP: the 'middle field'. An

[9] This also accounts for the fact that clausal complements do not take secondary predicates:

(i) *I believe that he left to be outrageous.

OBJ clausal argument is possible (for the speakers in question) in the middle field with a verb like *glauben* 'believe', but not with a verb like *(sich) freuen* 'be happy':

(38) Ger: weil ich [dass Hans krank ist] nicht glauben kann (Webelhuth 1992:107)
because I that Hans sick is not believe can
'because I cannot believe that Hans is sick'

(39) Ger: *weil ich [dass Hans krank ist] mich nicht freuen kann (Webelhuth 1992:107)
because I that Hans sick is Refl not be-happy can
'because I cannot be happy that Hans is sick'

5.3 Phrasal category constraints

Grimshaw (1982) pointed out that a verb like *express* requires a nominal and not a clausal OBJ:

(40) *The grammar expresses that the rule is obligatory.

The requirement for an OBJ of a particular phrase structure category is statable within LFG by means of the predicate CAT (see Kaplan and Maxwell 1996 for a definition), which associates f-structures with the set of category labels of the c-structure nodes corresponding to that f-structure. The CAT predicate is also relevant in the analysis of verbs such as *grow*, which require complements of a particular phrase structure category (*Kim grew political/*a success, Kim became political/a success*; see Pollard and Sag (1987) for more discussion). By using the CAT predicate, we can impose the special requirement, relevant only for particular verbs, for the OBJ to be of a nominal and not a clausal category. In the general case, and in the absence of semantic restrictions, we assume that either a clausal or a nominal OBJ can appear.

6 Alternative proposals

In accounts of the varying syntactic behavior of clausal complements, treatments involving preposition deletion have been proposed: on these accounts, a deleted or unpronounced preposition appears with the clausal complements that we call COMP (Rosenbaum 1967). This proposal has its roots in the observation that the COMP of a two-place verb often alternates with an OBL prepositional phrase. On this analysis, preposition deletion in English must be treated as obligatory, except when the clause is topicalized or passivized (in a pseudo-passive):

(41) That John would come, we all hoped for.

(42) That the plane flew at all was marveled at by them. (Rosenbaum 1967:83)

A different preposition deletion analysis would have to be proposed for Swedish, where preposition deletion would be optional (with some predicators) when the clause is in complement position, and impossible when the clause is topicalized or passivized (see Ralph 1975; Teleman et al. 1999:533). A similar analysis involving optional deletion of a head could also be made for German: in this case, deletion of a 'prepositional proform' like *darüber* 'thereover'. An equivalent analysis can be found in traditional German grammar, where our COMPs are included in the set of *Präpositionalobjekte* 'prepositional objects', a functional term that corresponds roughly to OBL_θ in LFG. See, for example, Duden (1984:668), Breindl (1989), and Zifonun et al. (1997:1097).

There are several reasons that preposition deletion should be abandoned. One problem is that it is not clear what the output of the operation of preposition deletion would be, though the most natural expectation would be a PP with an unexpressed head. We would then expect the resulting phrase to have the syntactic properties of an OBL_θ phrase, but this is not correct: there are important syntactic differences between COMP and OBL_θ.

Consider the following German data. Example (14) above shows that COMP cannot be topicalized; in contrast, OBL_θ can be topicalized:

(43) Ger: über die Situation habe ich ihn informiert
about the situation have I him informed
'I have informed him about the situation.'

Example (39) above shows that COMP cannot appear in the middle field, whereas OBL_θ can:

(44) Ger: weil ich ihn über die Situation informiert habe
because I him about the situation informed have
'because I have informed him about the situation'

And OBL_θ and COMP cannot be coordinated:

(45) Ger: *Ich informierte ihn dass Hans krank ist und über die Situation
I informed him that Hans sick is and about the situation
'I informed him that Hans is sick and about the situation'

Two of these differences are also relevant for English and Swedish: OBL_θ can enter into an unbounded dependency, whereas COMP cannot, and COMP and OBL_θ cannot coordinate. These facts would be impossible to account for in a natural way in a preposition deletion analysis. Moreover, we do not believe that the postulation of deleted material or unpronounced elements is a desirable feature of any grammatical theory, especially a non-derivational theory like LFG.

Other proposals have been made for treating mixed languages. For example, Pesetsky (1993) hints at an analysis that is not worked out, but which seems similar in some respects to our proposal: verbs which on our analysis take COMP clausal complements are those that specify that their thematic object must take zero case. Other proposals (Stowell 1981; Webelhuth 1992; Bošković 1995) also analyze differences between clauses in terms of abstract case. These proposals are like ours in positing an abstract syntactic distinction between different kinds of complement clauses, lexically governed by properties of the main verb.

7 Conclusion

An important question is why clausal complements are treated in different ways in the world's languages. We have claimed that there is a grammatical function COMP that is only realized by clausal complements, but that not all clausal complements realize it. There is a solid empirical basis for this claim. The typologist and functionalist tradition has contributed important insights concerning clausal complements in the world's languages that have so far not found their way into generative grammar. Foley and Valin (1984) show that the use of a finite clause as a core argument is a marked situation in UG, which is only allowed for verbs of saying in some languages. A finite clause can be grammaticalized as a core argument in more than one way. In some cases, the finite clause is not really integrated into the syntax of the sentence; it is what Foley and Valin (1984) call a peripheral argument, which does not take part in syntactic processes like other core arguments. These peripheral arguments are COMPs in our terms. In other cases, the finite clause is syntactically integrated, and will be an object in our terms. Foley and Valin (1984) point out that peripheral and integrated clausal complements can co-occur in the same language, using English as an example; in our terms, these languages are mixed.

We have shown that a distinction between two kinds of clausal complements is necessary in English, German, Swedish and Slave, languages that are typologically very different. We have also shown that LFG, with its rich representation of grammatical functions, is a framework that is especially well suited to account for this situation.

References

Alsina, Alex, Tara Mohanan, and K. P. Mohanan, 1996a. Responses to the discussion on COMP in LFG. Submission to the LFG List, 6 September 1996.

Alsina, Alex, Tara Mohanan, and K. P. Mohanan, 1996b. Untitled submission to the LFG list. 3 September 1996.

Andersson, Anders-Børje, 1974. The NP status of that-clauses and infinitives. *Gothenburg Papers in Theoretical Linguistics* 24, pp. 1–16.

Berman, Judith, 1996. Topicalization vs. left dislocation of sentential arguments in German. In Miriam Butt and Tracy Holloway King (editors), *On-line Proceedings of the First LFG Conference, Rank Xerox, Grenoble, August 26–28, 1996*. URL `http://csli-publications.stanford.edu/LFG/1/lfg1.html`.

Berman, Judith, 1998. On the syntax of correlative *es* and finite clause in German: An LFG analysis. URL `http://www.ims.uni-stuttgart.de/ judith/`. MS, University of Stuttgart.

Berman, Judith, Stefanie Dipper, Christian Fortmann, and Jonas Kuhn, 1998. Argument clauses and correlative *es* in German: Deriving discourse properties in a unification analysis. In Miriam Butt and Tracy Holloway King (editors), *On-line Proceedings of the LFG98 Conference*. URL `http://www-csli.stanford.edu/publications/LFG3/lfg98-toc.html`.

Bošković, Željko, 1995. Case properties of clauses and the Greed Principle. *Studia Linguistica* 49(1), pp. 32–53.

Breindl, Eva, 1989. *Präpositionalobjekte und Präpositionalobjektsäze im Deutschen*. Tübingen: Niemeyer.

Bresnan, Joan (editor), 1982. *The Mental Representation of Grammatical Relations*. Cambridge, MA: The MIT Press.

Bresnan, Joan, 1994. Locative inversion and the architecture of Universal Grammar. *Language* 70(1), pp. 72–131.

Bresnan, Joan, 1995. Category mismatches. In Akinbiyi Akinlabi (editor), *Theoretical Approaches to African Languages*, pp. 19–46. Trenton, N.J.: African World Press.

Bresnan, Joan, 2000. *Lexical-Functional Syntax*. Blackwell Publishers. To appear.

Büring, Daniel, 1995. On the base position of embedded clauses in German. *Linguistische Berichte* 159, pp. 370–380.

Culy, Christopher D., 1994. Extraposition in English and grammatical theory. MS, University of Iowa.

Dalrymple, Mary, Ronald M. Kaplan, John T. Maxwell, III, and Annie Zaenen (editors), 1995. *Formal Issues in Lexical-Functional Grammar*. Stanford University: CSLI Publications.

Dowty, David R., 1982. Grammatical relations and Montague Grammar. In Pauline Jacobson and Geoffrey K. Pullum (editors), *The Nature of Syntactic Representation*, pp. 79–130. Dordrecht: D. Reidel.

Dryer, Matthew S., 1980. The positional tendencies of sentential noun phrases in universal grammar. *Canadian Journal of Linguistics* 25, pp. 123–195.

Dubinsky, Stanley and Kemp Williams, 1995. Recategorization of prepositions as complementizers: The case of temporal prepositions in English. *Linguistic Inquiry* 26(1), pp. 125–137.

Duden, 1984. *Duden Grammatik der deutsche Gegenwartsprache*. Mannheim/Wien/Zürich: Dudenverlag. Bibliographisches Institut.

Emonds, Joseph E., 1970. *Root and Structure-Preserving Transformations*. Ph.D. thesis, MIT.

Emonds, Joseph E., 1985. *A Unified Theory of Syntactic Categories*. Dordrecht: Foris Publications.

Foley, William A. and Robert D. Van Valin, 1984. *Functional syntax and universal grammar*. Cambridge, England: Cambridge University Press.

Grimshaw, Jane, 1982. Subcategorization and grammatical relations. In Annie Zaenen (editor), *Subjects and other subjects*, pp. 35–56. Bloomington: Indiana University Linguistics Club.

Higgins, F. R., 1973. On J. Emonds's analysis of extraposition. In John P. Kimball (editor), *Syntax and Semantics 2*, volume 2, pp. 149–195. New York: Academic Press.

Jespersen, Otto, 1924. *The Philosophy of Grammar*. The Norton Library.

Kaplan, Ronald M. and Joan Bresnan, 1982. Lexical-Functional Grammar: A formal system for grammatical representation. In Joan Bresnan (editor), *The Mental Representation of Grammatical Relations*, pp. 173–281. Cambridge, MA: The MIT Press. Reprinted in Dalrymple et al. (1995:pp. 29–130).

Kaplan, Ronald M. and John T. Maxwell, 1996. LFG Grammar Writer's Workbench. Technical report, Xerox Palo Alto Research Center. URL `ftp://ftp.parc.xerox.com/pub/lfg/lfgmanual.ps`.

Kaplan, Ronald M. and Annie Zaenen, 1989. Long-distance dependencies, constituent structure, and functional uncertainty. In Mark Baltin and Anthony Kroch (editors), *Alternative Conceptions of Phrase Structure*, pp. 17–42. Chicago University Press. Reprinted in Dalrymple et al. (1995:pp. 137–165).

Kay, Paul, 1998. An informal sketch of a formal architecture for Construction Grammar. In *Proceedings of the Conference on Formal Grammar, HPSG and Categorial Grammar*. Saarbrücken.

Kuno, Susumu, 1973. Constraints on internal clauses and sentential subjects. *Linguistic Inquiry* 4, pp. 363–385.

Lødrup, Helge, 1991. Clausal complements in English and Norwegian. *Norsk lingvistisk tidsskrift* 9, pp. 105–136.

Lødrup, Helge, 2000. Clausal arguments and unbounded dependencies. In Arthur Holmer, Jan-Olof Svantesson, and Åke Viberg (editors), *Proceedings of the 18th Scandinavian Conference of Linguistics*. Lund: Travaux de l'Institut de Linguistique de Lund.

Manning, Christopher D. and Ivan A. Sag, 1999. Dissociations between argument structure and grammatical relations. In Andreas Kathol, Jean-Pierre Koenig, and Gert Webelhuth (editors), *Lexical and Constructional Aspects of Linguistic Explanation*. Stanford: CSLI.

Odijk, Jan, 1998. Topicalization of non-finite non-extraposed complements in Dutch. *Natural Language and Linguistic Theory* 16(1), pp. 191–222.

Perlmutter, David, 1983. *Studies in Relational Grammar 1*. Chicago: The University of Chicago Press.

Pesetsky, David, 1993. Topic…comment. *Natural Language and Linguistic Theory* 11(3), pp. 557–558.

Plann, Susan, 1986. On case-marking clauses in Spanish: Evidence against the case resistance principle. *Linguistic Inquiry* 17(2), pp. 336–345.

Pollard, Carl and Ivan A. Sag, 1987. *Information-Based Syntax and Semantics, Volume I*. CSLI Lecture Notes, number 13. Stanford University: CSLI Publications.

Pollard, Carl and Ivan A. Sag, 1994. *Head-Driven Phrase Structure Grammar*. Chicago: The University of Chicago Press.

Postal, Paul M., 1994. Parasitic and pseudo-parasitic gaps. *Linguistic Inquiry* 25(1), pp. 63–118.

Quirk, Randolph, Sidney Greenbaum, Geoffrey Leech, and Jan Svartvik, 1985. *A Comprehensive Grammar of the English Language*. New York: Longman.

Ralph, Bo, 1975. On the nature of preposition deletion in Swedish. In Karl-Hampus Dahlstedt (editor), *The Nordic languages and modern linguistics 2*, pp. 666–684. Stockholm: Almqvist and Wiksell.

Rice, Keren, 1989. *A Grammar of Slave*. Mouton de Gruyter.

Riemsdijk, Henk van, 1983. The case of German adjectives. In Frank Heny and Barry Richards (editors), *Linguistic Categories: Auxiliaries and Related Puzzles*, volume 1, pp. 223–252. Dordrecht: Reidel.

Rosenbaum, Peter, 1967. *The Grammar of English Predicate Complement Constructions*. Cambridge, MA: The MIT Press.

Sag, Ivan A., Gerald Gazdar, Thomas Wasow, and Steven Weisler, 1985. Coordination and how to distinguish categories. *Natural Language and Linguistic Theory* 3(2), pp. 117–171.

Speas, Margaret, 1990. *Phrase Structure in Natural Language*. Dordrecht: Kluwer Academic Publishers.

Stowell, Timothy, 1981. *The Origins of Phrase Structure*. Ph.D. thesis, MIT.

Teleman, Ulf, Staffan Hellberg, and Erik Andersson, 1999. *Svenska akademiens grammatik*. Stockholm: Svenska Akademien.

Thráinsson, Höskuldur, 1979. *On complementation in Icelandic*. New York: Garland.

Webelhuth, Gert, 1992. *Principles and Parameters of Syntactic Saturation*. Oxford: Oxford University Press.

Zaenen, Annie and Elisabet Engdahl, 1994. Descriptive and theoretical syntax in the lexicon. In B. T. S. Atkins and Antonio Zampolli (editors), *Computational Approaches to the Lexicon*, pp. 181–212. Oxford: Oxford University Press.

Zifonun, Gisela, Ludger Hoffmann, and Bruno Strecker, 1997. *Grammatik der deutschen Sprache*. Berlin: W. de Gruyter.

Pivots and the Theory of Grammatical Functions*

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1. Overview

Every once in a while, a theory needs to reevaluate its basic concepts. This reevaluation is necessary because, over time, as more empirical data are covered, one tends to lose sight of the original intent. What is involved in this reevaluation is not new data, but rather a new look at old data.

In the case of LFG, one of the most basic concepts is the grammatical function. LFG differs from almost every other generative theory in recognizing the centrality of grammatical functions. Other theoretical approaches recognize grammatical relations, but not grammatical functions. The concept of grammatical relation is vague; it just means some relation that is relevant to the grammar (or more precisely, the syntax). A grammatical function is something much more specific—it is a link between structure and function. We can identify grammatical relations by their (apparently arbitrary) properties; with grammatical functions, the properties are the result if we correctly understand the functions. Grammatical relations have no role in explanation; grammatical functions should be the centerpiece of explanation.

One of the most problematic grammatical functions, perhaps the most problematic, is the function SUBJ. It is problematic for two reasons. In the first place, SUBJs have many unique properties, more than other grammatical functions. Among the properties of SUBJs, we note the following (Keenan 1976, Andrews 1985).

(1) a. binding theory prominence
Agent, if there is one
addressee of imperative
most likely to be pro-dropped

b. controllee in Raising
most likely crosslinguistically to be extracted
“chaining” in coordinate structures
obligatory
often definite/wide scope
“external” structural position in configurational languages

c. controllee in Equi
verb agreement
not Case marked (“nominative”)
floats quantifiers

Second, in ergative and Philippine-type languages these properties are split between two elements, with the properties in (1a) typifying one element, those in (1b) typifying another, and those in (1c) going with one or both, depending on the language. A theory of grammatical functions should predict the properties, and the split in non-nominative-accusative languages.

The usual LFG view is that SUBJ is an argument function, specifically, the most prominent argument function on the relational hierarchy. We will call this function $\widehat{\text{GF}}$, parallel to the LFG notation $\hat{\theta}$ for thematically most prominent argument. The natural properties of $\widehat{\text{GF}}$ would be ones involving hierarchies of arguments. Lexical specification of properties of arguments would naturally follow the relational hierarchy, so such properties as the ability to be pro-dropped and being the addressee of an imperative, which involve lexical specification (as in (2)), are $\widehat{\text{GF}}$ properties.

(2) a. "pro-drop" (↑ AF PRED) = 'PRO'
b. imperatives (↑ AF NUM) = 2

Similarly, the mapping from thematic roles to grammatical functions, modeled in LFG as Lexical Mapping Theory, matches the thematic hierarchy to the relational hierarchy. Therefore, the thematically highest argument (Agent) is mapped to the relationally highest grammatical function ($\widehat{GF}$). What typifies all of these properties is that they are about local relations, as one would expect from the properties of an argument function.

Another subject property that follows from the function of $\widehat{GF}$ is binding theory prominence. Despite the fact that binding is not necessarily local, and is not related to predicate-argument relations, it is clear from research on binding in LFG and other frameworks that it is sensitive to hierarchies at various levels: a-structure (the thematic hierarchy), c-structure (linear order), and f-structure (the relational hierarchy). The reason for the argument-sensitivity of binding may be explained by the perspective of Jackendoff (1990), who views binding as an extension of lexical conceptual structure argument binding. Whatever the reason, binding is sensitive to argument status and, in particular, to the grammatical function $\widehat{GF}$.

Looking back at the original list of subject properties, the ones that are naturally accounted for by assuming that "SUBJ" is $\widehat{GF}$ are the ones in (1a). However, the properties in (1b) do not make sense from this perspective. To consider the status of these properties, it is useful to divide them into two groups.

(3) a. controllee in Raising
most likely crosslinguistically to be extracted
"chaining" in coordinate structures

b. obligatory
often definite/wide scope
"external" structural position in configurational languages

The properties in (3a) are not local; they deal with relations between clauses. There is no reason to expect these properties to follow from the SUBJ-as-most-prominent-argument approach. The ones in (3b), while not nonlocal, are not related to argument hierarchies. Instead, they seem to be based on the notion that the SUBJ is a distinguished element of the clause, with properties beyond being in a particular position on the relational hierarchy. The fact that these properties characterize a different element from the argument-related properties in certain types of languages reinforces the conclusion that these properties do not follow from the nature of the function $\widehat{GF}$.

We propose that the (1b) properties are associated with a grammatical function which we call PIV (pivot), following Foley and Van Valin (1984) and Dixon (1994). In the next section, we will outline our proposal for the function PIV.

2. Pivots

We can divide the grammatical functions generally assumed in LFG (as in, for example, Bresnan in press) into three groups: the argument functions, the adjunct functions, and the discourse functions. Of these, the argument functions and the adjunct functions are local in their scope—they function to express local relations within their clause. The discourse functions, on the other hand, relate elements to the larger discourse within which they are embedded. The argument functions and adjunct functions are further distinguished from each other in terms of the nature of their relation to the clause: arguments are directly (and lexically) related to the head, whereas adjuncts are related to the clause as a whole.

Something is missing from this set of relations expressed by grammatical functions: a function expressing the relation between elements of a clause and the sentence (i.e. larger *syntactic* structure) of which it is a part. It is this gap that we propose to close with the function PIV. The function of the PIV function is primarily syntactic cross-clausal continuity, a kind of sentence-internal topic. Just as a discourse topic (represented syntactically in many languages as the grammatical function TOPIC) identifies a single participant as the common thread running through a discourse, the PIV is the common thread running through clauses that make up a sentence.

Secondarily, by virtue of being singled out, the PIV has the status of the distinguished element of the clause. Although we will have nothing further to say about them here, such properties as obligatoriness, definiteness, and scopal properties may be a result of this "distinguished element" status of PIVs.

Crucially, PIV is not inherently characterized in terms of argumenthood properties. The function PIV is thus related to the discourse functions; like FOCUS and TOPIC, it is a second function assigned to an element of a clause. First and foremost, every element in syntax must be licensed locally, by being either an argument or an adjunct; more global functions are then added, or overlaid. Unlike such functions as FOCUS and TOPIC, PIV does not, as noted above, relate to discourse; we will therefore use the term "overlay function" (Johnson and Postal 1980) to refer to the class of functions consisting of the discourse functions and PIV.

The typological distinction between nominative-accusative, syntactically ergative, and Philippine-type languages is in the identification of the PIV, which, as an overlay function, is subject to the Extended Coherence Condition. In nominative-accusative languages, the equation (4a) identifies the PIV and in syntactically ergative languages (4b), while in Philippine-type languages the "voice" morpheme is associated with a specification for PIV (4c).[1]

(4) a. $(\uparrow \text{PIV}) = (\uparrow \widehat{\text{GF}})$
b. $(\uparrow \text{OBJ}) \Rightarrow (\uparrow \text{PIV}) = (\uparrow \text{OBJ})$
c. "Active voice": $(\uparrow \text{PIV}) = (\uparrow \widehat{\text{GF}})$
"Direct object voice": $(\uparrow \text{PIV}) = (\uparrow \text{OBJ})$
"Indirect object/locative voice": $(\uparrow \text{PIV}) = (\uparrow \text{OBJ}_\theta)$
"Instrumental voice": $(\uparrow \text{PIV}) = (\uparrow \text{OBL}_{\text{Instr}})$
etc.

Note the f-structures for the following sentence from Samoan, a syntactically ergative language (from Mosel and Hovdhaugen 1992), and for its translation into English, a nominative-accusative language.

[1] An interesting question about the Philippine-type languages is whether the benefactives, locatives, and other elements that can be PIV are adjuncts. If they are (and this is the most straightforward interpretation of the facts), nothing in my account precludes this possibility. On the other hand, it is not clear how something like the inverse mapping approach to be discussed in the final section of this paper could accommodate a nonargument as PIV.

(5) Sā fasi le maile e le teine.

Sā	fasi	le	maile	e	le	teine.
PAST	hit	ART	dog	ERG	ART	girl

‘The girl hit the dog.’

(6) a.

$$\left[\begin{array}{ll} \text{TENSE} & \text{PAST} \\ \text{PRED} & \text{‘hit}\left\langle(\uparrow \hat{\text{GF}})\ (\uparrow \text{OBJ})\right\rangle\text{’} \\ \text{PIV} & [\text{“dog”}] \\ \hat{\text{GF}} & [\text{“girl”}] \\ \text{OBJ} & \end{array}\right]$$

b.

$$\left[\begin{array}{ll} \text{PIV} & [\text{“girl”}] \\ \hat{\text{GF}} & \\ \text{TENSE} & \text{PAST} \\ \text{PRED} & \text{‘hit}\left\langle(\uparrow \hat{\text{GF}})\ (\uparrow \text{OBJ})\right\rangle\text{’} \\ \text{OBJ} & [\text{“dog”}] \end{array}\right]$$

The arguments map to the same grammatical functions in the two languages; the only difference is the identification of the PIV. There are other possibilities for the PIV as well. In Acehnese, for example, any core function can be the PIV (Durie 1985).

The idea that PIV is the function of syntactic cross-clausal continuity can be formalized in a way that recaptures a lost idea from early LFG. In Kaplan and Bresnan (1982), it was proposed that there is a locality condition on functional designations, a proposal that was subsequently abandoned with the advent of the formalism of functional uncertainty. The abandonment of the functional locality condition has left LFG with no formal expression of the intuitive idea that arguments are beholden exclusively to the predicates of which they are arguments. The PIV function allows us to express this: the only way to refer to a function in a lower nucleus is through the function PIV. We call this the Pivot Condition; it is a formal statement of the functional role of PIV. We also propose, more tentatively, that PIV only functions for outside-in designation.

(7) **The Pivot Condition**

① In a functional designation $(\uparrow \ldots\alpha\ldots\ \beta)$ where $\underset{(\rightarrow\ \text{PRED})}{\alpha}$ and $\beta \neq \varnothing$, $\beta = \text{PIV}$

② In a functional designation $(\alpha\ \beta \uparrow)$ where β is a single GF and and $\alpha \neq \varnothing$, $\beta \neq \text{PIV}$

The PIV, then, is an element of a clause which is distinguished by being singled out as the element of cross-clausal continuity in a sentence. As noted earlier, this makes it similar to TOPIC, which is the function of cross-sentence continuity in a discourse. However, PIV is purely syntactic in its scope, not relating directly to discourse matters. Interestingly, the position of PIV in the c-structure of configurational languages confirms this view of PIV as being in some sense intermediate between argument and adjunct functions on one hand and discourse functions on the other. The structural position for arguments is as sister to the lexical heads of which they are arguments, the closest possible structural position to the head. Adjuncts are typically adjoined to a higher node, farther away from the head. Elements bearing discourse functions are farther still, either adjoined to IP or in [SPEC, CP]. The structural position typically associated with PIV, [SPEC, IP], is closer to the lexical head than the place of discourse functions but farther than most adjuncts. The general picture that emerges is that configurational languages represent grammatical functions iconically in the c-structure. This approach also provides an explanation for what in purely c-structural theories is a stipulated property of subjects: the "external" structural position.[2] However, the external position is not associated with an argument, so the term "external argument" for SUBJ is inappropriate.

We will further flesh out this picture by focusing on the analyses of extraction and control. We will show how the notions of PIV and $\widehat{\text{GF}}$ provide the basis for an explanation of the observed patterns.

3. Long-Distance Dependencies

The relevance of subjecthood to long-distance dependency constructions is not a new observation. The fact that extraction of subjects is different from other types of extraction can be shown in many ways. In this section, we will examine three aspects of extraction. First, we will show how subject extraction formally differs from other types of extraction under the theory of pivots, then we will discuss subject/nonsubject asymmetries in across-the-board extraction, and finally, we will discuss the *that*-trace effect.

3.1. Extraction of Subjects and Nonsubjects

The LFG analysis of extraction constructions is based on the formalism of functional uncertainty. As originally proposed (Kaplan and Zaenen 1989), a functional uncertainty equation has the following form:

(8) (↑ DF) = (↑ PathIn GF)

Under the Pivot Condition, "GF" can only be PIV.

There are some languages in which only the PIV can be extracted, as predicted, such as Tagalog (Schachter 1976, Kroeger 1993), Jakaltek (Manning 1996), Dyirbal (Dixon 1994), Inuit (Manning 1996), etc. For other languages, we follow Bresnan (in press) in hypothesizing the availability of inside-out functional uncertainty licencing of long-distance dependencies as a loophole to the Pivot Condition. The more tentative half of the Pivot Condition will rule out the inside-out licensing of a long-distance dependency the lower end of which is PIV. This approach thus draws a sharp distinction between the extraction of PIV and the extraction of other elements. In this way, it echos an idea from early constraint-based theorizing (Gazdar 1981, Falk 1983) that null c-structure nodes exist in long-distance dependencies except for cases of subject extraction. Unlike the earlier accounts, however, the theory of pivots explains why "subject" extraction is different.

Local "extraction" of PIV may be different still. Since PIV is an overlay function, and in configurational languages occupies an overlay function position, it can also be assigned other overlay (discourse) functions as well. Thus, at least in some languages, discourse functions are

[2] A similar explanation can be found in Bresnan (in press), where SUBJ is identified as being simultaneously an argument function and a discourse function. However, Bresnan's motivation for calling SUBJ a discourse function is not entirely clear. I believe that the theory of pivots being proposed here captures the spirit of Bresnan's approach, but in a better motivated way.

assigned to PIV in situ, without need for a special structural position. The outside-in equation identifying a DF with a PIV will only be applicable in case the DF and local PIV are not identified with each other. English is one such language; it has long been noted that matrix subject questions appear to have the structure of ordinary declarative clauses. We assume, then, that English has three ways of licensing long-distance dependencies.

(9) a. (probably an optional annotation on verbs:)
$(\uparrow \text{DF}) \neq (\uparrow \text{PIV}) \Rightarrow (\uparrow \text{DF}) = (\uparrow \text{COMP}^{+} \text{PIV})$

b. Annotated to null c-structure nodes:
$\uparrow = ((\text{COMP}^{*}\ \text{GF} \uparrow)\ \text{DF})$

c.
$$\begin{array}{lll} \text{IP} \rightarrow & \text{NP} & \text{I}' \\ & (\uparrow \text{PIV}) = \downarrow & \uparrow = \downarrow \\ & \big((\uparrow \text{DF}) = \downarrow\big) & \end{array}$$

Other languages will have variations on this theme. For example, languages in which the PIV cannot be locally assigned a discourse function will have a Kleene star instead of a Kleene plus in the outside-in PIV equation (and will lack the conditional). Similarly, the outside-in equation may be associated with different c-structure nodes in different languages.

3.2. Across-the-Board Extraction

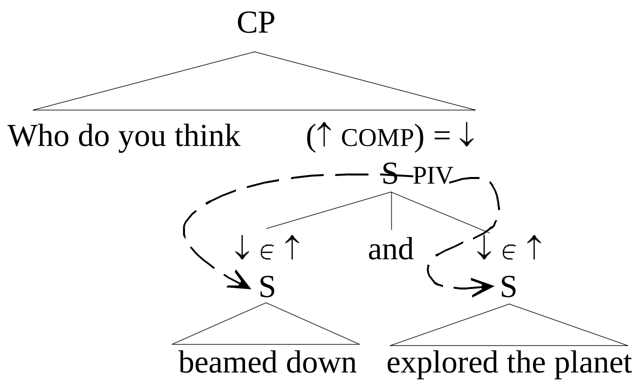
One place where subject/nonsubject asymmetries have been observed is in across-the-board extractions in coordinate structures. With one small addition, the above account of extraction in English accounts for the across-the-board facts.

In English, across-the-board extraction can involve subjects at the top level of the coordination in all clauses, or other elements in all clauses (nonsubjects and embedded subjects), but not a combination of top-level subjects and other elements.

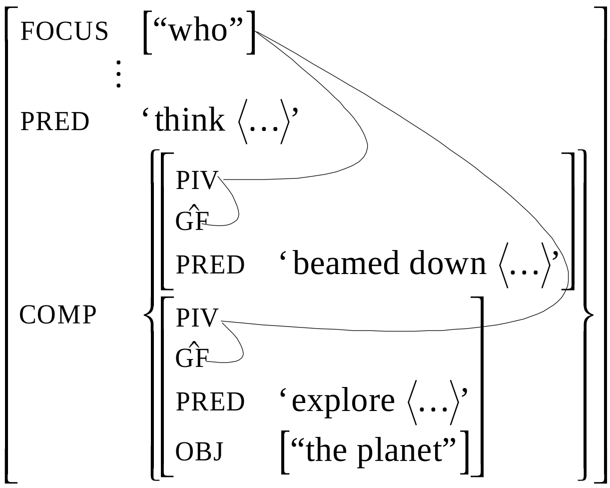
(10) a. Who do you think [[beamed down] and [explored the planet]]?
b. What did you claim [[I brought back] and [everyone thinks is fascinating]]?
c. *Who do you think [[the captain likes] and [got promoted]]?

Across the board extraction of top-level subjects follows automatically. The outside-in equation licensing PIV extraction will terminate at the coordinated complement, and the PIV thus identified will distribute among the conjuncts (Kaplan and Maxwell 1988).

(11) a.



b.



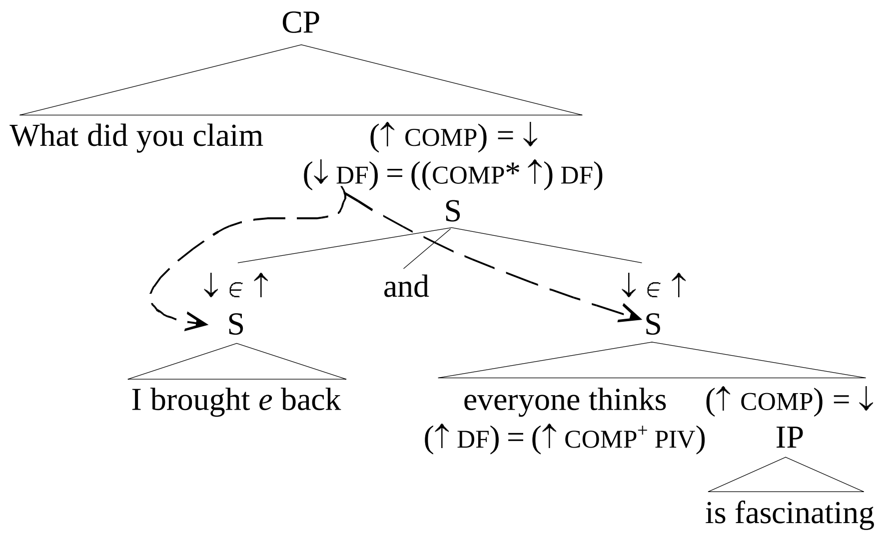
However, since other functions cannot be licensed as the lower end of extraction dependencies by outside-in specification (by the Pivot Condition), they must involve inside-out designation. Inside-out designators cannot “escape” conjoined structures. The only way to license across-the-board extraction in these cases is to associate the root of the coordinated structure with the following equation:[3]

(12) (↓ DF) = ((COMP* ↑) DF)

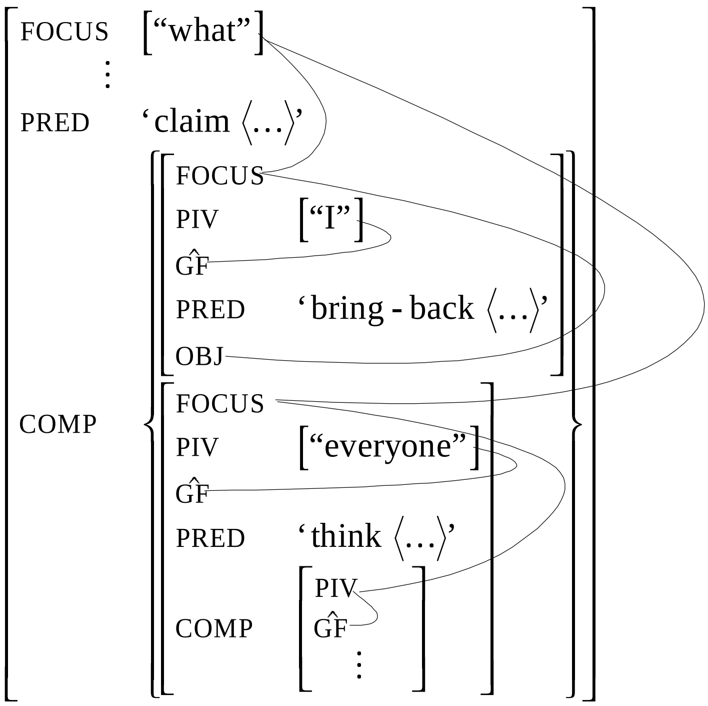
This “copy” DF will be distributed between the conjuncts.

[3]Joan Bresnan (personal communication) helped we work out some of the formal details here.

(13) a.



b.



Given this system, there is no way to license the subject-nonsubject version.

Other languages have slightly different patterns. For example, according to Saiki (1985) in Japanese no subject-nonsubject combination is permitted in across-the-board extraction, regardless of degree of embedding. The details will depend on which nodes the various functional uncertainty equations are annotated to.[4]

3.3. The *that*-trace effect

One of the best known, and least understood, constraints on extraction is the "*that*-trace effect." It is usually attributed to some ad hoc structural restriction. The theory of pivots provides a new approach, one which is more principled and less arbitrary.

The first observation is that, contrary to what is generally supposed, the *that*-trace effect is a lexical property of the head complementizer. For example, as observed by Shlonsky (1988), in Hebrew the complementizer *še* 'that' does not induce the *that*-trace effect, while *im* 'if' does.[5]

(14)	a.	Mi	taanta	še	niceax	et	ha-	romulanim?
		who	you.claimed	that	defeated	ACC	the-	Romulans
		'Who did you claim (that) defeated the Romulans?'						
	b.	*Mi	šaalta	im	niceax	et	ha-	romulanim?
		who	you.asked	if	defeated	ACC	the-	Romulans
		'Who did you ask if defeated the Romulans?'						

Sobin (1987) claims that some speakers of English display a similar pattern. So the *that*-trace effect will be due to some marking in the complementizer's lexical entry.

The second observation about the *that*-trace phenomenon is that different types of complement clauses are more or less closely bound to the main clause. For example, Givón (1990: 517) states that "cognition-utterance" verbs take complements which are less closely bound to the main verb than verbs of modality and manipulation. He also discusses different types of complements, and observes that finite complements involve a weaker bond than nonfinite. These two observations are related to each other, since verbs of cognition and utterance are more likely to take finite complements.

The complementizer, which marks the type of complement, is a natural place to expect

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[4]In this specific case, Saiki proposes that the outside-in equation is annotated to the root of the relative clause. We also assume that an outside-in equation can be associated with the root of the coordination.

(i) a.

$$\begin{array}{lcc} NP \rightarrow & S & NP \\ & \downarrow \in (\uparrow \text{ ADJ}) & \uparrow = \downarrow \\ & (\downarrow \text{ DF PRED}) = \text{ `PRO'} & \\ & \big((\downarrow \text{ DF}) = (\downarrow \text{ GF}* \text{ PIV})\big) & \end{array}$$

b.

$$\begin{array}{llcl} S \rightarrow & S & CONJ & S \\ & \downarrow \in \uparrow & \big((\uparrow \text{ DF}) = ((\text{GF}*\uparrow) \text{ DF})\big) & \downarrow \in \uparrow \\ & & \big((\uparrow \text{DF}) = (\uparrow \text{ GF}* \text{ PIV})\big) & \end{array}$$

If PIV extraction cannot be licensed inside-out, this will result in the Japanese facts.

[5]Shlonsky attributes this to *še* cliticizing to the element to its right. He claims that *še* is a "phonetic clitic" on the grounds that it is not related to another word (the way English *that* is), it cannot be contrastively stressed, and cannot occur in isolation. He then argues for the possibility of syntactic cliticization on the basis of a problematic (by his own admission) analysis of multiple *wh* constructions and on the basis of a particular analysis of free relatives in Hebrew. The argument for *še* even being a phonetic clitic is weak, as *that* is also resistant to contrastive stress and cannot occur (as a complementizer) in isolation.

notions such as the bond between clauses to be grammaticalized. And, under the theory proposed here, the bond between clauses is localized in the PIV. A loose bond with the main clause could then be formalized as a lexical specification on the complementizer blocking identity of the PIV with some higher element.

(15) (↑ PIV) ≠ ((GF* COMP ↑) GF)

This lexical specification has the *that*-trace effect as its consequence.

4. Control constructions

Control constructions provide a clear example of the complex interplay between notional construction types and formal analysis. In the standard LFG analysis, equi constructions can involve either functional control or anaphoric control.[6] While standard analyses identify the controllee as invariably SUBJ, the theory of $\widehat{\text{GF}}$ and PIV make different predictions for the two constructions. Anaphoric control is formally similar to "pro-drop": the verb licenses an unexpressed pronoun as one of its arguments.

(16) (↑ Controllee PRED) = 'PRO' + constraints on referential possibilities for Controllee

Functional control, on the other hand, is a lexical property of the governing verb, which specifies that one of its arguments is formally identical with an element in the XCOMP.

(17) (↑ Controller) = (↑ XCOMP Controllee)

Due to length limitations, we will not deal with the controller. We will, however, consider the nature of the controllee in these two constructions. In the case of anaphoric control, the verb specifies information about one of its arguments. Such argument-related specification is subject to the relational hierarchy; if it is limited to a single argument, it is limited to $\widehat{\text{GF}}$. On the other hand, in functional control information about an element in a lower nucleus is specified. Under the Pivot Condition, such specification can only involve PIV. We therefore predict that anaphoric controllees, if they are limited at all, will be limited to $\widehat{\text{GF}}$, while functional controllees must be PIV. This can, of course, only be tested in languages which do not automatically identify $\widehat{\text{GF}}$ and PIV.

One language in which the prediction holds is Tagalog[7] (Kroeger 1993). Kroeger shows that in Raising, which has to be functional control, the controllee is the PIV.[8]

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[6]Or a complex predicate construction. Complex predicates, whatever the correct analysis, involve manipulations of a-structure, so we will ignore them here.

[7]Abbreviations in the glosses: Aside from the obvious, ACT=Active "voice", DO=Direct Object "voice", IO=Indirect Object (or Dative) "voice", COMP=complementizer, LNK=linker. I gloss the Case marker for nonpivot Actors ERG.

[8]In some languages, particularly Polynesian languages, Raising is not limited to PIV. We conjecture that these allow inside-out raising. This conclusion is reinforced by the fact that in at least some of these languages a resumptive pronoun is allowed in the XCOMP. Tagalog, too, has what Kroeger calls the "copy raising" construction, in which the controllee is not the PIV.

(18) a. (Kroeger (2.11))

Pinang-	aakalaan	si	Fidel	na	makakagawa
IMPERF-	think.IO	NOM	Fidel	COMP	ACT.NONVOL.FUT.do

ng	mabute.
ACC	good

‘Fidel is thought to be able to do something good.’

b. (Kroeger (2.13))

Malapit	na	si	Manuel	na	hulihin	ng	polis.
STAT.close	already	NOM	Manuel	COMP	catch.DO	ERG	police

‘Manuel is about to be arrested by the police.’

For equi, he shows that, for semantic reasons, the controllee must be the Actor (i.e. $\widehat{\text{GF}}$). However, there is a lexically defined class of verbs which allow either the PIV or the $\widehat{\text{GF}}$ to be the controllee.

(19) a. (Kroeger (4.48))

Nagpilit	si	Maria	-ng	bigy-	an	ng	pera	ni	Ben.
PERF.ACT.insist.on	NOM	Maria	COMP	give-	IO	ACC	money	ERG	Ben

‘Maria insisted on being given the money by Ben.’

b. (Kroeger (4.54))

Nagpilit	si	Maria	-ng	bigy-	an	ng	pera	si	Ben.
PERF.ACT.insist.on	NOM	Maria	COMP	give-	IO	ACC	money	NOM	Ben

‘Maria insisted on giving money to Ben.’

Kroeger identifies the more common $\widehat{\text{GF}}$ controllee construction as involving anaphoric control, and the lexically governed PIV controllee construction as involving functional control.

While Kroeger’s account of functional control fits our prediction exactly, more needs to be said about anaphoric control. On the one hand, Kroeger claims that semantic constraints on control are enough to account for the properties of the construction, while on the other he assumes a universal syntactic constraint limiting controllees to core arguments. It can be argued that Tagalog has a syntactic constraint licensing $\widehat{\text{GF}}$ as anaphoric controllee, a constraint which operates in parallel to the semantic restrictions on control. Consider complement verbs in the nonvolitive mood. Because of the semantics of nonvolitive mood, the complement $\widehat{\text{GF}}$ cannot be the controllee. However, in at least some cases, the $\widehat{\text{GF}}$ can be an unexpressed pronoun with arbitrary interpretation.

(20) (Kroeger (4.46a)

Nag-	atubili	si	Maria	-ng	ma-	bigy-	an	ng	pera
PERF.ACT-	hesitate	NOM	Maria	COMP	NONVOL-	give-	IO	ACC	money

si	Ben.
NOM	Ben

‘Maria hesitated for (someone) to give the money to Ben.’

According to Kroeger, arbitrary interpretation is a property of anaphoric control; pro-drop in

Tagalog does not allow it. This unexpressed $\widehat{\text{GF}}$ must therefore be licensed by the same mechanism that licenses anaphoric control. In this case, it cannot be the semantics of the control construction, because those semantics rule out control with a nonvolitive complement. It must be a syntactic specification allowing an unexpressed pronoun with control properties as $\widehat{\text{GF}}$.

In other languages, equi may be more consistent. For example, in Chukchee (Comrie 1979) and Inuit (Manning 1996) the controllee is always $\widehat{\text{GF}}$, and in Balinese it is always the PIV (Arka and Simpson 1998). Such languages use only anaphoric control or only functional control.

5. Comparison with Inverse Mapping Theory

The theory proposed here contrasts with the generally accepted theory of ergative and Philippine-type languages in LFG. The more conventional approach, spelled out most completely by Manning (1996), can be called the "inverse mapping theory." According to the inverse mapping theory, languages differ in the mapping of arguments to grammatical functions. Nominative-accusative mapping maintains the a-structure hierarchy at f-structure, with the thematically most prominent core argument mapping to SUBJ and the lower one to OBJ. Ergative mapping, on the other hand, reverses the hierarchy: the thematically most prominent argument is mapped to OBJ and the lower one to SUBJ. On this view, our PIV is SUBJ, and our $\widehat{\text{GF}}$ is the most prominent argument in a-structure ($\hat{\theta}$ in standard LFG terminology, "a-structure SUBJ" in Manning's). The theory proposed here has both conceptual and descriptive[9] advantages over the inverse mapping theory.

The inverse mapping theory belongs to a family of approaches, including the Relational Grammar analysis of Bell (1983), which treat $\widehat{\text{GF}}$ and PIV as different types of SUBJ, or SUBJs at different levels (a-structure/f-structure, initial stratum/final stratum). Calling them different types of SUBJ implies that they are essentially the same type of entity, with similar properties. However, as we have seen, PIV properties and $\widehat{\text{GF}}$ properties are completely distinct from each other. Even cases that appear superficially to overlap, such as being the controllee in equi constructions, turns out on closer analysis to involve distinct formal constructions. The claim made here, that the two functions are formally distinct but coincide in most languages, is more in line with this observation.

More specifically, approaches like the inverse mapping theory conceptualizes them as having the same essential function at two different dimensions of linguistic structure. The inverse mapping theory identifies this function more specifically as expression of relative prominence of arguments. $\widehat{\text{GF}}$ and PIV are thus both argument functions. This distinguishes it sharply from the approach argued for here, under which PIV is not an argument function. At the outset, we argued that a theory of grammatical functions should explain the properties of syntactic elements; as we have shown, the properties of PIV are not argumenthood properties. The inverse mapping theory can stipulate that, for example, in certain languages only "surface/grammatical" subjects can extract, but it cannot explain this. The theory of pivots explains this and other properties.

Finally on the conceptual plane, there is something improbable about inverse mapping. It is understandable that in mapping from one dimension of linguistic structure to another basic concepts of prominence would be maintained. The sketch of argument mapping presented by

[9] I say "descriptive" instead of "empirical" because it is not clear to me that the theories can be distinguished empirically. That is to say, any empirical facts that can be expressed in one can also be expressed in the other. The question is rather how natural the description of empirical facts is.

Jackendoff (1990) is based on a hierarchy-to-hierarchy mapping, and this is also the idea behind the OT concept of Harmonic Alignment of prominence hierarchies. Inverse mapping seems strange under such a view.[10]

The theory proposed here is most like Schachter's seminal paper (1976) on Philippine-type languages; Schachter also proposed that two quite distinct grammatical functions are involved, although he was not very precise in defining the functions. Similar analyses have been proposed within Government/Binding theory, such as Guilfoyle, Hung, and Travis' (1992) study of Philippine-type languages and Bittner and Hale's (1996) discussion of Case typology. In the GB version, the functions are expressed in terms of structural positions: $\widehat{\text{GF}}$ in the VP-internal "subject" position and PIV in [SPEC, IP]. Bittner and Hale even explicitly state that their PIV position is an "$\bar{\text{A}}$" (nonargument) position. The GB version, lacking a concept of grammatical function, is less predictive, and the machinery is convoluted, being based on Case-induced movement. The LFG version is thus conceptually preferable to the GB version as well.

As mentioned above, there are also descriptive problems with the inverse mapping theory. One such descriptive problem is that it conflates the argument structure concept $\hat{\theta}$ and the grammatical function $\widehat{\text{GF}}$. Since a-structure–f-structure mapping preserves prominence relations, this conflation is usually innocuous. In fact, Manning seems to consider it an advantage. However, as he himself points out in his discussion of binding theory, while many languages seem to allow any $\hat{x}$ (i.e. either $\hat{\theta}$ or $\widehat{\text{GF}}$) to antecede reflexives, there are some that are limited to one or the other, such as Malayalam (in which only $\widehat{\text{GF}}$ can be the antecedent) and Marathi (in which only $\hat{\theta}$ can be the antecedent).

Certain phenomena in Indonesian have been discussed in LFG, using the inverse mapping theory, by Arka and Manning (1998). Much of their analysis can be translated in a straightforward manner into the theory proposed here. However, certain aspects of their analysis are problematic under their assumptions and simple under ours. Consider the question of structural realization of arguments. The PIV in Indonesian appears clause initially, in [SPEC, IP]. Within the VP, the verb is followed by non-PIV arguments other than the (non-PIV) Agent ($\widehat{\text{GF}}$). The Agent ($\widehat{\text{GF}}$) appears initially in the VP, either as a pronoun or a clitic on the verb. Under the inverse mapping theory, non-PIV Agents and non-PIV Patients both bear the function OBJ, even

[10]Chris Manning (personal communication) has objected to this objection on the grounds that identifying PIV with OBJ, as I claim syntactically ergative languages do, also involves a mismatch of prominence across different linguistic dimensions. While Manning's point does have some validity, and this may explain the rarity of languages in which PIV is not automatically associated with $\widehat{\text{GF}}$, there is a fundamental conceptual difference between inverse mapping and the theory of pivots. Mapping involves representing essentially the same relations (specifically, predicate-argument relations) at different dimensions of linguistic structure. An argument is the most prominent argument ultimately because of its position in conceptual structure. The most sensible system of mapping, and what I claim is the only available one, will maintain this prominence through to the syntax. Being a PIV, like being a TOPIC or being picked out by contrastive stress, represents a different type of prominence, one unrelated to argument status and ultimately unrelated to lexical conceptual structure. It also does not involve mapping from one level to another (since PIV and $\widehat{\text{GF}}$ are both f-structure functions). It simply assigns a second function to an element which is already part of the f-structure. In other words, denying PIV the status of an argument function is not mere terminology; it reflects the core difference between the approaches. Manning also observes, quite correctly, that despite the apparent negative reading that his theory gets here, there are some fundamental issues on which we are in complete agreement. Foremost among these is that he and I both reject an analysis of syntactically ergative languages in which all sentences are intransitive, with the ergative argument being similar to a passive *by* phrase.

though they have completely disjoint distributional properties. The phrase structure rules therefore need to refer to nonsyntactic representations. Under the account proposed here, only Patients are OBJ; Agents are $\widehat{\text{GF}}$.

Arka and Simpson (1998) discuss control in Balinese from the perspective of inverse mapping theory. They argue that Balinese control is problematic for the classical LFG theory of control (Bresnan 1982), because (functionally) controlled arguments need not bear the function XCOMP. The evidence is that functionally controlled arguments, both equi and raising, can be "subjects" (i.e. PIVs).

(21) a. Equi (Arka and Simpson (2))

[naar	ubad	ento]	tegarang	tiang
ACT.eat	medicine	that	DO.try	I

'To take the medicine I tried.'

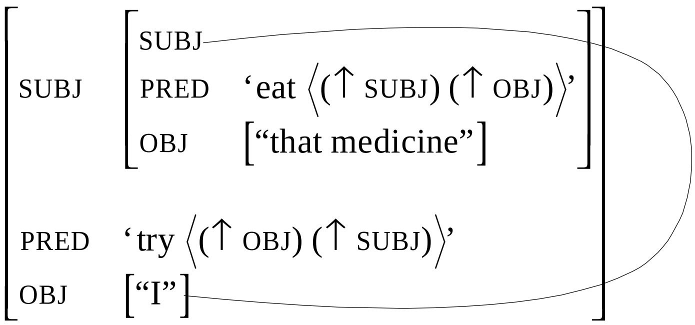
b. Raising (Arka and Simpson (57))

[ng-	alih	Luh Sari]	ane	tawang=a	tiang
ACT-	look.for	Luh Sari	REL	DO.know=3	I

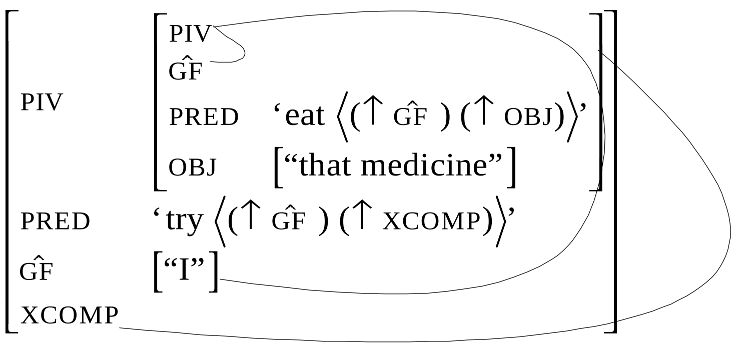
'Looking for Luh Sari is what (s)he knows of me.'

The inverse mapping theory f-structure for (21a) is (22a); ours is (22b).

(22) a.



b.



Under the theory proposed here, the Balinese control facts do not contradict the classical LFG theory of control. What makes Balinese different is that one realization of the "direct object voice" morpheme equation is:

(23) (↑ PIV) = (↑ XCOMP)

That is to say, Balinese allows XCOMPs to be PIV.

The theory of pivots is thus preferable to the inverse mapping theory of ergative and Philippine-type languages. It has stronger conceptual grounding, is more explanatory, provides more adequate descriptions of linguistic facts, and is more consistent with theoretical assumptions in LFG.

References

Andrews, Avery (1985) “The Major Functions of the Noun Phrase.” in Timothy Shopen, ed., *Language Typology and Syntactic Description, Vol. 1: Clause Structure.* Cambridge: Cambridge University Press. 62–154.

Arka, I Wayan, and Christopher D. Manning (1998) “Voice and Grammatical Relations in Indonesian: A New Perspective.” in Miriam Butt and Tracy Holloway King, eds., *Online Proceedings of the LFG98 Conference, The University of Queensland, Brisbane.* Stanford, Calif.: CSLI Publications. http://www-csli.stanford.edu/publications/LFG3/lfg98.html.

Arka, I Wayan, and Jane Simpson (1998) “Control and Complex Arguments in Balinese.” in Miriam Butt and Tracy Holloway King, eds., *Online Proceedings of the LFG98 Conference, The University of Queensland, Brisbane.* Stanford, Calif.: CSLI Publications. http://www-csli.stanford.edu/publications/LFG3/lfg98.html.

Bell, Sarah J. (1983) “Advancements and Ascensions in Cebuano.” in David M. Perlmutter, ed., *Studies in Relational Grammar 1.* Chicago: University of Chicago Press. 143–218.

Bittner, Maria, and Ken Hale (1996) “The Structural Determination of Case and Agreement.” *Linguistic Inquiry* 27: 1–68.

Bresnan, Joan (1982) “Control and Complementation.” in Joan Bresnan, ed., *The Mental Representation of Grammatical Relations.* Cambridge, Mass.: MIT Press. 282–390.

Bresnan, Joan (in press) *Lexical-Functional Syntax.* Blackwell.

Comrie, Bernard (1979) “Degrees of Ergativity: Some Chukchee Evidence.” in Frans Plank, ed., *Ergativity: Towards a Theory of Grammatical Relations.* New York: Academic Press. 219–240.

Dixon, R. M. W. (1994) *Ergativity.* Cambridge: Cambridge University Press.

Durie, Mark (1985) *A Grammar of Acehnese on the Basis of a Dialect of North Aceh.* Dordrecht: Foris.

Falk, Yehuda N. (1983) “Subjects and Long Distance Dependencies”. *Linguistic Analysis* 12: 245–270.

Falk, Yehuda N. (1999) “Philippine Subjects in a Monostratal Framework.” sixth annual conference of the Austronesian Formal Linguistics Association, 16–18 April 1999, University of Toronto.

Foley, William A., and Robert D. Van Valin, Jr. (1984) *Functional Syntax and Universal Grammar.* Cambridge: Cambridge University Press.

Gazdar, Gerald (1981) “Unbounded Dependencies and Coordinate Structure” ” *Linguistic Inquiry* 12:155–184.

Givón, T. (1990) *Syntax: A Functional-Typological Introduction, Volume 2.* Philadelphia: John Benjamins.

Guilfoyle, Eithne, Henrietta Hung, and Lisa Travis (1992) “SPEC of IP and SPEC of VP: Two

Subjects in Austronesian Languages.” *Natural Language and Linguistic Theory* 10: 375–414.
Jackendoff, Ray (1990) *Semantic Structures.* Cambridge, Mass.: MIT Press.
Johnson, David E., and Paul M. Postal (1980) *Arc Pair Grammar.* Princeton, N.J.: Princeton University Press.
Kaplan, Ronald M., and Joan Bresnan (1982) “Lexical-Functional Grammar: A Formal System for Grammatical Representation.” in Joan Bresnan, ed., *The Mental Representation of Grammatical Relations* Cambridge, Mass.: MIT Press. 173–281.
Kaplan, Ronald M., and John T. Maxwell III (1988) “Constituent Coordination in Lexical-Functional Grammar.” *Proceedings Of COLING-88* , vol. 1. 303–305. reprinted in Dalrymple et al., eds., 1995.
Kaplan, Ronald M., and Annie Zaenen (1989) “Long-distance Dependencies, Constituent Structure, and Functional Uncertainty.” in Mark R. Baltin and Anthony S. Kroch, eds., *Alternative Conceptions of Phrase Structure* Chicago: University of Chicago Press. 17–42.
Keenan, Edward L. (1976) “Towards A Universal Definition Of “Subject”.” in Charles Li, ed., *Subject and Topic* New York: Academic Press. 303–333.
Kroeger, Paul (1993) *Phrase Structure and Grammatical Relations in Tagalog.* Stanford: CSLI Publications.
Manning, Christopher D. (1996) *Ergativity: Argument Structure and Grammatical Relations.* Stanford, Calif.: CSLI Publications.
Mosel, Ulrike, and Even Hovdhaugen (1992) *Samoan Reference Grammar.* Oslo: Scandinavian University Press.
Saiki, Mariko (1985) “On the Coordination of Gapped Constituents in Japanese.” *CLS* 21: 371–387.
Schachter, Paul (1976) “The Subject in Philippine Languages: Topic, Actor, Actor-topic, or None of the Above.” in Charles Li, ed., *Subject and Topic* New York: Academic Press. 493–518
Shlonsky, Ur (1988) “Complementizer-Cliticization in Hebrew and the Empty Category Principle.” *Natural Language and Linguistic Theory* 6: 191–205.
Sobin, Nicholas (1987) “The Variable Status of COMP-Trace Phenomena.” *Natural Language and Linguistic Theory* 5: 33–60.

AUTOMATIC F–STRUCTURE ANNOTATION OF TREEBANK TREES

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Automatic F–structure Annotation of Treebank Trees [1]

Abstract

We describe a method that automatically induces LFG f–structures from treebank tree representations, given a set of f–structure annotation principles that define partial, modular c– to f–structure correspondences in a linguistically informed, principle-based way.

This work extends the approach of van Genabith, Sadler and Way (1999a,b,c) where f–structure annotation of treebanks is driven by manual annotation of treebank-extracted PS rules. In this paper we present a method for automatic f–structure annotation of treebank trees, building on a correspondence-based view of the LFG architecture. A rule-based approach is explored, in parallel, by Sadler, van Genabith and Way (2000).

In our method we build on a correspondence-based view of the LFG architecture, where annotation principles define ϕ–correspondences directly in terms of ϕ–projection constraints, relating partial (possibly non-local) c–structure tree fragments to their corresponding partial f–structures. Application of the modular annotation principles to treebank trees directly induces the f–structure. Due to the disambiguated tree input, the resulting f–structures require only minimal manual disambiguation, and can be used to build large f–structure corpora as training data for stochastic NLP applications.

The f–structure annotation principles provide by themselves a principle-based, modular description of the LFG c–structure/f–structure interface. They define characteristic functional correspondences between partial c–structure configurations and their f–structure projections. By abstracting from away from irrelevant c–structure context, these principles are highly general and modular, and therefore apply to previously unseen tree configurations.

To define and process the annotation principles we make use of an existing term rewriting system, originally designed for transfer-based Machine Translation. The method is inherently robust. It yields partial, unconnected f–structures in the case of missing annotation rules.

We present the results of a first experiment where we apply this method to the Susanne treebank. The experiment is designed to measure to which extent the partial c– to f–structure correspondences encoded in annotation principles scale up and generalize, by applying them to previously unseen tree configurations. We then extend the model to *selective* filtering of ambiguities, using lexical subcategorization information in conjunction with an OT-based constraint ranking mechanism for ambiguity filtering and ranking (cf. Frank et al. 1998, 2000).

Finally we address some conceptual issues. The principle-based projection of f–structures from disambiguated tree input has interesting implications for the definition of grammatical constraints as compared to the classical LFG parsing architecture. We also discuss issues such as systematic modifications of given treebank encodings, and which types of treebank encodings should be expoited for different applications: the construction of f–structure banks, as opposed to more far-reaching goals, including rapid, corpus-based LFG grammar development, and robust parsing architectures.

1 Introduction

Methods and insights of corpus-based linguistics are now applied to practically all areas of natural language processing, ranging from morphological and syntactic analysis over terminology extraction, semantic disambiguation and machine translation to areas of categorization or summarization.

This paper addresses two issues in corpus-based linguistics. First, we describe and extend a method that allows us to build large LFG f–structure resources as training material for stochastic NLP applications, including but not restricted to LFG processing (see e.g. Bod and Kaplan (1998), Cormons (1999), Johnson et al. (1999), Way (1999), Eisele (2000), Cancedda and Samuelsson (2000), Johnson and Riezler (2000), Bod (2000a, 2000b), Riezler et al. (2000)). More importantly, this method is itself essentially corpus-based

[1]Thanks go to Josef van Genabith, Andy Way and Louisa Sadler, for many discussions on the ideas presented below, and comments on earlier versions of the paper. Fruitful feedback was provided in particular by Ron Kaplan and John Maxwell, as well as Christer Samuelsson, the members of the Pargram group at presentations given at IMS Stuttgart and Xerox PARC, the participants of the Tübingen Workshop “Syntactic Annotation of Electronic Corpora” and the LFG-HPSG2000 conference, as well as my colleagues at XRCE.

in that it exploits existing corpora of disambiguated c–structure representations, i.e., large treebanks, to derive such f–structure resources, and, ultimately, independent LFG grammar resources. The approach is also attractive in that it combines corpus-based methods with traditional rule-based techniques. It allows us to enrich the information extracted from corpora with higher-level syntactic information, which is captured in generalized descriptions, and applied automatically. The external linguistic knowledge encoded in annotation principles imports linguistic generalizations that cannot (easily) be extracted from treebanks, and represents a substantial gain in information, compared to a purely corpus-driven approach.

Creation of LFG-parsed corpora

The construction of LFG-parsed corpora traditionally proceeds by parsing sentences of a text corpus with an existing or adapted LFG grammar, and manually selecting the correct analysis from a set of alternatives proposed by the system. Depending on the size of the grammar and the availability of reliable ambiguity filtering mechanisms, this manual disambiguation task can be significant and cost-intensive: A linguistic expert is needed to choose from a considerable set of alternatives.[2] Moreover, existing unification-based grammars are usually restricted to a specific type of text or domain, and require considerable extension in order to process free text from a variety of domains. This factor further increases the cost of constructing LFG-parsed corpora on a large scale.

To date, there exist rather small LFG f–structure banks.[3] To extend the scope of such f–structure banks to broad-coverage corpora comparable to e.g. the Penn Treebank or the NEGRA corpus, the LFG analysis grammars need to be considerably scaled up.[4] This by itself constitutes a major effort not yet achieved. In addition, with increasing coverage, ambiguities proliferate, leading to increased overhead for disambiguation. Proposals have been made for filtering and ranking parsing ambiguities either by grammar-based preference marks (Frank et al. 1998, 2000) or by stochastic disambiguation methods (Eisele (2000), Bod (2000a, 2000b), Johnson and Riezler (2000), Riezler et al. (2000)) to reduce the search space for manual disambiguation – the latter relying, however, themselves on larger LFG-based training corpora or analysis grammars than currently available to yield reliable results in practice.

Semi–automatic generation of f–structures from treebanks

In a series of papers van Genabith et al. (1999a, 1999b, 1999c) introduced a new method for semi-automatic corpus-based construction of LFG f–structure banks, to address the need of broad-coverage training resources for statistical LFG processing. This method exploits existing treebanks by extracting the context-free PS grammar implicitly encoded by the individual tree assignments, following the method of Charniak (1996). The rules of the extracted "treebank grammar" are manually annotated with functional descriptions. Together with a set of macros for lexical entries, these rules are then used to deterministically "reparse" the original treebank entries by following the tree structure assigned by the annotators. In this reparsing process the f–structure annotations are resolved, and an f–structure is produced. This process is deterministic if the f–structure equations are, and manual inspection of candidate analyses can be significantly reduced.

While this method circumvents the coverage and ambiguity filtering problems of the classical approach, it still involves an important labour intensive component, namely the manual annotation of the grammar rules. This is particularly worrisome due to the fact that treebank grammars are very large (growing with the size of the treebank), and typically consist of flat PS rules with a significant amount of redundancy in their right-hand sides. Manual annotation of rules with functional descriptions is therefore very labour-intensive, can give rise to inconsistencies, and risks missing generalizations.

[2]See King et al. (2000) for ambiguity managing techniques in the LFG grammar development platform XLE.

[3]Two corpora have been built at Xerox PARC and XRCE Grenoble, using the English and French grammars developed in the Pargram project: the "HomeCentre" corpus (approx. 1000 sentences for both English and French) and the VerbMobil corpus (540 sentences for English).

[4]See Dipper (2000) for grammar-based corpus annotation using an LFG grammar for German, which provides analyses for a restricted set of sentences within the corpus annotation project TIGER.

Automatic f–structure annotation of treebanks and CF grammars

In a collaborative effort the corpus-based approach of van Genabith et al. (1999a, 1999b, 1999c) was extended to two related methods for *automatic* f–structure annotation of treebanks (cf. Frank et al. (1999)). The two methods are based on a common underlying idea, but feature interesting differences. We present these alternative methods in two separate contributions, to allow for more in-depth discussion of the respective approaches.[5]

The key idea for automatic f–structure induction from treebanks is the observation that constituent- and higher-level feature structure representations stand in a systematic relationship. This insight is prevalent in theories like LFG and HPSG. In LFG c–structure and f–structure are independent levels of representation which are related in terms of a correspondence function ϕ. This correspondence follows linguistically determined principles which are partly universal and partly language specific (see in particular recent discussions of projection principles in Bresnan (2000) and Dalrymple (2000)). Following this idea, we propose two methods for automatic f–structure annotation of treebanks, driven by general annotation principles that describe systematic patterns, i.e. linguistic generalizations, in terms of partial c–structure/f–structure correspondences.

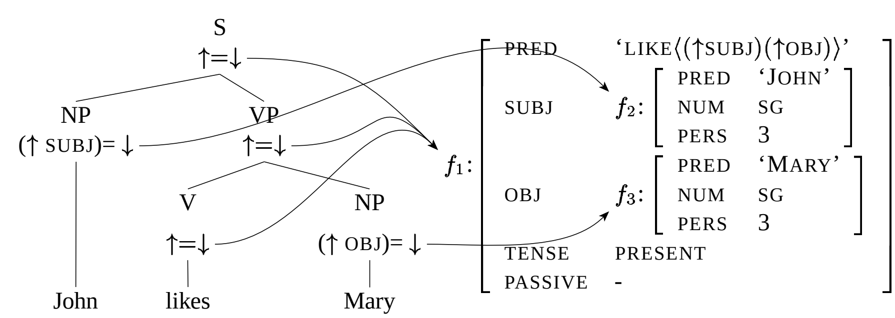
In one approach[5] we read off a CFG treebank grammar, develop annotation templates and compile the templates over the annotation grammar, augmenting it with f–descriptions. A corrected version of this grammar is then used to induce f–structure assignments for treebank trees following the reparsing method of van Genabith et al. (1999c).

In the alternative approach, described below, we operate directly on the PS trees from the treebank. Annotation rules define ϕ–correspondences between partial c– and f–structures. These rules are applied to the treebank tree structures, and annotate them directly with f–structures.

Both methods are partial: the first requires manual inspection and correction of the output produced by the automatic annotation process. The method described below is fully automatic and robust, and yields partial, unconnected f–structures in the case of missing annotation rules.

2 Principles for f–structure annotation of (treebank) trees

In the classical LFG architecture the ϕ–correspondence between c– and f–structure is defined in terms of functional annotations (f–descriptions) on the RHS categories in CFG rules. The f–structure is constructed in the parsing process by resolving the f–descriptions attached to the PS rules, with the meta variables $\uparrow$ and $\downarrow$ instantiated to f–structure nodes.



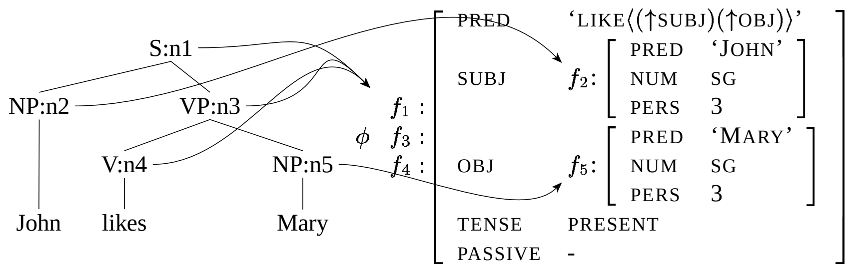
PS rules define f–structure via functional descriptions

$$\mathrm{S} \rightarrow \underset{(\uparrow\mathrm{SUBJ})=\downarrow}{\mathrm{NP}} \quad \underset{\uparrow=\downarrow}{\mathrm{VP}} \qquad\qquad \mathrm{VP} \rightarrow \underset{\uparrow=\downarrow}{\mathrm{V}} \quad \underset{(\uparrow\mathrm{OBJ})=\downarrow}{\mathrm{NP}}$$

Our first annotation method follows this classical LFG architecture, in that f–structure annotation principles apply to PS rules extracted from treebanks, and enrich them with f-descriptions. The resulting annotated rules are then used to “reparse” the assigned tree structure of treebank entries, thereby inducing the f–structure.

[5] See the companion paper Sadler et al. (2000) in these proceedings.

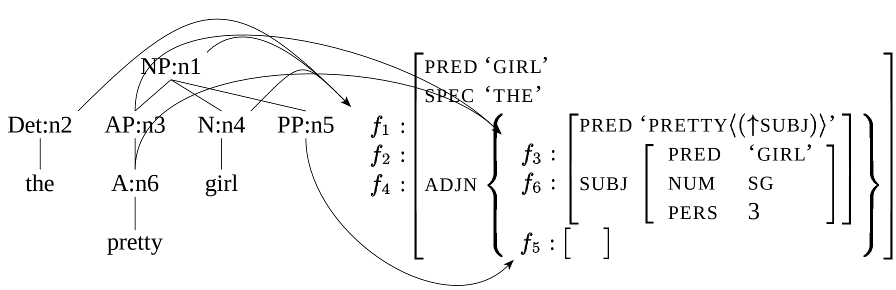
On a pure correspondence view of the LFG architecture we describe the correspondence between a given c–structure and its corresponding f–structure in terms of the projection function ϕ itself, as displayed below.[6]



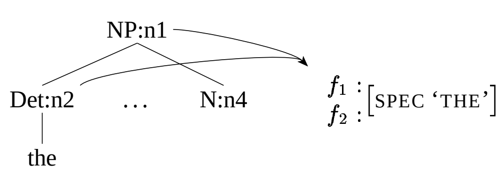
ϕ–correspondence:		f–structure:	
$\phi(\text{n1}) = f_1$	$\phi(\text{n2}) = f_2$	$(f_1$ SUBJ$)= f_2$,	$(f_2$ PRED$)=$ ’John’
$\phi(\text{n3}) = f_3$	$\phi(\text{n5}) = f_5$	$(f_1$ OBJ$)= f_5$,	$(f_5$ PRED$)=$ ‘Mary’
$\phi(\text{n4}) = f_4$		$(f_4$ PRED$=$ ’likes’	
$\phi(\text{n1}) = \phi(\text{n3}) = \phi(\text{n4})$		. . .	

The approach presented in this paper builds directly on this correspondence view of LFG, which leads us towards f–structure induction from c–structure *trees*, as opposed to PS rules. That is, annotation principles define ϕ–correspondences directly in terms of *ϕ–projection constraints*, relating partial c–structure configurations to their corresponding partial f–structures. Automatic application of these annotation principles to tree fragments directly induces the f–structure. This approach has two advantages. First, it can apply to non-local trees, while PS rules are restricted to trees of depth one. Second, by projecting f–structures from trees we skip the reparsing process for f–structure composition. While this purely correspondence-based f–structure annotation is decoupled from the parsing process, it can still be extended to a parsing architecture where a (probabilistic) PCFG grammar assigns a set (or parse forest) of best-ranked trees, which are then input to automatic f–structure annotation.[7]

Partial correspondences, partial and non-local trees Before going into details, let us first illustrate the key ideas of automatic f–structure annotation based on modular, partial annotation principles. Below we display the complex c–structure/f–structure correspondence of an NP. This complex picture can be broken down into modular, piece-wise correspondences of *partial* c– and f–structures, which abstract away from irrelevant material in their surrounding context.



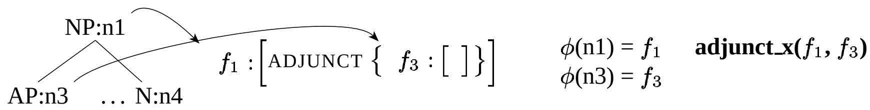
For instance, the functional contribution of the prenominal determiner *the* is independent from the presence of the AP or PP, and is captured by the following partial correspondence:



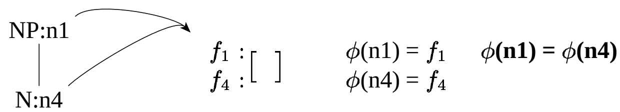
$\phi(\text{n1}) = f_1$ $\quad$ **ϕ(n1) = ϕ(n2)**
$\phi(\text{n2}) = f_2$ $\quad$ **spec(f_1, the)**

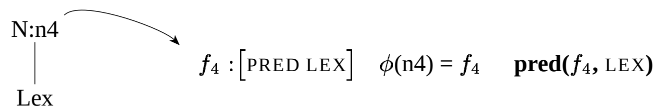
[6] See Dalrymple (2000) for a correspondence-based exposition of LFG syntax.
[7] See Section 6 for discussion.

Any AP daughter of NP is invariably analyzed as an ADJUNCT of the nominal head, unless the noun head N is omitted. The former generalization is captured in the following partial correspondence:



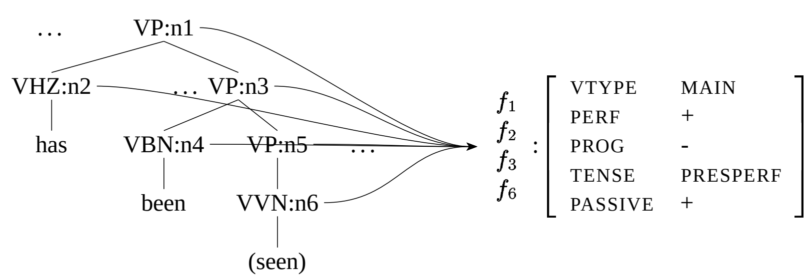
Projection principles for head categories and lexical nodes (here for nominal categories) are straightforward.[8]





Similar correspondences can be defined for the remaining c–structure fragments. By applying them all to the c–structure above, they define the corresponding complex ϕ–projection and f–structure in a modular, declarative way. Most importantly, due to the abstraction over immaterial c–structure context, these principles generalize over specific tree configurations, i.e. they can apply to fragments of unseen tree configurations.

Since the annotation principles apply to trees, they can be defined to involve partial, *non-local* tree fragments, while PS rules are restricted to trees of depth one. This allows us to define and constrain f–structure assignments in terms of complex non-local c–structure constraints. An example where this is fruitfully applied is the assignment of complex tense information in binary branching VPs.[9] By specifying characteristic partial, non-local c–structure contexts in a binary branching VP structure, we can capture the tense and active/passive distinctions of verbal constructions in a natural way. This is illustrated below for the characteristic complex construction indicative of present perfect tense.



In our approach, modular annotation principles establish correspondences between (possibly non-local) partial c–structure fragments and their corresponding partial f–structures. This is very much in the spirit of projection principles as proposed by Dalrymple (2000) and Bresnan (2000), and provides *a principle-based, modular c– to f–structure interface in the LFG architecture*.[10] The application of annotation principles to c–structure trees follows the traditional description-by-analysis (DBA) approach of Halvorsen and Kaplan (1995) in the c–structure/f–structure interface. Yet, while in the classical DBA approach *complete PS rules* are matched against the c–structure, in our approach *partial (non-local) c–structure fragments* are matched against the c–structure trees.

[8]See Sections 3.5 and 5 for the assignment of subcategorized grammatical functions.
[9]See also Section 3.5.
[10]It is also closely related to principle-based grammar description in HPSG.

3 Automatic f–structure annotation of trees

3.1 The XLE term rewriting component

To define and process f–structure annotation principles, we make use of an existing term rewriting system, originally designed as a rewriting component for transfer-based Machine Translation in the XLE (Xerox Linguistic Environment) system (see Kay (1999), Frank (1999)).

The system takes as input an unordered set of n-ary terms `p,q`, etc. and an ordered set of rewrite rules `p ==> q`.[11] If the LHS terms `p` of a rule `p ==> q` match the input, the matching terms `p` are eliminated from the input set, and the terms `q` are added to the input set. A rule applies to *each instantiation* of the LHS terms in the input. The LHS of a rule may contain positive `+p` and negative `-p` terms. A rule with positive constraint `+p` only applies if `p` matches some term in the input. Positive terms are not eliminated from the input set. A rule with negative constraint `-p` only applies if `p` does not match any term in the input set.

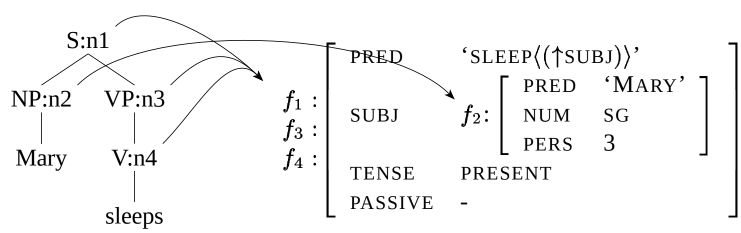
The order in which the rules are stated is crucial: each rule applies to the *current* input set, and yields an output set. The output set of a rule constitutes the input set for the next rule. Annotation principles will thus be interpreted as a cascade of rewrite rules that continuously transform, or enrich the input set of terms, to yield a final set of output terms.

3.2 A term representation of the LFG projection architecture

For the specific task of f–structure annotation of c–structure trees, using the XLE term rewriting component, we encode the LFG projection architecture in a term representation language as follows:[12]

imm. dominance	`arc(MNode, MLabel, DNode, DLabel)`
imm. precedence	`prec(CsNode_x, CsNode_y)`
lexical insertion	`lex(TerminalNode, Lex)`
ϕ-correspondence	`phi(CsNode, FsNode)`
	`equal(FsNode_x, FsNode_y)`
f–structure features[13]	`attr(FsNode_x, FsNode_y), attr(FsNode, Val)`

With this, the traditional representation



translates to the following set of terms:

`arc(n1,s,n2,np), arc(n1,s,n3,vp), arc(n3,vp,n4,v),`
`prec(n2,n3),`
`lex(n2,mary), lex(n4,sleeps),`
`phi(n1,`f_1`), phi(n2,`f_2`), phi(n3,`f_3`), phi(n4,`f_4`), equal(`f_1`,`f_3`), equal(`f_3`,`f_4`),`
`pred(`f_1`,sleep), subj_arg(`f_1`), subj(`f_1`,`f_2`), pred(`f_2`,mary), num(`f_2`,sg), tense(`f_1`,pres),..`

3.3 Automatic annotation of trees with f–structures

The basic steps of f–structure annotation of treebank trees are illustrated below.

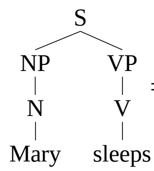
[11]There are obligatory (`==>`) and optional (`?=>`) rules. An optional rule creates two output sets, one where the rule applies, and one where it doesn't apply. All subsequent rules apply to all output sets of previous rule applications. The system operates on packed ("contexted") representations for efficient processing of ambiguities (see Kay (1999)).

[12]This term representation language can, in conjunction with the XLE term rewriting compenent, also be used for structure-based corpus queries, and is comparable in scope with the query tool presented in Kallmeyer (2000).

[13]with `attr` a variable over f–structure attributes

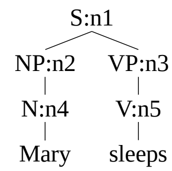
Preprocessing: converting bracket– to c–structure term representation In a preprocessing stage, we first compile the tree encodings of a given treebank to a canonical bracketing structure for PS trees. This bracket structure we convert to an equivalent term representation, where nodes are associated with unique node identifiers $\mathtt{n}_i$, besides their category labels.

```
[s,[np,[n,Mary]],
   [vp,[v,sleeps]]].
```



⇒

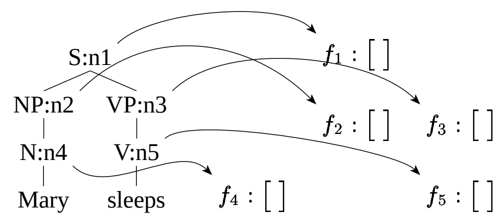
```
arc(n1,s,n2,np), arc(n2,np,n4,n)
arc(n1,s,n3,vp), arc(n3,vp,n5,v),
prec(n2,n3),
lex(n4,mary), lex(n5,sleeps)
```



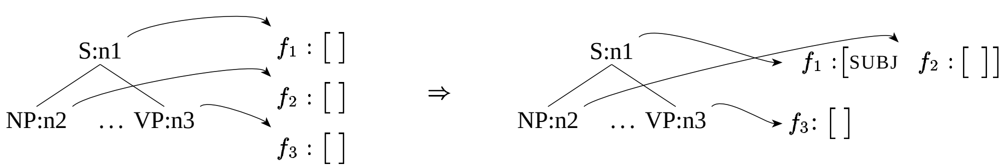
This c–structure term representation constitutes the input to automatic f–structure annotation with the term rewriting component of XLE. The task is to fill in the appropriate `phi` predicates and f–structure terms, i.e. to induce the ϕ–projection for the input c–structure.

Initialization: A trivial 1–1 ϕ–correspondence of c–structure nodes to f–structure nodes initializes, in a first step, a piece-wise partial mapping of c–structure nodes $\mathtt{n}_i$ to fully underspecified, empty f–structure nodes $\mathtt{f}_i$. This is defined by the following rules.[14]

```
+arc(n1,_,_,_) ==> phi(n1,f1).
+arc(_,_,CsNode,_) ==> phi(CsNode,FsNode).
```

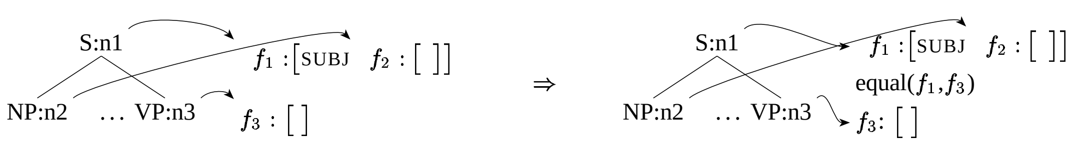


F–structure annotation rules associate partial c–structure configurations with their corresponding ϕ–projected f–structure information, and further restrict the trivial 1–1 ϕ–correspondence via the predicate `equal(Fx,Fy)`. Below we give an example. The first rule defines the f–structure node f_2 for the VP-external NP:n2 as the SUBJ of the node f_1 that is projected from the S:n1 node.[15] [16]




```
+arc(A,s,B,np), +phi(A,FA), +phi(B,FB),
+arc(A,s,C,vp), +prec_x(B,C) ==> subj(FA,FB).
```

The second rule applies to the output resulting from the previous rule application. The predicate `equal(Fx,Fy)` restricts the ϕ–function to map the VP and S nodes to identical nodes in f–structure.




```
+arc(A,s,C,vp), +phi(A,FA), +phi(C,FC) ==> equal(FA,FC).
```

---

[14] $\mathtt{n}_1$ and $\mathtt{f}_1$ are designated constants for the tree and f–structure root nodes, respectively. The RHS term `phi(CsNode,FSNode)` in the second rule introduces new constants $\mathtt{f}_i$ for the non-instantiated variable `FsNode`.

[15] The graphical representations illustrate the effect of the rules, in terms of input and output set.

[16] Note the predicate `prec_x(B,C)`, which is defined (by use of macros) as a finitely constrained transitive closure over the precedence relation `prec`. This allows us to underspecify precedence constraints holding between nodes n_x and n_y to allow for an arbitrary or else a restricted sequence of intervening categories.

A set of annotation rules of this kind (which we call an *annotation grammar*)[17] is applied to any given c–structure term representation from the treebank. These rules continuously restrict and enrich the ϕ–projection. After resolution of f–structure node equalities the process yields, in the general case, a complete c–structure/f–structure projection architecture for the sentence at hand.

3.4 Formal restrictions and simplifications

Formal restrictions Annotation rules are subject to formal constraints in order to guarantee the functional property of the ϕ–correspondence, in particular:

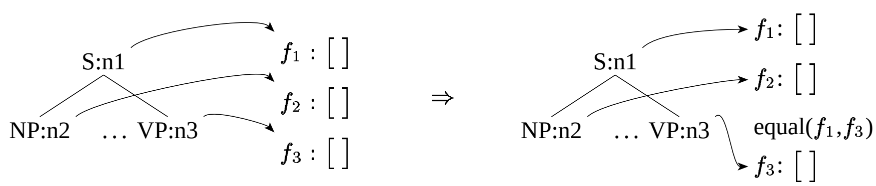
- `phi` predicates (`phi(C_Node,F_Node)`) are restricted to occur as *positive constraints*, i.e.
  - no `phi` predicate may be introduced (in RHS of rules)[18]
  - no `phi` predicate may be deleted (in LHS of rules), however,
  - new f–structure nodes may be introduced (in RHS of rules)

  Given the input specification of a 1–1 ϕ–projection, these constraints guarantee that the functional property of ϕ is preserved.

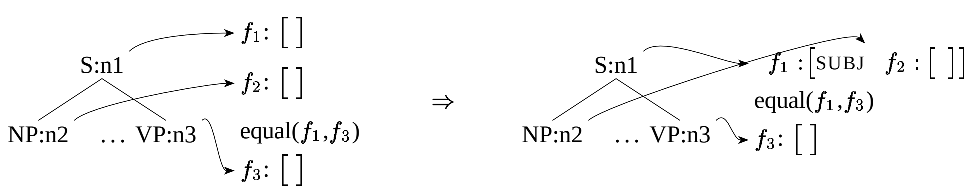
- `equal(F_Node_x,F_Node_y)` predicates *restrict* the ϕ–correspondence, while preserving its functional property. They may be introduced (in RHS), or used as constraints (in LHS of rules). `equal` predicates are resolved after the annotation process is completed.[19]

Order independence in a cascaded rewrite system Note that as long as annotation rules do not consume c–structure terms, or refer to f–structure terms introduced by other rules, the order in which the rules are stated, and thus applied by the system, is irrelevant.

This is illustrated by inverting the application order of the subject and VP head-projection rules from above: Below we first apply the VP head-projection rule. The subject annotation rule is then applied to the output of the first rule. Since we did not consume any c–structure terms, nor put constraints on f–structure terms, the rules yield the same result in any order of application.[20]




```
+arc(A,s,C,vp), +phi(A,FA), +phi(C,FC) ==> equal(FA,FC).
```




```
+arc(A,s,B,np), +phi(A,FA), +phi(B,FB),
+arc(A,s,C,vp), +prec_x(B,C) ==> subj(FA,FB).
```

[17]See Section 3.5 for more detail on the different types of rules, lexical, syntactic and morpho–syntactic, that make up such an annotation grammar.

[19]`equal` predicates could in principle also be resolved immediately during the annotation process.

[19]Except, of course, for the initialization rules above, which induce the 1–1 ϕ–correspondence.

[20]Had we consumed, for example, the term `arc(A,s,C,vp)` in the first rule, the second rule would not have applied. Nor would the first rule, if it had stated a positive constraint on the presence of a SUBJ function, which is introduced later in the annotation process.

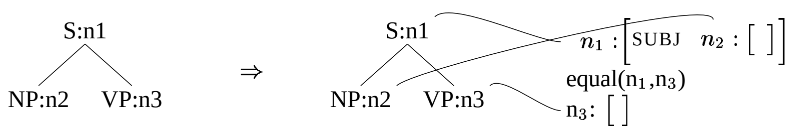
Order independence of f–structure annotation rules can be guaranteed by additional formal restrictions which prevent consumption of c–structure terms and constraints on (previously introduced) f–structure terms. This guarantees that *all* annotation rules have access to (a) the full information structure that constitutes the initial input, i.e. the c–structure plus the 1–1 ϕ-projection as defined via `arc, prec, lex`, and `phi` terms, and (b) no more than the initial information structure, i.e. no annotation rule is constrained in terms of f–structure information introduced by other rules:

- c–structure terms (`arc, prec, lex`) and `phi` terms only occur as positive constraints
- f–structure terms and `equal` terms only occur in RHSs of rules

These formal restrictions ensure that all f–structure annotation rules have access to the complete set of c–structure and `phi` terms, and no more than this, and thereby guarantee order-independence of rule application. The writer of annotation rules does not need to care about the order in which the rules are stated, and thus applied. However, the system is more powerful, and can be flexibly relaxed to allow for limited degrees of order-dependence where it appears to be useful.

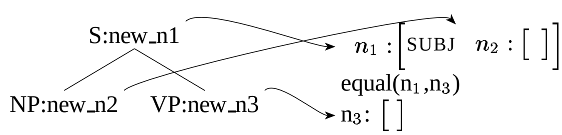
There is a trade-off between order-dependence and order-independence. Constraining rules to c–structure information only can require complex rule constraints in order to avoid application of different annotation rules to the same tree fragment, leading to inconsistencies. Moreover, access to f–structure information can be useful for generalizing annotation rules. If several c–structure configurations are indicative of, e.g. a subject function, or passive voice, it is possible to capture such diverse configurations in a more general way by referring to the more abstract f–structure information to guide further aspects of f–structure construction. In this case, the order of annotation rules needs to be respected, to make sure that the required f–structure information is being introduced by previously applied annotation rules. The term rewriting system is powerful enough to allow for flexible definition of annotation rules, providing much room for flexibility and experimentation in f–structure annotation.[21]

Simplifications To avoid cumbersome reference to `phi`-predicates in our annotation rules, we can exploit the fact that `equal`-predicates are resolved after the annotation process. Since the induced ϕ–projection is 1–1, we can effectively eliminate it during the annotation process, and attach f–descriptions directly to c–structure nodes n_i.




```
+arc(A,s,B,np), +arc(A,s,C,vp), +prec_x(B,C) ==> subj(A,B), equal(A,C).
```

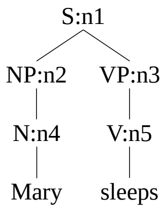
After the annotation process, and before resolution of equalities, we can restore the (implicit) 1–1 ϕ–correspondence between c–structure and f–structure nodes, which is of course essential to represent the mapping of distinct c–structure nodes to single (i.e. equated) f–structure nodes. This is performed by a set of rules which relabel the c–structure with new node identifiers, while encoding the 1–1 ϕ–correspondence between these new node identifiers and the original c–structure nodes, which are now playing the role of f–structure nodes.[22]



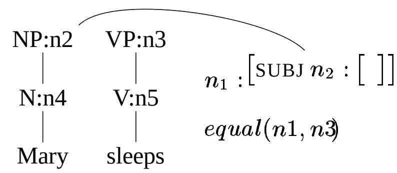
[21] See also Section 3.7. where order-dependence of rewrite rules is fruitfully applied for general c–structure transformations on existing treebank encodings, to facilitate principle-driven f–structure annotation.

[22] The rules rewrite the c–structure predicates `arc`, `lex` and `prec`, by replacing the node identifiers n_i with new constants $\mathrm{new\_n}_j$. Concurrently, a (new) phi-projection `phi` is defined between the new node identifiers $\mathrm{new\_n}_j$ and the corresponding nodes n_i that populate the f–structure space.

Alternative annotation schemes As an alternative to restoring the c–structure and ϕ–projection in this simplified annotation scheme, we can also choose to rewrite trees *into* f–structures, generating only *f–structures* instead of a full projection architecture. In this variant, we can *consume* c–structure predicates, stepwise, during the annotation process. This is illustrated below for the S – NP VP structure.




```
arc(A,s,B,np),
+arc(A,s,C,vp), +prec_x(B,C)
==> subj(A,B).

arc(A,s,C,vp) ==> equal(A,C).
```



Consumption of c–structure induces a certain amount of order-dependence in the annotation process. Once some c–structure fragment is consumed, later rules cannot refer to this c–structure bit to constrain the application of another rule. Note, however, that the *f–structure* that corresponds to consumed c–structure fragments is available for reference at later stages of processing. An advantage of this annotation variant is that we can easily avoid inconsistent f–structure assignments by multiple rule applications. Annotation rules that would require complex application constraints to avoid such situations can in this variant be less constrained, by exploiting the order-dependence of rule application. An annotation grammar which makes use of c–structure consumption and reference to f–structure terms was developed for our experiment in Section 4. This grammar defines a natural order of part-of-speech related sections of annotation rules.

3.5 On the nature of f–structure annotation rules

Just like in an ordinary LFG grammar, we find, in our f–structure annotation approach, a division between lexical, morpho–syntactic, and phrasal annotation rules. However, in contrast to classical LFG PS rules, our syntactic rules describe *partial* c–structure/f–structure associations, which can extend to *non-local* configurations. In addition, our formalism allows us to define *underspecified* annotation rules, generalizing over classes of c–structure categories – both lexical and phrasal.

Lexical and morpho–syntactic rules Morpho–syntactic rules introduce morphological (and to some extent semantic) information encoded in lexical category labels into the f–structure space. This is illustrated below, for NUMber and NTYPE features. The example illustrates how highly specific category distinctions in treebank encodings can be neutralized: once NUMber is encoded in f–structure, based on the `nn1` vs. `nn2` distinction, this category distinction can be neutralized by mapping both lexical category labels to the generalized label `nn`.[23] This generalization is essential for compact rule definition. For example, below, the instantiation of the PRED–value of nouns is captured in a single lexical rule which applies to all "generalized" `nn`-daughters.

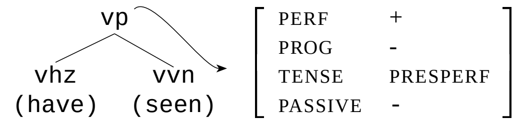
```
arc(A,RL,B,nn1) ==> num(B,sg), ntype(B,common), arc(A,RL,B,nn).
arc(A,RL,B,nn2) ==> num(B,pl), ntype(B,common), arc(A,RL,B,nn).

arc(A,RL,B,nnt1) ==> num(B,sg), ntype(B,temporal), arc(A,RL,B,nn).
arc(A,RL,B,nnt2) ==> num(B,pl), ntype(B,temporal), arc(A,RL,B,nn).

+arc(A,n,B,nn), +lex(B,Lex) ==> equal(A,B), pred(B,Lex), pers(B,'3').
```

Tense information as well as the active/passive distinction can be captured by stating constraints on the partial c–structure context of verbs, as illustrated below for active and passive present perfect tense in a flat VP structure, as it is assigned in the Susanne corpus.[24]

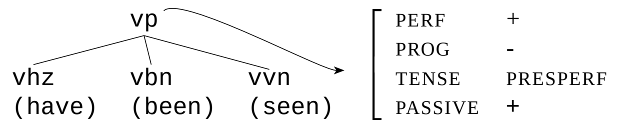
[23]See van Genabith et al. (1999b) for a similar approach.

[24]Since we assign a *flat* f–structure for complex tenses, we do not introduce PRED–values for lexical nodes of auxiliaries in the f–structure. See below for the assignment of appropriate subcategorization frames.

```
+arc(A,vp,B,vhz)  % have-aux
-arc(A,vp,D,vbn)  % no been-aux !
+arc(A,vp,C,vvn)  % main verb part.
==> perf(A,+), prog(A,-), tense(A,presperf),
     passive(A,-).
```



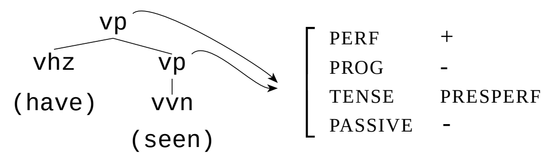

```
+arc(A,vp,B,vhz),  % have-aux
+arc(A,vp,C,vbn),  % been-aux
+arc(A,vp,D,vvn),  % main verb part.
==> perf(A,+), prog(A,+), tense(A,presperf),
     passive(A,+).
```



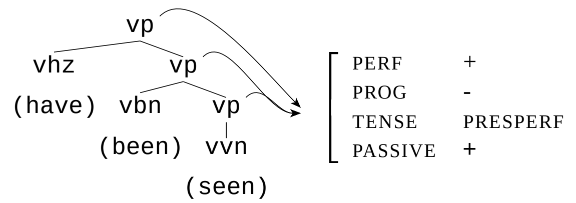

```
+arc(A,vp,D,vvn), +lex(D,Lex)
==> equal(A,D), pred(D,Lex), vform(D,main).
```

Given a treebank encoding that represents the verbal complex in terms of binary branching VP structures (as e.g. in the Penn Treebank, or the Lancester AP treebank), we can assign complex tense information in similar ways, by applying annotation rules to *non-local* tree fragments.

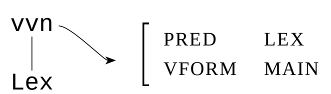
```
+arc(A,vp,B,vhz),                 % have-aux
+arc(A,vp,C,vp), +arc(C,vp,D,vvn)  % main verb part.
==> equal(A,C), perf(A,+), prog(A,-),
     tense(A,presperf), passive(A,-).
```




```
+arc(A,vp,B,vhz)                   % have-aux
+arc(A,vp,C,vp), +arc(C,vp,D,vbn),  % been-aux
+arc(C,vp,E,vp), +arc(E,vp,F,vvn)   % main vb part.
==> equal(A,C), equal(C,E), perf(A,+), prog(A,+),
     tense(A,presperf), passive(A,+).
```




```
+arc(A,vp,D,vvn), +lex(D,Lex)
==> equal(A,D), pred(D,Lex), vform(D,main).
```



Partial phrasal rules and underspecification As illustrated in Section 3.3, our annotation rules are designed to apply to linguistically motivated, i.e. modular, partial c–structure configurations, to define their corresponding functional projections. Even though treebanks do not encode classical X′ syntax, it still holds that specific types of tree branches correspond to functional dependencies in f–structure. Therefore, annotation rules apply, in the general case, to single tree branches, with some contextual constraints, and generalize to unseen tree configurations. Below, for example, *that*-clauses (with category label `f`) are associated with a function COMP in f–structure by referring to a single branch (`arc`) in the c–structure, abstracting away from irrelevant differences in the surrounding c–structure context.

The example also illustrates the effect of underspecification. *that*-clauses can appear in different syntactic contexts. By referring to an *underspecified* (variable) mother node label `RL`, we generalize over various possible mother labels (e.g. (in)finite, modal, nominal or adjective phrases).

```
+arc(A,RL,B,f), +comp_form(B,that) ==> comp(A,B).
```

Finer categorial restrictions can be captured by defining classes of category labels in (disjunctive) templates.[25] Below, the template `np_cat(X)` defines a class of category labels (`n, d, m`). The disjunctive template is called (by union) in the annotation rule for PPs (label `p`) to define this restricted class of alternative NP-types as complements (i.e., OBJ) of prepositions in a single rule.

[25] Disjunctive templates encode alternative rules, and can be unioned (&&) with annotation rules. While this does still involve disjunctive processing, the rules can be stated in a generalized, compact way.

```
template definition:  np_cat(X) ::  { X == n } ==> 0;   % n:  nominal phrase
                                    { X == d } ==> 0;   % d:  determiner phrase
                                    { X == m } ==> 0.   % m:  number phrase
annotation rule:      +arc(A,p,B,NP) ==> obj(A,B)
                      && np_cat(NP).
```

Grammatical function assignment In languages like English, grammatical function assignment relies heavily on c–structure configurations, while still not being fully deterministic. In case marking languages, morphological marking will be used to constrain grammatical function assignment. Below an example for the assignment of OBJ vs. OBJ2 functions for transitive and ditransitive verbs in English, which is determined by surface order.

```
+arc(A,vp,C,np), +arc(A,vp,D,np), +prec_x(C,D) ==> obj2(A,D).  % secondary OBJ of ditransitives

+arc(A,vp,C,np), +arc(A,vp,D,np), +prec_x(C,D) ==> obj(A,C).   % OBJ of ditransitives

-arc(A,vp,C,np), +arc(A,vp,D,np), {D \== C} ==> obj(A,D).      % OBJ of transitives
```

In various syntactic configurations we also need rules for non-local function distribution. Below, for example, a simple rule defines subject distribution in (the f–structure constructed from) VP-coordination.[26] Note that this rule refers uniquely to f–structure terms, since the generalization is easier to capture at the level of f–structure, rather than taking into account possible variations at the c–structure level.

```
+conj_form(A,_), +element(B,A), +subj(B,D),
                 +element(C,A), -subj(C,_) ==> subj(C,D).
```

Non-local dependencies, such as Wh-constructions can be captured by means of restricted path-equations `path(A,C)`. Below, we display an example from interrogative clauses, where the TOPIC clause, instantiated by the interrogative adverbial Wh-element (label `rrq`), is assigned the ADJUNCT function via restricted functional uncertainty embedding over the functions COMP and XCOMP (`comp_xcomp_path(A,C)`).[27]

```
+arc(A,f,B,r), +arc(B,r,C,rrq) ==> topic(A,B), comp_xcomp_path(A,C), adjunct_x(C,B).
```

Subcategorization assignment We induce subcategorization frames (so-called semantic forms) by collecting grammatical functions assigned by annotation rules into the predicate's semantic form, following van Genabith et al. (1999a)'s method.

Below we state the three rules that deal with OBJ assignment: an object `obj(A,B)` that is not yet assigned an argument position in the PRED's subcat list (`-arg(A,_,B)`) will be assigned the first argument position (`arg(A,1,B)`) in case of a coocurring non-thematic SUBJ (first clause), or if the head is a preposition (last clause); otherwise, it will be assigned the second argument position.

```
+obj(A,B), -arg(A,_,B), +subj(A,C), +nonarg(A,_,C) ==> arg(A,1,B).
+obj(A,B), -arg(A,_,B), +subj(A,C), -subj(A,2,C) ==> arg(A,2,B).
+obj(A,B), -arg(A,_,B), -subj(A,C) ==> arg(A,1,B).
```

---

[26]The rule is adjusted to the specificities of the Susanne corpus, where VP coordination is encoded as S-coordination, leaving the second conjunct without subject NP in the c–structure.

[27]In subcategorization filtering (see below Section 5.1) restricted functional uncertainty path equations are expanded by means of disjunctive templates, and the subcategorization constraints (with subscript _sc: e.g. `comp_sc(A,B)`) are checked against the f–structure.

```
path_exp(A,B) :: comp_xcomp_path(A,B) ?=> equal(A,B);
                 comp_xcomp_path(A,B) ?=> 0 && comp_or_xcomp(A,B);
                 comp_xcomp_path(A,B) ?=> 0 && comp_or_xcomp(A,C) && comp_or_xcomp(C,B);
                 comp_xcomp_path(A,B) ==> 0 && comp_or_xcomp(A,C) && comp_or_xcomp(C,D) &&
                                                                     comp_or_xcomp(D,B).

comp_or_xcomp(A,B) ::  0 ?=> comp_sc(A,B);
                       0 ==> xcomp_sc(A,B).
```

Obviously, pure c–structure information does not allow us to distinguish between NP/PP arguments vs. adjuncts, or infinitival complements vs. adjuncts. Similarly, lacking lexical information, raising and control constructions can only be represented as involving anaphoric control. In Section 5 we show how to integrate lexical subcategorization information, combined with strategies for ambiguity filtering (cf. Frank et al. (1998, 2000)).

3.6 Partial annotation and robustness

Our method for f–structure induction from trees embodies an important aspect of robustness. In cases of missing or incomplete annotation rules, the system does not fail, but partial trees are left without f–structure annotation. We obtain (typically large) partial, unconnected f–structures. See in particular the results and discussion of our Experiment in Section 4.

3.7 Moving treebanks

Finally, our framework can also be used to adjust particular treebank encodings, by *"moving"* treebanks to a different structural encoding, thereby facilitating principle-based f–structure induction. In our treatment of the Susanne corpus, we defined a set of general c–structure rewriting rules, which transform the encoding of coordination and flat modal VP structures into a more standard PS analysis, which lends itself to principle-driven f–structure annotation.[28]

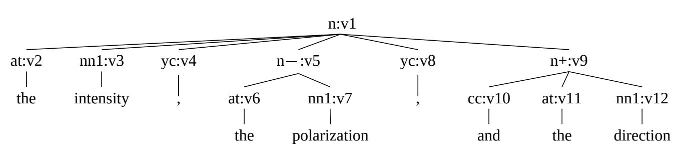
4 Experiment: An annotation grammar for the Susanne corpus

In a first controlled experiment, we applied our annotation method to the Susanne treebank. We developed an annotation grammar for two sections of the corpus, using an annotation scheme that consumes c–structure while building up the f–structure. For this approach, we set up a natural order for the various types of annotation rules presented in Section 3.5. In the following we summarize the basic results, and show, in Section 5, how the integration of lexical subcategorization information and preference ranking solves the obvious shortcoming of this first approach.

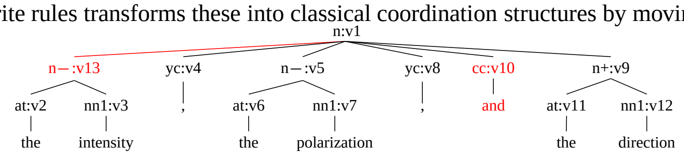
Data The Susanne treebank encodes labelled bracketed structures, where category labels are enriched with functional labels (subject, object). The trees contain traces to indicate certain control and long-distance dependencies. Functional labels and traces were eliminated in a preprocessing stage, to guarantee a non-biased evaluation scheme which takes conventional PS trees as input. In preprocessing we also collapse overspecific category labels, similar to van Genabith et al. (1999b). The treebank encoding was converted to a term representation as input for f–structure annotation.

Quite a few decisions on PS assignment in the Susanne corpus are debatable, and some make it difficult to assign f–structures in a principle-driven way. We therefore defined a set of initial (c–structure) rewriting rules, which transform the encoding of coordination and flat modal VP structures into a standard PS analysis. Finally, attachments in the NP are often flat, so that, for instance, complements to adjectives are not always correctly attached in the PS tree.

[28]In the Susanne corpus, coordination is encoded in a rather non-standard way:



A set of c–structure rewrite rules transforms these into classical coordination structures by moving and creating new nodes:



Experiment We chose two sections of the Susanne corpus, J01 and J02 (text type: learned writing). We ran an experiment in 3 steps. First, based on the 66 sentences of J01, we develop f–structure annotation rules to cover 50 sentences. In step 2 we apply the resulting annotation grammar AG1 to the unseen first 50 sentences of J02 (J02-1), and evaluate the results of f–structure annotation. Grammar AG1 is upgraded to AG2, which then covers these 50 sentences of J02-1. We record the number of rules that were added or modified. In step 3, AG2 is applied to the remaining unseen 46 sentences of J02 (J02-2). Again, we measure the results of f–structure annotation.

Evaluation and Results Table T1 provides basic data on the relevant subsections: the number of sentences processed and average sentence length (tokens, including punctuation); the number of phrasal and lexical categories and the number of distinct (i.e. types of) PS rules and PS branches encoded by the corpus trees (after categorial filtering in preprocessing).

Note that the percentage of new (unseen) tree branches in J02-1 and J02-2 is considerably lower than for new (unseen) PS rules.[29] This is not surprising, and supports our annotation scheme, where annotation involves underspecified, partial trees – often single branches.

T1	sentences	length	phrasal cat	lexical cat	PS rules	tree branches
J01	66	34.27 (max. 94)	32	73	430	281
J02-1	50 (1-50)	21.68 (max. 47)	25 (3 new)	64 (8 new)	249 (150=60.34% new)	172 (36=20.93% new)
J02-2	46 (51-96)	24.8 (max. 45)	24 (4 new)	57 (3 new)	212 (96=45.28% new)	163 (26=15.95% new)
	166		39	84	676	434

The results are summarized in table T2. Note that in this experiment correctness of f–structure assignment is measured modulo the PP argument/adjunct distinction, the missing assignment of control/raising equations, and systematic ambiguities as to the distinction between ADJUNCT vs. XCOMP readings of infinitives. Also, attachment or labelling mistakes in the treebank are not counted as annotation mistakes if the resulting f–structure is predicted from the given tree.

AG1 consists of 173 tag simplification and lexical rules, and 118 non-lexical f–structure assignment rules. AG1 covers 48% of the unseen sentences of J02-1. As expected from the above data, the upgrade from AG1 to AG2 required little effort: it involves 28 new and 5 modified rules, and required approx. 1 person day of work. AG2 applied to the unseen section J02-2 covers 76.09%.

T2	correct fs		partial fs		tag rules	lexical rules	non-lex rules	all rules
J01 with AG1	50	75.76%	16	24.24%	41	132	118	291
J02-1 with AG1	24	48%	26	52%	41	132	118	291
J02-1 with AG2	49	98%	1	2%	41+4	132+4 (2 mod)	118+20 (3 mod)	291+28 = 319
J02-2 with AG2	35	76.09%	11	23.91%	45	136	138	319

Discussion Our first experiment confirms the intuition that *partial c–structure/f–structure correspondences* generalize much stronger than full PS rules-to-f–structure correspondences, due to the fact that annotation principles typically select tree branches (plus some contextual constraints), which correspond to functional dependencies in f–structure. This is brought out by the ratio of new, unseen tree branches vs. PS rules in the corpus, and the corresponding ratio of added/modified annotation rules (table T3). The percentage of added/modified annotation rules corresponds almost exactly to the percentage of unseen PS branches. Our figures are of course not yet sufficient to judge whether the number of new annotation rules will decrease proportional to the number of new PS branches. But, since our rules make heavy use of category underspecification (see Section 3.5), we anticipate that the number of new annotation rules will show even stronger convergence.

T3	new PS rules	new PS branches	new phrasal annotation rules
J01 to J02-1	60.34%	20.93%	19.49%
J02-1 to J02-2	45.28%	15.95%	—

[29] And this already as evaluated on types, not on tokens. With growing coverage, novelty percentages at the level of tokens should be lower.

These results are promising, and particularly important for corpus-based approaches that rely on grammars (or trees) extracted from treebanks. Such grammars typically feature large, flat PS rules with repeated material in their right-hand sides. That is, they lack the information about optionality of daughter constituents, which in classical grammar writing is encoded by linguists. This linguistic knowledge captures generalizations that cannot easily be extracted from treebank grammars (and if so, only to a limited extent). The figures above confirm that our approach to f–structure induction compensates for this inherent lack of generalization by defining modular, principle-based annotation rules that apply to *partial c–structure configurations* of flat PS rules. The annotation principles import rule-based linguistic knowledge into the corpus-driven annotation process: they define how to generalize over varying syntactic contexts, abstracting away from linguistically irrelevant co-occurrences.

The amount of generalization captured by modular, partial annotation principles is also brought out by the high percentage of f–structures that could be correctly assigned for unseen portions of text: 48% and 76.09%, respectively.[30] These figures are extremely promising, but further work has to show how the novelty curve converges with repeated upgrades over new portions of text.

The robustness of our f–structure induction method – clearly indicated by the amount of large, partial f–structures in the case of missing annotation rules – relies on two main factors. One is the underlying rule compiler, the XLE term rewriting component. The rules are conditional, i.e., they only apply if their LHS terms match the input. They do not apply otherwise, hence the system doesn't fail in the case of missing rules. And since the principles specify small, modular c–structure configurations, they typically do not fail to apply in larger, unseen contexts. Second, in our application we rely on manually approved (i.e. deterministic) c–structure input, whereas in a classical LFG parsing architecture c– (and f-) structures are freely constructed from a set of PS rules, which therefore must encode numerous grammaticality constraints as a filter on a large set of possible structures assigned to an input string. Such grammars are by necessity more constrained, and therefore less robust. This burden is taken from annotation grammars that operate on disambiguated c–structure input.

5 Subcategorization and OT constraint ranking

The evaluation of our experiment in Section 4 does not measure the correctness of certain grammatical function assignments, in particular the argument/adjunct distinction for PPs and *to*-infinitives, and raising/control equations. In this first setup we focussed on the structural aspects of f–structure assignment, to test how well we can do without explicit lexical knowledge. Since we did not incorporate any lexical subcategorization knowledge, it is obvious that in some nondeterministic contexts grammatical function assignment cannot be correctly disambiguated, given only c–structure or lexical category information.

The next step is to integrate lexical subcategorization information in the annotation process. We first describe the basic formal account on how to integrate subcategorization information to resolve nondeterminism in grammatical function assignment. However, a simple, straightforward application of this scheme will involve considerable overhead in computation, and, in essence, compromise one attractive feature of our approach, its inherent robustness. We therefore propose a selective approach to subcategorization-based ambiguity filtering, combined with techniques for OT-based ambiguity ranking in large-scale LFG grammars (cf. Frank et al. (1998, 2000)).

5.1 Lexical information for grammatical function assignment

Subcategorization ambiguities that cannot be predicted from ordinary c–structure encodings in treebanks are illustrated in (1) and (2) for argument/adjunct ambiguities of PPs and *to*-infinitives.[31]

[30]Even though section J01 features sentences with about 10 words in average more than in the later sections, this result is significant. Note also that these figures are conservative, in that they only record *completely* connected f–structures, whereas almost all remaining sentences yielded large pieces of partial, unconnected f–structures.

[31]Some treebanks, e.g. PennTreebank, encode subcategorization distinctions of this type. See Sec. 6 for discussion.

(1) A plug and a tube with holes in its cylindrical walls divided the chamber above the porous plug <u>into two parts</u>.
[s, [n, a plug and a tube with holes in its cylindrical walls], [v,[vvd,divided]],[n, the chamber above the porous plug], [p, into two parts]]

(2) The high heat fluxes existing at the electrode surfaces of electric arcs necessitate extensive cooling <u>to prevent</u> <u>electrode ablation</u>.
[s,[n, the high heat fluxes existing at the electrode surfaces of electric arcs], [v,[vv0,necessitate]], [n, extensive cooling], [t, to prevent electrode ablation]]

In such nondeterministic contexts, annotation rules assign grammatical functions disjunctively, by use of optional rules. Below, the first rule applies optionally, defining the PP (`p`) as an ADJUNCT of the VP (`v`); the second rule (alternatively) assigns the PP the argument function OBLique.

```
arc(A,v,B,p) ?=> adjunct_x(A,B)
arc(A,v,B,p) ==> oblique(A,B)
```

Without any further lexical information about the governing verb, *divide* in (1), the ambiguity can only be resolved manually. Similar rules produce a systematic ambiguity for *to*-infinitives as in (2), which can be either ADJUNCTs or XCOMP complements.

In order to (partially) resolve such ambiguities, we integrate subcategorization knowledge, extracted from machine-readable dictionaries.[32] The subcategorization frames stated in the dictionary are compiled into the rule format illustrated below. Largely equivalent to subcategorization encoding in LFG semantic forms, the PRED value is expanded to a predicate `pred_x`, with an index `Id`, a unique identifier for the subcat-reading at hand (`pred_x(X,Lex,Id)`), together with a set of terms `GF_sc(X,Id)` for each grammatical function GF the lexical item subcategorizes for on reading `Id`.

```
pred(A,exist)        ==> pred_x(A,exist,1), subj_sc(A,1).
pred(A,necessitate)  ==> pred_x(A,necessitate,1), subj_sc(A,1), obj_sc(A,1).
pred(A,divide)       ?=> pred_x(A,divide,1), subj_sc(A,1), obj_sc(A,1).
pred(A,divide)       ==> pred_x(A,divide,2), subj_sc(A,2), obj_sc(A,2), obl_sc(A,2,into).
```

These lexical rules apply late in the annotation process, after the f–structure is completed through c–structure-guided, partially nondeterministic grammatical function assignment. With matching `pred` terms in the input, the rules introduce the respective subcategorization constraints into the f–structure space, where they can be used to check and filter the GF assignment ambiguities. This is done by encoding LFG completeness and coherence constraints in a straightforward way, as illustrated below for the SUBJ function. If completeness or coherence is violated, for any of the grammatical functions, we record the type of violation in a term `o_x(X,OTmark)`.

```
completeness constraints (subj):   +pred_x(A,_,X), +subj_sc(A,X), -subj(A,_) ==> o_x(A,incomplete).
coherence constraints (subj):      +pred_x(A,_,X), -subj_sc(A,X), +subj(A,_) ==> o_x(A,incoherent).
```

In this way we model the approach to OT constraint ranking for ambiguity filtering in LFG grammars proposed in Frank et al. (1998, 2000), extending it to well-formedness constraints of completeness and coherence. By declaring the "OT marks" `incomplete` and `incoherent` as `UNGRAMMATICAL`- or `NOGOOD`-marks in a grammar-specific constraint ranking hierarchy (see below), the f–structures marked with the respective OT marks will not be considered grammatical, and therefore effectively filtered from the set of grammatical f–structures.[33]

```
Optimalityranking:  pp_obl inf_xcomp NEUTRAL UNGRAMMATICAL incomplete incoherent
                    NOGOOD.
```

[32]The COMLEX dictionary, for example, (distributed by the Linguistic Data Consortium LDC at `http://www.ldc.upenn.edu`) provides extensive subcategorization information for English.
[33]For more detail on the interpretation of the various types of OT marks, see Frank et al. (1998, 2000). We implemented a corresponding constraint ranking algorithm which we apply to filter and rank ambiguities in the output of f–structure annotation.

Given the lexical entry for *necessitate* above, the XCOMP reading for the *to*-infinitive in (2) is marked incoherent, the ambiguity is successfully resolved to the adjunct reading. On the other hand, *divide* in (1) *optionally* subcategorizes for an OBLique PP (*into*). Whereas an OBL function is penalized on the transitive reading 1, and vice versa for ADJUNCT assignment with reading 2, we cannot resolve the ambiguity between subcat reading 1 and 2 in terms of coherence and completeness constraints. However, in such cases of real syntactic ambiguity we can state a general preference for the OBLique reading of *optional* PP arguments, by assigning a preference mark `o_x(A,pp_obl)` in the corresponding lexical entry, and similarly for ambiguities involving *optional* XCOMP arguments.

```
pred(A,divide)  ?=> pred_x(A,divide,1), subj_sc(A,1), obj_sc(A,1).
pred(A,divide)  ==> pred_x(A,divide,2), subj_sc(A,2), obj_sc(A,2), obl_sc(A,2,into), o_x(A,pp_obl).
```

With the OT constraint ranking hierarchy given above, the (preferred) oblique reading will be determined as the winner in competition against the unmarked (NEUTRAL) ADJUNCT reading, which will be determined as suboptimal. While it will always be possible to construe counterexamples where such general preference constraints make wrong predictions, they prove very efficient and reliable in practice, and can be refined by further knowledge sources (cf. Frank et al. (1998, 2000)).

5.2 A selective approach to ambiguity filtering

With such a general approach for subcategorization-based ambiguity filtering and preference ranking, we could now compile large subcategorization dictionaries into lexical rules as illustrated above. Given the large amount of subcategorization frames that verbs, adjectives and also nouns can allow, this does not only imply a significant amount of processing, it also raises the issue of robustness. It is still easy to account for missing lexical entries in the subcategorization lexicon – here we exploit the conditional format of our lexical rules: if no entry is present for a given lexical form, no rule is applied. The worst that can happen in this case is that we do not filter any nondeterministic function assignments. We still get a set of (minimally) ambiguous f–structures for manual selection. However, the lexicon might contain a subcat entry for a lexical item which is missing a particular frame, the one that is crucial for the sentence at hand. In such a case, the corresponding (correct) function assignment will be judged incoherent or incomplete, the analysis will be rejected. One possible remedy is to declare completeness and coherence constraint violation as ungrammatical marks, as shown above. As in classical Optimality Theory, this type of constraint violation will only be considered "ungrammatical" if some other, less strongly marked competing analysis is available. That is, the analysis can surface as long as no other subcategorization frame fits the correct function assignment better, or no competing analyses can be validated. Yet, in such situations, unwarranted ambiguities may arise.[34]

But . . . let us step back and reconsider our experiment above, where – without any lexical subcategorization information – most types of grammatical function assignments could be reliably stated by looking at c–structure configurations, lexical items, or lexical categories in treebank entries. For illustration, looking at (3), consider *that*-clauses adjacent to nouns, which could be either subcategorized COMPlements or relative clauses. Since the treebank uses distinct lexical categories for *that* as a complementizer, relative or demonstrative pronoun, the function assignment can be unambiguously determined by constraining the local syntactic context. Similarly, we can distinguish predicative *be* from the tense auxiliary in terms of its immediate c–structure context. And even though we generalize over the (original) distinct treebank categories for relative, adjunct, or complement clauses, the distinct f–structure contributions of these clauses can, again, be assigned by looking at a small class of lexical functional heads in the immediate syntactic context.

(3) This result suggests a very high temperature at the solid surface of the planet, <u>although</u> there <u>is</u> the possibility <u>that</u> the observed radiation may <u>be</u> a combination of both thermal and non-thermal components and <u>that</u> the observed spectrum is <u>that of a black body</u> merely by coincidence.

[34] As an example, if for some verb the lexicon specifies two subcat frames: ⟨SUBJ⟩ and ⟨SUBJ, OBL⟩, but misses a valid transitive frame ⟨SUBJ, OBJ⟩, a structure that introduces SUBJ and OBJ functions will be assigned an equal number of ungrammatical (completeness & coherence) violation marks for both incorrect readings.

A natural, selective approach to ambiguity filtering is thus to rely on grammatical function assignments *without lexical validation* in all those cases where the information can be gathered from the c–structure context (or morphological marking in case-marking languages), that is, by exploiting linguistic insights and generalizations encoded in the respective treebank annotations. Only those types of ambiguities that need to be validated or disambiguated in terms of lexical subcategorization properties will be checked by consulting lexical knowledge bases – which are by necessity error-prone and incomplete.[35] This *selective* approach to lexicon-based ambiguity filtering is an important move, in that it proposes a novel partition of ambiguity filtering knowledge in the LFG architecture, which is also essential to preserve the inherently robust architecture of our f–structure induction method. It is evident that this approach is strongly dependent on language-specific properties, the specific encoding schemes of the underlying treebanks, as well as, of course, our specific application scenario: f–structure annotation of *disambiguated* trees. Yet, the investigation of language-specific encoding strategies of grammatical functions constitutes an interesting research topic in itself.[36]

5.3 Future Work

We have implemented the basic and selective approach to subcategorization filtering and ambiguity ranking for a toy dictionary. In future work we will extract subcategorization frames for the 3 types of ambiguities discussed above from a large subcategorization dictionary, and test the lexicalized f–structure annotation grammar on the sections of the Susanne corpus analyzed in Section 4. The evaluation will then measure correct subcategorization assignment in *optimal* f–structures.

6 Annotating Treebanks – A Balancing Act

At this point, we need to raise an issue about varieties in treebank annotation schemes, and how best to exploit them for different applications. Some treebanks, such as the PennTreebank, encode a significant amount of subcategorization in complex category labels. The obvious question to ask then, is why not directly exploit these encodings. If our objective is simply to build f–structure banks, this is the best option. In our experiment we have shown that our approach is more flexible, in that it allows us to construct correct f–structures from poorer treebank encodings. Moreover, encoding grammatical functions in terms of complex category labels and coindexations in c–structure misses generalizations that appear, in a *normalized* representation, at f–structure (consider e.g. active/passive distinctions, extraposition, or topicalization). More importantly, our method can be extended to free parsing architectures, with c–structure filtering based on probabilistic CFGs, *trained on treebanks*. If such grammars are trained on highly complex PS categories, they will not generalize enough to deliver good statistics. Instead, treebank grammars are typically trained on suitably impoverished categorizations, stripping off special indexations and collapsing overspecific functional labels. The c–structures delivered by such a PCFG will miss some of the extra knowledge encoded in the treebank, but can be supplemented with the additional, much more general knowledge imported by annotation principles and lexical knowledge sources in subsequent f–structure projection. Finally, we can define *varying* annotation grammars for a validation scenario: one annotation grammar can exploit highly specific treebank encodings, i.e. functional labels and coindexations. The resulting f–structure bank can then be used as a reference corpus for evaluation of the second grammar, eventually used in free parsing, which operates on a coarser set of category labels (both in parsing and annotation), but exploits the complementary linguistic knowledge encoded in annotation principles and subcategorization lexica.

[35] In practice, this means that our subcategorization lexicon contains only a limited subset of lexical entries and subcat frame types, those related to the specific types of ambiguities we need to resolve – and these are limited. Lexicon lookup is then restricted to contexts where these respective types of ambiguities arise.

[36] See, for instance, the generalizations on morphological marking across languages in Berman (1999), as well as studies on head-marking languages (e.g., Nordlinger (1997), Bresnan (2000)).

7 Conclusion

We presented one of two alternative methods to automate the approach of van Genabith et al. (1999a,b,c). Annotation principles define ϕ–correspondences from partial c–structure configurations to their corresponding partial f–structures. Our first experiment shows that this approach is a promising method for treebank annotation with f–structures. In particular, we show first promising figures for upgrading to extended fragments, which stem from generalizations captured in linguistically motivated, *modular and partial* annotation principles. Moreover, the method can be viewed as a technique for rapid, corpus-based grammar development. Our annotation grammar was set up in a time frame of about 3 weeks, and covers contiguous real-life text, including sentences with up to 94 words. The grammar comprises lexical and morphological rules ($\approx$ lexicon templates), tag compaction rules, as well as rules for virtually all core phenomena of syntax.[37]

In our approach – which we might call "corpus-based LFG" (CB-LFG) – we exploit the linguistic knowledge about c–structure organization that is implicit in the treebank entries, together with the fact that the assigned trees are disambiguated. In comparison, classical LFG grammars must not only define the context-free rule set for a particular language. Broad-coverage LFG grammars also have to cope with massive ambiguity arising from large sets of PS rules, and therefore state f–structure constraints to tame the amount of unwarranted ambiguities and ungrammatical analyses. In the context of f–structure induction from treebanks, we rely on c–structure disambiguation and, by and large, grammaticality of the input. The f–structure projection principles can be stated in a less constrained, declarative way, which naturally increases the robustness of such "grammars".

The annotation principles we use for f–structure induction from trees can be considered as a *modular, principle-based c–structure/f–structure interface for LFG grammar architectures*, and we apply it, here, to real-life language fragments, combining a corpus-driven approach with rule-based linguistic knowledge. There is, however, still some way to go to extend f–structure induction from treebank trees to a probabilistic robust parsing architecture for the analysis of new sentences.

References

Berman, J. (1999). Does German Satisfy the Subject Condition? In Butt, M. and King, T., editors, *Proceedings of the LFG99 Conference*, Manchester University, CSLI Online Publications, Stanford, CA.

Bod, R. and Kaplan, R. (1998). A Probabilistic Corpus-Driven Model for Lexical-Functional Analysis. In *Proceedings of COLING/ACL'98*, pages 145–151.

Bresnan, J. (2000). Lexical-Functional Syntax. Blackwells Publishers, Oxford.

Cancedda, N. and Samuelsson, C. (2000). Experiments with Corpus-based LFG Specialization. In *Proceedings of ANLP-NAACL2000*, Seattle, Washington, Seattle, Washington.

Charniak, E. (1996). Tree-bank Grammars. In *AAAI-96. Proceedings of the Thirteenth National Conference on Artificial Intelligence*, pages 1031–1036. MIT Press.

Cormons, B. (1999). *Analyse et désambiguïsation: Une approche à base de corpus (Data-Oriented Parsing) pour les représentations lexicales fonctionnelles*. PhD thesis, Université de Rennes, France.

Dalrymple, M. (2000). Lexical-Functional Grammar. Manuscript, Xerox PARC.

Dipper, S. (2000). Grammar-based Corpus Annotation. In *LINC 2000*.

Eisele, A. (2000). *Representation and stochastic resolution of ambiguity in constraint-based parsing*. PhD thesis, Universität Stuttgart, Stuttgart.

Frank, A. (1999). From Parallel Grammar Development towards Machine Translation. A Project Overview. In *Proceedings of Machine Translation Summit VII "MT in the Great Translation Era"*, pages 134–142.

[37] An example f–structure is given in the Appendix.

Frank, A., van Genabith, J., Sadler, L., and Way, A. (1999). Automatic F-structure Annotation of Treebanks and CF Grammars. Unpublished Ms., Xerox Research Centre Europe, Dublin City University, University of Essex.

Halvorsen, P.-K. and Kaplan, R. (1995). Projections and Semantic Description in Lexical-Functional Grammar. In Dalrymple, M., Kaplan, R., Maxwell, J., and Zaenen, A., editors, *Formal Issues in Lexical-Functional Grammar*, pages 279–292. CSLI Lecture Notes, No.47.

Johnson, M., Geman, S., Canon, S., Chi, Z., and Riezler, S. (1999). Estimators for Stochastic "Unification-based" Grammars". In *Proceedings of the ACL*.

Johnson, M. and Riezler, S. (2000). Exploiting auxiliary distributions in stochastic unification-based grammars. In *Proceedings of the 1st NAACL conference*, Seattle, Washington.

Kallmeyer, L. (2000). A Query Tool for Syntactically Annotated Corpora. In *Proceedings of Joint SIGDAT Conference on Empirical Methods in Natural Language Processing and Very Large Corpora*, Hong Kong, to appear.

Kay, M. (1999). Chart Translation. In *Proceedings of Machine Translation Summit VII "MT in the Great Translation Era"*, pages 9–14.

King, T.-H., Dipper, S., Frank, A., J.Kuhn, and Maxwell, J. (2000). Ambiguity Management in Grammar Writing. In *ESSLLI'2000 Workshop on Linguistic Theory and Grammar Implementation*, Birmingham, Great Britain.

Nordlinger, R. (1997). *Constructive Case. Dependent-Marking Nonconfigurality in Australia*. Ph.D. Thesis, Deperatment of Linguistics, Stanford University, Stanford.

Riezler, S., Prescher, D., Kuhn, J., and Johnson, M. (2000). Lexicalized Stochastic Modeling of Constraint-Based Grammars using Log-Linear Measures and EM Training. In *Proceedings of the 38th Annual Meeting of the Association for Computational Linguistics (ACL'00)*, Hong Kong, China.

Sadler, L., van Genabith, J., and Way, A. (2000). Automatic F-Structure Annotation from the AP Treebank. In Butt, M. and King, T., editors, *Proceedings of the LFG00 Conference*, University of California, Berkley, CSLI Online Publications, Stanford, CA. `http://www-csli.stanford.edu/publications/`.

van Genabith, J., Sadler, L., and Way, A. (1999a). Data-Driven Compilation of LFG Semantic Forms. In *EACL'99 Workshop on Linguistically Interpreted Corpora (LINC-99)*, pages 69–76, Bergen, Norway.

van Genabith, J., Sadler, L., and Way, A. (1999b). Structure Preserving CF-PSG Compaction, LFG and Treebanks. In *Proceedings ATALA Workshop - Treebanks*, Journees ATALA, Corpus annotes pour la syntaxe, Universite Paris 7, France, 18-19 Juin 1999, pages 107–114.

van Genabith, J., Way, A., and Sadler, L. (1999c). Semi-Automatic Generation of F-Structures from Tree Banks. In Butt, M. and King, T., editors, *Proceedings of the LFG99 Conference*, Manchester University, 19-21 July, CSLI Online Publications, Stanford, CA. `http://www-csli.stanford.edu/publications/`.

Way, A. (1999). A Hybrid Architecture for Robust MT using LFG-DOP. In *Journal of Experimental and Theoretical Artificial Intelligence 11 (4) (Special Issue on Memory-Based Language Processing)*.

Appendix: An example f–structure from the Susanne Corpus

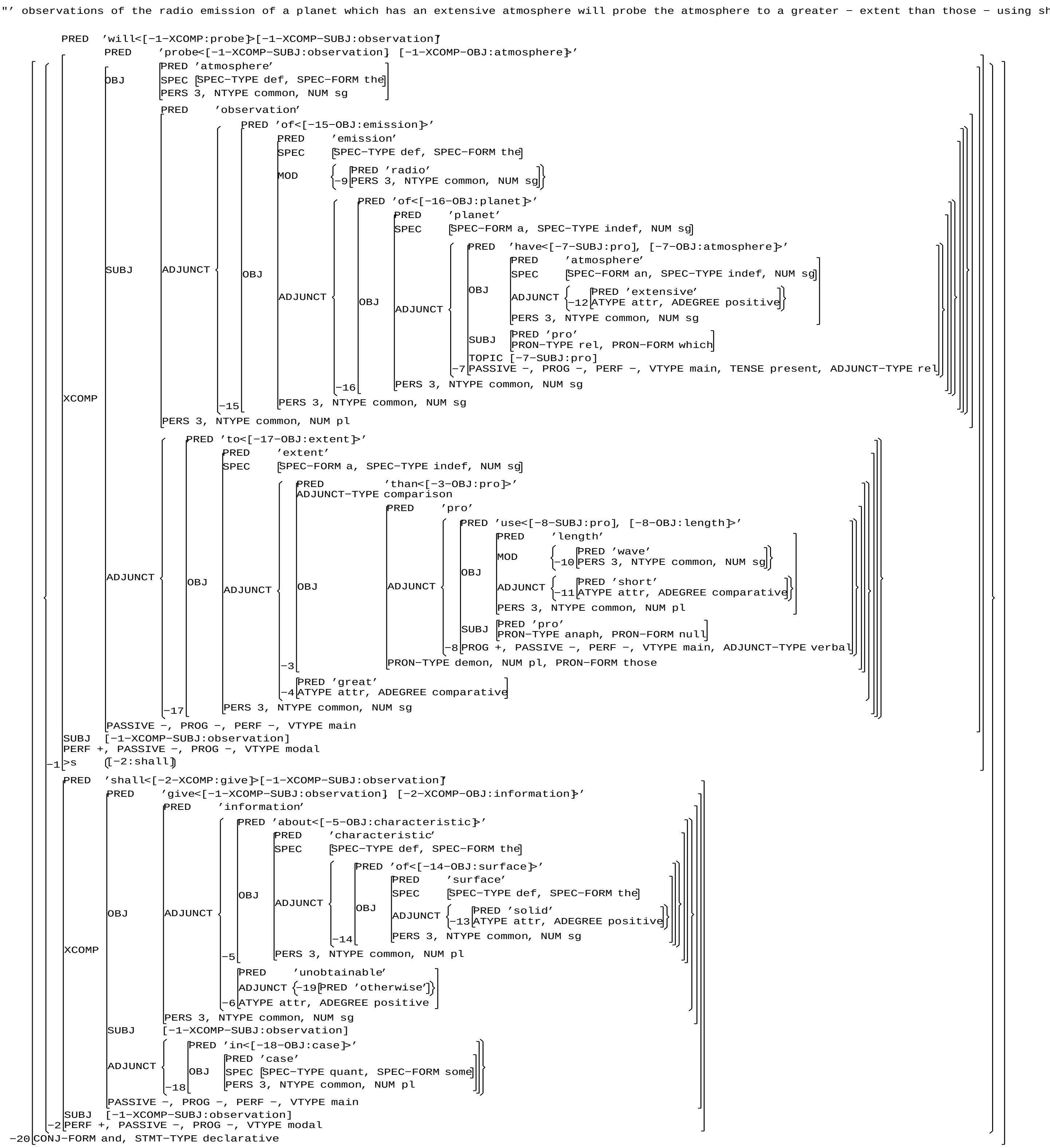


Figure 1: F–structure for: *Observations of the radio emission of a planet which has an extensive atmosphere will probe the atmosphere to a greater extent than those using shorter wave lengths and should in some cases give otherwise unobtainable information about the characteristics of the solid surface.*

Faithfulness violations and bidirectional optimization

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Abstract

The systematic assumption of faithfulness violations in Optimality Theory implies an infinite space of candidates. Under the methodological principle of trying to explain as much possible through constraint interaction, control over this infinite space should be exerted by the constraints. Assuming the subsumption-based candidate definition of OT-LFG, the candidate space is indeed sufficiently structured to facilitate computational processing according to this principle. However, the parsing direction in the standard production-based optimization model is not subject to optimization, so for the parsing task, a decidability issue arises. Adopting a bidirectional optimization model is one way of solving this problem, but the required strong concept of bidirectional optimization may not be linguistically desirable. Other possible conclusions are discussed briefly.

1 Introduction

The key insight in the Optimality-theoretic (OT) approach in phonology and syntax[1] has been that variation between languages can be derived in a system assuming a universally invariant set of (conflicting) constraints on well-formed linguistic structures where it is only the relative ranking of these constraints that differs cross-linguistically. A constraint may be violated to satisfy some more highly ranking constraint. The different language-specific constraint rankings will bring out different ways of resolving conflicts between the constraints, leading to a different set of optimal (i.e., by definition grammatical) structures.

Slightly more technically, an OT system is thus set up as the combination of (i) a candidate generation component (*Gen*) that – given some underlying form (the *input*) – produces a set of competing structures which all satisfy some inviolable principles, and (ii) an evaluation component (*Eval*) that checks the candidate structures for constraint violations and determines the optimal (most harmonic) candidates relative to the constraint ranking of the language in question. (The customary tableau notation focuses on component (ii), assuming the candidate set as given and illustrating the constraint violations of the individual candidates and the harmony evaluation across the candidates.)

This general set-up leaves quite some space for variation as to the implementation of a particular OT system for use in a linguistic study or a computational system. One may choose to assume a relatively restrictive set of inviolable principles (as part of *Gen*), leaving a fairly small set of alternatives for the optimization step, or one may assume very weak inviolable principles and leave most of the work to the interaction of violable constraints.

Of course, keeping the candidate space small has the practical advantage of making the optimization task more perspicuous to the theorist, and indeed most OT studies in the literature focus on just some small set of candidates considered relevant for the studied phenomenon. However, this practical move doesn't justify the conclusion that the overall system that OT theorists see themselves as contributing to has a *Gen* component doing that much work. To the contrary, a widely assumed methodological principle is:

(1) *Methodological principle of OT*
Try to explain as much as possible as an effect of constraint interaction.

[1](Prince and Smolensky 1993); see (Kager 1999) for an introduction.

This implies an overall OT model with a very weak *Gen* component.

As an end in itself, principle (1) would not be of much scientific value. What is behind it is the above mentioned observation that for certain linguistic phenomena, OT constraint interaction has been shown to successfully predict the space of cross-linguistic variation (through *factorial typology*, cf. e.g., Kager 1999, sec. 1.7), including the systematic exclusion of certain logically possible languages. So the reason for following (1) is to investigate to what extent OT constraint interaction may serve as the key explanatory device in modelling linguistic knowledge in general. Evaluation of success in this investigation should be based on criteria like the following: Is the empirically observable typological space predicted based on a set of well-motivated constraints?[2] The strong hypothesis of the Optimality-theoretic approach is thus that all (and only) the observed cross-linguistic variation can be explained as an effect of constraint reranking.

A closer investigation of the formal and computational implications of the strong OT hypothesis is one way of checking to which degree it is tenable. The present paper is an attempt to follow this path, focusing on the division of labour between *Gen* and *Eval*. A key question will be under what circumstances the processing tasks (parsing/recognition and generation) based on an OT model are decidable (Johnson (1998) observes a decidability problem for the general, unrestricted OT model).

The reasoning in this paper is as follows: we can observe certain variations across the languages of the world (whether or not (i) expletive elements are used and (ii) pronominals may be dropped): sec. 2. If we want to model these variations as a mere effect of constraint interaction, *Gen* has to have a certain property (generating particular faithfulness violations); such a system is definable in the OT-LFG framework: sec. 3. Now, if we want all the processing tasks (in particular parsing) to be decidable with this type of *Gen*, we are forced to assume a bidirectional optimization regime. (A processing scheme for OT-LFG is reviewed in sec. 4; sec. 5 addresses the decidability issue and bidirection.) Bidirectional optimization has been variously argued for on empirical grounds, but it also has certain problems and is certainly not the standard model assumed for OT. Thus, it is somewhat surprising that under the given assumptions and hypotheses, bidirectional optimization is enforced on computational grounds. There are different possible conclusions to be drawn from this result (sec. 6).

The approach taken in this paper differs from the approach of (Kuhn 2000a), where the methodological principle (1) wasn't given highest priority, but the goal was to directly exploit results from formal work on classical LFG in order to set up a model for OT-LFG with decidable processing tasks.

2 Variation across languages

The types of cross-linguistic variation that motivate the assumption of considerable differences between the competing candidates' surface strings are very basic ones and were already discussed in the earliest work on OT syntax (cf. Grimshaw 1997): for syntactic reasons, some

[2]In the motivation of constraints for OT syntax there is a certain danger for circularity, since often an obvious functional motivation (like phonetic restrictions in OT phonology) cannot be given, so the best motivation is through effects of the constraint in interaction, essentially based on factorial typology.

languages require the use of expletive elements where other languages do not (cf. the expletive *do* in English (2a), vs. the German example (2b)).

(2) *Expletive elements*

a. *Who did John see*

b. *Wen sah John*
whom saw John

According to the methodological principle of OT (1), this contrast should be explained as an effect of constraint interaction; i.e., the structures of both sentences have to be competitors in the same candidate set. The candidate winning in English is a case where the surface string contains some additional element not present in the underlying *input*. So, quite similarly as in OT phonolgy, faithfulness to the input has to be a violable constraint in OT syntax. In English, it is outranked by some structural Markedness constraint, thus giving rise to an unfaithful winner. The constraint at stake here is DEP-IO:

(3) DEP-IO: Output segments must have input correspondents.—'No epenthesis'

(4) MAX-IO: Input segments must have output correspondents.—'No deletion'

For the MAX-IO constraint, we also find syntactic examples: *Pro-drop* languages like Italian (5b) have no overt correspondence for the subject pronoun referring to a topical entity (5a) (cf. Grimshaw and Samek-Lodovici 1998). This demonstrates that it is possible to leave some *input* material unrealized to satisfy some high-ranking Markedness constraint.

(5) *Dropped pronominal*

a. *She has sung*

b. _ *ha cantato*

Consequences for *Gen* As already stated in the introduction, identifying something as an effect of constraint interaction implies that the other component of an OT system, *Gen*, has to preserve the status quo. Assuming faithfulness as a violable constraint means that candidate generation has to be insensitive to the preservation of the *input* information in the surface string.

Assuming a predicate-argument structure with additional tense information as in (6) as *input* (cf. Grimshaw 1997), we are thus faced with all items in (7) as possible candidates, most of them violating DEP-IO or MAX-IO or both (violating MAX-IO twice will for instance lead to a phonologically empty candidate: (7f)).

(6) *Input*
laugh(*Ann*) & TENSE: PAST

(7) a. Ann laughed
 b. Ann did laugh
 c. it laughed Ann
 d. laughed
 e. Ann
 f.
 g. she laughed
 h. she did
 i. Ann yawned
 j. Ann saw him, etc.

With an appropriate number of MAX-IO violations (precluding the underlying input form to appear overtly) and DEP-IO violations (introducing material that normally denotes something else) we can arrive at every conceivable word string, no matter what the input is. At first sight, such an OT system clearly seems computationally intractable due to an incontrollable candidate space. As will be shown in the next section, the LFG-based conception of OT syntax provides a natural framework for modelling the intuitions about faithfulness violations addressed in this section in a way that allows one to structure the candidate space adequately for computational processing.

3 Optimality-theoretic LFG: the subsumption-based conception

The starting point for the LFG-based framework for OT syntax, due to (Bresnan 1996; Bresnan 1998), is the observation that the following two intuitions underlying candidate generation can be captured in a formally precise way using LFG:

- All candidates satisfy certain inviolable principles;
- competing candidates are alternative realizations of the input.

The inviolable principles can be encoded in a formal grammar, and using a formalism with a structural representation abstracting away from language-specific realization issues (f-structure), we also have a way of making the role of the input in candidate generation explicit. Inputs are simply formalized as (not yet fully specified) f-structures.

Then the candidates for a given input can be defined as

- analyses of an LFG grammar encoding the inviolable principles (call it G_{inviol})
- containing (i.e., being subsumed by) the input in their f-structure.

More formally, we have the following definition of *Gen* (cf. Kuhn 2000a; Kuhn 2000b – the language generated by an LFG grammar is defined as a set of c-structure/f-structure pairs $\langle T, \Phi \rangle$):

(8) Definition of *Gen*

Φ_{in}: input representation,

Gen$(\Phi_{in}) = \{\langle T, \Phi' \rangle \in L(G_{inviol}) | \Phi_{in} \sqsubseteq \Phi'$, where Φ' contains no more semantic information than $\Phi_{in}\}$

This means that candidates may monotonically add (non-semantic) information to the input f-structure, plus they each specify a particular c-structure.

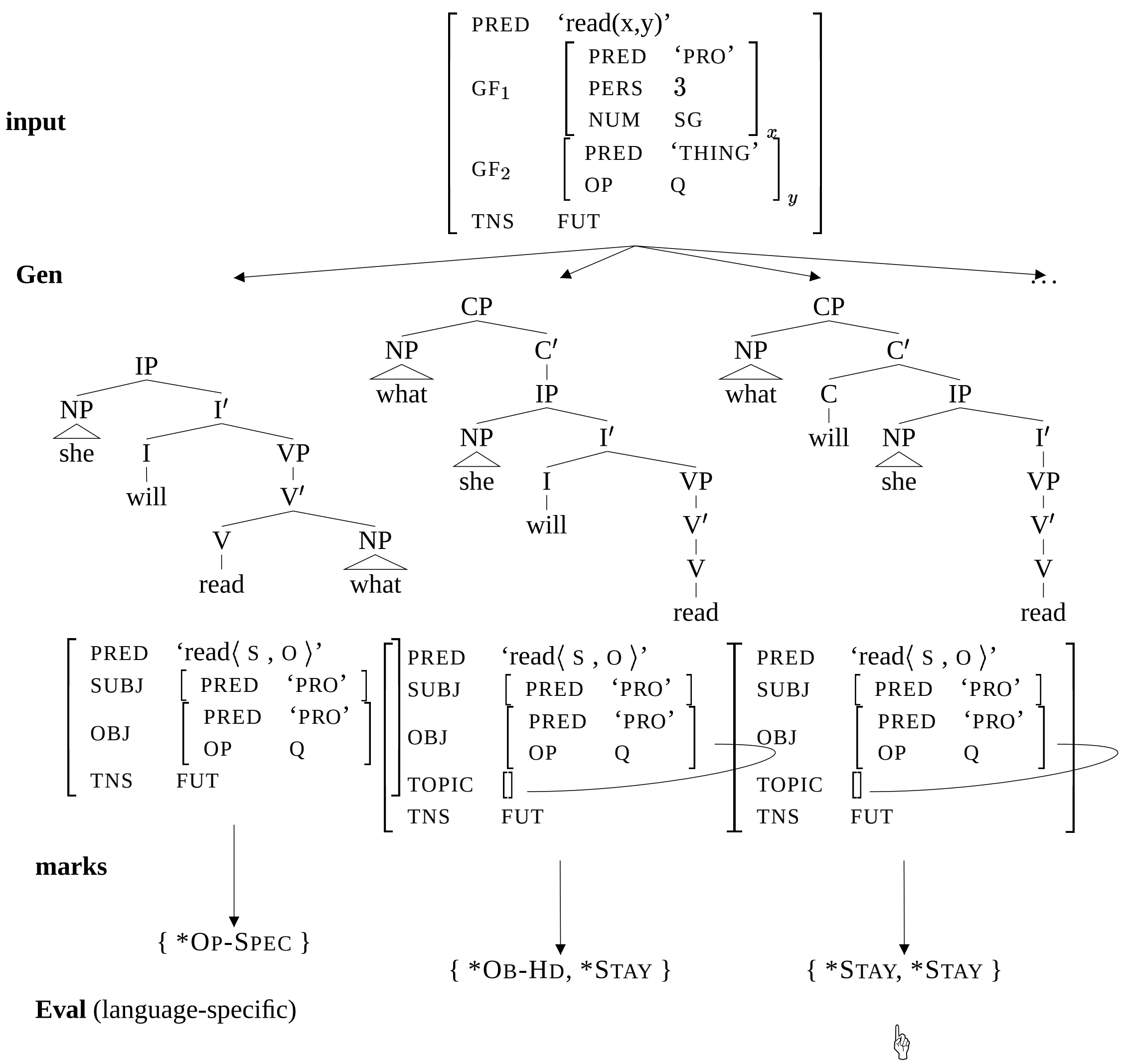


Figure 1: Illustration of the OT-LFG model

With this conception of *Gen*, the Markedness constraints can be formulated straightforwardly as descriptions of structural configurations in the candidate c-structure/f-structure pairs (for more discussion, see Kuhn 2000a, sec. 3.2). So, the standard OT definition of *Eval* (which has been much more explicit in the literature than the definition of *Gen*) can be applied. The entire OT-LFG system is illustrated graphically in fig. 1. The inviolable principles underlying candidate generation are essentially an extended X-bar theory (Bresnan 2000, ch. 7), the three violable constraints at work (listed in (9)) are taken from Bresnan's (1998) LFG-based reconstruction of (Grimshaw 1997). (Application of the violable constraints is called *marks*.)

(9)	OP-SPEC	An operator must be the value of a DF in the f-structure.
	OB-HD	Every projected category has a lexically filled [extended, JK] head.
	STAY	Categories dominate their extended heads.

The language generated by an OT system is thus defined as follows (note the existential quantification over input representations, which will be of importance when looking at the parsing/recognition task in sec. 4.2):

(10) *Language generated by an OT system*

A string w is contained in the language defined by an OT system

iff there exists an underlying input representation Φ_{in} s.th. w is the terminal string of the optimal candidate in *Gen*(Φ_{in}).

3.1 Faithfulness violations in OT-LFG

Let us come back to the faithfulness violations addressed in sec. 2. Following the methodological principle (1), we do not want to *exclude* overly unfaithful candidates from the candidate set, building some limit into the definition of *Gen*.[3] The fact that overly unfaithful candidates play no role when it comes to finding the most harmonic candidate should follow from constraint interaction alone. So, *Gen* should provide arbitrarily serious faithfulness violations.

Definition (8) looks very restrictive, with the subsumption condition disallowing the deletion of input information (as seems to be required for modelling MAX-IO violations), and an additional clause excluding the addition of semantic information (cf. DEP-IO violations/epenthesis). However, it is a crucial point of the approach taken here that this restrictive definition of *Gen* is kept up – it will be the basis of keeping control over the candidate in processing. The intended faithfulness violations *can* indeed be captured within the limits of this definition, by regarding unfaithfulness as a tension between f-structure and the categorial/lexical realization:

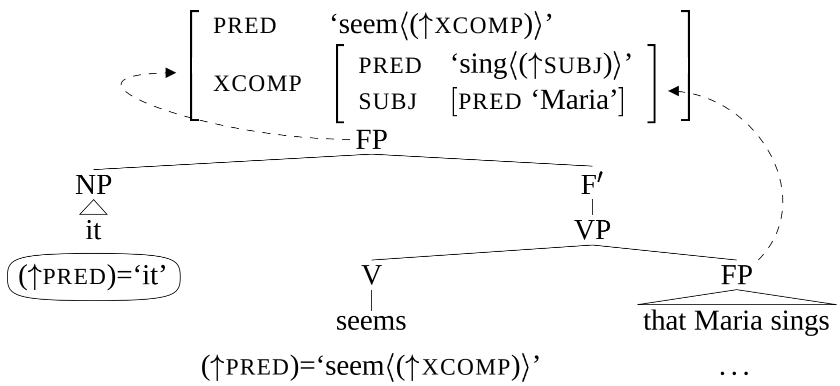
At f-structure, semantic information may neither be added nor removed. C-structure on the other hand may contain material without an f-structure reflex (epenthesis), or leave f-structure information categorially unrealized (deletion). This is illustrated in the following examples ((11)–(14)). Below the lexical entries, the 'morpholexical constraints' introduced by the lexical item are shown. Standardly, these functional annotations are treated exactly the same way as annotations in grammar rules, i.e., after instantiation of the meta-variables (↑) they include, they contribute to the overall set of f-descriptions the minimal model of which is the f-structure.

[3]This would of course be possible, and is a sensible thing to do from a practical point of view. But for our understanding of the theoretical underpinnings of OT syntax we want to be sure that the system will also work otherwise.

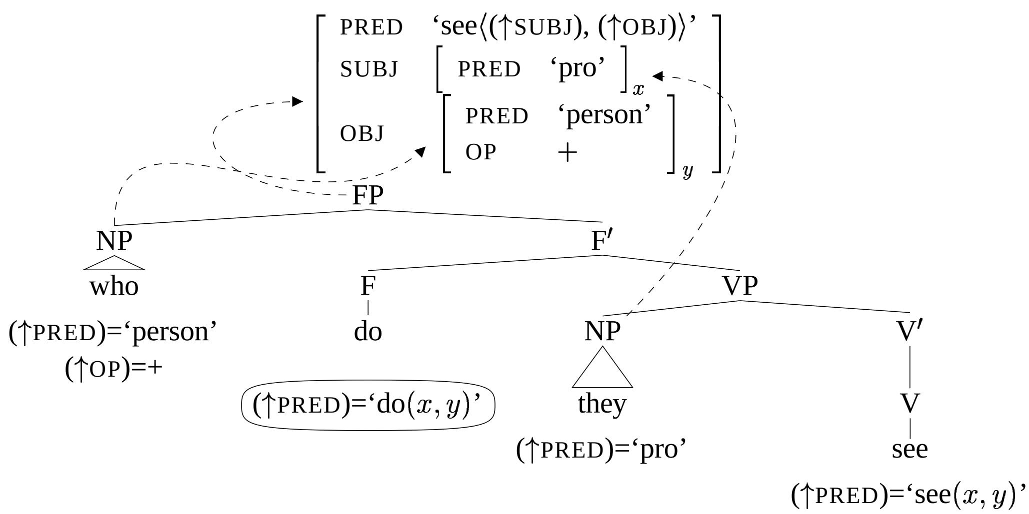
As Bresnan (1998) discusses for the expletive *do*, the DEP-IO-violating use of a lexical item can be modelled by assuming that (part of) its morpholexical contribution is not actually used in the construction of the f-structure. This is illustrated by encircling the respective morpholexical constraint.[4]

(11) is an example of an expletive use of the pronoun *it* in English, as assumed, e.g., in (Grimshaw and Samek-Lodovici 1998, sec. 4). (12) is the well-known example of the expletive *do*. Note that in contrast to classical LFG, in both these cases the ordinary lexicon entry is used (i.e., referential *it*, and full verb *do*). It is merely used in an unfaithful way.[5]

(11) Violation of DEP-IO (3) (or FILL; Grimshaw: FULL-INT)



(12)



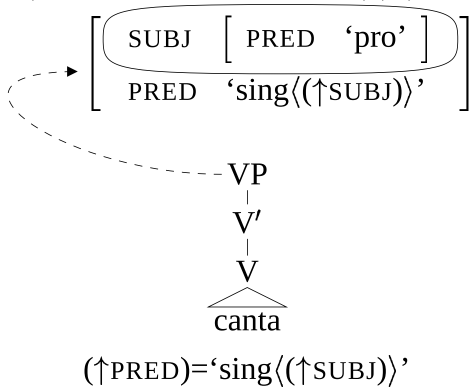
MAX-IO violations are the opposite situation. Some part of the f-structure (reflecting the input) isn't contributed by any of the lexical items' morpholexical constraints. In the examples, this is highlighted by encircling the respective part of the f-structure. (13) is a *pro-drop* example

[4]There are various ways how this can be formalized more rigorously. In (Kuhn 2000a, sec. 3.3.2), I introduce a special λ-projection from c-structure to l-structure. L-structure comprises *all* morpholexical constraints, some of which may not be reflected in f-structure – thus faithfulness constraints can be formulated as structural conditions on c-structure/l-structure/f-structure triples. In a set-up that doesn't assume a strict modular split between *Gen* and *Eval* this extra projection is superfluous. Faithfulness violations can be registered along with lexical access.

[5]In this paper, I do not address the question why it is not some other lexical item that is chosen and used unfaithfully. See (Kuhn 2000a, sec. 3.3.1) for some discussion.

from Italian. Note that – again as opposed to classical LFG – the PRED value of the subject is not introduced by the inflection on the verb; it simply arises "from nothing" as a faithfulness violation.

(13) Violation of MAX-IO (4) (or PARSE)



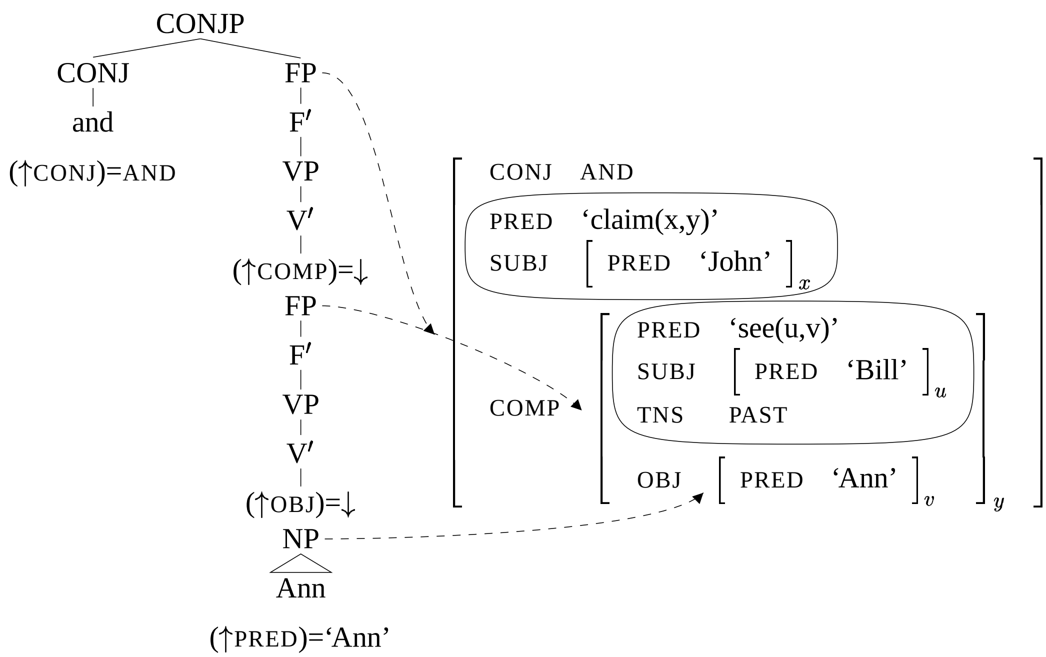


Figure 2: MAX-IO-unfaithful candidate in an ellipsis account

With such MAX-IO violations being part of the candidate space, it becomes conceivable to set up an OT account of ellipsis that explains the (im)possibility of ellipsis in context as an effect of constraint interaction. Let us look at the candidate in fig. 2 as one such MAX-IO-unfaithful candidate. It is the c-structure/f-structure analysis assumed for B's reply in dialogue (14).[6] This example is interesting since it illustrates the need for arbitrarily large portions of dropped material (the recursive embedding in A's utterance could be arbitrarily deep, which

[6]The representation builds on L. Levin's (1982) analysis of sluicing, assuming that at f-structure, the antecedent structure is fully reflected.

would have to be reflected in the f-structure for B's reply, according to the account assumed here).[7]

(14) A: John claimed that Bill saw Sue.
B: And Ann.

A short digression on the constraint set required for such an ellipsis analysis: It is quite clear how we can make the candidate in fig. 2 win over less elliptical competitors like *and that Bill saw Ann*, or even *and John claimed that Bill saw Ann*: the assumption of anEconomy-of-expression constraint like *STRUCT outranking MAX-IO will do the job – the elliptical utterance is as expressive, using less c-structural material. However, this immediately raises the question how to make sure that Economy of expression does not fire all the time, wiping out most if not all of the linguistic material. Intuitively it is quite clear that only contextually *recoverable* material may be ellided, but this idea has to be implemented more formally. A rather straightforward way is to assume a constraint REC that is violated when some material is left unrealized without there being an antecedent in the local context (cf. Pesetsky 1998). Note that the architecture of the OT system has to be extended in order to make the extra-sentential context visible for the OT constraints (a similar modification would be required in other approaches to capture recoverability too).[8]

To sum up this section, the intuitive way of looking at the relation between the input and the candidates in OT-LFG should be as follows: What is characteristic of an individual candidate is its lexical material and c-structure; a candidate's f-structure is mostly a reflex of the input.[9] Input-output faithfulness amounts to comparing a candidate's f-structure with its morpholexical constraints. Thus one may call this the "lexicalist view of faithfulness" (cf. Kuhn 2000a).

3.2 Varying the input to optimization

Before addressing processing issues in view of the definition of candidate generation (*Gen*) discussed above, it should be noted that a parameter in this definition can be modified. This will give us a formal system with very similar properties, which may however be used to model a different empirical concept.

So far, we have followed the standard application of OT as a definition of the grammatical structures of a language. What is kept constant across candidates is (more or less) the part of

[7]The non-branching dominance chain dominating *Ann* in c-structure (which would be excluded by offline parsability in classical LFG) reflects the assumption that the path to [PRED 'Ann'] in the f-structure cannot arise as an effect of further MAX-IO violations. Instead, the standard X-bar annotation principles are at work, introducing the COMP and OBJ embedding (and along the way, an Economy-of-expression constraint like *XP or *STRUCT is violated). It is however conceivable to devise an account that assumes more compact c-structures on the one hand, but further MAX-IO on the other.

[8]The condition that the REC constraint checks for is rather complicated, so one may hope to replace it by simpler constraint, interacting. This becomes possible in a bidirectional optimization framework as discussed below.

[9]In particular, faithfulness violations cannot lead to the situation that a candidate has a different meaning than the meaning encoded in the input. This excludes a derivation of language-particular ineffability in the style of (Legendre, Smolensky, and Wilson 1998), which works with LF-unfaithful winners. Ineffability is however derivable through bidirectional optimization, without assuming LF-unfaithfulness.

the structure that defines the meaning. The competing candidates are thus synonymous (potential) realization alternatives. In the procedurally flavoured standard terminology, this is called *production-based optimization*, since *Gen* is in fact defined as an abstract production function.

Alternatively, we may let the f-structure vary freely across candidates and rather leave the terminal string of the c-structure constant.[10] The competing candidates are thus alternative parses of the same string, and we have *comprehension-based optimization*. Overloading the function name *Gen* to also cover the analogous string-based candidate generation function, we get the definition (15). Hendriks and de Hoop (1999) use a comprehension-based optimization model in what they call OT semantics; the winning structure models what native speakers conceive as the preferred reading of a sentence.[11]

(15) Definition of *Gen* for comprehension-based optimization

w: string,

$\mathit{Gen}(w) = \{\langle T, \Phi\rangle \in L(G_{inviol}) | w$ is the terminal string/yield of $T\}$

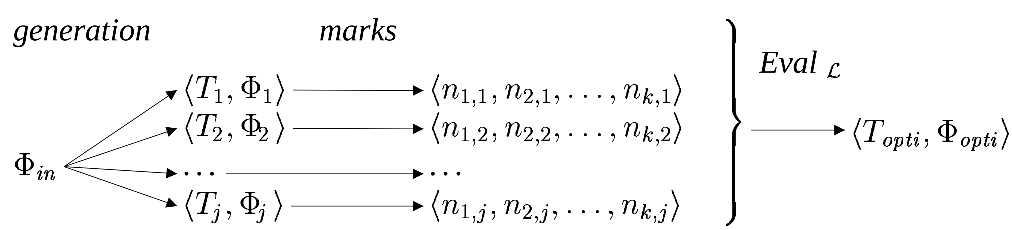
A stronger criterion for grammaticality can be formulated if the two concepts are combined conjunctively: the successful candidate must be optimal both among all structures with the same underlying form and among the structures with the same string. This is the underlying idea of *bidirectional optimization*, which will be addressed more extensively in sec. 5.

4 Processing OT-LFG

Let us now turn to the question whether computational procedures can be devised for tasks based on the formal system defined in sec. 3. We will start with the generation task for a production-based optimization system: given an underlying form, what is the optimal candidate according to an OT system? I will call this task (A1).

The initial idea how to approach this task is quite obvious: we can follow the definition of the OT-LFG system illustrated in fig. 1, using standard LFG processing techniques (cf. Kuhn 2000a for a detailed discussion): (i) generate from the input f-structure, using the LFG grammar for inviolable principles; (ii) apply constraints to the candidates (this gives us a sequence of constraint violation counts for each candidate); (iii) pick the most harmonic candidate:

(16)



[10]Formally, all kinds of other criteria for specifying the candidate set are conceivable. In Minimalism-influenced work in OT syntax, the candidate is often assumed to be defined by a common numeration, i.e., an unstructured bag of lexical items. However, using the underlying (logical) form on the one hand and the surface string on the other has a much clearer conceptual motivation in the broader cognitive context.

[11]Comprehension-based optimization also plays a role in learning. Tesar and Smolensky (1998) assume it as *robust interpretive parsing* (cf. also Smolensky 1996). It is also being applied as a preference mechanism in the large-scale LFG grammars developed in the Pargram project (Frank, King, Kuhn, and Maxwell 1998; Frank, King, Kuhn, and Maxwell 2000).

For the parsing task with a comprehension-based optimization system (call it (B1)), the same set-up suggests itself, only starting with a string and applying standard LFG parsing rather than generation as the initial step. But are these obvious approaches possible, given the faithfulness violations allowed by *Gen*?

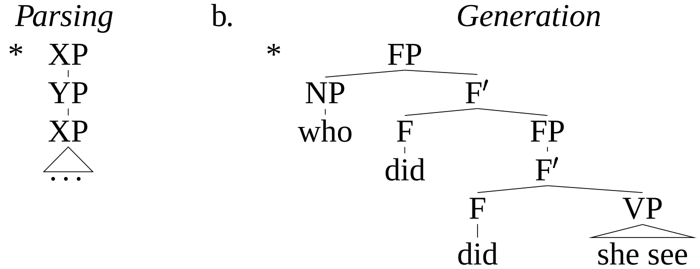
4.1 Infinite candidate sets in processing

For each of the two directions of optimization, one of the faithfulness constraints is a processing issue (when violated): In *production-based optimization*, DEP-IO violations (epentheses) create an infinite number of possibilities for generation. MAX-IO violations (deletions) are no problem, since there is only a finite amount of information in the input to delete. Vice versa in *comprehension-based optimization*, MAX-IO violations create an infinite number of possibilities for parsing, whereas DEP-IO violations are unproblematic, as there is only a finite number of string elements that could have been inserted.

Why doesn't the problem arise in classical LFG parsing and generation? The bare formalism – a combination of a c-structure grammar as an unrestricted context-free grammar and f-structure projected from c-structure – does actually allow for an infinite number of different structures over a given terminal string: if the context-free grammar contains a rule recursion that can be used in a non-branching way, there are arbitrary many c-structures, including zero to n recursions. To ensure decidability of the parsing task, such recursions are excluded by definition: the offline parsability condition (Kaplan and Bresnan 1982, 266) basically says that if there is a potential recursion in a nonbranching chain, the structure passing this recursion zero times is the only valid LFG structure (see (17a)).

For the classical generation task, there is a parallel issue to take care of: in a unification-based framework, the same feature information can arise from arbitrary many c-structural places, all being unified together. To guarantee decidability of the generation task, an *offline generability* condition has to be assumed, again excluding vacuous application of rule recursion, here with reference to resourced feature structures (cf. the example in (17b), assuming that *did* doesn't introduced a resourced PRED value).[12]

(17) a. *Parsing* b. *Generation*



Now, coming back to OT processing, in a set-up that is supposed to reflect the methodological principle (1) we cannot base the candidate generation step on the classical parsing/generation tasks with the offline parsability/generability conditions. The procedure for *Gen* should create an infinite candidate space, and only constraint application acts as a restrictive device. For this to work, we obviously need a procedure where the OT constraints are checked *online*, along

[12] See (Wedekind 1999; Kaplan and Wedekind 2000) for discussion; the use of an offline generability condition is currently explored by the XLE group at Xerox PARC.

with candidate generation. The sequential set-up (16) cannot work, since the first step wouldn't terminate.

Such a procedure is proposed in (Kuhn 2000b), using a chart for generation and parsing (see below). Since the constraints do the work of limiting the search space, we have to be sure that the system contains adequate constraints that will differentiate the candidates arising through rule recursion. We may even call this the *relaxed offline parsability/generability* condition:

(18) *Relaxed offline parsability/generability*
A rule recursion may only be applied if at least one constraint violation is incurred by the recursive structure.

Note that it is quite easy to guarantee for an entire OT system that all candidates satisfy (18): a sufficient condition is that the set of constraints include the Economy-of-expression constraint *STRUCT.

Markedness constraints A decidability problem may still arise if the constraint checking cannot be performed at intermediate points in time during candidate generation. Therefore, the constraints, in particular the Markedness constraints may not be of arbitrary complexity.

Recall that the conditions which markedness constraints check for are expressed as structural descriptions of (parts of) candidate representations. We saw some examples in (9). In order to ensure decidability, we assume the following restriction:

(19) *Restriction on constraints:*
The structure (c-structure/f-structure) denoted by the constraint condition must be bounded.

Note that this restriction is fully compatible with the methodological principle (1) – although here a different facet of the principle is relevant than before: trying to explain as much as possible as an effect of constraint *interaction* means that we're not interested in very expressive *individual* constraints; the explanatory power should really arise out of the *interaction* of several simple constraints (cf. also Grimshaw 1998, making the same point).

Chart-based optimization Here, I will not go into the details of the chart-based optimization approach. A brief summary should be enough. Tesar (1995) proposes a chart-based OT algorithm for generation with regular grammars and context-free "position grammars". This basic idea is extended to OT-LFG in (Kuhn 2000b), using Earley deduction parsing and generation (following Neumann 1994; Neumann 1998).

The strategy is to store the constraint profile of (partial) constituents in the chart edges. Whenever a constraint may or may not apply, both options are entered into the chart. The assumption of relaxed offline parsability/generability (18) and the boundedness of constraint conditions (19) ensure that recursions not helping to avoid some local constraint violation lead back to an already existing edge.

When an identical edge exists in the chart, the new edge is considered as blocked as usual in chart parsing/generation – however only if the new edge is equally or less harmonic as the existing one. If it is more harmonic, the new constraint profile is propagated through the chart, which will potentially lead to further options.[13] Due to this online processing of constraints, the algorithm can deal with an infinite candidate set.

4.2 Directionality in processing

So far, we have looked at procedures for

(A1) the generation task for production-based optimization (typically modelling grammaticality); and – symmetrically –

(B1) the parsing task for comprehension-based optimization (typically modelling preference).

This leaves open the respective *recognition tasks*. In a production-based optimization model, we want a procedure telling us whether a given string is contained in the language defined by the OT model. We may also want to know what the correct structure for this string is, which is what Johnson (1998) calls the *universal parsing task*. Recognition and parsing (for production-based optimization) are closely related. Let's refer to both tasks as (A2). According to the definition of the language generated by an OT system (10), the (A2) tasks amount to checking whether there is *some* underlying input representation for which the string is the optimal candidate.[14] From the previous discussion it should be clear that the (A2) task is different from (B1) where we merely choose between alternative parsing analyses of a particular string (for more discussion see (Johnson 1998) and (Kuhn 2000a)). During parsing, (A2) requires a ("backwards") generation step, since in the production-based optimization model grammaticality is defined that way. With this forward and backward processing involved, we may call the procedure a bidirectional processing procedure. (20) summarizes the steps required; fig. 3 (taken from Kuhn 2000a) illustrates the process graphically for an abstract example (parsing the string 'a b c'). Note that a given string may have no or many grammatical readings.

(20) *Bidirectional processing*
Task: determine whether a given string is grammatical according to production-based optimization

- parse string to determine possible underlying forms
- *"backward generation"* from underlying forms
- optimal candidate in a generation-based competition determines grammaticality
- string in optimal candidate has to match the initial string; else, initial string is not grammatical for this particular underlying form

In the context of the present paper we have to ask: Is task (A2) also decidable?

[13] Clearly, the computational complexity of this algorithm is considerable, but the point is just to show that a decidable procedure can be specified. For a more efficient system, various optimizations could be attempted.

[14] For comprehension-based optimization (B), the parallel task – (B2) – may be intuitively less interesting (given a logical form, is it the preferred reading for some string in the language under consideration?). I will thus focus on the (A2) task.

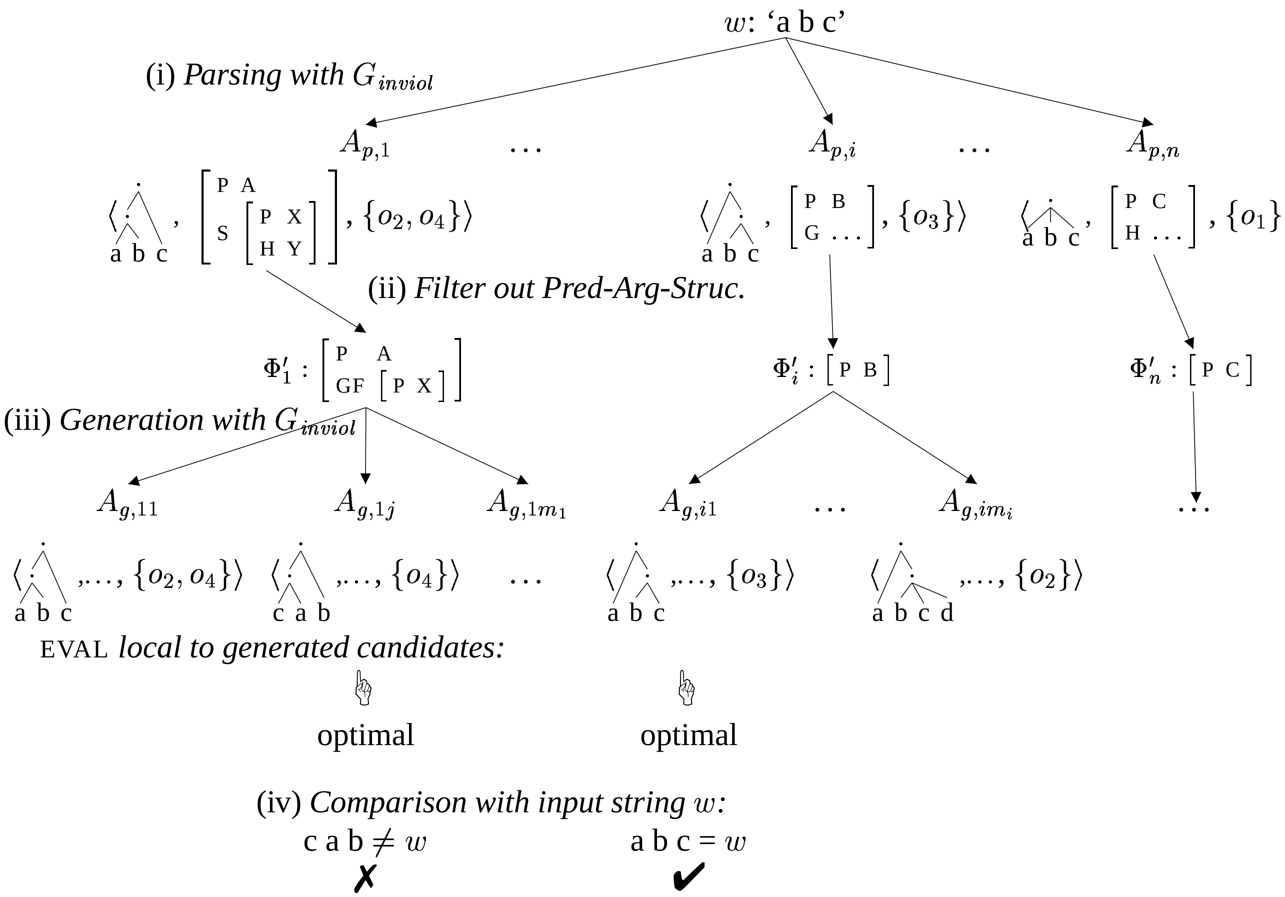


Figure 3: Parsing and "backward generation"

4.3 More infinity issues

For the simpler (A1) task – basically a one-way generation task – we noted above that MAX-IO violations (deletions) don't pose a decidability problem because there is only a finite amount of information that can be dropped. With the initial parsing step preceding "backward generation" in the bidirectional (A2) task, MAX-IO violations *do* become an issue: an infinite space of potential underlying forms has to be considered.

There are two options for dealing with the situation:

- assume that the space of underlying forms is restricted by some *recoverability principle*[15] (ensuring that only a finite number of *contextually recoverable* options has to be considered), or
- try to derive the effect of such a recoverability principle as a consequence of constraint interaction.

[15] Note that the assumption of a violable constraint REC (Pesetsky 1998; discussed in sec. 3.1) does not help to avoid the decidability problem in the parsing direction.

The latter option seems much more in the spirit of the methodological principle of OT (1), so it is this one we will adopt here (I will briefly come back to the other option in the conclusion, sec. 6). It forces us to assume that not only the generation direction of (A2), but also the initial parsing direction is controlled by an OT-style optimization (since it is in this step that we want to demand recoverability). So we get a system that involves not only bidirectional processing, but *bidirectional optimization*.

The intended effect of the constraint interaction modelling recoverability is that during the initial parsing step in (A2) just those MAX-IO violations are postulated (i.e., possible with the optimal candidate) which are justified through an antecedent in the local context (which is finite). This effect can be reached quite simply by assuming that we have a kind of alignment constraints comparing the underlying f-structure for the input string with the given context; these constraints disprefer any kind of divergence. Now, for overt material expressing new information (i.e., diverging from context) there is no alternative to violating the context alignment constraints, but for everything that is not overtly expressed (the MAX-IO violations), the most harmonic option will always be postulating that what's being dropped *does* align with the local context.

5 Bidirectional optimization

Bidirectional optimization has been argued for variously in the theoretical OT literature, on empirical and conceptual grounds (see, e.g., Wilson 1998; Boersma 1998; Smolensky 1998; Lee 2000; Morimoto 2000; Kuhn 2000a; Blutner 2000). It is thus interesting that independent of all this, there are computational arguments for such a model – of course depending on the assumptions about faithfulness violations made in this paper, and taking the methodological principle (1) rather seriously.

With bidirectional optimization, will the (A2) task actually be decidable? If both (A1) and (B1) are decidable, resulting in a finite set of winning candidates,[16] then the bidirectional optimization task is decidable too, since it can be solved by applying (A1) after (B1). Given a string, (B1) is used to determine the optimal candidate(s)[17] according to comprehension-based optimization, then (A1) determines the optimal candidate(s) for the (B1)-winner(s), according to production-based optimization. Ultimately, the terminal string of the (A1)-winner(s) is compared with the initial string (as in (20)), and if they match we have found the bidirectionally optimal candidate. (In the Earley-style chart implementation of (Kuhn 2000b) – following Neumann's (1998) interleaved generation/parsing approach – the strictly sequential set-up need not be kept up, so intermediate backward processing steps can be performed rather early on given chart edges, allowing to prune off erroneous search paths early.)

Note that this scheme implements a strong concept of bidirectional optimality. The successful candidate has to be independently optimal according to both production-based and comprehension-based optimization. So we have changed the definition of the language generated by the OT system:

[16]The formal proofs need yet to be written down, so there may be some tacit assumptions underlying the approach discussed above and in (Kuhn 2000b), but this shouldn't affect the overall result.

[17]There may be more than one equally harmonic candidate, but due to the relaxed offline parsability/generability condition (18), there will only be finitely many.

(21) *Language generated by a strongly bidirectional OT system*

A string w is contained in the language defined by an OT system

iff it is the optimal candidate in *Gen*(w)

and there exists an underlying input representation Φ_{in} s.th. w is the terminal string of the optimal candidate in *Gen*(Φ_{in}).

This is not the only conceivable option of combining the two directions of optimization: one may want define the candidate set of one (or both) of the two individual directions as depending on the result of the other optimization. For example, if the idea is kept up that (A1) models grammaticality, while (B1) models preference, the following dependence would make intuitive sense: grammaticality is defined based on (A1) only (i.e., independently of preference), while preference is determined between grammatical candidates. So, if we start out with a string, we have to find all potential underlying forms and check for each of these whether the given string is actually the optimal candidate (since this is the way grammaticality is defined). If there are several options, we compare them to determine the preferred reading. This weaker and asymmetrical scheme was assumed in (Kuhn 2000a, sec. 4.2). The original definition of the language generated by the OT system (10) is left unchanged, assuming that preference is a concept subordinate to grammaticality.

Blutner (2000) proposes a symmetrical concept of *weak bidirection* (contrasting it with the type of *strong bidirection* I have discussed above), assuming mutual dependence of the candidate sets. Impressionistically, one may envisage optimization according to this concept as an inductive process, alternately running (A1) and (B1) optimization. If a candidate wins both directions, it is an acceptable option for the language modelled and is removed from the candidate sets for further induction steps; thus, candidates that couldn't win under strong bidirection can become winners after their competitor has been retracted. Blutner argues that this concept is useful for deriving partial blocking effects in lexical pragmatics (using abstract examples at this stage, rather than detailed empirical examples).

A straightforward way of guaranteeing decidability (with the infinite candidate sets we are confronted with, assuming faithfulness as a violable constraint) exists only for the strong bidirectional optimization model.[18] The decidability problem for the asymmetrical model may become intuitively clear when we go through the (A2)-type parsing of an ungrammatical string involving the potential for arbitrarily many MAX-IO violations: after initially parsing the string, we pick the optimal parsing analysis, applying backward generation (i.e., production-based optimization, modelling grammaticality) to its underlying form. Since the string is ungrammatical, we don't get back to the initial string. In the strong bidirectional case, we would already be finished, but since in the weaker account the comprehension-based direction models just preference (grammaticality being a stronger requirement), we have to consider the next best parsing

[18]It is conceivable that a way of controlling the infinite candidate space in the parsing direction can be found that doesn't throw out candidates that are non-optimal according to comprehension-based optmization (this means that the strong bidirectional interpretation wouldn't be enforced). One would have to find a systematic way of constructing a more harmonic backward competitor for arbitrary parsing analyses constructed through recursions beyond a certain point. Having such a recipe would show that all the interpretations underlying the recursive structures are out of the question (in terms of production-based optimization!) for the string being processed.

Such a procedure could be applied both to unidirectional optimization models and at least to the asymmetrical weaker bidirectional optimization model.

candidate, etc. Even after trying the best n underlying forms in the backward optimization, we won't have found a grammatical candidate, but there are infinitely many possibilities, so there is no point where we can be sure that the string is ungrammatical.

Potential problems with strong bidirectional optimization It is not so clear whether the conjunction of the two directions of optimization in the definition of grammaticality is fully desirable from a linguistic point of view. Since the candidate set in comprehension-based optimization is defined on the basis of a common terminal string and the candidates thus differ in meaning, there will be interference of extra-linguistic factors such as world knowledge about what is more plausible etc. For example, word order freezing effects as discussed in (Lee 2000) and (Kuhn 2000a, sec. 4.2) as an application of bidirectional optimization can be overruled by world knowledge.

Of course, it is not necessarily a bad idea to try and model the overall cognitive process of language understanding as some optimization task starting from a perceived speech signal (cf. the broader cognitive scope of Harmony Theory, Smolensky 1986), but as discussed in the introduction, it is an hypothesis of the OT approach that the restricted structure of the OT model is particularly well suited to explain the language faculty. If extra-linguistic cognitive processes are modelled by an optimization process, one wouldn't expect the possibility of systematic re-ranking of constraints with a factorial typology predicted.

Since according to *strong* bidirectional OT, comprehension-based optimization with its extra-linguistic aspects is involved in the definition of the language generated by the OT system, there is no clear way of identifying the scope of a *linguistic* theory as part of the overall cognitive system. Maybe some way of separating out the linguistic part of the comprehension-based optimization can be found. However until this has been clarified, strong bidirectional optimization is presumably inadequate for an explicit formal account of larger sets of data.

The problem can be illustrated with the derivation of the recoverability principle discussed at the end of sec. 4.3: the *strong* bidirectional model forces us to adjust the constraints in a way that makes the contextually adequate candidate optimal in both directions. Now, most non-trivial sentences have more than reading. For the strong model to work we have to assume an intricate conspiration of constraints that gives us exactly the right reading as the optimal one in parsing. Finding such constraints is clearly not just a linguistic issue. For the (asymmetrical) weaker model in contrast, it would be enough to exclude those candidates from the parsing possibilities that are unfaithful beyond recoverability – however, this model will not guarantee decidability of the parsing task.

6 Possible conclusions

Let us briefly review the reasoning in this paper: based on the methodological principle of OT to try and explain as much as possible as an effect of constraint interaction (1), it was argued that a limit on the unfaithfulness of candidates should not be built into the definition of *Gen*, but should follow from constraint interaction. In a chart-based optimization algorithm, it is actually possible to keep the candidate space under control in this way, provided the critical processing direction undergoes optimization. The standard OT definition assumes optimization just for the production or generation direction, i.e., parsing with arbitrarily unfaithful candidates poses a decidability problem.

There are (at least) three possibilities of reacting to this problem: first (the option that was mainly explored in this paper), changing the definition of the language generated by an OT system to also include comprehension-based optimization. This way, decidability can be guaranteed and principle (1) is kept up. However it is not so clear whether this extended application of constraint interaction really follows the same restricted scheme of optimization (which includes that one expects predictions on the basis of factorial typology). So, it is not so clear whether we should really regard the second option as refuted: deciding not to follow principle (1) for controlling the space of MAX-IO violations. We could assume a more restrictive definition of *Gen* with a built-in recoverability condition, so comprehension-based optimization would not be required for guaranteeing decidability (this does not exclude the application of comprehension-based optimization to model a different concept like preference).

There is a third possibility: acknowledge undecidability of the parsing task in the general case. This would mean saying that there can be strings for which the parsing (and backward generation) procedure runs forever. Recall the situation of parsing an ungrammatical string. The first n underlying forms have been considered without success, but there are infinitely many possibilities, so there is no point where we can be sure that the string is ungrammatical. In practice one would of course adopt a heuristics enforcing a decision after some finite number of steps – at the risk of wrongly excluding a string that is actually grammatical.

If we look at what is actually being modelled by the theoretical concept of grammaticality – namely acceptability judgements of native speakers –, this implication of the third possibility seems rather plausible. Recall under what circumstances candidates that are heavily unfaithful to MAX-IO (like the one in fig. 2) can turn out to be winners: it is when the context allows ellipsis of large chunks of the underlying (input) form.

Now, looking at the human sentence processor in such a situation is quite revealing: as is well-known when presented with elliptical utterances out of context, our processor breaks down surprisingly fast – in a certain sense. Sentences are judged unacceptable that would be considered perfect if the context was known. For example,

(22) Bill for the doctor's

is likely to be judged ungrammatical if no appropriate context (like *Has anyone left early today?*) is provided (cf. e.g., Klein 1993 for discussion and further examples).

So, the human sentence processing system displays a behaviour suggesting that something like heuristics we just discussed are at work. So undecidability of the parsing task may not be something we have to avoid at any cost.

References

Blutner, R. (2000). Some aspects of optimality in natural language interpretation. Ms.

Boersma, P. (1998). *Functional Phonology. Formalizing the interactions between articulatory and perceptual drives*. Ph. D. thesis, University of Amsterdam.

Bresnan, J. (1996). LFG in an OT setting: Modelling competition and economy. In M. Butt and T. H. King (Eds.), *Proceedings of the First LFG Conference*, CSLI Proceedings Online.

Bresnan, J. (1998). Optimal syntax. In J. Dekkers, F. van der Leeuw, and J. van de Weijer (Eds.), *Optimality Theory: Phonology, Syntax, and Acquisition*. Oxford University Press. To appear.

Bresnan, J. (2000). *Lexical-Functional Syntax*. Blackwell. to appear.

Frank, A., T. H. King, J. Kuhn, and J. Maxwell (1998). Optimality theory style constraint ranking in large-scale LFG grammars. In M. Butt and T. H. King (Eds.), *Proceedings of the Third LFG Conference*, CSLI Proceedings Online.

Frank, A., T. H. King, J. Kuhn, and J. Maxwell (2000). Optimality theory style constraint ranking in large-scale LFG grammars. Ms., to appear in Peter Sells (ed.), *Formal and Empirical Issues in Optimality-theoretic Syntax*, Stanford: CSLI Publications.

Grimshaw, J. (1997). Projection, heads, and optimality. *Linguistic Inquiry 28*(3), 373–422.

Grimshaw, J. (1998). Constraints on constraints in optimality theoretic syntax. Manuscript, Rutgers University.

Grimshaw, J. and V. Samek-Lodovici (1998). Optimal subjects and subject universals. In P. Barbosa, D. Fox, P. Hagstrom, M. McGinnis, and D. Pesetsky (Eds.), *Is the Best Good Enough?*, pp. 193–219. MIT Press and MITWPL.

Hendriks, P. and H. de Hoop (1999). Optimality theoretic semantics. *Linguistics and Philosohpy*. to appear.

Johnson, M. (1998). Optimality-theoretic Lexical Functional Grammar. In *Proceedings of the 11th Annual CUNY Conference on Human Sentence Processing, Rutgers University*. To appear.

Kager, R. (1999). *Optimality Theory*. Cambridge: Cambridge University Press.

Kaplan, R. M. and J. W. Bresnan (1982). Lexical-functional grammar: a formal system for grammatical representation. In J. W. Bresnan (Ed.), *The Mental Representation of Grammatical Relations*, Chapter 4, pp. 173–281. Cambridge, MA: MIT Press.

Kaplan, R. M. and J. Wedekind (2000). Lfg generation produces context-free languages. In *Proceedings of COLING-2000*, Saarbrücken, pp. 297–302.

Klein, W. (1993). Ellipse. In J. Jacobs, A. von Stechow, W. Sternefeld, and T. Vennemann (Eds.), *Syntax: An International Handbook of Contemporary Research*, pp. 763–799. Berlin: de Gruyter.

Kuhn, J. (2000a). Generation and parsing in optimality theoretic syntax – issues in the formalization of OT-LFG. Ms., IMS, University of Stuttgart, to appear in Peter Sells (ed.), *Formal and Empirical Issues in Optimality-theoretic Syntax*, Stanford: CSLI Publications.

Kuhn, J. (2000b). Processing optimality-theoretic syntax by interleaved chart parsing and generation. ACL-2000.

Lee, H. (2000). Markedness and word order freezing. Ms., Stanford University, to appear in Peter Sells (ed.), *Formal and Empirical Issues in Optimality-theoretic Syntax*, Stanford: CSLI Publications.

Legendre, G., P. Smolensky, and C. Wilson (1998). When is less more? faithfulness and minimal links in *wh*-chains. In P. Barbosa, D. Fox, P. Hagstrom, M. McGinnis, and D. Pesetsky (Eds.), *Is the Best Good Enugh? Optimality and Competition in Syntax*. Cambridge, Massachusetts: MIT press.

Levin, L. S. (1982). Sluicing: A lexical interpretation procedure. In J. W. Bresnan (Ed.), *The Mental Representation of Grammatical Relations*, Chapter 9, pp. 590–654. Cambridge, MA: MIT Press.

Morimoto, Y. (2000). "Crash vs. Yield": On the conflict asymmetry in syntax and phonology. Ms. Stanford University, to appear in Peter Sells (ed.), *Formal and Empirical Issues in Optimality-theoretic Syntax*, Stanford: CSLI Publications.

Neumann, G. (1994). *A uniform computational model for natural language parsing and generation*. Ph. D. thesis, Universität des Saarlandes, Germany.

Neumann, G. (1998). Interleaving natural language parsing and generation through uniform processing. *Artifical Intelligence 99*, 121–163.

Pesetsky, D. (1998). Some optimiality principles of sentence pronunciation. In P. Barbosa, D. Fox, P. Hagstrom, M. McGinnis, and D. Pesetsky (Eds.), *Is the Best Good Enugh? Optimality and Competition in Syntax*, pp. 337–383. Cambridge, Massachusetts: MIT press.

Prince, A. and P. Smolensky (1993). Optimality theory: Constraint interaction in generative grammar. Technical Report Technical Report 2, Rutgers University Center for Cognitive Science.

Smolensky, P. (1986). Information processing in dynamical systems: Foundations of harmony theory. In D. E. Rumelhart, J. L. MacClelland, and the PDP Research Group (Eds.), *Parallel distributed processing : explorations in the microstructure of cognition, volume 1: Foundations*, pp. 194–281.

Smolensky, P. (1996). On the comprehension/production dilemma in child language. *Linguistic Inquiry 17*, 720–731.

Smolensky, P. (1998). Why syntax is different (but not really): Ineffability, violability and recoverability in syntax and phonology. Handout of a talk given at the workshop *Is Syntax Different?* at Stanford University, December 1998.

Tesar, B. (1995). *Computational Optimality Theory*. Ph. D. thesis, University of Colorado.

Tesar, B. B. and P. Smolensky (1998). Learnability in optimality theory. *Linguistic Inquiry 29*(2), 229–268.

Wedekind, J. (1999). Semantic-driven generation with LFG- and PATR-style grammars. *Computational Linguistics 25*(2), 277–281.

Wilson, C. (1998). Bidirectional optimization and the theory of anaphora. Ms. Johns Hopkins University. To appear in Jane Grimshaw, Géraldine Legendre, and Sten Vikner (eds.), *Optimality Theoretic Syntax*, MIT Press, Cambridge, MA.

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On oblique arguments and adjuncts of Hungarian event nominals – A comprehensive LFG account

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1. Introduction

The paper will offer a revised and comprehensive analysis, in an LFG framework, of all the three principal modes of realizing the oblique arguments of event nouns derived from verbs (of these three strategies, only two are available to adjuncts). The structure of the paper is as follows. First, I will demonstrate the basic facts and briefly discuss the most important previous accounts (sections 2.1–2.3). Then the modified or entirely new analyses will be presented (sections 3.1–3.3). Finally, I will summarize the most important points (section 4).

2. The basic facts and previous analyses

2.1. Adjectivalized constructions

The NP core of the Hungarian DP is fundamentally right-headed, that is, under normal circumstances all the oblique arguments and adjuncts (either with or without complements) must precede the NP head (whether a derived or non-derived noun). In the first, and by far the most productive, construction type, all these modifying elements must be either adjectival or participial in form. I will collectively call such phrases *adjectivalized* constituents.[1] Consider the following examples.[2]

(1) a. János (váratlan-ul) meg-érkez-ett Budapest-re.
John (unexpected-ly) PERF-arrive-past.3sg Budapest-onto
'John arrived in Budapest (unexpectedly).'

b. *János(nak a) (váratlan) Budapest-re meg-érkez-és-e
John(dat the) (unexpected) Budapest-onto PERF-arrive-NOM-his
'John's (unexpected) arrival in Budapest'

c. János(nak a) (váratlan) Budapest-re való meg-érkez-és-e
John(dat the) (unexpected) Budapest-onto BEING PERF-arrive-NOM-his
'John's (unexpected) arrival in Budapest'

(2) a. *Edit ebéd után levizsgáztat-ás-a
Edith lunch after examine-NOM-her
'the examination of Edith after lunch'

---

[1] As Szabolcsi (1994) points out, the adjectivalization requirement in Hungarian is rather poorly understood. The reason for this is that in a number of head-final languages the head can be preceded by unadjectivalized PPs, and in Hungarian, too, adjectivalization is not needed (or, rather, it is not allowed) when the argument or adjunct follows the head, cf. section 2.3. Thus, this requirement can only be stipulated. A neat way of capturing it has been suggested by Chris Pinón (p. c., 1992): we can impose a categorial restriction on the premodifying constituents combining with N' in the Hungarian NP to the effect that they must have the [+V] feature. This gives us APs and (participial) VPs and excludes PPs and case-marked NPs (or DPs).

[2] The following abbreviations are used in the glosses: AFF = adjectivizing suffix, NOM = nominalizing suffix, PERF = perfectivizing preverb.

b. Edit ebéd után-i levizsgáztat-ás-a
Edith lunch after-AFF examine-NOM-her
'the examination of Edith after lunch'

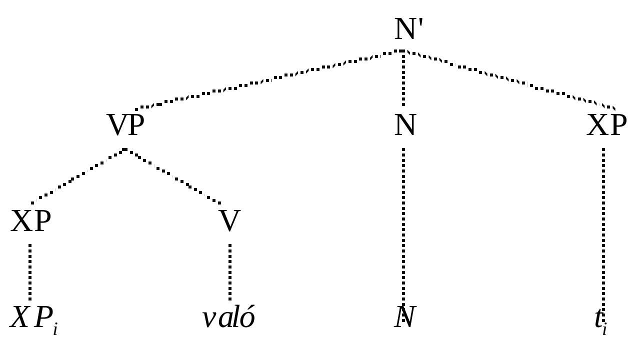
c. Edit ebéd után való levizsgáztat-ás-a
Edith lunch after BEING examine-NOM-her
'the examination of Edith after lunch'

The use of an adjective (*váratlan* 'unexpected') is exemplified in (1c). PPs and (oblique) case-marked DPs are adjectivalized by one of the present participial forms of the copula *van* 'be': *való*, glossed as BEING. This is illustrated in (1c) and (2c). In addition, certain kinds of PPs can also be adjectivalized by the PP head taking the general adjectivizing suffix *-i*, as demonstrated by (2b). If no adjectivalization takes place, the nominal construction is ungrammatical, cf. (1b) and (2a). The adjectivalized constituents corresponding to oblique arguments of the input verbs are true arguments of the derived nominals, because they are as obligatory as the input verbs' arguments. The analysis of PP constituents adjectivalized by *-i* is unproblematic. They are AP arguments of the nominals. The PP and (oblique) case-marked DP constituents combined with *való* 'being' pose a special problem. Should the participial form be analysed as an argument-taking predicate or should it be regarded as a mere formative element without any semantic content?

So far there has not been any satisfactory analysis proposed in either GB or MP. Szabolcsi (1990), working in a GB framework, briefly points out that *való* cannot be taken to be an ordinary (that is, argument-taking) predicate. She writes: "Although *való* is formally a participle, phrases like *a Péter-rel való találkozás* 'the Peter-with being meeting' cannot be said to contain a participial modifier since, in contrast to English for instance, the corresponding clause would almost always be ungrammatical: **A találkozás Péterrel volt* 'The meeting was with Peter'. In categorial grammar terms I would say *való* is a type-lifter" (1990: 153, Footnote 3). Type-lifting, however, is not legitimate in GB; moreover, this kind of account is hardly feasible when *való* adjectivalizes an adjunct (cf. Szabolcsi 1994: 260–261).

É. Kiss (to appear) offers an MP analysis of the Hungarian DP. She assumes that all arguments and adjuncts of the nominal head in the NP core are generated in a post-head position and then, with the exception of some marginally acceptable construction types, these post-head constituents have to be moved to a pre-head position and they have to be adjectivalized by *való*, some other (more meaningful) participles or the *-i* adjectivizing suffix attaching to postpositions. É. Kiss is not very explicit about the details of these processes. However, it is obvious even from her sketchy presentation of this aspect of her approach that there are at least three significant problems with it. First, she lumps *való* and the other "true" participles together without any justification despite the fact that Szabolcsi (1990) and especially Laczkó (1995b) explicitly argue against treating *való* as an ordinary participle. Second, although É. Kiss (to appear) does not discuss the internal structure of the NP core of the Hungarian DP that she postulates, it is apparent that the movement of a constituent from a post-head position into a pre-head VP will violate the ECP, no matter what internal structure is assumed. For instance, if we posit a flat structure for the relevant part of the NP, as É. Kiss (1998) does, we cannot avoid the ECP violation. Consider:

(3)



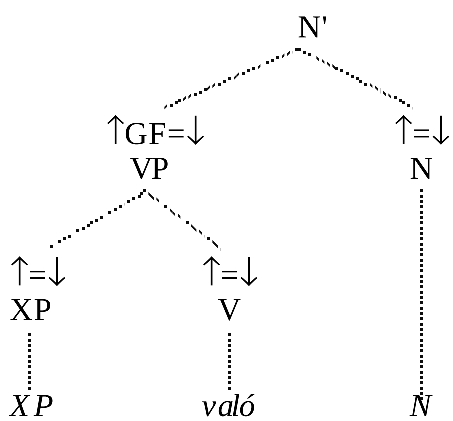
The violation remains even if the pre-head VP is assumed to be higher up in the structure because the moved constituent will still fail to c-command (or m-command) its trace. Third, É. Kiss (to appear) suggests that the movement of the post-head constituent is forced by her Case Constraint:

(4) a. The case suffix must cliticize to the right edge of the noun phrase.
b. The case suffix cannot cliticize to a case marked stem.

This condition, however, only partially justifies the transformation. Although it is compatible with the generation of arguments and adjuncts in a post-head position and motivates the movement of the constituents from that position, it says nothing about why the landing site is within a pre-head VP, that is what triggers the movement into that particular position. É. Kiss does not discuss this aspect of the transformation at all.

In Laczkó (1995a, 1995b) I argue against regarding *való* as a true (argument-taking) participial predicate in a detailed fashion. The essence of my argumentation is as follows. Just like Szabolcsi (1994), I point out that the relevant DPs containing *való* do not have sentential counterparts with the copula *van* 'be' as the predicate (cf. the citation from Szabolcsi above). Then I go on to show that even if we disregard this problem, we cannot attribute any plausible argument structure to *való* as an argument-taking predicate, because the type and form of the constituent combined with it is always exclusively determined by the nominal head and not *való*. Instead, I propose an LFG analysis (inspired by Ackerman' s (1987) account of the finite use of the Hungarian copula), which assumes that the *való* form is of category V and it functions as the "structural head" of a VP constituent, and the PP/DP as well as the V are the "functional co-heads" of this VP; however, it is only the (head of the) PP/DP that also has a PRED feature. I annotate the entire VP with either an OBL or an ADJ function, depending on the status of the VP, and both the PP/DP and the V with the functional head equation. Consider:

(5)



The only problematic aspect of this analysis, which I was not aware of at the time, is that there can be more than one element within a *való* constituent and they can carry any mixture of OBL and ADJ functions. Consider:

(6) a. János-nak az Edit-tel Budapest-re való meg-érkez-és-e
John-dat the Edith-with Budapest-onto BEING PERF-arrive-NOM-his
'John's arrival, with Edith, in Budapest'
b. János-nak a Budapest-re Edit-tel való meg-érkez-és-e
John-dat the Budapest-onto Edith-with BEING PERF-arrive-NOM-his
'John's arrival in Budapest with Edith'

Budapest-re ' in Budapest' is an oblique argument and *Edit-tel* ' with Edith' is an adjunct. As (6a) and (6b) show, an adjunct and an argument can follow or precede each other. Laczkó (1995b) only counts with one element within a *való* constituent; therefore, that analysis cannot cover the data in (6). In section 3.1 I will offer a solution to this problem.

2.2. The unadjectivalized type

In this construction type, the nominal head is preceded by an oblique argument which is not adjectivalized. Consider the following examples and compare them with those in (1).

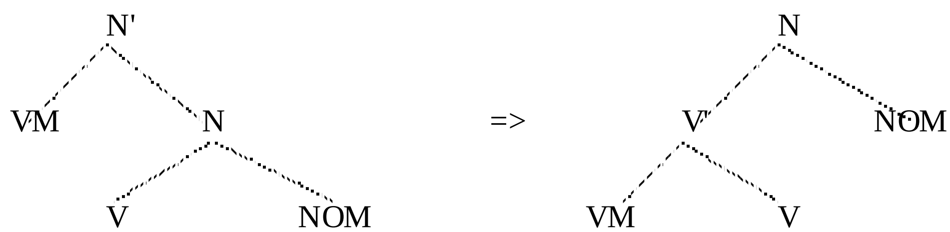
(7) a. János Budapest-re érkez-ett.
John Budapest-onto arrive-past.3sg
'John arrived in Budapest.'

b. János Budapest-re érkez-és-e
John Budapest-onto arrive-NOM-his
'John's arrival in Budapest'

This type is restricted to the designated oblique argument of a nominal predicate which has been derived from a verb that constitutes a special complex predicate with that designated argument. Here the theoretical challenge is to capture, in a principled manner, the fact that the designated argument can avoid being adjectivalized. So far two major analyses of such structures have been proposed: one by Szabolcsi (1994) and the other by Laczkó (1995a).

Szabolcsi (1994), in a GB framework, inspired by Pesetsky (1985), assumes that the oblique argument and the derived nominal form a syntactic complex predicate and then, at LF, the nominalizing suffix raises to have scope over the oblique argument + verb complex. Consider:

(8)



This proposal is not compatible with some basic principles of LFG: in this theory there is no LF and bound morphemes are incapable of syntactic movement.

In Laczkó (1995a), in an LFG framework, I suggest that the verb incorporates its oblique argument and they form a complex predicate in the lexicon, which is also nominalized in the lexicon. Consider:

(8) a. érkez-
b. Budapest-re érkez-
c. Budapest-re érkez-és

I concentrate on incorporated arguments expressed by oblique case-marked NPs and demonstrate that these NPs can never be preceded by an article in such a way that it is analysed as belonging to the incorporated constituent and not to the entire (matrix NP) headed by the derived nominal. Thus, I conclude that it is never a maximal projection that is incorporated in the lexicon, which is an important and generally accepted condition on these processes. However, if we extend the examination of the relevant data to incorporated arguments realized by PPs (postpositional phrases) it turns out that the correct generalization is not a restriction against maximal projections but rather a prohibition against the use of a constituent containing an article. Consider:

(9) a repülŒgép-nek a közvetlen-ül London fölé érkez-és-e
the airplane-dat the direct-ly London above arrive-NOM-its
'the airplane's arrival right above London'

In this example there is a fully-fledged PP expressing the designated argument. Therefore, the account in Laczkó (1995a) would be forced to admit the lexical incorporation of an XP, contrary to the above-mentioned generalization.

In section 3.2 I will propose an alternative solution which does not apply incorporation in the lexicon and which is compatible with the general principles of LFG.

2.3. Modifiers in post-head position

In the third construction type, an oblique argument or an adjunct (or even both of them) follow the derived nominal head. In this case they must not be adjectivalized. Consider:

(10) a. János meg-érkez-és-e Budapest-re tegnap
John PERF-arrive-NOM-his Budapest-onto yesterday
'John's arrival in Budapest yesterday'

b. *János meg-érkez-és-e Budapest-re való tegnap
John PERF-arrive-NOM-his Budapest-onto BEING yesterday
'John's arrival in Budapest yesterday'

c. *János meg-érkez-és-e Budapest-re tegnap-i
John PERF-arrive-NOM-his Budapest-onto yesterday-AFF
'John's arrival in Budapest yesterday'

There are several severe restrictions on its occurrence. É. Kiss (to appear) fundamentally makes the following empirical generalizations.

She claims that this type is very rare and it is basically restricted to isolated usage in titles. Consider one of her examples:

(11) Találkoz-ás egy fiatal-ember-rel
meet-NOM a young-man-with
'Encounter with a young man'

She distinguishes two cases in which a constituent occurs after the NP head which is not part of a title. A) As I pointed out in section 2.2, she assumes that all arguments and adjuncts in the NP core are base generated after the head and these constituents have to be moved to a pre-head position so that her Case Constraint should be satisfied. She states that the only exception to this general rule is when the entire DP is in the nominative (because this case in Hungarian has no overt phonological exponent). In such constructions the post-head constituent may, rather marginally, remain in situ. Compare her examples.

(12) a. ??Még a találkoz-ás Péter-rel is elviselhetŒvolt.
even the meet-NOM.nom Peter-with also bearable was
'Even the meeting with Peter was bearable.'

b. *Még a találkoz-ás-t Péter-rel is kibír-tam.
even the meet-NOM-acc Peter-with also stand-past.1sg
'I could even stand the meeting with Peter.'

c. **Még a találkoz-ás-ban Péter-rel is reményked-tem.
even the meet-NOM-in Peter-with also hope-past.1sg
'I hoped even for the meeting with Peter.'

In the examples, É. Kiss uses the particles *még* 'even' and *is* 'also', which according to her always surround single constituents. She intends to ensure in this way that the relevant post-head constituents are within the core NPs and are not extraposed, that is, moved out of the matrix DP. B) The other type she mentions, then, is the extraposition of the post-head constituent. She appears to assume that it is grammatical. However, she does not exemplify it and does not discuss the rather severe restrictions on its use.

It seems to be the case that Type B) is not a classic instance of extraposition. Compare the following English and Hungarian examples.

(13) A student entered the room with long hair.

(14) a. A tegnap-i találkoz-ás Péter-rel egészen elviselhetŒvolt.
the yesterday-AFF meet-NOM.nom Peter-with quite bearable was
'Yesterday's meeting with Peter was quite bearable.'

b. Én is kibír-tam a tegnap-i találkoz-ás-t Péter-rel.
I also stand-past.1sg the yesterday-AFF meet-NOM-acc Peter-with
'I could also stand the meeting with Peter.'

c. Én is reményked-tem a következŒ találkoz-ás-ban Péter-rel.
I also hope-past.1sg the next meet-NOM-in Peter-with
'I also hoped for the next meeting with Peter.'

The English example in (13) is an ordinary instance of what is normally meant by extraposition. The Hungarian examples are all grammatical in (14). From the discussion of É. Kiss's approach it should be obvious that she would analyse them as containing extraposed constituents. However, in these Hungarian constructions, as opposed to (13), no other element can intervene between the matrix DP and the allegedly extraposed constituent. Compare, for instance, (14b) and (15).

(15) *A tegnap-i találkoz-ás-t én is kibír-tam Péter-rel.
the yesterday-AFF meet-NOM-acc I also stand-past.1sg Peter-with
'I could also stand the meeting with Peter.'

(15) is ungrammatical on the reading on which *Péter-rel* 'Peter-with' is the complement of the head noun *találkozás* 'meeting' and not the (comitative) modifier of the verbal predicate. In the light of these facts, I think the correct generalization is to assume that the post-head constituent is not extraposed but rather right-adjoined to the matrix DP. Naturally, this adjunction analysis is not compatible with É. Kiss's approach as the adjoined constituent is still "in the way" and causes a violation of her Case Constraint. Nevertheless, there appears to be no independent evidence for the alleged extraposed constituents' ever leaving the entire DP. Thus her distinction between (12) and (14) seems vacuous and her explanation circular. Moreover, in my idiolect and according to some informants the examples in (12) are far from being as unacceptable as É. Kiss indicates. It is also noteworthy that when the post-head constituent is expressed by a PP, the acceptability of the construction improves even in a *még* 'even' … *is* 'also' environment, the diagnostic for single constituenthood for É. Kiss. This is problematic for her account. Consider:

(16) Még a tegnap-i összeesküv-és-rŒl az elnök ellen is megfeledkez-tünk.
even the yesterday-AFF conspire-NOM-about the president against also forget-past.1pl
'We forgot even about yesterday's plot against the president.'

In addition to all this, my general problem with the *még* 'even' … *is* 'also' environment is that it is potentially ambiguous: these particles can be interpreted in two different ways: as modifying either the entire DP including the post-head constituent or only the post-head constituent. And the latter interpretation is the more dominant. This may also contribute to the fact that for several speakers, including É. Kiss, the former interpretation is much less acceptable.

3. A new comprehensive account

3.1. The adjectivalized type – a modification of Laczkó (1995b)

It is my conviction that the analysis of this type that I offer in Laczkó (1995a) and especially in Laczkó (1995b) is along the right lines. However, as I have pointed out in section 2.1, it cannot capture one intriguing aspect of such constructions: the fact that there can be more than one element within a *való* constituent and they can have either OBL or ADJ functions. Consider (6) repeated here for convenience:

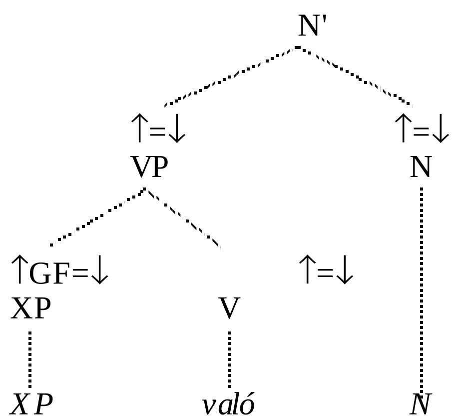
(6) a. János-nak az Edit-tel Budapest-re való meg-érkez-és-e
John-dat the Edith-with Budapest-onto BEING PERF-arrive-NOM-his
'John's arrival, with Edith, in Budapest'

b. János-nak a Budapest-re Edit-tel való meg-érkez-és-e
John-dat the Budapest-onto Edith-with BEING PERF-arrive-NOM-his
'John's arrival in Budapest with Edith'

In Laczkó (1995a, 1995b) I only count with one element within a *való* constituent; therefore, that analysis cannot cover these data. The reason for this is that it annotates the VP node itself with either an OBL or an ADJ function, thus it is incapable of capturing a possible mixture of these function types within the VP, for instance in (6). In the light of examples like this, the correct empirical generalization is that in this construction type the noun head's arguments and adjuncts must be adjectivalized by *való* (and some other participial forms to be discussed below) but not one by one, as a single occurrence of *való* is capable of adjectivalizing several of them.

Now I want to propose the following modification of the analysis.[3] Let us annotate the VP node with the $\uparrow=\downarrow$ equation, instead of $\uparrow$OBL=$\downarrow$ or $\downarrow\varepsilon\uparrow$ADJ, and the oblique case-marked DP(s) and/or PP(s) with their appropriate ($\uparrow$OBL=$\downarrow$ or $\downarrow\varepsilon\uparrow$ADJ) equations, instead of $\uparrow=\downarrow$. The V node dominating *való* will continue to be associated with $\uparrow=\downarrow$. Compare (17) with (5).

(17)



These functional annotations yield the correct f-structure representation. Consider the following simplified schematic structure:

(18)

$$\begin{bmatrix} \text{GF} & [\,'XP'\,] \\ \text{PRED} & '\mathit{N}' \end{bmatrix}$$

I would like to make three general remarks on this analysis.

1. The internal structure of the VPs premodifying NP heads is as flat as the propositional core of Hungarian clauses (without the discourse-functional left periphery), which É. Kiss (1998), for instance, also takes to be a VP. The fundamental difference between the two VPs is that the former is strictly right-headed and the latter is left-headed (according to É. Kiss).

2. It is a crucial aspect of the modified account that the premodifying VP has to be annotated with the $\uparrow=\downarrow$ equation, as opposed to $\uparrow$OBL=$\downarrow$ or $\downarrow\varepsilon\uparrow$ADJ, as in Laczkó (1995b). This is definitely a marked aspect of the new approach and I leave the investigation of its consequences for the theory for future research. Its marked nature has to do with the fact that the sister of an N' head has the status of a co-head.[4] The original solution did not pose a problem of this kind;

[3] My thanks are due to András Komlósy because I have benefited greatly from discussions of this issue with him.
[4] For an overview of the default annotations, see Bresnan (to appear).

however, as I pointed out in section 2.1, it failed to describe all the relevant constructions. In the modified version, all we need to do technically is to allow the association of the premodifying VP with any one of the three equations: ↑=↓, ↑OBL=↓ and ↓ε↑ADJ. The well-formedness or ill-formedness of the relevant constructions containing *való* and other (genuine) participles will follow from the general syntactic and semantic principles of the theory. I have already shown why the VP containing *való* has to be annotated with the ↑=↓ equation and not with ↑GF=↓. Let us now consider an example with an ordinary participle heading the VP and the two annotation possibilities.

(19) #a Budapest-re érkez-Œ meg-érkez-és
the Budapest-onto arrive-PART[5] PERF-arrive-NOM
'#the arrival arriving in Budapest'

On the one hand, if the VP containing the participle *érkezŒ* 'arriving' in the c-structure representation of (19) was annotated with the ↑=↓ equation, then both the NP head *megérkezés* 'arrival' and the participle, and, consequently the entire VP (including possible OBL and ADJ constituents), would contribute a PRED feature. However, this kind of rather marked (syntactic) predicate composition is not available in the case of these two and similar Hungarian predicates. This situation is different from that of the syntactic causatives analysed by Alsina (1993). There the simplex predicate is at the same time an argument of the causative predicate. In this case, by contrast, the participle with its PRED feature cannot serve as an argument of the nominal predicate (because the latter takes a theme and a directional argument), and the relationship in the opposite direction is semantically anomalous, also cf. the English gloss in (19). On the other hand, if the VP was annotated with ↑GF=↓, with ↑OBL=↓ in this particular case, then there would arise three problems. First, the constituent associated with the OBL function would have a participial (and not a directional) predicate. Second, the theme argument of the participial predicate would be unidentifiable, and thus the relevant part of the f-structure incomplete: to begin with, it would require some ad hoc machinery to ensure that the NP head *megérkezés* 'arrival' should be identified with the missing theme, the only theoretically possible candidate; furthermore, even if this could be achieved, the construction would be semantically anomalous, cf. the foregoing discussion of the first annotation alternative. Third, if there were more constituents within the VP than one, the ↑GF=↓ annotation would be problematic anyhow, cf. the discussion of a problematic aspect of Laczkó's (1995b) analysis in section 2.1.

3. So far I have only discussed and described the adjectivalizing property of *való*. As should be clear from the discussion, if it solely had this function then it would be restricted to this poorly understood superficial category change to be checked at the level of c-structure. However, there is another important aspect of its use: VPs headed by it can fundamentally premodify NP heads that express complex events. Thus, it also has to encode, in one way or another, this very important combinatorial information which has to be checked in the semantic component of the grammar. In order to appreciate this point, let us take a brief look at the major adjectivalizing elements premodifying either ordinary or derived nominal heads.

The Hungarian copula, *van* 'be' has two present participial counterparts. One of them is *való*, whose use I have been discussing so far. As I have just pointed out, it adjectivalizes the (oblique) arguments and adjuncts of event nominals, whether they are expressed by case-marked DPs or PPs. The other participial form is the suppletive *lévŒ*, and it is best regarded as a true, that is, argument-taking, participial counterpart of the locative version of the copula. A VP headed by this participle can only premodify non-event NP heads, so *való* and *lévŒ* are in complementary distribution, cf.:

(20) a. a ház elŒtt lévŒ/*való garázs
the house in front of BEING garage
'the garage in front of the house'

b. a ház-ban *lévŒ/való találkoz-ás

[5] PART = (present) participial suffix.

the house-in BEING meet-NOM
'the meeting in the house'

There are two additional participial forms that can also be analysed as pure adjectivalizing formatives, just like *való*.[6] They are the present and the past participial counterparts of the verb *történik* 'happen': *történ-Œ* 'happen-ing' and *történ-t* 'happen-ed'. While *való* is compatible with both stative and dynamic event nominal heads, these forms can only be combined with non-stative nominals. Presumably this has to do with the semantics of the input verb *történik* 'happen'. In addition, *történt* must be used with events anterior to the moment of speech, and *történŒ* must be applied if this aspectual relationship is simultaneous or posterior. Consider the following examples.

(21) a. János-nak a csoport-hoz való/*történŒ/*történt tartoz-ás-a
John-dat the group-to BEING/HAPPENING/HAPPENED belong-NOM-his
'John's belonging to the group'

b. az elnök-nek a tegnap-i mise után történt/*történŒ beiktat-ás-a
the president-dat the yesterday-AFF mass after HAPPENED/HAPPENING inaugurate-NOM-his
'the president's inauguration after yesterday's mass'

c. az elnök-nek a holnap-i mise után *történt/történŒ beiktat-ás-a
the president-dat the tomorrow-AFF mass after HAPPENED/HAPPENING inaugurate-NOM-his
'the president's inauguration after tomorrow's mass'

The adjectivizing suffix *-i* is compatible with both event and non-event noun heads; however, it can only attach to the majority of PPs (more precisely, to the heads of PPs) and never to case-marked DPs. Compare:

(22) a. a ház elŒtt-i garázs/találkoz-ás
the house in front of-AFF garage/meet-NOM
'the garage/meeting in front of the house'

b. *a ház-ban-i szoba/találkoz-ás
the house-in-AFF room/meet-NOM
'the room/meeting in the house'

Given these combinatorial facts, the four adjectivalizing elements[7] can be characterized in the following way.

(23)

-i	[_event]	[_dynamic]	[_anterior]
való	[+event]	[_dynamic]	[_anterior]
történt	[+event]	[+dynamic]	[+anterior]
történŒ	[+event]	[+dynamic]	[−anterior]

The above specifications have to be encoded in the lexical representations of these elements, and they have to be checked in the semantic component of the grammar. This means that these adjectivalizers do not merely play a role at c-structure, but they also have compatibility properties,

[6] Cf. Szabolcsi (1994) and Laczkó (1995b). However, in this case the tests used to establish the purely formative status of *való* do not yield the same straightforward results; therefore, a true participial analysis of *történŒ* and *történt* is a possible alternative to consider. If this latter tact is chosen then the discussion of pure adjectivalizing formatives above has to be restricted to *való* and *-i*.
[7] *LévŒ* does not belong here, because it is a true argument-taking predicate. On *történŒ* and *történt*, see Footnote 6.

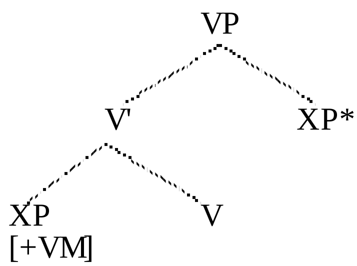
so their presence is also felt at other levels of representation (semantic structure and, consequently, the mediating f-structure).

3.2. A new analysis of the unadjectivalized type

In section 2.2 I characterized the unadjectivalized premodifying construction type and briefly mentioned two previous analyses. I pointed out that Szabolcsi's (1994) account is not compatible with the principles of LFG and my proposal in Laczkó (1995a) is problematic because it is forced to admit the lexical incorporation of maximal projections. Below, I will suggest an alternative solution which avoids this problem.

It is generally acknowledged that the verbs occurring in the relevant (syntactic) complex predicates have two important distinguishing features: (i) in a sentence with a neutral intonation pattern, they must be preceded by their designated oblique argument and they together make up a syntactic V'; and (ii) the *aktionsart* of the complex predicate is very often telic, although the verb itself must not contain a perfectivizing preverb. As regards the first feature, É. Kiss (1998), for instance, assumes the following c-structure:

(24)



[+VM] below the XP in V' means that the XP[8] has a special status: it is a "verbal modifier".[9] The properties of this special use of these verbs allowing VM arguments has to be encoded in their lexical forms in one way or another. For the purposes of this discussion I will informally assume that these verbs have a lexical form with the following specification:

(25) verb, V 'VERB <…>'
[+VM]

[+VM] indicates that in a sentence with a neutral intonation pattern the verb must be immediately preceded by its designated argument, and this feature also has to be related to the fact that under clearly specifiable (default) circumstances the interpretation of the construction is telic.[10] Compare the following lexical forms.

(26) a. érkez, V 'ARRIVE <th, dir>'
[+VM] [–r] [–o]

b. meg-érkez, V 'ARRIVE <th, dir>'
[–r] [–o]

The fundamental difference between the two predicates is that the one in (26b) cannot be preceded by the designated directional argument in the specific VM position.[11]

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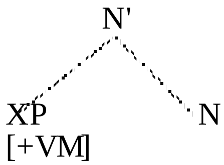
[8] Note that this VM position is distinct from the focus position, which precedes the entire VP, cf., for instance, É. Kiss (1998: 42).
[9] For an exhaustive list of argument-types that can serve as verbal modifiers, see Komlósy (1985). For the subset of these types that can be found in unadjectivalized constructions, see Laczkó (1995a).
[10] The discussion of these circumstances lies beyond the scope of this paper.
[11] However, this directional argument can precede the verb in other positions, but these instances do not concern us here.

My new analysis of the unadjectivalized type has the following two major components.

A) I assume that in the NP core of the Hungarian DP the "first" N' node dominates a VM node and the head in such a way that the former precedes the latter, cf.:

(27)



Thus I draw a complete structural parallel between the basic V' in VPs and the basic N' in NPs.

B) I propose that the nominal derived from a verb with the [+VM] specification inherits this specification as well. Compare (26) and (28).

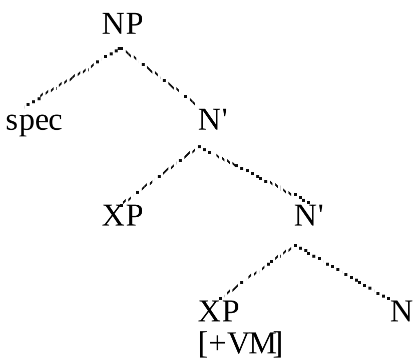
(28) a. érkez-és, N ' ARRIVAL <th, dir>'
[+VM] [–r] [–o]

b. meg-érkez-és, V ' ARRIVAL <th, dir>'
[–r] [–o]

In this way I can capture the empirical generalization that only specific verbs and their nominalized counterparts can (and must) be preceded by a designated argument under normal, that is unmarked, circumstances.

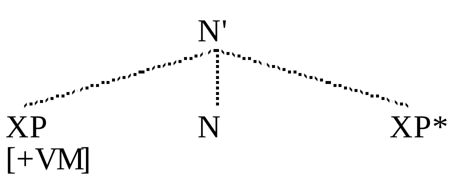
It is noteworthy that there is no parallel between the rest of the NP structure that I assume an the rest of the VP structure that É. Kiss (1998) assumes. Compare É. Kiss's VP structure in (24) with the NP structure I postulate in (29).

(29)



Furthermore, É. Kiss (to appear) draws a parallel between the VP and NP structures. As has been pointed out in section 2.3, she assumes that all the arguments and adjuncts of the noun head are generated in post-head positions and then they are moved into pre-head positions and adjectivalized.[12] However, she does not discuss the unadjectivalized type. If she did, I think she would have to postulate exactly the same pre-head structure as I do in (29). Then the post-head portion of her NP structure would most probably be flat and dominated by the same N' as dominates XP [+VM], cf.:

(30)



[12] For some critical remarks, see section 2.3.

Moreover, although Szabolcsi (1994) is not explicit about the pre-head portion of the NP structure she assumes in her analysis of the unadjectivalized type, I suspect that she has a structure similar to (29) in mind.

Let us now take a look at some of the most salient properties of the unadjectivalized type and compare the three analyses discussed in section 2.2 and in this section with respect to how they can capture these properties.

1. The VM and the N form a phonological word. This can be derived from a salient property of the VM + V combination: it is clearly not a morphological or syntactic word but a phonological one. This is an empirical fact which can be conveniently stated over the postulated V' constituent. That the VM + N combination has the same phonological word status is sufficiently captured by all the three accounts (if we assume that Szabolcsi (1994) has the same NP structure in mind as I have posited in this section, cf. (29)). In my new analysis this correspondence is directly captured by the postulation of parallel V' and N' structures and the inheritance of the [+VM] feature by the derived nominal. In my previous analysis in Laczkó (1995a) the VM + N combination is taken to be a morphological word, hence its phonological wordhood trivially follows.

2. No other element can intervene between the VM and the N, cf.:

(31) a. a váratlan Budapest-re érkez-és
the unexpected Budapest-onto arrive-NOM
'the unexpected arrival in Budapest'

b. *a Budapest-re váratlan érkez-és
the Budapest-onto unexpected arrive-NOM
'the unexpected arrival in Budapest'

Szabolcsi (1994) captures this by the following generalization: the nominalizing suffix raising at LF has to have the minimal complex predicate in its scope. In Laczkó (1995a) this fact is explained again by the assumption that *Budapestre* and *érkezés* form on morphological word in the lexicon and, thus, no other syntactic word may intervene. In the spirit of my new account again we can simply point out that the very same ban on intervention holds for the VM + V combination. This has to be stated, and then this property will be inherited by the VM + N combination.

3. The designated argument and the preverb are in complementary distribution, cf.:

(32) a. a Budapest-re érkez-és
the Budapest-onto arrive-NOM
'the arrival in Budapest'

b. a meg-érkez-és
the PERF-arrive-NOM
'the arrival in Budapest'

c. *a Budapest-re meg-érkez-és
the Budapest-onto PERF-arrive-NOM
'the arrival in Budapest'

Szabolcsi's theory captures this fact by assuming that "the nominalizing suffix must have the smallest possible fully specified conceptual structure in its scope" (1994: 264). In (32a), the designated oblique argument and in (32b) the perfectivizing preverb make up a complex predicate with the verb stem, and thus these complex predicates satisfy Szabolcsi's condition, because complex predicates have fully specified conceptual structures. By contrast, in (32c) only the preverb and the verb stem can be in the scope of the nominalizer as these two elements make up the minimal fully specified conceptual structure. Consequently, the oblique argument is outside its scope and, therefore, it could only be used in an adjectivalized form, cf. (32c) and (1c). On my new account, the ungrammaticality of (32c) can be captured by the now familiar inheritance mechanism. It has to be stated in one way or another that verbal predicates containing a preverb do not allow VMs (cf., for instance, (26)), and this feature of theirs is inherited by their nominal counterparts (cf. (28)). Laczkó (1995a) refers to the complementarity of the two types of complex predicate formation in the lexicon.

4. The VM in the VM + N combination does not need to, or rather must not, undergo adjectivalization. I think this is the only property of these constructions that is more neatly and more straightforwardly captured in Laczkó (1995b). The explanation is that the relevant complex verb formation and then nominalization takes place in the lexicon and the whole morphological complex is inserted below an N^0 node, while adjectivalization is a syntactic phenomenon. Szabolcsi (1994) is not explicit on this point; however, I think both in her analysis and in mine it has to be stipulated that adjectivalization applies to sisters of N's but not sisters of N^0s.[13]

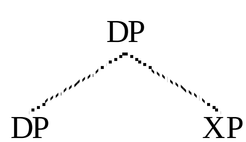
If we just took the four points above into consideration then we could easily conclude that of the three accounts, Laczkó (1995a) was superior because in the first three points it was on a par with the two alternatives and in the fourth it offered a more principled solution. However, this account has two extremely marked features, which are closely related and which strongly call its tenability into question. One of them, already mentioned in section 2.2, is that Laczkó (1995a) is forced to allow the incorporation of maximal projections (e. g., in the case of designated arguments expressed by PPs). This is not compatible with the generally accepted notion of (lexical, that is, morphological) incorporation. The other equally marked aspect of the analysis is that it has to assume that the combination of the verb and the case-marked noun or the entire PP is one morphological word nominalized in the lexicon and then this whole complex is inserted under a single N^0 node. Furthermore, as far as the stipulation of adjectivalization in the analysis proposed here is concerned, it appears to be the case that in the characterization of all the three fundamental types some special aspect of the c-structure plays a significant role. A) In the adjectivalized type, on the one hand, adjectivalization is only imposed on sisters of N' constituents and, on the other hand, the VP node is annotated with the $\uparrow=\downarrow$ equation. B) In the unadjectivalized type, which we are now discussing, on the one hand, a VM position is postulated below the N' level and, on the other hand, adjectivalization does not affect this constituent. C) I will assume that in the post-head type, to be discussed in the next section, the postmodifying arguments and adjuncts are right-adjoined to the entire DP.

3.3. The post-head type: right-adjunction

In section 2.3 I have pointed out that É. Kiss (to appear) postulates that all arguments and adjuncts are generated after the noun head and they are either preposed and adjectivalized or extraposed. I have argued that on the one hand, the preposing and adjectivalizing process appears to be problematic in the MP framework she applies and, on the other hand, it does not seem to be possible to tell the base-generated and the extraposed constituents apart, because the allegedly extraposed ones and the noun heads cannot be separated by any intervening elements.

In an LFG framework an approach along the lines of É. Kiss (to appear), even if it were unproblematic in MP, cannot be adopted, as no movement is allowed in the theory. In sections 3.1 and 3.2 I have analysed, without movement, the two other construction types in which the arguments precede the head. As far as the post-head type is concerned, I propose that a constituent following the head is generated in a position right-adjoined to the DP, cf.:

(33)



The underlying assumptions are as follows.

- There is no evidence that the post-head constituent ever leaves the domain of the DP (as I have already pointed out, no other element can intervene between this constituent and the noun head).
- Given the extremely severe restrictions on this construction type, it is not reasonable to postulate ordinary argument and adjunct positions after the head. That is why the right-

[13] Cf. Footnote 1.

adjunction analysis can be regarded as more feasible. It is further supported by the fact that the adjoined constituent receives the same kind of strong stress as ordinary appositional constituents.

At this point two related questions arise. A) If Hungarian NPs are (assumed to be) strictly head-final, what is the explanation for right-adjunction? B) If right-adjunction is available, what is the reason for its being extremely limited? My hypothesis is as follows. It is economy that motivates right-adjunction. We have seen that pre-head arguments and adjuncts have to be used in adjectivalized forms (except for the special unadjectivalized type; however, it is drastically confined to the designated argument of nominals derived from a small subset of verbal predicates). By using right-adjunction the necessity of adjectivalization can be avoided. At the same time, because of the otherwise strict head-final nature of the NP, right-adjunction can only be applied if the adjoined constituent can be easily identified as belonging to the DP and not to any other element (for instance, the verbal predicate) of the sentence in which the DP occurs. That is why the overwhelming majority of DPs with a right-adjoined constituent appear at the very end of sentences.

I suggest that the right-adjoined constituents get integrated in the "NP core" by outside-in functional uncertainty. There are two facts that motivate this directionality of functional uncertainty. (A) In Hungarian "NP cores" there are no distinguished positions for ordinary oblique arguments (except for the designated oblique argument in the second construction type; however, that argument may never follow the head). (B) Adjuncts can also follow the NP head. Thus, there is no "starting point" for functional uncertainty within the NP.

4. Summary

In this paper I have offered a comprehensive analysis of the three ways of expressing oblique arguments and adjuncts of event nominals in Hungarian.

In the first, and by far the most productive, type the arguments and adjuncts preceding the head have to be adjectivalized by means of either the adjectivizing suffix *-i* (but it can only attach to the majority of postpositions) or *való*, one of the present participial counterparts of the copula *van* 'be'. The account proposed here has been a modified version of Laczkó (1995b). Its most essential aspects are as follows. *Való* is not a true argument-taking predicate: it is a formative element; however, it also carries combinatorial information. In the modified analysis I assume that the VP headed by *való* is annotated with the $\uparrow=\downarrow$ equation, and in this way we can also capture cases in which *való* simultaneously adjectivalizes more than one constituent (for instance, an argument and an adjunct at the same time).

In the second type, which is limited to designated oblique arguments of nominals derived from a small subset of verbal predicates, the oblique argument preceding the head is not adjectivalized. As opposed to Szabolcsi's (1994) GB analysis, raising the nominalizing suffix at LF, and Laczkó's (1995a) lexical incorporation, combining the oblique argument and the verb in the lexicon and nominalizing them there, here I have proposed an entirely new account. I have drawn a parallel between a special V' portion of the Hungarian VP, which dominates a particular VM (verbal modifier) constituent and the V head, and a corresponding N' portion of the NP, which dominates the same VM constituent and the nominal head. Furthermore, I assume that these nominals inherit the distinguishing feature of the input verb to the effect that the VM position has to be filled by the designated oblique argument.

The third type, in which the oblique argument or adjunct follows the head and must not be adjectivalized, is rather rare and it is limited to cases in which we can clearly identify the post-head constituent as belonging to the NP headed by the nominal and not to any other element (for instance the verbal predicate) of the sentence. I have argued that because of these limitations it is not reasonable to postulate ordinary post-head argument and adjunct positions (contra É. Kiss (to appear)). At the same time, I have pointed out that no other element can intervene between the nominal and the post-head constituent; therefore, this is not an instance of ordinary extraposition. Instead, I assume that these post-head constituents are right-adjoined to the DPs in which their nominal heads occur, and they get integrated into the NPs they belong to by outside-in functional uncertainty.

References

Ackerman, Farrell (1987) *Miscreant Morphemes: Phrasal Predicates in Ugric*. Ph.D. dissertation. University of California at Berkeley.

Alsina, Alex (1993) *Predicate Composition: A Theory of Syntactic Function Alternations*. Ph.D. dissertation. Stanford University.

Bresnan, Joan (to appear) *Lexical-Functional Syntax*. Oxford: Basil Blackwell.

É. Kiss, Katalin (1994) Sentence structure and word order, in: Kiefer, Ferenc – É. Kiss, Katalin eds. *The Syntactic Structure of Hungarian*. San Diego–New York: Academic Press, 1–90.

É. Kiss, Katalin (1998) *Mondattan* (Syntax), in: É. Kiss, Katalin – Kiefer, Ferenc – Siptár, Péter. *Új magyar nyelvtan* (New Hungarian Grammar). Budapest: Osiris, 15–184.

É. Kiss, Katalin (to appear) The Hungarian noun phrase is like the English noun phrase, in: Kenesei, István – Alberti, Gábor eds. *Approaches to Hungarian. Volume 7.* Szeged: JATE.

Komlósy, András (1985) Predicate composition, in: Kenesei, István ed. *Approaches to Hungarian. Volume 1. Data and Descriptions*. Szeged: JATE, 53–78.

Laczkó, Tibor (1995a) *The Syntax of Hungarian Noun Phrases: A Lexical-Functional Approach*. Frankfurt am Main: Peter Lang.

Laczkó, Tibor (1995b) On the status of *való* in adjectivalized constituents in noun-phrases, in: Kenesei, István ed. *Approaches to Hungarian. Volume 5. Levels and Structures*. Szeged: JATE, 125–152.

Pesetsky, David (1985) Morphology and logical form, *Linguistic Inquiry* **16**, 193-246.

Szabolcsi, Anna (1990) Suppressed or PRO subjects? The argument structure of event nominals in Hungarian, in: Kenesei, István ed. *Approaches to Hungarian. Volume 3. Structures and Arguments*. Szeged: JATE, 147–181.

Szabolcsi, Anna (1994) The noun phrase, in: Kiefer, Ferenc – É. Kiss, Katalin eds. *The Syntactic Structure of Hungarian*. San Diego–New York: Academic Press, 179-274.

TENSE AS A NOMINAL CATEGORY

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Abstract

Recent work in morphology in LFG (Nordlinger 1998, Sadler 1998, Barron 1998) has highlighted the fact that NPs in some languages inflect for the traditionally verbal categories of tense, aspect or mood (henceforth TAM). This phenomenon is extremely problematic for head-driven approaches such as HPSG, which assumes that clause-level information will be associated with clausal heads, and not with nominal arguments or adjuncts. In this paper we show first that the phenomenon of TAM-inflected nominals is well established and not typologically marginal. We discuss data from a range of typologically diverse languages and show that such data cannot simply be reanalysed to fit head-driven approaches, but demand an analysis in which clause-level information such as TAM is directly contributed by nominal arguments. We then go on to show how the correspondence architecture of LFG, and particularly the constructive morphology approach currently being developed within it (Nordlinger 1998, Sadler 1998, Barron 1998, Sells 1998, Lee 1999, Sharma 1999) permits a simple and natural analysis of these data, which are extremely problematic for other formal approaches. This approach not only provides an explanatory account for the cross-linguistic phenomenon of tense as a nominal category, but also highlights one of the strengths of LFG in contrast with head-driven frameworks.

1 Introduction

[1] Recent work in morphology in LFG (Nordlinger 1998, Sadler 1998, Barron 1998) has highlighted the fact that NPs in some languages inflect for the traditionally verbal categories of tense, aspect or mood (henceforth TAM). For example, in the Kayardild examples in (1) an argument of the embedded clause, *mala*, is inflected for TAM information (Evans 1995, Nordlinger 1998). The cases glossed M.PROP and M.LOC function as markers of tense and mood interacting with the verbal marking, as shown by the meaning contrast between (1a) and (1b), despite the fact that the verbal affix remains the same.

(1) a. Ngada kurri-nangku mala-wu balmbi-wu.
1.SG.NOM see-NEG.POT sea-M.PROP morrow-M.PROP
'I won't be able to see the sea (tomorrow).' (Evans 1995:404, ex. 10-12)

b. Ngada kurri-nangku mala-y barruntha-y.
1.SG.NOM see-NEG.POT sea-M.LOC yesterday-M.LOC
'I could not see the sea (yesterday).' (ibid., ex. 10-13)

A similar phenomenon is exemplified by the English example in (2), in which the non-syllabic reduced auxiliary is incorporated into the subject pronoun, which therefore contributes tense information to the clause (Sadler 1998):

(2) You'll be leaving tomorrow.

Data such as these show clearly that nominal elements may define the clause level TAM information typically associated with verbal elements: in other words, they exemplify a particular type of mismatch between featural information content and syntactic category. This phenomenon is extremely problematic for theories which postulate a rigid relationship between syntactic form and featural content.

[1] We are grateful to subscribers to the LINGTYP list for their input and also to Joan Bresnan, Ida Toivonen and Andy Spencer for discussion and comments.

Interestingly, it is also problematic for the head-driven approach of HPSG to accommodate both heads which morphologically incorporate into dependents (2) and cases in which dependents express clausal (head) information (1). The very architecture of HPSG builds in the assumption that clause-level information will be associated with clausal heads, and not with NP arguments and adjuncts, thus requiring this type of phenomenon to be reanalysed as involving head-dependent agreement or pronominal incorporation into auxiliary heads.

In this paper, we show first that the phenomenon of TAM-inflected nominals is well established and not typologically marginal, contrary to the claim made in (Bender and Sag 1999) that the phenomenon of subjects projecting tense is unattested cross-linguistically. We discuss data from a range of typologically diverse languages and show that such data cannot simply be reanalysed to fit head-driven approaches, but demand an analysis in which clause-level information such as TAM is directly contributed by nominal arguments. We then go on to show how the correspondence architecture of LFG, and particularly the constructive morphology approach currently being developed within it (Nordlinger 1998, Sadler 1998, Barron 1998, Sells 1998, Lee 1999, Sharma 1999) permits a simple and natural analysis of these data, which are extremely problematic for other formal approaches. This approach not only provides an explanatory account for the cross-linguistic phenomenon of tense as a nominal category, but also highlights one of the strengths of LFG in contrast with head-driven frameworks.

This paper is structured as follows. In section 2 we survey this phenomenon in a range of typologically diverse languages. In sections 3 and 4 we discuss the analysis that can be given to such data within the LFG model of constructive morphology, and the problems that these data pose for the head-driven framework HPSG. Finally in section 5 we address these differences more specifically through the discussion of Sadler's (1998) LFG analysis of reduced non-syllabic auxiliaries in English and the counter-analysis proposed by Bender and Sag (2000) in HPSG.

2 General Survey of the Phenomenon

The encoding of clause-level TAM information on dependent nominals, while having been virtually ignored by linguistic theory, is reasonably prevalent cross-linguistically, appearing in a variety of forms across typologically diverse and unrelated languages. In this section we demonstrate this with data from languages such as Supyire (Niger-Congo), /Gui (Khoisan), Chamicuro (Arawak) and Pitta Pitta (Pama-Nyungan). While the details may differ, all of these languages share the property of morphologically encoding information about the tense, aspect or mood of the clause on dependent nominals (both arguments and non-arguments).

There are a number of other ways in which TAM information can come to be associated with nominals and nominal categories. For example:[2]

(i) A language may have TAM clitics which can attach phonologically to nominals. This situation is found in Garrwa (Australia) (E. S Furby and C. E. Furby 1977) and Apurina (Arawak, Brazil) (da S. Facundes in progress).

(ii) TAM affixes may appear on nominals to encode semantic features of the NP, e.g. chair-PAST means 'a former chair', chair-FUT means 'a future chair', etc. This use is found in some Amazonian languages, for example, such as Tariana (Aikhenvald 1999).

(iii) Pronominal elements may incorporate into a tensed auxiliary. This can give the appearance of tense-

[2]We would like to thank the many LINGTYP readers who provided much of the language data on which this summary is based. In particular, we are grateful to Matthew Dryer for first identifying and distinguishing these different types of TAM-inflected nominals.

inflected pronouns while actually being a verbal category simply inflected for pronominal features of subject and possibly other arguments. This situation is found in Hausa and other Chadic languages, for example (Burquest 1986).

However, these possibilities do not pose the theoretical problems that we are interested in here. In the case of (ii), the TAM category is relevant only to the NP, and not to the whole clause, thus the fact that it is encoded on the NP is entirely appropriate. As for (i) and (iii), in neither of these situations is a dependent nominal inflected for TAM: in (i), the TAM marker is a clitic, a distinct syntactic element, which just happens to be realised phonologically on the dependent nominal; and in (iii) the tensed element is actually a verbal category which is inflected for the pronominal features of its subject. Thus, while these are all cases of nominals bearing TAM information, in none is the nominal actually inflected for the TAM category of the clause.

We have already seen in (1) two examples of dependent nominals inflected for clausal TAM. The Kayardild data is discussed in detail in Nordlinger (1998) (also (Evans 1995)) and so won't be discussed further here. The English data will be discussed in more detail in section 5. Many other languages of the world exhibit similar and related phenomena, as we will now see.

In the Niger-Congo language Supyire (Carlson 1994), first and second person pronouns have two distinct forms depending on whether the mood of the clause is declarative or non-declarative. The two sets of forms are shown in the table below (taken from Carlson 1994:152, 154).

	DECL.	NON-DECL.
1.SG	mìi	na
2.SG	mu	ma
1.PL	wùu	wu
2.PL	yìi	yi

The distinction between these two pronoun sets is shown in the following examples. Note that in (4b) and (4c) the distinction in mood is shown by the pronouns alone.

(3) a. mìi ŋ∼kùùŋi
my chicken.DEF
'my chicken' (Carlson 1994:152, ex. (1a))

b. Mìi à pa.
I PERF come
'I have come.' (ibid. ex. (1b))

c. Mu a mìì kánhá.
You PERF me tire
'You have annoyed me.' (ibid, ex. (2b))

(4) a. Ma ∅ pa.
you.NONDECL SUBJUNC come
'Come' (polite command). (Carlson 1994: 154, ex. (6a))

b. Na wìì.
me.NONDECL look.at
'Look at me.' (imperative) (ibid., ex. (7a))

c. Na cevoo ŋ∼kùu, taá ma kɛ-ɛ-gé ke?
my.NONDECL friend chicken where you.NONDECL go.IMPFV LOC.Q
'My friend chicken, where are you going?' (ibid., ex. (7c))

In (3) we see the declarative pronouns in possessor, subject and object functions. In (4) we see the equivalent pronouns in the same functions in non-declarative sentences. While declarative pronouns can sometimes appear in non-declarative clauses, the reverse is not true: it would be totally ungrammatical for the first singular pronoun *na*, for example, to appear in one of the declarative clauses in (3). Furthermore, in examples like (4b), it is only by virtue of the pronoun that we know the clause is non-declarative at all. It is quite clear, therefore, that these pronouns carry (non-declarative) mood information for the clause.

A similar situation is found in /Gui [g|ui], a Central Khoisan language spoken in Botswana. In /Gui subject pronouns are usually in the nominative case (5), except for in imperative clauses, in which case they must appear in the distinct imperative form (6). As is clear in the contrast between (5) and (6), the verb remains in the same form in both sentence types: the imperative mood of the clause is encoded by the subject pronoun alone (Hitomi Ono, pc):

(5) Cire !koõ
1.SG.NOM go
'I go.'

(6) Da !koõ.
1.SG.IMP go
'Let me go.'

In Chamicuro, an Arawak language spoken in Peru, clausal tense information is encoded on the definite article which must usually accompany (definite) nominal subject and object arguments (Parker 1999). There are two forms of the definite article: *na*, used in present and future tenses, and *ka* which marks past tense. These articles do not bear stress, and Parker shows that they cliticize phonologically to C final, but not to V final, preceding words, a behaviour which is completely predictable on purely phonological grounds. These phonological enclitics semantically modify the following nominal (e.g. (9)).

(7) I-nis-kána na čamálo.
3-see-PL THE bat
'They see the bat.' (Parker 1999:552, ex. (2))

(8) Y-alíyo ka ké:ni.
3-fall THE(PAST) rain
'It rained' (the rain fell). (ibid., ex. (3))

(9) U-ʔ-yéʔ=na Pámpa Hermosa-šána.
1-go-FUT=THE Pampa Hermosa-LOC
'I will go to Pampa Hermosa.' (ibid., p. 554 ex. (9))

The tense contrast between these two forms is shown most clearly by the following pair of sentences, in which there is no independent tense marker on the verb. Thus, the tense constrast is encoded by the definite article alone.

(10) a. P-aškalaʔt-ís=na čamálo.
2-kill-2.PL=THE bat
'You (plural) are killing the bat.

b. P-aškalaʔt-ís=ka čamálo.
2-kill-2.PL=THE(PAST) bat
'You (plural) killed the bat.' (Parker 1999:553, ex. 7, 8)

That these are indeed definite articles and not part of the verbal complex is shown by the fact that they appear within NPs:[3]

(11) anáʔ=na čmeṣ̌óna
this=THE man
'this man' (ibid., p. 554, ex. (13))

(12) Y-ahkašamustá-wa ka maʔpóhta ka maʔnáli
3-scare-1.OBJ THE(PAST) two THE(PAST) jaguar
'The two jaguars scared me.' (ibid., ex. (14))

Thus, it is clear that these definite articles in Chamicuro, while belonging syntactically to dependent NP constituents, encode clause-level tense information.

Another variation on this same general phenomenon is found in the Australian language Pitta Pitta (Blake 1979), in which the case suffixes obligatorily attached to nominals in the clause additionally encode tense information. Furthermore, the case marking system differs dependent on the tense category encoded, as shown in the following table (taken from (Blake 1987): 59, see also (Nordlinger 1998) for discussion with the LFG framework).

	S	A	O	Inst
Non-Future	-∅	-lu	-nha	-lu
Future	-ngu	-ngu	-ku	-ngu

Thus, in future tense the case marking makes a nominative-accusative distinction, with subjects marked with -*ngu* and objects marked with -*ku* (which is also the dative case). In non-future tenses (past and present), on the other hand, there is a three way opposition between intransitive subject (-∅), transitive subject (-*lu*) and object (-*nha*). Note that this tense distinction is also encoded in the case suffixes of instrumental NPs, so it is not purely a property of core grammatical functions.

Examples illustrating the case alternations on subjects (13-14) and objects (15-16) include the following: [4]

(13) Ngamari karnta-ya ngartu-nga kankari-marru.
mother(NOM) go-PRES nardoo-PURP knife-having(NOM)
'Mother's going for (to get) nardoo with a knife.' (ex. 4.11)

(14) Ngamari-ngu karnta ngartu-nga kankari-marru-ngu.
mother-NOM.FUT go nardoo-PURP knife-having-NOM.FUT
'Mother will go for (to get) nardoo with a knife.' (ex. 4.13)

(15) Ngamari-lu ngunytyi-ka ngali-nha mangarni-marru-nga-nha kathi-nha.
mother-ERG give-PAST we.DU-ACC bone-having-GEN-ACC meat-ACC.
'Mother gave us the doctor's meat.' (ex. 4.12)

(16) Ngamari-ngu ngunytyi ngali-ku mangarni-marru-nga-ku kathi-ku.
mother-NOM.FUT give we.DU-ACC.FUT bone-having-GEN-ACC.FUT meat-ACC.FUT.
'Mother gave us the doctor's meat.' (ex. 4.14)

[3]In (12), the definite article appears twice within the NP: once before the numeral and once before the head noun, as is typical for Chamicuro NPs containing numerals and demonstratives (Parker 1999: 554).

[4]These examples are taken from Blake (1987: 59-60).

The contrasts between (13) and (14) and again between (15) and (16) show very clearly the interaction of case marking in Pitta Pitta with tense. In the future tense clauses in particular, in which the verb carries no tense inflection at all, it is only the form of the case markers that specify the tense of the clause.

In this section we have presented data from a wide range of typologically diverse languages demonstrating the fact that dependent NPs, including subjects, can and do provide TAM information directly to the clause. In fact, the languages that we have discussed constitute only a small portion of the total number of languages which exhibit this phenomenon. Other languages which space considerations prevented us from discussing here include: Lardil (non-Pama-Nyungan, Australia) (Hale 1997), Gurnu (Pama-Nyungan, Australia) (Wurm and Hercus 1976), Yag Dii (Niger-Congo, Cameroon) (Bohnhoff 1986), Sahidic Coptic (Egyptian) (Lambdin 1983), Gusiilay (Niger-Congo) (Raible to appear), Iai (Oceanic) (Tryon 1968), Tigak (Oceanic) (Elena Filimonova, pc) and Guaymi (Chibchan, Costa Rica and Panama) (Tom Payne, pc). The sheer number and typological diversity of languages in which this phenomenon is found argue strongly that it is by no means marginal. Rather the possibility that TAM information is directly contributed to the clause by dependent nominal arguments, must be accounted for within any theory of universal grammar.

3 LFG Analysis

The use of nominals to encode clause-level information, such as we saw at length in the preceding section, is dealt with simply and naturally within LFG's model of constructive morphology. Constructive morphology makes use of inside-out constraints (e.g. Halvorsen and Kaplan 1988, Dalrymple 1993, see also Andrews 1996:41-43) associated with the lexical elements or morphological processes to enable nominal constituents to define the larger syntactic (f-structure) context in which they are embedded. For example, the /Gui imperative subject pronoun in (5) would have associated with it the inside-out constraint in (17):

(17) *da* ((SUBJ $\uparrow$) MOOD) = IMP

The inside-out designator (SUBJ $\uparrow$) in this constraint defines an f-structure containing a SUBJ attribute whose value is the f-structure of the pronominal (i.e. that designated by $\uparrow$). In other words it creates a larger f-structure within which the pronominal's f-structure is embedded as the SUBJ:

(18)

$$\left[\begin{array}{ll} \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{PRO} \\ \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{array}\right] \end{array}\right]$$

Furthermore, this constraint also stipulates that the larger f-structure (that denoted by (SUBJ $\uparrow$) has a MOOD attribute whose value is IMP. Thus, the complete f-structure constructed by the imperative subject pronoun *da* is that in (17).

(19)

$$\left[\begin{array}{ll} \text{MOOD} & \text{IMP} \\ \text{SUBJ} & \left[\begin{array}{ll} \text{PRED} & \text{PRO} \\ \text{PERS} & 1 \\ \text{NUM} & \text{SG} \end{array}\right] \end{array}\right]$$

Note that the MOOD information contributed by the subject pronoun has been unified into the outer f-structure, namely the f-structure for the whole clause. Thus, this model accurately captures the fact that such TAM information associated morphologically with (pro)nominals is, in fact, *clause-level* information, and not information relevant to the nominal host.

Although, as we will see below, an account can in principle be given of these cases of TAM inflected nominal arguments by postulating otherwise unmotivated nominal features and concord requirements, it seems to us that a more adequate account of these data is available in a theory whose description language includes inside-out statements. While inside-out function application is well-established in LFG through work in such areas as quantifier scope (Halvorsen and Kaplan 1988), anaphoric binding (Dalrymple 1993), internally-headed relative clauses (Culy 1990), Russian genitive of negation (King 1995), Urdu case (Butt 1995), case in Australian Aboriginal languages (Nordlinger 1998), and topicalization (Bresnan 2000), it is not generally assumed in HPSG (although both Bredenkamp (1996) and Koenig (1998) explore phenomena which lend themselves most naturally to inside-out formulations, and provide sketches of how they may be accommodated in specific description languages for HPSG). As Koenig (1998) shows, this rules out versions of the Kasper Rounds logic for HPSG since what is required is a description language in which you can refer to feature structures.

4 Problems for Head Driven Grammars

In contrast to the ease with which LFG's model of constructive morphology captures the encoding of clause-level TAM properties on subject and non-subject NPs, the expression of head properties on a dependent, especially on a subject, is highly problematic for HPSG. This is because the theory is strongly head-driven, and adopts what is essentially a constituent based theory of headedness. This means that it is committed to a single notion of syntactic head, grounded in the notion of categorial similarity. Under this view, heads can control for local properties of the elements which they subcategorise or otherwise select, and themselves uniquely determine the HEAD features of their mother, while dependents do not place constraints on the heads they combine with or the constructions within which they appear[5]. For example, a typical case of concord and index agreement within N might be treated by providing each (agreeing) element with its own intrinsic features, which are then shared or identified, either by specification in the lexical entry for the head, which can see into the dependent which it selects (as exemplified below), or, in principle, at the level of the construction or ID schemata.

[5]Where dependents select or co-select their syntactic heads, additional features are introduced: for example, adjectival modifiers will select nominal heads via a special MOD feature, and determiners co-select their heads via a SPEC feature: the general point, however, remains valid.

(20)
$$
\begin{bmatrix} \textit{word} & \\ \text{PHON} & \langle .... \rangle \\ \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{noun} & \\ \text{CASE} & [1]\ \text{nom} \end{bmatrix} \\ \text{SPR} & \langle \text{DP:[CASE [1]:[2]]} \rangle \end{bmatrix} \\ \text{CONTENT} & \begin{bmatrix} \textit{nomobj} & \\ \text{INDEX} & [2] \begin{bmatrix} \text{PER} & 3 \\ \text{NUM} & \text{SG} \\ \text{GEN} & \text{FEM} \end{bmatrix} \\ \text{RESTR} & .... \end{bmatrix} \end{bmatrix}
$$

Such an approach is reasonable in the (hypothetical) case where a nominal dependent of a verbal head is marked to agree with some TAM feature of the verbal head, but positing intrinsic TAM features for nominal dependents of verbal heads does not capture the intuition concerning the data discussed here, in which the nominal elements directly co-describe or constrain the TAM values of the clause (or verbal projection) within which it appears. In LFG, as we saw above, this can be achieved without positing TAM features within the f-structure of the nominal itself, an important facet of the analysis proposed in work on this phenomenon in LFG.

In the Supyire data of section 2 the choice of first and second person pronouns depends on the mood of the clause (see examples (3) and (4) above). To view this in a head-driven fashion, we must first assume a declarative/nondeclarative distinction inherent to the pronominal system, expressed either in the signature (by recognising subtypes of the type *noun* or in the theory by reference to specific (dedicated) feature, for example, DECL. For concreteness, we suppose the latter. [6] Then the head must be specified to share its own DECL feature with that of its dependents: this can be expressed in a lexical entry similar to that in (20) above. However there are two further issues. Firstly, although the distinction is *only* relevant to pronominal arguments, as a consequence of the feature sharing or concord analysis along the lines shown above, all nominal arguments must be provided with a DECL feature (and given that the distinction is not always marked in the verbal element, the requirement that linguistic objects be totally well-typed and sort-resolved seems to necessitate also the declaration of a default value for DECL). Secondly, examples such as (4c) show that within a clause the arguments of arguments of the verbal head (here, the possessor within NP) also code clausal distinctions of mood, if pronominal. This requires a significant degree of feature percolation on the head-driven, concord based view of the phenomenon: as well as being shared between verbal heads and their arguments, the HEAD feature DECL must be shared between nominal heads and their arguments.

In sum, then, an HPSG analysis of this phenomenon appears to require the postulation of (a) a HEAD feature DECL on (at least) nominal and verbal heads, including those heads for which the distinction is not signalled by any morphology; (b) an assumption that DECL defaults to + (or -); (c) explicit encoding in lexical entries of DECL concord (by feature sharing) within NP and within the clause.

This is somewhat clumsy, although clearly workable in principle. More importantly, it misses the point, which is that the pronominal element directly contributes clausal information which we do not want to associate with the nominal projections. It is not yet clear to us whether in Supyire distinctions of mood are

[6]For the purposes of illustration, we assume that the shared feature is a syntactic feature, that is, one which would be represented in the CAT value rather than the CONTENT values. Nothing hangs on this detail.

ever made on the verbal head. If they are, then this at least potentially motivates the feature DECL as a verbal HEAD feature. However, the /Gui data in (5) and (6) illustrate further why a concord analysis along these lines is less than satisfactory. In this language, the verb itself does not code the distinction between declarative and imperative, which is encoded by choice of *subject* pronoun alone.

With the Kayardild data in (1), the feature passing approach is even more problematic. In this data, certain TAM features are verbally marked and a complementary set are nominally marked. Together they define the TAM properties of the clause. Under a feature passing/sharing view we are committed to treating distinctions which are never verbally introduced as though they might be.

Finally, we should also mention the analytic difficulties posed by the existence of TAM marking on a variety of adjunct nominals. This is illustrated for Kayardild in (1), and is also found in Pitta Pitta. True adjuncts are not visible to heads. It is not easy to see how any plausible argument could be made that the full range of adjuncts, whether syntactically selected or not, and including those such as *balmbi*- “tomorrow” and *barruntha*- “yesterday” in (1) , should be taken to be complements (and therefore visible to heads on the COMPS and ARG-ST lists), rather than adjuncts. TAM marking on adjuncts is therefore problematic for a head-driven approach to the phenomenon.

Given the difficulties posed for HPSG in providing a natural and explanatory account of the marking of clausal head properties on dependent nominals, it is not surprising that recent work within the framework has attempted to claim that such phenomena are not attested empirically (Bender and Sag 1999).[7] In contrast, we showed in section 2 that, although virtually ignored in the theoretical and typological literature, this phenomenon is in fact well-attested cross-linguistically, appearing in a number of typologically and genetically diverse languages. In the languages discussed so far, the nominal TAM marking takes the form of a distinction in the pronominal system, a case marker attached to the nominal or nominal group or a distinction in the form of the article. We have shown that a concord-based approach, such as is available within HPSG, fails to capture the central insight (direct and independent contribution by the dependent nominals of clausal properties), and leads to the postulation of otherwise unnecessary distinctions (such as the distinction between DECL+/- nonpronominals in Supyire). It is therefore legitimate to ask why the analysis of this well-attested, though little studied, phenomenon is problematic in HPSG, while relatively straightforward in LFG.

There are several fundamental distinctions between LFG and HPSG. In HPSG, constituent structure (or tectogrammatical structure) has a centrality which it does not occupy in LFG. While LFG relativises the notion of head to the level of linguistic description, in HPSG it is largely the case that the constituent structure head is the head of the construction. Furthermore, the notion of syntactic head is fundamental to much of the mechanics of HPSG - principles such as the Head Feature Principle and the Subcat Principle (Pollard and Sag 1994) and more recent additions such as the set of Lexical Amalgamation principles depend on a constituent structure based notion of syntactic head for their operation. This means that the notion of categorially defined syntactic head is much more important in HPSG than LFG.

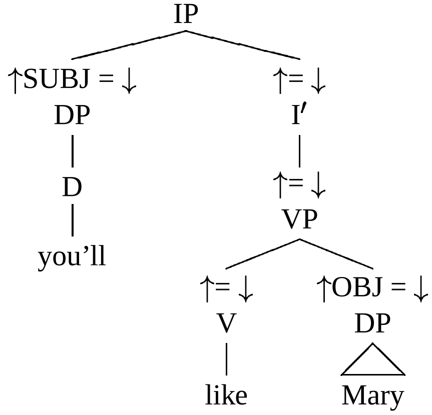
The centrality of headedness is seen, for example, in the head-driven approach to concord above. In this view of the world, heads can see and constrain their arguments, but arguments cannot directly constrain their heads, or the constructions in which they occur. However, as we saw in the LFG analyses in section 3, this is exactly what is required for an accurate account of TAM-inflected nominals, suggesting that the descriptive metalanguage of HPSG must be extended to permit dependents to constrain their heads/constructions.

[7]Bender and Sag (1999) argue that all apparent instances of this phenomenon can be reanalyzed as either head-dependent agreement, or pronominal incorporation. In fact, none of the examples we present in this paper could be reanalyzed in this way without substantially altering or skewing the empirical facts.

5 English Reduced Auxiliaries and Head Driven Grammars

A more radical challenge to head driven grammatical models is provided by recent LFG analyses of English reduced auxiliaries in Sadler (1998) and Barron (1998) as tense-inflected pronominals. These analyses follow the insight of Spencer (1991) who argues on morphological and phonological grounds that nonsyllabic reduced auxiliaries (such as *you'll*, *we've*) form a morphological unit with the pronominal form to which they are attached. Accepting these arguments, Sadler (1998) provides an analysis of such morphologically complex, tense-inflected pronouns in LFG (and Sadler's analysis is adopted in Barron (1998), who gives further arguments for the conclusion that nonsyllabic reduced auxiliaries are pronominal inflections, and shows how the lexicalist analysis accounts for facts taken by Radford (1998) to argue in favour of a movement analysis). The lexical entry for e.g. *you'll* involves an inside-out constraint as shown below, and the constituent structure lacks an I node:

(21)



(22)

$$\begin{bmatrix} \text{PRED} & \left\langle (\uparrow\text{SUBJ}), (\uparrow\text{OBJ}) \right\rangle \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{`PRO'} \\ \text{PERS} & 2 \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{`Mary'} \end{bmatrix} \\ \text{TENSE} & \text{FUT} \end{bmatrix}$$

(23) *you'll*: (↑PRED) = 'PRO'
(↑PERS) = 2
((SUBJ ↑) TENSE) = FUT

The inflected pronoun contributes constraints over both the f-structure corresponding to the entire sentence, and the SUBJ f-structure. This analysis is possible in LFG because the mapping between c-structure and f-structure is defined in such a way as to accommodate divergences in headedness bewteen functional and constituent structures.

Motivated primarily by the difficulties we have already seen for HPSG in adopting a similar analysis of this data - namely, an analysis which treats these auxiliaries as tense-inflected pronominals - Bender and Sag (2000) argue against Sadler's (1998) approach, and present an alternative analysis that fits more readily into the head-driven framework of HPSG.

Bender and Sag accept the arguments that these forms are morphologically derived, and thus constitute single syntactic atoms or *word*s. Under their HPSG analysis, however, these elements are verbs which incorporate pronominal arguments, rather than pronominals which incorporate tensed verbal heads. [8]

As Bender and Sag note, the two analyses are largely equivalent in terms of account for the data under discussion. The driving force behind this re-analysis is the fact that the incorporation of heads into dependents is ruled out by the ‘head-driven’ nature of HPSG, in which a large number of principles are formulated in terms of the notion of syntactic head (which is itself essentially based on a notion of constituent structure head). These principles include the Valence Principle and the Head Feature Principle.

The analysis is formalised by Bender and Sag by means of a lexical rule of Pronominal Incorporation which operates at the level of the *word*, taking two lexical entries as input (one with a SS|LOCAL value of type *pr-loc*, appropriate for pronominals and the other with the HEAD features of a finite auxiliary) and outputting a third. In the output, the incorporated pronominal is constrained to have a SYNSEM value of type *affix* and the SUBJ feature is the empty list ([1] and [2] refer to the PHON values of the input, [3] is the LOCAL value of the pronominal and [4] the HEAD features of the input auxiliary verb).

$$(24)\quad < {}_{word}\begin{bmatrix} \text{PHON} & \langle \boxed{1} \rangle \\ \text{SS}\,|\,\text{LOC} & \boxed{3}\,\text{pr-local} \end{bmatrix}, {}_{word}\begin{bmatrix} \text{PHON} & \langle \boxed{2} \rangle \\ \text{HEAD} & \boxed{4}\ {}_{verb}\begin{bmatrix} \text{AUX} & + \\ \text{VFORM} & \text{fin} \end{bmatrix} \\ \text{ARG-ST} & \boxed{5} \end{bmatrix} >$$

$$\Rightarrow \begin{bmatrix} \text{PHON} & \text{FP1}(\boxed{1}\,\boxed{2}) \\ \text{SUBJ} & \langle\rangle \\ \text{HEAD} & \boxed{4} \\ \text{ARG-ST} & \boxed{5}\left\langle {}_{aff}\begin{bmatrix}\text{LOC} & \boxed{3}\end{bmatrix}, \ldots \right\rangle \end{bmatrix}$$

The HPSG analysis, then, essentially assimilates the phenomenon to the well-known phenomenon of pronominal incorporation. Although technically workable, we believe there are several strong arguments against such an analysis.[9] There are several reasons to doubt the identification of these data with the phenomenon of pro-drop. For a start, standard English does not elsewhere generally permit pronominal incorporation.[10] If this is pro-drop, it is not clear why pronouns incorporate *only* into the reduced forms of the auxiliaries, and why only into auxiliary verbs (rather than, for example, all tensed verbs).

Furthermore, note that the analysis is less than natural from a morphological point of view. Firstly, the element which has reduced morphology, the auxiliary, is taken to be the head of the morphological construction, while the element which is unreduced, the pronominal, is taken to be an affix. In well established cases of pronominal incorporation, however, it is clearly the pronominal which has reduced morphology (as

[8]Bender and Sag (2000) are correct in observing that the tensed pronoun proposal of Sadler and Barron utilise the theory of blocking of Andrews (1990) to provide in addition an account of preemption. They suggest that this is a weakness, in the case where there is no blocking effect. But as they observe, the invocation of blocking is independent of the analysis of the phenomenon. If, contrary to fact, there were no blocking, the appeal to blocking would be dropped. Moreover, Bresnan (pc) points out that blocking might be substituted by an OT alternative to give the desired degree of sensitivity.

[9]We thank Joan Bresnan, Ida Toivonen and Andy Spencer for discussion of the points made in this section.

[10]This is not to deny, of course, that English does permit both subjects and tensed verbs to be dropped in certain discourse circumstances, but this is a different matter.

in Bantu, see (Givón 1976, Bresnan and Mchombo 1987)). The identification of the pronominal as being of type *affix* is crucial to the Argument Realization Principle which is used to ensure that the first argument on the ARG-ST list (which corresponds to the pronominal argument) is not on the COMPS list, and therefore not externalised in the syntax (since elements of type *affix* do not occur as independent elements in the syntax).

Secondly, the pronominal affix view amounts to claiming that English has pronominal *prefixes*, which is extremely questionable on morphological grounds. English makes very scant use of prefixation (as opposed to suffixation) at all, and subject prefixes can hardly be argued to be natural in the language.

Turning now to the phonological consequences of incorporation (be it head incorporation (as on the Sadler/Barron view) or dependent incorporation (as on the Bender and Sag view)), Bender and Sag specify a partial function over input forms, explicitly enumerating the output forms to account for the phonological processes associated with what is, on their view, prefixation of pronominal forms to a verbal stem. It is clear, however, that they view the process as involving a “rule of laxing of tensed vowels that applies only to the vowels of pronouns in combination with contracted auxiliaries” (p4). The appeal to class specific phonological rules is unfortunate, given that phonology has largely moved away from such devices. But more importantly, this formulation misses the crucial point that what is involved here is a case of the well-known phenomenon of affix-conditioned stem allomorphy (which does not, moreover, always involve laxing of tensed vowels): consider *we've* $\rightarrow$ /wIv/ */wəv/ versus *we're* $\rightarrow$ /wə(J)/ */wI(J))[11].

In our view, an important consideration in the evaluation of these different analyses of a synchronic phenomenon is the degree of fit between the analysis and diachronic tendencies. On this ground, the head incorporation view is to be preferred. Alongside the non-syllabic reduced auxiliaries under discussion, English has a set of syllabic reduced auxiliaries which are *phonologically* enclitic. The diachronic drift to grammaticisation, by which a form reduces and phonologically cliticises and then is absorbed into the host as a bound element is well known; it is well established, for example, that incorporated pronominals have evolved diachronically from full pronominals which became phonologically weakened cliticised forms, and then bound forms. Under the head incorporation view, the affixal auxiliaries merely represent a further step on the path away from full wordhood. The pronominal incorporation view, on the other hand, which treats the reduced element as the head, runs counter to the evidence of this diachronic path.[12]

While the core phenomenon involves subject pronouns, there are several suggestions in the literature that at least some speakers accept non-syllabic (and hence incorporated) forms for certain lexical NPs (Barron cites the non-syllabic pronunciation of *The BBC've accepted the contract* as acceptable to some speakers, and Bender and Sag themselves cite *The sky over California's always blue* from a Pullum and Zwicky 1997 LSA conference presentation). The issue is complicated by the fact that phonological processes can also (independent of this phenomenon) produce non-syllabic forms, which it is necessary to control for. Furthermore, much detailed work on speaker variation is required before definitive pronouncements can (if ever) be made on these matters.[13] Note however that the extension to larger sets of incorporations is more natural on the head incorporation view: more permissive speakers are simply less selective about stem selection. On the other hand, the head driven account requires the incorporation of a lexical N (as affix) into

[11]This point is made in the discussion in (Spencer 1991)

[12]Putting this another way, we might ask why it is that pronouns incorporate only into *reduced* forms of the auxiliaries. On the Bender and Sag view, this is essentially stipulated by enumeration in the phonological function, while on the view which we adopt, incorporation of the reduced auxiliary as an affix/bound form is a natural progression for a phonological clitic.

[13]Bender and Sag give examples suggesting that forms of *be* other than the tense auxiliary also involve incorporation. The LFG account can be extended straightforwardly to cover these data, as Bender and Sag acknowledge. However, many of these examples seem ungrammatical to at least one author of the current paper, underlining the point that much detailed informant work is required to establish the facts in these murky areas.

the auxiliary.[14]

Before leaving the discussion of Bender and Sag, we note that they suggest that there is some correlation between the head-incorporation in LFG and a morpheme-based view of morphology, on the one hand, and between pronominal incorporation and a non-morphemic (presumably, realizational) view of morphology. In fact, there is no such correlation. In the work on constructive case, Nordlinger (1998) assumes lexical entries for affixes, thus treating them as morphemes, as a notational convenience (p. 21). Nordlinger's principle of morphological composition, for example, can be reformulated in terms of morphological functions or constructions, rather than in terms of morphological trees. Sadler (1998) makes no commitment whatsoever to morphological analysis, simply presenting lexical entries for completely derived words and eschewing all discussion of how the morphology itself is modelled. There is no necessary connection at all between these two aspects.

To sum up, we think there are several grounds for questioning Bender and Sag's reanalysis of the English facts as a case of pronominal incorporation. We have shown in this paper that there is good cross-linguistic evidence for the existence of tense-inflecting pronominals. The fundamental difficulty that Sadler's (1998) analysis of the English data poses for HPSG is that it involves a constituent structure which lacks a head (a verbal projection without a verb). Bender and Sag's argumentation is built on the covert premise that such structures are not attested (and indeed, the centrality of the structural notion of head is a fundamental HPSG idea). Although much further work needs to be done, we suggest that English is not the only language exhibiting this radical form of head incorporation. In the rest of this section we sketch out some other possible cases. Even if Bender and Sag were correct about English, HPSG will have to take account of these cases.

The past tense is expressed in Polish by means of a *l* form participle and a perfect auxiliary (a form of the verb *be*). The auxiliary (which bears subject agreement features and may be the sole expression of the subject) may be combined with the participle or may appear attached to an element to the left of the verb. The phenomenon of so-called "floating inflection"is exemplified in (25) to (31) (Dziwirek 1998, Borsley and Rivero 1994).

(25) Wieczorem czytali**śmy** książki
evening read-1pl books-acc

(26) Wieczorem**śmy** czytali książki
evening-1pl read books-acc

(27) Książki wieczorem**śmy** czytali
books-acc evening-1pl read

(28) Książki**śmy** wieczorem czytali
books-1pl evening read

(29) Wieczorem książki**śmy** czytali
evening books-1pl read

(30) My**śmy** wieczorem czytali książki.
we-1pl evening read books-acc
In the evening we read books.

[14]Bender and Sag criticise the use of long distance paths in LFG, stating that a theory which excludes long distance selection is to be preferred. The architecture of LFG is one which makes a clear separation between *c-structure* locality and *f-structure* locality precisely to allow for mismatches and apparent long distance feature flow: c-structure locality of selector and selection is only a theory-internal desideratum of HPSG and similar theories. Given that the phenomenon of tense-inflected nominals is one of many cases in which non-local selection is precisely what is at issue, this criticism simply begs the question.

(31) Ewy-s ksi aźk e czytal
Ewa's-2S book read.SM
You read Ewa's book.

It is clear that these forms of the verb *be* are part of a periphrastically expressed tense/aspect form in combination with a participle (which inflects adjectivally). The auxiliary element was diachronically a phonological clitic. Analyses are split on whether to treat this element as a syntactic atom phonologically cliticised, or as a bound form precisely because of the difficulty in head driven syntactic frameworks of accommodating the resultant 'headless' construction: for example, Borsley and Rivero (1994) treat the participle-auxiliary combination as syntactically analysable syntactic incorporation of V into Aux and the "floating inflection" as PF (phonological) cliticization of I to the constituent to its left. Dziwirek (1998) treats the auxiliary morphologically . The morphophonological evidence for affixal status is extremely strong, (see (Spencer 1991) for a full discussion), and, as Spencer observes, the only evidence against this view is the lack of strong selection of the stem/host by the auxiliary (promiscuous attachment). Indeed, this mix of properties led Booij and Rubach (1987) to argue for a lexical treatment, but keeping the process of word-internal cliticisation separate from other word formation processes. The evidence therefore strongly suggests that the combination of host and auxiliary is not syntactically transparent. If this is correct, then these data constitute another case in which a head (here, the auxiliary (and subject agreement marker) in the past tense formations) is incorporated into a dependent. This can be captured by means of inside out equations in LFG, but, like the English data, appears problematic on a head driven view [15].

(32) *Wieczoremśmy*
(↑PRED) = 'evening'
((GF ↑) SUBJ) = ↓
((↓PRED) = 'PRO')
(↓NUM) = PL
(↓PER) = 1
(GF ↑) TNS) = PAST

(33) *Książkiśmy*
(↑PRED) = 'book'
((GF ↑) SUBJ) = ↓
(↓PRED) = 'PRO'
(↓NUM) = PL
(↓PER) = 1
(GF ↑) TNS) = PAST

Borsley and Morris Jones (Welsh Syntax 2000 workshop presentations) discuss some cases in Welsh where verbless sentences with pronominal subjects are permissible. Copula-less patterns are found with 2S, 1PL and 2PL pronouns (in all these cases the final consonant of the "missing" copula form and the initial consonant of the pronoun are the same). The glosses in the following data (attributing verbal properties to the pronominal forms) are those provided by Morris Jones.

(34) ti 'n licio sudd oren.
[be+pres]2S PROG like juice orange
You like orange juice.

[15] We do not give a full analysis here, which would require the addition of f-precedence constraints to capture the "left of V" constraint.

(35) chi ddim yn licio sudd oren.
[be+pres]2PL not PROG like juice orange
You don't like orange juice.

Morris Jones establishes several crucial facts about these data, which distinguish them from a clipped or fast informal speech phenomenon and in particular from similar forms with full NPs. The diagnostics include control of responsives appropriate for questions with forms of *be*, form of tag questions, possibilities for fronting constituents, possibility of ellipsis and occurrence in noun clauses (the last is illustrated below):

(36) Dw i'n meddwl ti 'n gwbod
Be.PRES.1SG I-PROG think [be+pres].2SG PROG know
I think you know

(37) *Dw i'n meddwl dadi 'n gwbod
Be.PRES.1SG I-PROG think Daddy PROG know
I think Daddy knowing

Again, these data strongly suggest that these forms are pronouns carrying tense and aspect information, and are appearing in subject (NP) position. As Borsley (workshop presentation) points out, an analysis of these data in HPSG appears to require either some sort of empty copula, or a headless construction type (in constructional HPSG), or a re-analysis of the pronominal forms as pronominal incorporations into Aux.

6 Conclusion

In this paper we have shown that the phenomenon of TAM-inflected nominals is not typologically marginal but is, on the contrary, well established across a range of typologically diverse languages. We have argued that these data are not straightforwardly captured in a head-driven fashion, but are naturally accommodated by the use of inside out constraints, as in the constructive morphology approach of LFG.

Bibliography

Aikhenvald, A. Y. 1999. Multiple marking of syntactic function and polysynthetic nouns in Tariana. In *Papers from the 35th Chicago Linguistic Society*. CLS.

Andrews, A. 1996. Semantic case-stacking and inside-out unification. *Australian Journal of Linguistics* 16(1):1–55.

Barron, J. 1998. 'have' contraction: explaining 'trace effects' in a theory without movement. *Linguistics* 36(2):223–251.

Bender, E., and I. Sag. 1999. Incorporating contracted auxiliaries in English. Unpublished conference presentation at HPSG 1999.

Bender, E., and I. Sag. to appear. Incorporating contracted auxiliaries in English. In Ronnie Cann and Claire Grover and Philip Miller (Ed.), *A Collection of Papers in Head-driven Phrase Structure Grammar*. Stanford: CSLI Publications.

Blake, B. 1979. Pitta Pitta. In R. M. W. Dixon (Ed.), *The Handbook of Australian Languages*, 182–242. Canberra: ANU Press.

Blake, B. 1987. *Australian Aboriginal Grammar*. London: Croom Helm.

Bohnhoff, L. E. 1986. Yạg Dii (Duru) Pronouns. In U. Wiesemann (Ed.), *Pronominal Systems*, 103–129. Gunter Narr Verlag.

Booij, G., and J. Rubach. 1987. Postcyclic versus Postlexical Rules in Lexical Phonology. *Linguistic Inquiry* 18:1–44.

Borsley, R., and M. L. Rivero. 1994. Clitic Auxiliaries and Incorporation in Polish. *Natural Language and Linguistic Theory* 12(4):373–422.

Bredenkamp, A. 1996. Towards a binding theory for HPSG. unpublished PhD thesis, University of Essex.

Bresnan, J. 2000. Lexical Functional Syntax. forthcoming, Blackwell's.

Bresnan, J., and S. Mchombo. 1987. Topic, pronoun and agreement in Chichewâ. *Language* 63:741–82.

Burquest, D. 1986. The pronoun system of some Chadic Languages. In U. Wiesemann (Ed.), *Pronominal Systems*, 71–101. Gunter Narr Verlag.

Butt, M. 1995. *The Structure of Complex Predicates in Urdu*. Stanford, CA: CSLI.

Carlson, R. 1994. *A Grammar of Suyire*. Berlin: Mouton de Gruyter.

Culy, C. 1990. *The syntax and semantics of internally-headed relative clauses.* PhD thesis, Stanford University, Stanford, CA.

da S. Facundes, S. in progress. The language of the Apurina People of Brazil(Maipure, Arawak). PhD in progress, SUNY Buffalo.

Dalrymple, M. 1993. *The Syntax of Anaphoric Binding.* Stanford,CA: CSLI Publications.

Dziwirek, K. 1998. Reduced Constructions in UG: Evidence from Polish Object Control Constructions. *Natural Language and Linguistic Theory* 16(1):53–99.

E. S Furby and C. E. Furby. 1977. *A Preliminary Analysis of Garawa phrases and clauses.* Canberra: Pacific Linguistics.

Evans, N. 1995. *A Grammar of Kayardild.* Berlin: Mouton de Gruyter.

Givón, T. 1976. Topic, pronoun, and grammatical agreement. In Charles N. Li (Ed.), *Subject and Topic*, 149–88. New York: Academic Press.

Hale, K. 1997. Remarks on Lardil phonology and morphology. In *Lardil Dictionary*, 12–56. compiled by Ngalkulmungan Kangka Leman (Language Projects Steering Committee). Gununa, Queensland (Australia): Mornington Shire Council.

Halvorsen, P.-K., and R. M. Kaplan. 1988. Projections and Semantic Description in Lexical-Functional Grammar. In *Proceedings of the International Conference on Fifth Generation Computer Systems*, 1116–1122, Tokyo.

King, T. H. 1995. *Configuring Topic and Focus in Russian.* Stanford: CSLI Publications.

Koenig, J.-P. 1998. Inside-out constraints and description languages for HPSG. In G. Webelhuth, J.-P. Koenig, and A. Kathol (Eds.), *Lexical and Constructional basis of linguistic explanations.* CSLI Publications.

Lambdin, T. O. 1983. *Introduction to Sahidic Coptic*. Georgia: Mercer University Press.

Lee, H. 1999. Aspectual and thematic licensing of grammatical case. In *Papers from the 35th Chicago Linguistic Society*. CLS.

Nordlinger, R. 1998. *Constructive Case: Evidence from Australian Languages*. Stanford: CSLI.

Parker, S. 1999. On the behavior of definite articles in Chamicuro. *Language* 75(3):552–562.

Pollard, C., and I. Sag. 1994. *Head Driven Phrase Structure Grammar*. Chicago: Chicago University Press.

Radford, A. 1988. *Transformational Grammar: A first course*. Cambridge: Cambridge University Press.

Raible, W. to appear. Language universals and language typology. In Martin Haspelmath, Ekkehard Knig, Wulf Oesterreicher and Wolfgang Raible (Ed.), *Language Typology and Language Universals: An international handbook.*

Sadler, L. 1998. English auxiliaries as tense inflections. *Essex Research Reports* 1–16.

Sells, P. 1998. Japanese postposing involved no movement. presented at LAGB, April 1998.

Sharma, D. 1999. Nominal clitics and constructive morphology in Hindi. In *Proceedings of LFG99*. http://www-csli.stanford.edu/publications.

Spencer, A. 1991. *Morphological Theory*. Oxford: Blackwells.

Tryon, D. T. 1968. *Iai Grammar*. Canberra: Pacific Linguistics.

Wurm, S., and L. Hercus. 1976. Tense-marking in Gurnu pronouns. *Papers in Australian Linguistics* 10:33–49.

Error Recognition and Parsing of Syntactically Mildly Ill-formed Natural Language

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Error Recognition and Parsing of Syntactically Mildly Ill-formed Natural Language

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1 Introduction

This paper describes the error-recognition module of an interactive CALL-system. Using the system the language learner is invited to produce complete written sentences in little dialog tasks with the computer. This setting challenges the learner to use language interactively in order to enhance the development of 'communicative competence'. Emphasis is put on the possibility to give adequate feedback to the learner if an ill-formed sentence is encountered. As mentioned in e.g. Menzel and Schröder (1998), usually a program does not support both requirements at the same time. If free formed input is allowed, the system is not able to do a detailed analysis of the input while if the error-recognition capabilities are advanced for satisfying feedback, the choice of exercises is in most cases quite limited. Thus the main goal in developing a CALL-system should be to provide a stimulating environment *and* to give adequate feedback. The preconditions therefore are robust parsing and error recognition, which are both handled by the system described below.

The paper begins with a short description of the system's design. Various modules analyse the learner's input sentence for orthographic, syntactic and semantic errors. Finally a dialog component produces output either reacting to an error or continuing the dialog.

Then some introductory remarks about error-recognition follow. Mainly two ways to provide feedback to the learner have been applied in CALL-systems. One way is to introduce 'mal-rules' into the grammar to get structural descriptions for erroneous input (e.g. Schneider and McCoy (1998)). The other way is to develop costly parsing methods (Menzel, 1992). Alternatively the system described here is using a more traditional grammar-theory (Lexical Functional Grammar) without any anticipation of errors and uses a modified unification algorithm to analyse the learner-input and to provide methods to increase the efficiency of the parsing process.

The main part of the paper decribes the parser and the methods for error recognition. The parser is an Earley style chart-parser (Earley (1970); implemented following Naumann and Langer (1994)) and the grammar is an unaugmented LFG-grammar. The term 'mild syntactic errors' is used because the error analysis works until now only for errors encodable in the f-structures of a sentence. Therefore, for example, linearisation errors will not be recognised. I will show how a modified unification process can relax constraints if the values contradict each other on the one hand and on the other hand encode errors in the functional structure (f-structure) for feedback purposes. For efficiency purposes some methods have been integrated affecting the structures resulting from the unification as well as the chart-items entered into the chart.

Furthermore some arguments for the usage of LFG in this setting are discussed. Essentially LFG has proven to be useful in applied computational linguistics and provides concepts understandable by language learners.

2 System Design

While using the system every input sentence (usually an answer to a question asked by the system) is first passed to a module checking for orthographic and syntactic errors. The *orthographic check* is done based on methods developed by Oflazer (1996). With the help of a finite state recognizer mildly deviating strings are identified and correct versions are presented to the learner if necessary. The methods for a *syntactic analysis* will be described below. As a next step the analysis of the sentence is checked against a *world knowledge base*, from which feedback is given to the learner if the sentence contains an error of sortal restrictions. If the learner has made an error, the system provides feedback to support the learner in typing a syntactically correct or semantically more plausible sentence. After this step the *dialog module* tries to find a reaction to continue the dialog.

The main focus in all the analyses is to continue the dialog without ignoring the errors made by the learner. Only the orthographic check will actually interrupt the dialog with a suggestion of correct words for the misspelled items. In all other cases either the 'dialog partner' will react to the erroneous input or the system will display an error message, mark the sentence incorrect and simply continue the dialog. This means that either the dialog partner states that it was difficult to interpret the input and might ask for a rephrasal or the sentence was interpretable for the continuation of the dialog by the modules following the syntactic analysis.

As an example the dialog might take the following form.

(1) `system:` Polizeirevier. Ja bitte?
Police station. May I help you?
`user:` * Ich habe ein Unfall gesehen.
I have seen an accident.
`system:` Was ist denn genau passiert?
What exactly happened?

Following the analysis of the user-input an error-message is displayed.

(2) `error message:` Es gibt vermutlich einen Fehler im direkten Objekt: das Genus ist nicht korrekt: masc vs. neut.
There is possibly an error in the direct Object: the Gender is incorrect: masc vs. neut.

This message has to be deleted to continue the dialog as shown in example (1).

Error Analysis

Error diagnosis depends on sensitive parsing for the identification of errors. As opposed to robust parsing with heuristics (e.g. Alexandersson et al. (1994)) the task is not to get the largest chunk possible of the sentence, but to achieve an analysis spanning the complete sentence including a recognition of a possibly minimal error.

Efficient error-sensitive parsing has to make some assumption about the possible errors it will encounter, otherwise no solution would be found as mentioned above. One choice could be the integration of the so-called 'mal-rules' into the grammar, which are used to analyse erroneous learner input. This has been done as early as 1978 (Weischedel et al. (1978) uses 'meta-rules' outside the core grammar) and in various other approaches. It does allow for a precise recognition of errors but unfortunately mal-rules may increase the search space in a grammar dramatically and additionally rely on the foresight of the linguist writing the grammar. As the error-analyses by Heringer (1995) in the computer program

“Aus Fehlern lernen” shows, about half of the thirteen most common errors made by learners of German appear in areas covered by the f-structure (e.g. agreement, subcategorisation for certain preposition, valency). Foreseeing every possible error a system might encounter is therefore difficult to realise. It seems more plausible to avoid the usage of anticipation of errors and introduce some methods for error-sensitive parsing.

Another way of coping with ungrammatical input could be the usage of a probabilistic grammar. Probabilistic grammars can achieve a higher degree of robustness by using variable levels of correctness instead of clear-cut right-wrong decisions. However to be able to diagnose an error these systems would have to be trained on large amounts of *erroneous* annotated texts produced by language learners. Annotation of erroneous text corpora taken from language learning tasks hasn’t been done to my knowledge.

A further difficulty in the diagnosis of an error is the inclusion of relevant information from different levels of the analysis. In case of an error a purely syntax-driven diagnosis might suggest more than one alternative for correction (example taken from Menzel and Schröder (1998)).

(3) * The cars drives fast.

To correct this sentence, the noun could be changed to singular or alternatively the verb could be plural. Here the system should ideally provide a method for finding a single diagnosis, for example decide that - based on a semantic representation of the current situation - there should only be one car hence the noun should be singular. Albeit - as is well known -, modelling the situation at hand and obtaining the correct inferences from the knowledge base is a difficult task. In the case at hand based on a syntactic analysis the computer would state that there is a disagreement in number/person between the subject noun-phrase and the verb-phrase (3sg vs. non-3sg). Besides, leaving the decision for the correction to the user has the advantage of producing a learning effect.

In the system at hand, errors can theoretically occur at all features of an f-structure. Since this is unlikely and even implausible, only linguistically relevant features may be relaxed in the unification process. Therefore the concept of this system starts with an unrestricted approach and adds methods for limiting the complexity instead of opening up a very restricted system.

There have been various previous attempts to deal with error analysis in a CALL-context. Schwind’s system (1988) follows a dual strategy in using constraint relaxation for agreement errors and error-rules for e.g. linearisation errors. Unrestricted constraint relaxation as in this case works for smaller grammars, but, used in larger grammars, leads to a large computational overhead. As mentioned above, error-rules seem unsuitable for more complex systems because of the enlargement of the search space and of the fact that their limited ability can only account for some errors.

This means that also no Optimality Theory-style additions should be used as suggested e.g. in Kuhn and Rohrer (1997). Using OT-type markings with ps-rules to achieve robust parsing of erroneous text would require the addition of rules describing ungrammatical constructions which in turn would lead to the mentioned problems.

Menzel’s system (1992) avoids anticipation, but uses a model-theoretic approach, which only allows for small grammars to be used due to computational complexity.

A different approach is described in Menzel and Schröder (1998). Their system allows for errors on the syntactic, semantic and pragmatic level due to the structure of the grammar. The system includes a constraint based dependency grammar with weighted constraints using the method of *partial constraint satisfaction* and more specifically solving the *minimal violation problem.* The grammar concept allows for the recognition not only of syntactic errors but also of linearisation errors, since these rules are included in the constraint structures as well. However, as the authors concede, some problems remain. The grammar formalism only allows for binary branching, which is rather artificial for some linguistic structures, even though the expressive power of the formalism is not limited by this restriction. Another difficulty is the scoring of constraints. Although this allows one to set preferences for single constraints, is not clear that a meaningful error-analysis can be reached. A certain final structural description of a sentence might have the lowest scoring from the set of structures even though a human corrector would choose another solution accidently having a higher score. Once every single constraint in a sufficiently large-scale grammar has received a scoring, the effects on the results of a parse might be difficult to determine.

To this end a system was developed that is able to analyse sentences with mild syntactic errors, identify the error and present meaningful feedback to the learner. In order to avoid the anticipation of (mild) syntactic errors the unification process was modified to allow for a relaxation of features, valuation of the error type and a subsequent encoding of the error in the f-structure. Additionally a common linguistic framework was chosen which allows for the encoding of various grammatical phenomena.

At the heart of the system is an Earley-based chart parser and an LFG-type unification grammar. Elements of both parts (chart-parsing and unification) are used in combination to identify errors and control the parsing-process. With the help of an error-value the structure describing a sentence with minimal errors is identified. This means, that also other unification based grammar theories could be used. Up to now the parsing technique of the ps-rules is rather traditional but it is planned to enhance this in order to allow for recognition of linearisation-errors as well (e.g. Kato (1994)).

3 Modified Error-Sensitive Parsing

The main idea is to relax constraints in order to continue the unification process in case the values of an attribute contradict each other. Additionally the number of relaxed constraints is used to mark the resulting structure with an error-measure. For feedback purposes the error-attributes can then be interpreted and a message given to the learner.

Unification

The difference between the definition for this type of unification in Schwind (1988) and mine is that in my system the resulting structure does not contain value sets with the mismatching values but instead a new attribute (`err`) is introduced into the resulting structure. This feature in turn has a complex value containing the non-unifiable feature and value. Also Schwind's concepts does not include the handling of complex values and has no mechanism for stating preferences, which I consider important (see below).

The type of unification can also be compared with the so-called *default unification.* It is similar to Carpenter's (1993) *credulous default unification* in that it also returns sets of feature structures. But unlike this definition, my version of unification always returns a tuple perhaps containing the mismatching value in an extra error-feature. Subsumption is then defined as follows (simplified; see Carpenter (1993) for details):

Definition 1 *A f-structure* F *subsumes another f-structure* F' *if and only if* F' *provides at least as much information about path values* or atomic values and their immediate attributes contained in error-attributes *as* F.

It must be noted, that complex/complex clashes are not handled by this definition. The defintion of unification based on subsumption is than straightforward without any modification:

Defintion 2 *The unification of two f-structures* F *and* F' *is taken to be the least upper bound of* F *and* F' *in the collection of f-structures ordered by subsumption.*

As a result of the expanded definition of subsumption two structures will result from the unification, if values do not match.

(4) $[F:a] \sqcup_{err} [F:b] = \left\{ \begin{bmatrix} F{:}a \\ err{:}[F{:}b] \end{bmatrix}, \begin{bmatrix} F{:}b \\ err{:}[F{:}a] \end{bmatrix} \right\}$

As opposed to other treatments of inconsistencies in feature-structures this procedure is monotonic, symmetrical and results in completely consistent feature-structures (cf. Vogel and Cooper (1995)). If multiple errors occur, these are treated in the same way as adjuncts or coordination are handled in LFG. Sets are introduced into the f-structure to contain all the elements of an error-unification. The implementation of the coherence and completeness condition is slightly modified to account for error-features.

In the following example two f-structures (5) and (6) result in the structures (7) and (8) when unified (*Mice likes milk*).

(5) $$\begin{bmatrix} \texttt{pred:} & \texttt{'like}\left\langle(\uparrow\texttt{subj}),(\uparrow\texttt{obj})\right\rangle\texttt{'} \\ \texttt{tense:} & \texttt{pres} \\ \texttt{subj:} & \begin{bmatrix} \texttt{pers:} & \texttt{3sg} \end{bmatrix} \\ \texttt{obj:} & \begin{bmatrix} \texttt{pred:} & \texttt{'MILK'} \end{bmatrix} \end{bmatrix}$$

(6) $$\begin{bmatrix} \texttt{subj:} & \begin{bmatrix} \texttt{pers:} & \texttt{-3sg} \\ \texttt{pred:} & \texttt{'MICE'} \end{bmatrix} \end{bmatrix}$$

(7) $$\begin{bmatrix} \texttt{pred:} & \texttt{'like}\left\langle(\uparrow\texttt{subj}),(\uparrow\texttt{obj})\right\rangle\texttt{'} \\ \texttt{tense:} & \texttt{pres} \\ \texttt{subj:} & \begin{bmatrix} \texttt{pers:} & \texttt{3sg} \\ \texttt{pred:} & \texttt{'MICE'} \\ \texttt{err:} & \begin{bmatrix} \texttt{pers:} & \texttt{-3sg} \end{bmatrix} \end{bmatrix} \\ \texttt{obj:} & \begin{bmatrix} \texttt{pred:} & \texttt{'MILK'} \end{bmatrix} \end{bmatrix}$$

(8) $$\begin{bmatrix} \texttt{pred:} & \texttt{'like}\left\langle(\uparrow\texttt{subj}),(\uparrow\texttt{obj})\right\rangle\texttt{'} \\ \texttt{tense:} & \texttt{pres} \\ \texttt{subj:} & \begin{bmatrix} \texttt{pers:} & \texttt{-3sg} \\ \texttt{pred:} & \texttt{'MICE'} \\ \texttt{err:} & \begin{bmatrix} \texttt{pers:} & \texttt{3sg} \end{bmatrix} \end{bmatrix} \\ \texttt{obj:} & \begin{bmatrix} \texttt{pred:} & \texttt{'MILK'} \end{bmatrix} \end{bmatrix}$$

Since structures (7) and (8) subsume each other, only one resulting structure will be added to the chart. Notice, that even though an implemented program seems more complicated than the simple standard unification, unification of two error-less unifiable structures does not take more steps than with the standard program.

Some method has to be integrated to allow for a selection from the multiple resulting descriptions of the sentence. Therefore a scoring mechanism is introduced. Scoring the number of conflicting values gives the ‘distance’ between the resulting f-structure and an error-less f-structure. The unification is completely sucessful when the error-value equals 0. Otherwise the f-structure with the lowest error-value is chosen to continue the dialog. If for example the f-structure in example (7) is the structure with the lowest error-value spanning the complete sentence, the learner is informed of a number-agreement error.

Using this mechanism in a small grammar without the advanced naming of ‘relaxable’ features seems feasable because the encoding of the error brings about the possibility for adequate feedback to the learner. Unrestricted usage of this mechanism in larger grammars would probably lead to large amounts of structures, which slow down the analysis considerably and do not contribute to the final result. Therefore some measures are taken to decrease the processing load.

One method is to restrict the types of features which actually may be relaxed. It seems sensible to restrict the constraint relaxation mechanism to only the linguistically relevant features, i.e. especially agreement features. Features which for example only enhance the parsing process will result in a failed unification and thus do not produce an additional item to be parsed. These irrelevant features are of course more a kind of linguistically *less* relevant features. Usually they represent a kind of redundancy to guide the parsing process and make the grammar more stable (c.f. Butt et al. (1999)).

A second method is to limit the maximum number of features which may fail. The unification then fails if too many constraints have to be relaxed in order to produce a resulting f-structure, and an additional entry in the chart is prevented. As is shown in Menzel and Schröder (1998), sentences with too many recognised errors are not interpretable anymore. So this is a plausible strategy if one is able to find a suitable threshold.

Chart-Parsing

The methods to constrain the production of items during the unificaton process can and should be continued in the parsing process with ps-rules to increase the efficiency, since the parsing is already in the standard case at worst exponential.

After the unification one of the resulting items is being tested against the chart with the modified subsumption test and might be entered. The error-measure is also entered into the chart along with the chart-item, according to the number of relaxations, i.e. the number of error-features.

To further reduce the number of items in the chart, the error-value can be utilized. The chart is divided into two parts with ‘active’ and ‘passive’ items. The number of items in the chart with only passive items can be reduced by adding only items whose error value is smaller than or equal to the error value of items of the same category already in the chart. This reduces the number of items mainly if an almost correct sentence is parsed.

A subsumption-check including the use of the error-value could also be done on the chart with active items. As experiments have shown subsumption on the already found elements of an active chart-item does indeed reduce the overall number of items. Nevertheless the gain is lost especially with short sentences due to the costly subsumption-procedure and the comparatively few items that contain partial findings.

4 LFG and CALL

There are several reasons, why LFG should be chosen in an CALL-environment. More specifically I should talk about 'intelligent' CALL (ICALL), since almost all commercial language learning programs do not make use of any method of natural language processing and rely purely on anticipation-based methods for implementing exercises.

Firstly LFG has proven to be useful not only as a grammar theory but also as a computationally sensible choice in NLP as shown e.g. in the ParGram-project (Butt et al. (1999)). This of course depends partly on the general preference for unification based grammars, where implementational issues are better understood than the implementation of e.g. movement of nodes in a tree as in Government&Binding-based concepts.

Secondly LFG seems to be useful in large-scale grammar development even though the concept in the ParGram-project has been modified in some ways from the standard LFG. The introduction of the m-structure for example is owed to the overall goal of *parallel* grammar development.

Finally and most importantly LFG uses concepts and terminology which can easily be transformed into meaningful concepts for language learners. The grammar by Schwarze (1995) using LFG for a description of Italian demonstrates this.

One example is the functional approach to grammar theory. Concepts like 'subject' or 'direct object' are easy to understand for language learners. Thus messages can be created directly from the f-structure. As shown in the previous example (7) the f-structure can be used to create a message saying that the subject does not agree with the verb in number (3sg vs. non-3sg).

Another example might be the direct coding of surface-structure with ps-rules. This conforms much more to the ways used in language teaching than other grammar theories. The use of e.g. deep- and surface-structure as well as movement is not part of traditional descriptive grammars and therefore difficult to understand. The grammar and more specifically the ps-rules can be used for informative messages to the learner. Using a parsing method following Kato (1994) the following example could be explained in a way a learner would easily understand .

(9) * Dog barks.

(10) NP -> N {ntype $=_c$ mass | num = pl}
NP -> Det N ntype $=_c$ std

Here the explanation could be extracted with the help of the simplified example rules (10), that the noun-phrase containing only a noun should be either a mass-noun or plural in number or should include a determiner. The important point is that the term 'noun-phrase' is (maybe still) more common in language teaching than terms like for example 'DP' meaning 'determiner-phrase'.

All grammatical information encoded in the f-structure and possibly in the ps-rules can be used in this way to present helpful instead of simple 'wrong!'-messages to the learner.

The grammar so far includes the following grammatical constructions:

- Declarative sentences, imperative sentences
- Main verb-complements (direct object, indirect object, prepositional object, infintival complement, sentential complement)
- Topicalized constructions (subject-verb-inversion)
- Complex verbal groups (auxiliar-, modal-, 'Verbklammer'-construction, separable prefix)

- NPs with relativ sentences
- Simple adjectival phrases
- Attributives and attributive prepositional phrases

With these types of constructions the grammar covers almost all constructions learners entered in preliminary experiments. Mainly conjuctive and some subjunctive constructions the system could not handle during these experiments. Therefore it seems that the grammar does not need to be a *very* large grammar in a language learning scenario, since some construction will probably never be used by a learner.

5 Discussion and Conclusion

The parsing module in this CALL-system analyzes syntactically mildly deviating natural language input and is able to produce an error-feedback, which can guide the learner to a meaningful correction. The system therefore is suited for language learners because of immediate and precise feedback originating from the f-structures. Additionally the chart can be used to create a partial parse consisting of items covering large chunks of the input sentence.

In the mentioned preliminary user-study some 200 sentences were collected in two scenarios. The first was the graphical presentation of a car accident and the task for the learner to report this accident to the police 'by telephone'. The second scenario consisted of simple questions presented to the learner about her/his name, hobbies, subjects taken at university, etc. The results show, that almost 30 % of the syntactically erroneous sentences lead to precise and meaningful error-messages. The 70 % of sentences not covered included mainly sentences with errors, which are not encoded in the f-structure (e.g. linearization) or are simply not included in the grammar at all (e.g. subjunctive sentences). About 5 % of the correct sentences were not covered by the grammar at that stage of development.

Some difficulties remain. Since the error-recognition takes place at the highest point in the derivation tree, one can not be sure to have found the minimal error.

(11)	*	[*Der*	*Männer*]$_{NP}$	[*lachen*]$_{VP}$	.
		sg-nom/pl-gen	pl	pl	
		The	men	laugh	

In the above example the analysis would give a mismatch in Case between the NP (genitive plural) and VP (subcategorising for nominative plural). But in fact *Männer* can also be nominative. It is therefore more plausible that the form for the nominative plural determiner was not known than that a genitive plural NP was constructed. For cases like this an error explanation should be based on an analysis of the tree as far down as possible, i.e. on the pre-terminal level.

Some features of the underlying grammar theory, which have proven useful to decribe linguistic phenomena have not been integrated yet. These include the concept of 'functional uncertainty' and also disjunctions, but the system does contain negation and conditional equations. While disjunctions can theoretically be replaced by listing the disjuncts, functional uncertainty is an inherent concept in the grammar theory.

Finally some work still has to be done to improve the efficiency of the parsing mechanism. The performance depends very much on the number of functions a lexeme can have and not so much on the number of ps-rules in the grammar. The higher the number of functions the more items are added especially to the chart containing active items. With all sensible features allowed to be relaxed the parsing-time needed was about 200 % longer than without using the error-recognition mechanism.

In this paper, I proposed a method for analysing free formed input in an CALL-environment that allows to provide feedback to the learner about errors made. The system is based on a well-founded grammar formalism and parsing technique. It provides feedback to the learner about a variety of errors without anticipating them in any way, including

- agreement
- auxiliary selection
- Case frames

The description of the error can be taken directly from the structure produced by the parser during the unification-process. By limiting the types of errors and scoring the error occurences a significant gain towards an efficient parsing process is achieved. The grammar theory LFG seems especially suited in an ICALL-system, because on the one hand it is computationally feasible and on the other hand uses concepts and terminology which correspond to the ones used in descriptive grammars.

References

Jan Alexandersson, Elisabeth Maier, and Norbert Reithinger. 1994. A robust and efficient three-layered dialog component for a speech-to-speech translation system. Verbmobil-report 50, DFKI, Saarbrücken.

Ted Briscoe, Ann Copestake, and Valeria de Paiva, editors. 1993. *Inheritance, Defaults and the Lexicon.* Cambridge University Press, Cambridge.

Miriam Butt, Stefanie Dipper, Anette Frank, and Tracy Holloway King. 1999. Writing large-scale parallel grammars for English, French and German. In *Proc. LFG99 Conference*, Manchester. CSLI Publications.

Bob Carpenter, 1993. *Skeptical and Credulous Default Unification with Applications to Templates and Inheritance*, pages 13–37. In Briscoe et al. (Briscoe et al., 1993).

J. Earley. 1970. An efficient context-free parsing algorithm. *Communications of the ACM*, 13.

Hans Jürgen Heringer. 1995. Aus fehlern lernen. CD-ROM für Win9x/NT, http://www.phil.uni-augsburg.de/phil2/faecher/germanis/daf/forschung/forschung.html.

Tsuneaki Kato. 1994. Yet another chart-based technique for parsing ill-formed input. In *Proc. 4th Conference on Applied Natural Language Processing (ANLP)*, pages 107–112, Stuttgart.

Jonas Kuhn and Christian Rohrer. 1997. Approaching ambiguity in real-life sentences - the application of an Optimality Theory-inspired constraint ranking in a large-scale LFG grammar. In *Proc. der Jahrestagung der Sektion Computerlinguistik der DGfS*, Heidelberg.

Wolfgang Menzel and Ingo Schröder. 1998. Constraint-based diagnosis for intelligent language tutoring systems. Fachbereich Informatik Report Nr. FBI-HH-B-208-98, Universität Hamburg.

Wolfgang Menzel. 1992. *Modellbasierte Fehlerdiagnose in Sprachlehrsystemen*. Niemeyer, Tübingen.

Sven Naumann and Hagen Langer. 1994. *Parsing.* Teubner, Stuttgart.

Kemal Oflazer. 1996. Error-tolerant finite-state recognition with applications to morphological analysis and spelling correction. *Computational Linguistics*, 22(1).

David Schneider and Kathleen F. McCoy. 1998. Recognizing syntactic errors in the writing of second language learners. In *Proc. 17th Int. Conference on Computational Linguistics (COLING)*, Montreal.

Andreas Schöter and Carl Vogel, editors. 1995. *Nonclassical Feature Systems*, volume 10 of *Edinburgh Working Papers in Cognitive Science*. Edinburgh University.

Christoph Schwarze. 1995. *Grammatik der italienischen Sprache*. Niemeyer, Tübingen.

Camilla Schwind. 1988. Sensitive parsing: Error analysis and explanation in an intelligent language tutoring system. In *Proc. 12th Int. Conference on Computational Linguistics (COLING)*, pages 608–613.

Carl Vogel and Robin Cooper, 1995. *Robust Chart Parsing with Mildly Inconsistent Feature Structures*, pages 197–216. Volume 10 of Schöter and Vogel (Schöter and Vogel, 1995).

Ralph M. Weischedel, Wilfried M. Voge, and Mark James. 1978. An artificial intelligence approach to language instruction. *Artificial Intelligence*, 10.

AUTOMATIC F-STRUCTURE ANNOTATION FROM THE AP TREEBANK

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Abstract

We present a method for automatically annotating treebank resources with functional structures. The method defines systematic patterns of correspondence between partial PS configurations and functional structures. These are applied to PS rules extracted from treebanks. The set of techniques which we have developed constitute a methodology for corpus-guided grammar development. Despite the widespread belief that treebank representations are not very useful in grammar development, we show that systematic patterns of c-structure to f-structure correspondence can be simply and successfully stated over such rules. The method is partial in that it requires manual correction of the annotated grammar rules.

1 Introduction

The present paper discusses a method for the automatic annotation of treebanks with functional structures. A companion paper (Frank 2000) presents an alternative method for the automatic annotation of corpus resources. These closely related, but interestingly different methods have developed through much collaborative interchange. We present them in two separate contributions to allow for more in-depth discussion and comparison. We first describe our method and then exemplify its application to a grammar of 330 rules derived from a fragment of the AP treebank. We give some results concerning precision and recall for this grammar.

Treebanks which encode higher-level functional structure information in addition to phrase structure information, are required as training resources for probabilistic unification grammars and data-driven parsing approaches, e.g. (Bod and Kaplan 1998). Manual construction of such treebanks is very labour and cost intensive. As an alternative, one could envisage the construction of new, or the scaling-up of existing, unification grammars which could then be used to analyze corpora. However, these approaches are equally labour and cost intensive. What is more, even if a large-coverage unification grammar is available, typically, for each sentence it would come up with hundreds or thousands of candidate analyses from which a highly trained expert has to select. Although proposals have been made for filtering and ranking parsing ambiguities (e.g. (Frank et al. 1998)), to date none is guaranteed to uniquely determine the best analysis. In order not to compromise the quality of the corpus under construction, a linguistic expert is required to find the best among a large number of candidate analyses.

As a partial response to this data problem, van Genabith et al. (1999a,b,c) introduce a method for bootstrapping the construction of grammars from treebank resources. Their basic idea is the following: take an existing treebank, read off the CF-PSG following (Charniak 1996), manually annotate it with f-structure annotations, provide macros for the lexical entries and then “reparse” the treebanked trees simply following the original c-structure annotations. During this reparsing process, the f-structure annotations are resolved, and an f-structure is produced. The process is deterministic if the annotations are, and to a large extent costly manual inspection of candidate analyses is avoided. The method successfully allows the creation of grammar resources but still involves one labour intensive manual component, namely annotation of the grammar rules with functional information. Much recent work in LFG, however, has shown that the c-structure f-structure correspondence for a configurational, generally endocentric language such as English, is largely predictable from a small set of mapping principles (King 1995, Kroeger 1995, Bresnan 2000). In the approach of Bresnan (2000) and colleagues, the mapping principles assume a highly articulated set of X'-schemata involving both functional and lexical projections in a configurational language such as English. A similar, but largely implicit, assumption about the predictability of the c- to f-structure mapping is also present in the earlier work in LFG (Kaplan and Bresnan 1982) where it turns up essentially as constraints on pairings of categories and grammatical functions (e.g. COMP is only appropriate for S, only NPs/DPs are OBJs and so forth). In general, the correspondence between c-structure and f-structure follows from linguistically determined principles which are partly universal, and partly language specific (Bresnan 2000), (Dalrymple 1999).

In the light of this, an obvious strategy to pursue is to implement a set of principles to automatically provide f-structure annotations of CFG rules derived from treebank representations, eliminating the manual step in the previous method. As a side effect, this can be expected to cast light on the soundness, accuracy and appropriacy of the linguists' generalisations: that is, the automatic procedure as applied to a large ruleset derived from a treebank, can serve as a potentially interesting testbed for the linguistic principles.

This paper substantially extends the research in van Genabith et al. (1999a,b,c) by showing how f-structure annotations of grammar rules extracted from treebanks may (to a large extent) be automated. The basic idea is very simple. We read off a CFG treebank grammar, using the first 100 trees of the AP treebank (Leech and Garside 1991). Systematic correspondences between elements in the c-structure domain and elements in the f-structure domain are then defined in general annotation templates. A corrected/completed version of this grammar is then used to induce f-structure assignments for PS trees from the treebank following the reparsing method of van Genabith et al. (1999a,b,c). The method is partial in that it requires manual inspection and correction of the output produced by the automatic annotation process. The method results in a set of annotated rules for real text.

The challenge for our for our approach is provided by the overtly flat analyses provided by the treebank input data, which in general do not conform to strongly hierarchical and recursive X' design principles. This has the effect that often what should be a single separate constituent is not assigned a corresponding *subtree* but merely a *substring* in the RHS of a flat treebank grammar rule. Our feature structure annotation principles underspecify rule RHSs and aim to pick out suitable substrings in flat rule RHSs.

Annotation principles express linguistic generalisations. The number of principles is substantially lower than the number of annotated CF-PSG grammar rules. The potential benefits of automation using annotation principles are considerable: substantial reduction in development effort, hence savings in time and cost for treebank annotation and grammar development; the ability to tackle larger fragments in a shorter time, a considerable amount of flexibility for switching between different treebank annotation schemes, and a natural approach to robustness. The method we present may be viewed as a corpus-guided grammar development methodology.

The paper is structured as follows. In Section 2 we introduce the formalism for writing annotation templates. In Section 3 we discuss in some detail the NP fragment of our grammar and present a number of the templates involved. Section 4 presents the design of the automatic annotation experiment and evaluates the results obtained. Finally we conclude and outline further work.

2 Automatic f-structure annotation of CF Rules

Treebank grammars (CFGs extracted from treebanks) are very large and grow with the size of the treebank (Charniak 1996), (Krotov et al. 1998). They feature flat rules, many of which share and/or repeat significant portions of their RHSs. This causes several problems for manual annotation approaches such as the one described in van Genabith et al. (1999a,b,c). Annotation is labour intensive and repetitive, because of the sheer size and similarity of the rules, and annotation of rules on a one by one basis means that generalisations known to the annotator are simply not expressed. Of course, if the cardinality of the ruleset continues to grow with the size of the treebank, so too will the manual annotation task.

In LFG the correspondence between functional and constituent structure is partly defined in terms of annotations associated with c-structure nodes. Annotation follows universal and language specific principles. We can define principles as involving *partial* phrase structure configurations and apply them to all CFG rules that meet the relevant *partial* configuration. To give a simple example: a head principle assigns $\uparrow = \downarrow$ to the X daughter in all XP $\rightarrow \ldots X \ldots$ configurations, irrespective of the surrounding categorial context. Such annotation principles capture generalisations, which can be used to *automatically* annotate PS configurations with functional structures in a highly general and economical way.

2.1 Feature Description Templates

In our approach to automatic annotation of c-structure rules, the linguist states generalisations over local sub-trees in the form of possibly partial and underspecified annotation principles, which take the following form:

```
Rhs > Lhs @ Anno
```

`Rhs > Lhs` is a possibly partial and underspecified CF-PSG grammar rule description using regular expressions, `Anno` is a set of feature structure annotations. To give a simple example, the following three annotation principles for `vp` rules state that the leftmost `v0` is the head of `vp`, that an `np` following a `v0` is a direct object and that a sequence of two `v0`s (as in the flat treebank analyses of auxiliary/modal constructions) induces open complement `xcomp` feature structures where the subject of the complement is controlled by the subject of the superordinate feature structure.

```
vp:VP > v0:V *
      @ [VP === V]
vp    > * v0:V0 np:NP *
      @ [V0:obj === NP]
vp    > * v0:V0 v0:V1 *
      @ [V0:xcomp === V1, V0:subj === V0:xcomp:subj]
```

Given a flat (treebank) CF-PSG rule (for strings like *did order a recount*) of the form

```
vp:VP > v0:V0 v0:V1 np:NP
```

these annotation principles conspire to induce the following feature structure annotation, as required:

```
vp:VP > v0:V0 v0:V1 np:NP
      @ [VP === V0, V1:obj === NP,
         V0:xcomp === V1, V0:subj === V0:xcomp:subj]
```

Our CF-PSG rule description language consists of regular expressions including Kleene star `*`, positive Kleene `+`, optionality `?`, disjunction `|` and a limited form of complement `~`. Terminal symbols are either `category:feature structure` pairs (as in `np:NP`) or, for convenience, simple categories if the feature structure associated with the category is not mentioned in the feature structure annotations. The `*` and `+` operators can be used with or without arguments. Without arguments `*` denotes any string (including the empty string) while `+` denotes any string of lenght greater one.

Both `Lhs` and `Rhs` in annotation principles are regular expressions. The interpretation of an annotation principle such as

```
vp    > * v0:V0 v0:V1 *
      @ [V0:xcomp === V1, V0:subj === V0:xcomp:subj]
```

is: if you find a sequence of two adajecent `v0`s in the RHS of a `vp` rule then annotate that rule with the feature structure annotations stated in the `@ Anno` part of the annotation principle. A single CF-PSG rule may receive annotations from more than one (partial) annotation principle. What is more, a single annotation principle may match a single CF-PSG rule more than once. Consider the following flat `vp` rule:

```
vp:VP > v0:V0 v0:V1 v0:V2 np:NP
```

for a string such as *may have ordered a recount*. The rule RHS features two adajecent `v0` sequences and the `v0` sequence annotation template is going to match twice. The feature structures induced by all such matches are collected and the rule is annotated accordingly:

```
vp:VP > v0:V0 v0:V1 v0:V2 np:NP
      @ [VP === V0, V1:obj === NP,
         V0:xcomp === V1, V0:subj === V0:xcomp:subj,
         V1:xcomp === V2, V1:subj === V1:xcomp:subj]
```

As a final example, consider a flat (treebank) CF-PSG rule for a string such as *may have ordered the county to recount the ballot*.

```
vp:VP > v0:V0 v0:V1 v0:V2 np:NP infp:I
```

The final infinitival phrase *to recount the ballot* is an open complement argument to the rightmost `v0`. In our rule description language this can be expressed as follows:

```
vp > * v0:V0 *(~v0) infp:I *
     @ [V0:xcomp === I]
```

This annotation principle matches `vp` rules containing an `infp` constituent. This constituent provides an `xcomp` to a `v0` such that no other `v0` (though possibly other constituents) may intervene between it and the `infp`:

```
vp:VP > v0:V0 v0:V1 v0:V2 np:NP infp:I
      @ [VP === V0, V1:obj === NP,
         V0:xcomp === V1, V0:subj === V0:xcomp:subj,
         V1:xcomp === V2, V1:subj === V1:xcomp:subj,
         V2:xcomp === I]
```

Notice that the principle does not specify a subject function for the open complement. This is provided lexically by a feature structure macro for object control verbs such as *order*.

Our annotation principles factor out and express generalisations over the flat treebank CF-PSG rules. The generalisations are expressed in terms of partial and underspecified rule descriptions. The annotation principle compiler applies principles to the CF-PSG rules extracted from the treebank. Statement and processing of the annotation principles is order independent. The compilation of principles over grammar rules is efficient. Our current implementation annotates about 50 CF-PSG rules per second.

3 The NP Grammar and Templates

In the previous section, we introduced the formalism for writing annotation templates. To give a flavour of what is involved, in this section we will present several aspects of the NP grammar. We show that this approach permits the linguist to state simple generalisations and translate them straightforwardly into templates. In our work to date we have developed templates for the entire grammar of 330 rules derived from the treebank. However, we have chosen to concentrate on one section of the grammar for expository purposes.

The NP fragment constitutes the largest and most complex set of phrase structure rules induced for a single non-terminal category from our set of sentences. Because of its size and complexity, and because the issues which it raises give a good feel for what is involved in our approach to automatic annotation, we limit discussion to this fragment. The grammar fragment contains 142 rules, for which we have written 29 templates. 23 categories are attested within NP, a very high proportion of the overall number of categories in the grammar, which is 41 (29 lexical and 12 non-terminal categories)[1].

(1) Categories found within NP

det	ndet	adj	adjp	dadj
n0	np	num	title	posspron
pron	pnct	conj	relcl	pp
p	ntadv	adv	v0	vp
fn	tgp	infp		

3.1 Compaction and Supercategories

In earlier work (van Genabith et al. 1999c) we found that the rich set of tags used in the AP treebank provided much useful f-structure information which could be simply re-expressed in a set of lexical macros. The distinctions introduced by the AP tagset, in common with other tagsets, are extremely fine-grained because all sorts of subcategorial distinctions are expressed by means of the monadic category labels. In very many cases, these subcategorial distinctions are ones which would be expressed by means of grammatical features at f-structure in LFG (distinctions such as number, verbform, and so on). Since this information is recaptured by means of these lexical macros, they hypothesized that it would be helpful to abstract away from the specificities of the particular set of tags used in their database of sentences in favour of a smaller set of "supertags" in order to develop a stand-alone resource. This can be viewed as plugging holes in the grammar, for it permits a more general grammar to be derived from that which would otherwise be read off from the treebank entries. Therefore van Genabith et al. (1999b) introduce a structure-preserving grammar compaction method which first uses lexical macros to associate f-structure constraints with the words in

[1] The category set that we are dealing with is derived from the original AP tagset by a process of compaction, which we describe in the following section.

the tree and then, having specified a mapping between tags and "supertags" (generalisations over tags), uses the latter to reparse the treebank entries and compile a "generalised" CFG from the tree using the method of (Charniak 1996).

The work described here investigates the automatic association of f-structure constraints with the rules of the CFG by means of annotation templates. We have found that the categorial compaction described in (van Genabith et al. 1999b) has provided an excellent basis for automatic f-annotation: many of the distinctions preserved in the reduced (generalised) tagset are precisely those which we require to guide automatic annotation. For example, in the nominal domain, the large number of distinctions made between nominal elements on the basis of morphosyntactic class membership are eliminated, but the distinction of nouns with adverbial function is maintained. We make use of such information to directly guide the f-structure annotation process. Likewise, the AP tagset makes a series of distinctions within the verbal/sentential system which, suitably generalised over, are useful in the same way. As an example, we assign supertags over sets of AP tags as indicated below:

(2)

Supertag	AP Tag	Description
FA	Fa	Adverbial clause
	Fa&	First conjunct of an adverbial clause
	Fa+	Second conjunct of an adverbial clause
FN	Fn	Noun clause
	Fn&	First conjunct of a noun clause
	Fn+	Second conjunct of a noun clause
RELCL	Fr	Relative clause
	Fr&	First conjunct of a relative clause
	Fr+	Second conjunct of a relative clause
INFP	Ti	to + infinitive clause
	Ti&	First conjunct of a to + infinitive clause
	Ti+	Second conjunct of a to + infinitive clause

The following, exceptionless generalisations can be stated about these derived categories.

(3) An FN within NP is a COMP in the NP's f-structure

```
np:NP > * fn:FN *
      @ [NP:comp === FN]
```

(4) An infinitival VP within NP is an XCOMP in the NP's f-structure

```
np:NP > * infp:I *
      @ [NP:xcomp === I]
```

(5) A RELCL within NP is a RELMOD in the NP's f-structure

```
np:NP > * relcl:R *
      @ [NP:relmod === R]
```

Of course, not all constituents which map to the f-structure function RELMOD *are* represented as **relcl** in the treebank entries. The sample of 100 sentences contains a number of cases of reduced relative clauses, which are associated with the (super-)category **vp** in our collapsed tagset. Given the distinctions made in the verbal supertag set, the following generalisation may be made about the occurrence of the (super-)tag **vp** within the noun phrase:

(6)
```
np:NP > * vp:R *
      @ [NP:relmod === R]
```

Notice that the two **relcl** annotation principles can be collapsed into a single principle as follows:

(7)
```
np:NP > * (relcl:R|vp:R) *
      @ [NP:relmod === R]
```

Since the AP tagset encodes adverbial function, the supertag **ntadvp** (for nominal temporal adverbial) can be straightforwardly related to a specific function:

(8) An NTADVP maps to an NP_ADJUNCT in the mother's f-structure

```
np:NP > * ntadvp:NT *
      @ [NP:np_adjunct:el === NT]
```

The original AP tagset contains more than 20 pronominal tags, which we collapse to two supertags: **posspron** for possessive pronouns, and **pron** for all other pronouns. Again, the c-structure to f-structure mapping templates are simple to write for these categories[2]:

(9)
```
np:NP > * posspron:P *
      @ [NP:poss === P]
```

(10)
```
np:NP > * pron:P *
      @ [NP === P]
```

To take a more complicated example, the AP tagset distinguishes the following subtypes of Adjectives: **ja jb jj da da2 dar dat**. All the "j" tags are adjectives, either predicative, central and attributive. The "d" adjectives are "after determiners" such as "former, such, few, several...". The "j" adjectives are attributive modifiers within NP, and under our treatment,

[2]Of course, given the flatness of the trees, a **posspron** might denote a POSS function, but not necessarily the POSS of the f-structure of its mother node (it might be more deeply embedded in the f-structure). However, in our fragment this is not attested and we can make do with the simple generalisation in (9).

correspond to NP_ADJUNCT and HEADMOD grammatical functions,[3] while the "d" adjectives map to SPEC or may serve as the head of NP in the absence of a nominal element. In our collapsed tagset, all the "d" adjectives are treated as **dadj** and all the "j" adjectives as **adj**: this distinction, which is a simple generalisation of the categorial distinctions made in the treebank tags, corresponds to a difference in grammatical functional possibilities for these subtypes of adjectives. For **dadj**, the generalisation that we wish to state is that it maps to SPEC if there is a nominal f-head, otherwise to f-head.

(11)
```
np:NP > * dadj:DA * (n0|np|num) *
      @ [NP:spec === DA]
```

(12)
```
np:NP > * dadj:DA *(~(n0|np|num))
      @ [NP === DA]
```

This pair of templates is essentially equivalent to annotating a **dadj** node with a disjunction $(\downarrow\in(\uparrow\text{ADJ}))\vee(\downarrow=\uparrow)$. We recognise the ability of these adjectives to stand on their own as the head of NP by permitting the category **dadj** to serve as the head (when no other potential head is present) rather than by reassigning them to a nominal or determiner category.

The other subclass of adjectives serve as nominal modifiers within NP. The LFG treatment of attributive adjectives is as members of the set-valued feature ADJUNCT (here NP_ADJUNCT). This is appropriate for iterative uses of adjectives which separately restrict the interpretation of the head noun. However, our corpus contains a significant number of cases in which an adjective may appear on the left periphery (and part) of what is essentially a complex (internally-modified) nominal head, as in *jump shot*, *national guard troops, wide area telephone service*. For the latter cases we have used the additional grammatical function HEADMOD: the prototypical use of this function is in cases of noun-noun compounding, which abound in our small corpus extract. We shall have more to say about the HEADMOD function when we discuss NN compounds below.

Treating adjectives as potentially mapping to HEADMOD as well as to NP_ADJUNCT leads to the following template information for **adj**: adjectives next to nominal heads are either NP_ADJUNCTs or HEADMODs, other adjectives are NP_ADJUNCTs.

(13)
```
np:NP > * adj:A (n0:N|np:N|num:N) *
      @ [ ( NP:np_adjunct:el === A ;
              N:headmod === A ) ]
```

(14)
```
np:NP > * adj:A ~(n0|np|num) *
      @ [NP:np_adjunct:el === A]
```

Since only single, uncomplemented and unmodified adjectives can be used as part of these sorts of structures, the template for AP is simple to state: it maps to the nominal adjunct function.

[3] We discuss this distinction at greater length below.

```
(15)  np:NP > * adjp:A *
            @ [NP:np_adjunct:el === A]
```

3.2 PP Dependents

Distinguishing OBL from ADJUNCTs is a notoriously difficult problem, especially within NPs, where the PP dependents are largely optional. One possible tack would be to treat all PP dependents of nominals as ADJUNCTs (this approach is adopted in (Butt et al. 1999)), that is, to treat all optional arguments of nominal heads as syntactic modifiers (some of which will be semantic arguments) rather than syntactic arguments. On this view, our annotation templates would simply need to state the generalisation that the category `pp` maps to the ADJUNCT function. However, inspection of our set of sentences suggests that while the second of two PPs is always an ADJUNCT, a PP adjacent to the nominal head may be either an OBL or an ADJUNCT. Although it is claimed that OBLIQUE and ADJUNCT PPs can reorder rather freely, the strings in the template reflect the ordering which would be imposed by the X'-schemata. The following templates, therefore, introduce a measure of disjunction into the annotation process:

```
(16)  np:NP > * pp pp:P *
            @ [NP:np_adjunct:el === P]

(17)  np:NP > * (no|np|num) pp:P *
            @ [ ( NP:np_adjunct:el === P ;
                  NP:obl === P ) ]
```

3.3 Head Modifier Structures

The treebank representations of NPs are very flat and often quite complex - the following are representative.

```
(18)   np:A > [det:B,adj:C,adj:D,n0:E,n0:F,adjp:G]
       np:A > [det:B,adj:C,n0:D,n0:E,relcl:F]
       np:A > [det:B,adj:C,n0:D,n0:E]
       np:A > [det:B,adj:C,n0:D,ntadvp:E,relcl:F]
       np:A > [det:B,adj:C,n0:D,pnct:E,vp:F]
       np:A > [det:B,adj:C,n0:D,pp:E]
       np:A > [det:B,dadj:C,n0:D,n0:E,n0:F,relcl:G]
       np:A > [n0:B,n0:C,n0:D,n0:E,vp:F]
       np:A > [n0:B,n0:C,n0:D,n0:E]
       np:A > [n0:B,n0:C,n0:D,np:E]
       np:A > [n0:B,n0:C,n0:D,ntadv:E,pp:F)]
```

```
np:A > [n0:B,n0:C,n0:D]
np:A > [n0:B,n0:C,np:D,pnct:E,np:F]
np:A > [n0:B,n0:C,np:D]
np:A > [n0:B,n0:C,pnct:D,np:E]
np:A > [n0:B,n0:C,pnct:D,relcl:E]
```

Given the remarkable paucity of internal structure here, a major issue is determining what category is the head of NP; that is, what category is to be annotated (↑= ↓A striking feature of many of the NP rules is that they contain strings of nominal categories. In such cases, these flat strings of nominal categories behave in an essentially right-headed fashion. The elements **n0**, **num** and **np** typically serve as the head and the rightmost such element present (provided it is not preceded by **pnct**, which marks an appositional structure), is the head of the NP. This generalisation can be stated as follows:

```
(19) np:NP > *(~conj) ~(conj|pnct) (n0:N|np:N|num:N)
             *(~(n0|np|num))
           @ [NP === N]
```

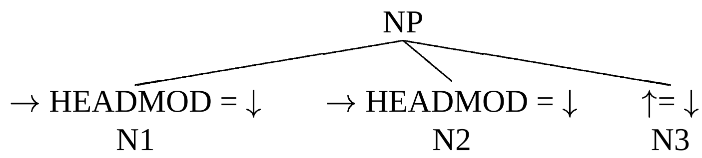
As can be seen, this template must take into account the complicating factor of coordination, and in particular, the flat representation of coordination, which we discuss in the following section. The fragment of grammar in (18) and the template (19) illustrate nicely a feature of treebank representations, namely their extremely flat representations. The template above must search for the rightmost category appropriate to serve as head, from a sequence of categories.

The overly flat treebank representations are very problematic when it comes to determining the correct head-modifier relationships within the noun phrase. One possibility is to treat all pre-head nominal (and adjectival) elements as direct modifiers of the final nominal head. It would be trivial to then define the appropriate annotation template mapping all such prehead nominal modifiers into a set-valued ADJUNCT f-structure. This would entail, for example, treating *law enforcement officer* as a head *officer* modified by a set of adjuncts { *law, enforcement* }. This is essentially the approach adopted in the LFG grammars of the PARGRAM project described in (Butt et al. 1999). The difficulty with this is that a flat representation as ADJUNCTS at f-structure would fail to encode the semantic modification relations which hold within these pre-head modifiers (although, of course, it is possible to keep trace of at least linear position in the string of modifiers by judicious indexing of the elements in the ADJUNCTS set).

These structures are extremely common in our fragment: for example, there are 52 rules containing a total of 72 simple **n0 n0** sequences in which nominal elements modify nominal structures to their right. We treat these as head-modifer structures, introducing a new (single-valued) grammatical function HEADMOD. Strings such as *guard helicopters*, *smoke inhalation*, *hospital spokesman*, *law enforcement officers*, and many others in our sample, may be viewed as syntactic structures (each word is associated with a separate terminal category in the treebank representations) which are built according to “morphological” principles (number is marked on the final element, the structures are head final), in which each element modifies the f-structure of the element to its right.

This approach is also problematic, however. A nominal is taken to modify the f-structure projected from its nominal sister, as shown schematically in (20), where (→) denotes the f-structure of the immediately adjacent right sister, with the corresponding schematic f-structures in (21).

(20)



(21)
$$\begin{bmatrix} \text{PRED} & \text{'N3'} \\ \text{HEADMOD} & \begin{bmatrix} \text{PRED} & \text{'N2'} \\ \text{HEADMOD} & \begin{bmatrix} \text{PRED} & \text{'N1'} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

It is clear, however, that such “left-branching” structures are not always correct for the strings in our corpus, and that in some cases a “right-branching” f-structure, with a complex head (as shown in (22) would be more correct[4]. These sorts of structures, with what amounts to complex PREDs, are not permissible in LFG.

(22)
$$\begin{bmatrix} \text{HEAD} & \begin{bmatrix} \text{PRED} & \text{'N3'} \\ \text{HEADMOD} & \begin{bmatrix} \text{PRED} & \text{'N2'} \end{bmatrix} \end{bmatrix} \\ \text{HEADMOD} & \begin{bmatrix} \text{PRED} & \text{'N1'} \end{bmatrix} \end{bmatrix}$$

For the moment, however, the template simply picks out sequences of **n0** categories and adds the f-structure constraint that the first is the HEADMOD of the second. Note that the template cannot, of course, equate the f-structure of the mother with the rightmost category in the pair, since the f-structure of this category may itself be a HEADMOD within a containing f-structure: picking out the head of NP is performed by the head template given in (19) above.

(23)
```
np > * n0:N1 n0:N0 *
        @ [N0:headmod === N1]
```

[4]Nevertheless, it must be stated that such NPs in our grammar are all treated as ‘left-branching’ structures. As we point out, this means that in some cases we provide the wrong treatment for such phenomena. The results given later in the paper were performed on this ‘faulty’ set of NPs. We are confident that reinterpreting these N-N compounds correctly will not prevent us from achieving equally good figures for precision and recall, but we have yet to rewrite the grammars and templates as desired, so that this must remain as speculation at this stage.

What else, apart from **n0**, maps to the headmod function? Members of the category **num**, like **adj** may be either ADJUNCTs or HEADMOD: the template is shown in (24). We extend the same treatment to titles, as in (25).

(24)
```
np > * num:N n0:N0 *
   @ [ (N0:headmod === N ; N0:np_adjunct:1 === N) ]
```

(25)
```
np > * title:T n0:N0 *
   @ [N0:headmod === T]
```

3.4 Coordination and Flat Trees

The approach to constituent coordination in LFG treats the conjuncts as a set at f-structure, with the conjunction contributing a value directly to the semantic structure. Our formalism does not currently support set values, and we model constituent coordination by treating the conjunction as a predicate taking a CONJ argument which itself takes any number of indexed arguments. The treatment of the conjuncts themselves then closely resembles our treatment of the set valued feature ADJUNCT, as (26) illustrates.

(26)
```
np:A > [np:B,pnct:C,np:D,pnct:E,conj:F,np:G]
```

$$\left[\begin{array}{ll} \text{PRED} & \text{and} \\ \text{CONJ} & \left[\begin{array}{ll} 1 & \left[\text{PRED} \quad ....\right] \\ 2 & \left[\text{PRED} \quad ....\right] \\ 3 & \left[\text{PRED} \quad ....\right] \end{array}\right] \end{array}\right]$$

Ideally, then, the template must pick out the **conj** as the f-head and treat other categories, except for **pnct** as CONJ functions. However, consideration of the set of np rules involving coordination makes clear that things are unfortunately considerably more complicated. Because the treebank representations are extremely flat, the scope of coordination is not indicated by the presence of a distinct sub-tree: this means that it is not possible to assign all daughters (except **conj** and **pnct** to CONJ functions.

(27)
```
np:A > [n0:B,conj:C,n0:D)]
np:A > [np:B,conj:C,np:D)]
np:A > [np:B,pnct:C,conj:D,np:E)]
np:A > [np:B,pnct:C,np:D,conj:E,np:F)]
np:A > [np:B,pnct:C,np:D,pnct:E,conj:F,np:G)]
np:A > [adj:B,conj:C,adj:D,n0:E,n0:F)]
```

```
np:A > [adj:B,conj:C,adj:D,n0:E,pp:F)]
np:A > [adv:B,num:C,adj:D,n0:E,n0:F,conj:G,n0:H)]
np:A > [det:B,adj:C,n0:D,conj:E,n0:F,n0:G)]
np:A > [det:B,adj:C,n0:D,conj:F,n0:G,pp:E)]
np:A > [det:B,adv:C,conj:D,adv:E,adj:F,n0:G,pnct:H,
        relcl:I)]
np:A > [det:B,n0:C,n0:D,pnct:E,n0:F,conj:G,n0:H)]
np:A > [posspron:B,n0:C,pp:D,conj:E,adv:F)]
```

The **n0** conjunction principle assigns `n0`s preceding a `conj n0` sequence as individual conjuncts. It matches as many times as there are `n0`s preceding the `conj n0` sequence, the resulting annotations are collected and the rule is annotated accordingly. Notice that this can result in multiple but identical `C:conj:el === N0, NP === C` annotations which does not cause any harm. However, because of the flat treebank rules the **n0** conjunction principle is no more than an approximation. It can introduce errors in case two adjacent `n0`s should be analysed as `headmod` structures rather than as coordinate elements in a coordinate structure.

(28)
```
np:NP > * n0:Nx * conj:C n0:N0 *
      @ [C:conj:el === Nx, C:conj:el === N0,
         NP === C]
```

Further complications are the coordination of adjectives directly under np and even of adverbs modifying adjectives under np. General statements can be written for these under which in each case the coordinate structure is identified and assigned the correct sort of ADJUNCT function in the mother f-structure.

(29)
```
np:NP > * adj:Ax * conj:C adj:A *
      @ [C:conj:el === Ax, C:conj:el === A,
         NP:np_adjunct:el === C]
```

4 Experiments

In this section, we report on experiments in automatically compiling the templates over the grammar rules and compare the results to our hand-coded grammar.

4.1 Experiment Design and Data

Our experiment involves the first 100 trees of the AP treebank (Leech and Garside 1991). We preprocess the treebank using the structure preserving grammar compaction method reported in (van Genabith et al. 1999b) and extract a treebank grammar following (Charniak 1996).

The large number of highly discriminating terminal and non-terminal categories results in a large number of often very specific rules: the grammar compaction method provides a more general grammar that still preserves all important categorial information to drive automatic annotation. Compaction works by generalising tags, i.e. collapsing tags (and categories) into supertags. This reduces the number of rules from 509 to 330. The sentences in the fragment range from 4 to 50 terminal tokens (including punctuation symbols). We develop a set of feature structure annotation templates. Our template interpreter compiles the templates over the rules in the treebank grammar.

In order to evaluate the results of automatic annotation we manually constructed a reference grammar following (van Genabith et al., 1999a,b,c). The grammar features 1128 annotations, on average about 3.4 annotations per rule.[5]

4.2 Automatic Annotation and Evaluation

We constructed 129 templates, this against 330 CFG rules resulting in a template/rule ratio of 0.39. We expect the ratio to skew in favour of templates as we proceed to larger fragments. Automatic annotation generates 1108 annotations, on average about 3.36 annotations per rule. We evaluate the automatic annotation procedure in terms of *precision* and *recall*.

(30)

$$precision = \frac{\#generated\ annotations\ also\ in\ reference}{\#generated\ annotations}$$

$$recall = \frac{\#reference\ annotations\ also\ generated}{\#reference\ annotations}$$

	Experiment
precision	93.38%
recall	91.58%

These numbers, although good, are conservative: *precision* and *recall* are computed automatically and currently our annotation matcher is not complete.[6]

The results are encouraging and indicate that while automatic annotation is (slightly) more often partial than incorrect, a small number of annotation templates can be written for a

[5] Templates, grammars and f-structures are available at
`http://www.compapp.dcu.ie/~away/Treebank/treebank.html`.

[6] E.g.: `P1 = P2` $\models$ `P2 = P1` and `A=B, A:P1 = P2` $\models$ `B:P1 = P2` where `Pi` are paths and `A,B` variables; currently our precision and recall programme misses `P1:P2 = P3, P1 = A` $\models$ `A:P2 = P3` type inferences.

grammar fragment which appears to be quite complex. The generalisations made are simple and robust, and can be expected to considerably ease the annotation burden on the grammar writer.

Having been confronted with 'real' text, we have been forced to distinguish a number of grammatical functions for which there is good c-structure evidence and/or motivation in real text, but which are not discussed in the theoretical literature. In particular, we have postulated a pre-modificational HEADMOD grammatical function within NPs. The biggest challenge presented by the very flat treebank representations concerns the coordination data, and in particular the interaction of coordination with other phenomena.

5 Conclusions and Further Work

We have presented and extensively exemplified a method for the automatic f-structure annotation of treebank grammars. At this stage our intent has been to present the methods and to explore some of their potential. The approach applies to a CFG, such as that derived from a treebank, and yields an annotated grammar, which can either be used to reparse treebank trees to induce feature structure annotations for treebank trees or serve as a basis for developing a stand-alone LFG resource. It uses a compaction technique for generalising overspecific categorisation. The structure of treebank entries remains unchanged. We implemented an order-independent annotation template interpreter. Order independence can ease development and maintainance of annotation principles, but requires more complex rule constraints.

Automatic annotation holds considerable potential in curtailing development costs and opens up the possibility of tackling large fragments. To date, our experiments are admittedly small-scale. Still, we have presented an important grammar development and treebank annotation methodology which is data-driven, semi-automatic and reuses existing resources. We found the LFG framework very conducive to our experiments. We do believe, however, that the methods can be generalised, and we intend to apply them in an HPSG scenario. Note further that our methods encourage work in the best linguistic tradition as (i) they are concerned with real language and (ii) they enforce generalisations in the form of annotation principles. The experiments show how theoretical work and ideas on principles can translate into grammar development for real texts. In this sense the methods bridge the often perceived gap between theoretically motivated views of grammar as a set of principles versus grammars for 'real' text.

Bibliography

Bod, R., and R. Kaplan. 1998. A Probabilistic Corpus-Driven Model for Lexical-Functional Analysis. In *Proceedings of COLING/ACL'98*, 145–151.

Bresnan, J. 2000. Lexical Functional Syntax. Forthcoming, Blackwells Publishers, Oxford.

Butt, M., T. H. King, M.-E. Nino, and F. Segond. 1999. *The Grammar Writer's Cookbook*. Stanford: CSLI Publications.

Charniak, E. 1996. Tree-bank Grammars. In *AAAI-96. Proceedings of the Thirteenth National Conference on Artificial Intelligence*, 1031–1036. MIT Press.

Dalrymple, M. 1999. Lexical-Functional Grammar. Manuscript, Xerox PARC.

Frank, A., T. King, J. Kuhn, and J. Maxwell-III. 1998. Optimality Theory Style Constraint Ranking in Large-scale LFG Grammars. In M. Butt and T. King (Eds.), *Proceedings of the LFG98 Conference*, University of Queensland, Brisbane, CSLI Online Publications, Stanford, CA. `http://www-csli.stanford.edu/publications/`.

Frank, A. 2000. Automatic F-structure Annotation of Treebank Trees. In M. Butt and T. King (Eds.), *Proceedings of the LFG00 Conference*, CSLI Online Publications, Stanford, CA. `http://www-csli.stanford.edu/publications/`.

Kaplan, R., and J. Bresnan. 1982. Lexical Functional Grammar: a Formal System for Grammatical Representation. In J. Bresnan (Ed.), *The Mental Representation of Grammatical Relations*, 173–282. Cambridge, Mass: MIT Press.

King, T. H. 1995. *Configuring Topic and Focus in Russian*. Stanford: CSLI Publications.

Kroeger, P. 1995. *Phrase Structure and Grammatical Relations in Tagalog*. Stanford: CSLI.

Krotov, A., M. Hepple, R. Gaizauskas, and Y. Wilks. 1998. Compacting the Penn Treebank Grammar. In *Proceedings of COLING/ACL'98*, 699–703.

Leech, G., and R. Garside. 1991. *Running a Grammar Factory: On the Compilation of Parsed Corpora, or 'Treebanks'*. Mouton de Gruyter, Berlin. 15–32.

van Genabith, J., L. Sadler, and A. Way. 1999a. Data-Driven Compilation of LFG Semantic Forms. In *EACL'99 Workshop on Linguistically Interpreted Corpora (LINC-99), Bergen, Norway, June 12th*, 69–76.

van Genabith, J., L. Sadler, and A. Way. 1999b. Structure Preserving CF-PSG Compaction, LFG and Treebanks. In *Proceedings ATALA Workshop - Treebanks*, Journées ATALA, Corpus annotés pour la syntaxe, Universite Paris 7, France, 18-19 Juin 1999, 107–114.

van Genabith, J., A. Way, and L. Sadler. 1999c. Semi-Automatic Generation of F-Structures from Tree Banks. In M. Butt and T. King (Eds.), *Proceedings of the LFG99 Conference*, Manchester University, 19-21 July, CSLI Online Publications, Stanford, CA. `http://www-csli.stanford.edu/publications/`.

Negation in Swedish: Where It's Not At

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Introduction

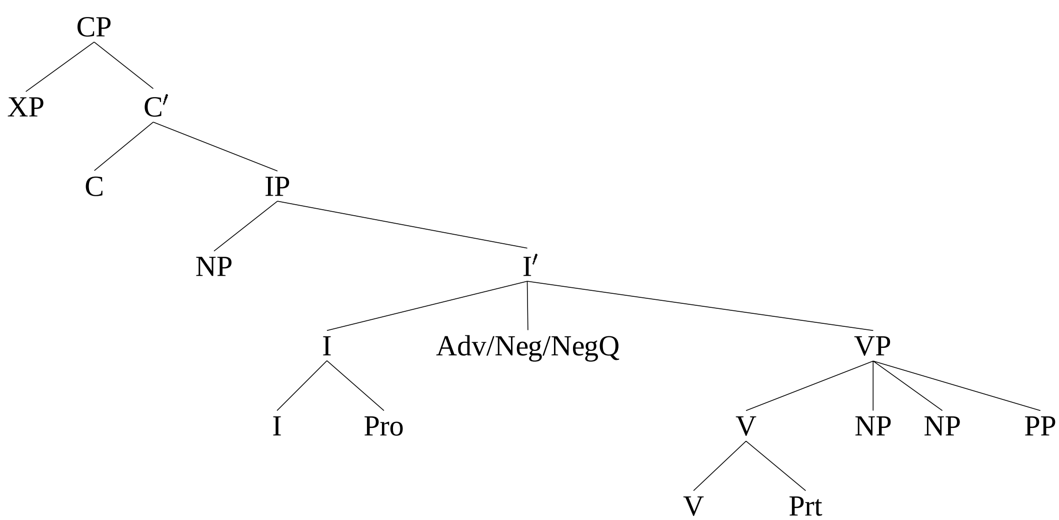
Christensen (1986) noted that negative quantifiers in the Scandinavian languages have an unusual distribution that suggests some interesting syntactic properties. More recently, Kayne (1998) and Platzack (1998) have taken the Scandinavian data to present evidence for a positive licensing condition on negative quantifiers, to the effect that they must be in the Specifier of a NegP. Illustrating with data from Swedish, I will discuss the structural positions of negation and of negative quantifiers, and show that the right generalization for their positions is in fact a negative one: in a clause articulated into CP-IP-VP structure, these negative elements cannot appear within VP. I will also discuss how this characterization can be neatly modelled in a base-generated theory like LFG, and adopt a realizational approach to the analysis of negation. Finally, I will discuss an extension of the analysis to negative concord languages.[*]

1. Overview and Background

1.1. Swedish Clause Structure

Main clauses in Swedish are V2 structures rooted in either IP or CP, depending on whether the initial phrase is a subject or a non-subject, with a finite verb in the second position. SpecIP in Swedish is the subject position, and SpecCP is an initial topic or focus position. Objects in Swedish (as in all the Scandinavian languages) can be shifted forward out of VP, in the celebrated phenomenon of Object Shift. Swedish allows a variety of constituents to appear between I and VP in the clause structure schematized in (1), including shifted pronominal objects, and various medial adverbials.

(1) Swedish Clausal Structure



The basic facts of clausal positioning are summarized in (2).

[*] For their help in answering my many questions about Swedish, I am grateful to Elisabet Engdahl and Benjamin Lyngfelt. Line Mikkelsen and Helge Lødrup kindly provided me with examples from Danish and Norwegian when I was first learning about the phenomena discussed here. I also thank Joan Bresnan and participants at the LFG-00 conference in Berkeley for useful suggestions about the analysis.

(2) a. In subject-initial V2 clauses, the subject is in SpecIP and the finite verb in I.

b. In non-subject-initial V2 clauses, the subject is in SpecIP, the finite verb in C, and the topicalized non-subject is in SpecCP.

c. In non-V2 embedded clauses, I is not instantiated and the finite verb is in V (see (3)c).

Some possibilities are shown in (3), with a showing normal argument positions within VP, and b showing a shifted pronominal object, which is in the position of 'Pro' in (1).

(3) a. Jag har inte [$_{VP}$ gett boken till henne].
I have not [$_{VP}$ given the.book to her]

b. Jag kysste henne inte
I kissed her not

c. ... att jag inte [$_{VP}$ har gett boken till henne]
... that I not [$_{VP}$ have given the.book to her]

In embedded clauses, where V2 structures are usually absent, the finite verb necessarily follows medial adverbials, as seen in (3)c.

It is uncontroversial in Scandinavian that negation appears to the left of the position of a canonical VP. In (3)a, the finite verb is in I and the non-finite participle form is in V, with negation preceding it. Additionally, the forward placement of the pronominal object in (3)b is evidence of Object Shift out of VP, and negation follows the object, showing that negation follows I but precedes V in the structure in (1). The original proposal about the distribution of negative quantifiers in Christensen (1986) recognizes that they have an affinity with the position of negation, that is, they are external to VP. There seems to be a similarity between pronominal objects shifting forward out of their base position within VP, and NegQP objects also moving from their base position to one outside of VP. These similarities will be seen more clearly in section 2 below. However, there are also some crucial differences in the distribution of shifted pronominal objects and of NegQPs, and which show that the two phenomena are theoretically quite distinct.

1.2. Negation

Let us first look at the expression of simple clausal negation, by the adverb *inte*. This is one member of a large class of medial adverbs in Swedish, which come in a relatively fixed order, as shown in (4); (5) gives some illustrative examples, with *inte* underlined (based on Holmes and Hinchliffe (1994, 513)).

(4) Order of Medial Adverbial Elements

a. Short modal adverbs, e.g., *ju* 'as you know', *nog* 'probably'.

b. Short pronominal adverbs, e.g., *alltså* 'therefore', *därför* 'for that reason'.

c. Longer modal adverbs, e.g., *visserligen* 'to be sure', *verkligen* 'really', *möjligen* 'possibly'.

d. Negations, e.g., *inte* 'not', *aldrig* 'never'.

e. 'Floated' quantifiers, e.g., *alla* 'all'.

(5) a. Igår kunde han [$_{I'}$ ju alltså troligen <u>inte</u> [$_{VP}$ ha läst bockerna]].
yesterday could he [$_{I'}$ as.you.know thus probably not [$_{VP}$ have read the.books]
'Yesterday as you know he could probably have not read the books thus.'

b. Jag [$_{I'}$ kysste dem <u>inte</u> alla [$_{VP}$ på kinden]].
I [$_{I'}$ kissed them not all [$_{VP}$ on the.cheek]]

As these examples involve V2 clauses, naturally such adverbials have to be at least in third position within the clause. In fact, once the V2 requirement is removed, these adverbials can precede the subject. The examples in (6) from Holmberg (1993) (see also Holmberg and Platzack (1995)) show that in a non-V2 embedded clause, a sentential adverb can appear anywhere within the IP domain, but cannot appear within VP.[1]

(6) a. att (möjligen) Johan (möjligen) [$_{VP}$ köpte (*möjligen) en bok]
that (possibly) Johan (possibly) [$_{VP}$ bought (*possibly) a book]

b. att (inte) Johan (inte) [$_{VP}$ gillar (*inte) prinsesstårta]
that (not) Johan (not) [$_{VP}$ likes (*not) princess cake]

Finally, in a V2 clause, any adverb, including negation, can be placed in the initial position, which is SpecCP.

(7) Inte var det Selma.
not was it Selma
'It was NOT Selma.'

The unmarked position for negation is in the medial position, just to the left of VP, as shown in (1), though positions higher in the FP projections (IP and CP) are also possible, as the examples here have shown.

1.3. Negative Quantifiers

The Scandinavian languages have a set of negative quantifiers which intuitively alternate with or replace a sequence of negation and a negative polarity indefinite pronoun (as schematized in (8)). Each word has forms which vary by gender and number, for example *ingen* ('N'-gender, singular), *inget* ('T'-gender, singular), *inga* (plural).

(8) a. The negative quantifier *ingen* ('no(one)')
alternates with *inte* ... *någon* ('not ... any(one)').

b. The negative quantifier *ingenting* ('nothing)'
alternates with *inte* ... *någonting* ('not ... anything').

Some simple Swedish examples (after Holmes and Hinchliffe (1994, 198)) are shown in (9)–(10). Note that, compared to English, (10)a/c are surprisingly ungrammatical.

(9) a. Ingen såg mig.
noone saw me

b. Jag såg ingen.
I saw noone

[1] Faarlund et al. (1997, 890ff.) cite the pre-subject position as the unmarked position for embedded clause negation in Norwegian.

(10) a. *Jag har sett ingen.
I have seen noone

b. Jag har inte sett någon.
I have not seen anyone

c. *Jag pratade med ingen.
I spoke with noone.

d. Jag pratade inte med någon.
I spoke not with anyone.

These examples contain either a negative quantifier or a negative polarity indefinite in construction with negation. I will use 'NegQP' to refer to both the quantifier and the containing noun phrase. The first main theoretical discussion of these elements and their distribution is in Christensen (1986), which is mostly about Norwegian, but the other Mainland Scandinavian languages show similiar behavior. Christensen shows that the NegQPs can appear in the surface position of negation, or in front of that position; but they can appear no further back in the sentence than the position where negation would (or perhaps, could) appear. Platzack (1998) updates this analysis by suggesting that both *inte* and negative quantifiers are in SpecNegP, located above VP. Kayne (1998) also develops the idea the object negative quantifiers move out of the VP to SpecNegP. As the surface position of a negative quantifier cannot be further back than the expected position of negation, the examples in (9) allow *ingen*, while the grammatical examples in (10) have *någon*, as the surface position of the object with a finite auxiliary and main verb is after the surface position of negation, as is the position of a prepositional object in (10)c–d. Note that in (9)b, the finite verb is in I, so the following *ingen* need not be within VP.

In addition to being in the subject position as in (9)a, NegQPs can also be in 'topic' position; in fact, topicalizing a NegQP object from its position in ungrammatical examples like those in (10) leads to grammatical examples: even though (10)a/c are ungrammatical, the examples in (11) are fully grammatical.

(11) a. Inga romaner läser Jon ut.
no novels reads John out

b. Inga romaner har jag läst.
no novels have I read

c. Inga romaner berättade han om.
no novels told he about

The relation of the topic to its argument position can involve a true long-distance dependency. (12)a illustrates this with a Norwegian example from Christensen and Taraldsen (1989, 72); note that the medial or final positioning of the NegQP in (12) is ungrammatical.

(12) a. Ingen bøker har Jens prøvd å lese. Nor.
no books has Jens tried to read

b. *Jens har ingen bøker prøvd å lese. Nor.
Jens has no books tried to read

c. *Jens har prøvd å lese ingen bøker. Nor.
Jens has tried to read no books

Based on these examples, the distribution of NegQPs can be stated as follows: they may appear in initial position in any kind of V2 clause; beyond that they may naturally follow the finite verb only if the finite verb is the main verb and hence is in I or C. Putting this in more technical terms, we can state it as in (13):

(13) a. A NegQP may be a TOPIC, in SpecCP (as in (11)).

b. A NegQP may be a SUBJ, in SpecIP (as in (9a)).

c. A NegQP may be an OBJ (9b), but it cannot appear within VP (hence (10) requires *någon*).

In fact, there is a very simple abstraction over these generalizations, including the negative *inte*: negative elements cannot appear within VP. The data that follow will show the correctness of these generalizations, though the claim that the object in (9)b is not within VP needs to be properly substantiated.

For completeness, I will mention here that there are 3 expressions of negative quantification in Swedish, as outlined in (14):

(14) The expression of negative quantification:

a. as a NegQP like *ingen*

b. as a sequence of clausal negation and a negative polarity indefinite *inte* ... *någon*

c. as a constituent with negation negating a negative polarity indefinite [*inte någon*]

The focus in this paper is on the distribution of the type (a) expression. The type (b) expression is grammatical as long as *inte* c-commands/precedes the indefinite. The type (c) expression is always grammatical, but sometimes has a narrow scope constituent negation interpretation, rather than always expressing clausal negation. However, the existence of the type (c) expression has an important consequence for the way the relation between the f-structure and c-structure is handled here, discussed below regarding (35).

2. The Distribution of NegQPs

2.1. NegQPs are External to VP

It is in fact not entirely straightforward to show that an object NegQP appears external to VP, for in its surface position it actually follows most medial adverbs, as illustrated with *ju* and *ofta* below. Only the orders of medial elements shown here are grammatical.

(15) a. Man förstår ju <u>ingenting</u>.
one understands as.you.know nothing

b. Hon hade ofta <u>ingenting</u> sagt.
she had often nothing said

c. Hon påstod att hon ofta <u>ingenting</u> hade sagt.
she claimed that she often nothing had said

These data show that the NegQP is not in the surface position of object shifted pronouns, for these canonically precede all medial adverbs (see (3)b), and in fact (15)b/c would be ungrammatical if the negative object were replaced by a pronominal object. Naturally, the relative position of the negative adverb *inte* and a NegQP cannot be determined, but the evidence suggests that the NegQP is under I′, as a left sister of VP, in the same hierarchical position as the negative adverb *inte*. This part of Christensen's analysis, that *inte* and an object NegQP are roughly in the same position, seems to be correct; Platzack (1998) effectively updates this analysis by putting both elements in SpecNegP (where NegP has a null negative head).

Yet, on the basis of the examples in (15), it could be argued that a VP-external position for NegQP has not yet been motivated, and the fact that a NegQP follows all medial adverbs could be taken as counter-evidence, to the effect that the NegQP is actually within VP, at its left edge.

There is other evidence that shows more clearly that the NegQP in the grammatical examples is external to VP—that it really is effectively in the same position as a medial adverbial, following the finite verb in I but preceding VP. One strong argument is that if there is more than one auxiliary, the NegQP can only appear right after the finite auxiliary: (16)a is grammatical and (16)b is not.

(16) a. Jag skulle <u>ingenting</u> ha sett ändå.
I should nothing have seen nevertheless

b. *Jag skulle ha <u>ingenting</u> sett ändå.
I should have nothing seen nevertheless

The reason that (16)b is ungrammatical is that it forces the NegQP to be placed within VP (internal to the VP headed by *ha*), and this is clearly not tolerated. The alternate account, that the NegQP is at the left edge of VP, would have to stipulate that a NegQP can only be at the left edge of the highest VP, to account for the contrast in the examples.

Although the positioning of NegQPs is different from that of shifted objects ((15)b/c and (16)a are ungrammatical with pronominal objects), the two phenomena interact. The two bare objects of a ditransitive verb in Swedish come in the order Goal–Theme and are usually referred to as the IO and DO respectively. If the NegQP is the DO, the only grammatical examples involve a pronominal (and preceding) IO, which allows a surface analysis in which both objects are external to VP.

(17) a. Jag lånade dig inga pengar.
I lent you no money (*dig* can shift to be outside VP)

b. *Jag lånade Sven inga pengar.
I lent Sven no money (*Sven* must be in VP)

c. Jag lånade inte Sven några pengar.
I lent not Sven any money

(18) a. Jag gav honom ingenting.
I gave him nothing (*honom* can shift to be outside VP)

b. *Jag gav Elsa ingenting.
I gave Elsa nothing (*Elsa* must be in VP)

c. Jag gav inte Elsa någonting.
I gave not Elsa anything

The b examples are key: they are ungrammatical, and as non-pronominal objects (proper names here) cannot be shifted out of VP, the following NegQPs are necessarily within VP. The contrasting acceptability of the a examples shows that there must be no VP containing the NegQPs, and this is possible if the pronominal IOs have undergone Object Shift, thereby allowing the NegQPs to appear external to VP too.[2]

Now consider (19) from Teleman et al. (1999, vol. 2, p. 432):

(19) Hon hade inga biljetter köpt.
he had no tickets bought

Here *köpt* heads VP, and so the NegQP either precedes that head in VP, or is external to VP. The former possibility is unlikely, as Swedish does not allow anything to precede a non-finite verb in VP. This is why the lowest placement of *alla* in (20), from Holmberg (1999), is ungrammatical.

(20) Jag undrar varför studenterna inte (alla) har (*alla) åkt till Lund.
I wonder why the.students not (all) have (*all) gone to Lund

Hence there are 3 pieces of evidence that NegQPs are external to VP, and not left-periperheral within VP.

2.2. Problem Examples

In a transformational approach, there are some similarities about the surface positioning of pronominal objects and of NegQPs which suggest similar derivations—essentially, both involve moving an object forward from its base position, out of VP. Pronominal Object Shift is subject to some surface constraints usually referred to as 'Holmberg's Generalization', following the pioneering work of Holmberg (1986). Conceived of as a process, Object Shift cannot apply to an object if there is any overt material (a verb, a particle, or another object) within the VP to the left of the position of the potentially shifting object (see Holmberg (1997), Holmberg (1999)). In an analysis which directly moves a NegQP subject to Holmberg's Generalization, examples like (15)b/c and (16)a violate Holmberg's Generalization, for the NegQP has moved over an overt VP-internal verbal material. Such examples suggest that Holmberg's Generalization is irrelevant to the distribution of NegQPs.

However, the idea that NegQPs move and are subject to Holmberg's Generalization is apparently seen in the difference between Swedish and Norwegian when there is a particle in VP. In contrast to (21)a, which is good (in Norwegian), the Swedish examples in b and c are both ungrammatical, and only the periphrastic expression in d is possible, with the negative polarity determiner *några* (examples from Christensen (1986)).

(21) a. Jon leser ingen romaner ut. Nor.
John reads no novels out
'John finishes reading no novels.'

b. *Jon läser inga romaner ut. Swe.
John reads no novels out

c. *Jon läser ut inga romaner. Swe.
John reads out no novels

d. Jon läser inte ut några romaner. Swe.
John reads not out any novels

[2] See also Jónsson (1996) for similar arguments from Icelandic.

The contrast between a and b is directly attributable to Holmberg's Generalization; an object may precede a particle in VP in Norwegian, and so it may undergo Object Shift, if we allow that a NegQP phrase such as *ingen romaner* can undergo Object Shift. Replacing the NegQP in each example by an object pronoun would preserve grammaticality. In Swedish, an object must normally follow a particle, and hence that object must be in VP. From this point of view, example c has the right phrase structure, but it violates the condition that NegQPs cannot appear within VP. Hence only the periphrastic expression in d is grammatical.

Nothing in the present proposal accounts for the contrast in (21)a/b, and I leave it as an open problem. However, it is worth noting that a medial NegQP with a following non-finite verb form is much more acceptable than a following simple particle:[3]

(22) a. ?Jon har inga romaner läst ut.
John has no novels read out

b. *Jon läste inga romaner ut.
John read no novels out

In terms of Holmberg's Generalization, example a represents a greater violation than b does, but a is clearly more acceptable. Hence it seems unlikely that the account of (21)b is due to Holmberg's Generalization, for in many other grammatical examples it is clearly violated.[4]

2.3. The Distribution of NegQPs Does Not Involve Movement

Returning to the analysis of Christensen (1986), her proposal is that the distribution of NegQPs is captured by a transformation which turns an adjacent sequence of *inte* and a negative polarity item into the corresponding NegQP. This transformation applies in two cases: first, if the two items which need to be adjacent happen to be adjacent in the string, as in the case of *inte* and an immediately following negative polarity object, and second, if the negative polarity element is a subject or topic which precedes *inte*, in which case *inte* moves up to cliticize to it, and then the NegQP transformation applies. This is illustrated in (23):

(23) a. Jag såg inte någon. ⟹ Jag såg ingen. (= (9b))
I saw not anyone I saw noone

b. Någon såg inte mig. ⟹ Någon-inte såg mig. ⟹ Ingen såg mig. (= (9a))
anyone saw not me anyone-not saw me noone saw me

c. Jag har inte sett någon. (no change, = (10b))
I have not seen anyone

Christensen's account will only account for some of the examples seen so far; and, for example, the transformation would not apply in (24)a, as *inte* and *någonting* are not adjacent, and *någonting* does not precede *inte*.

(24) a. Hon har inte sett någonting.
she has not seen anything

[3] My thanks to Benjamin Lyngfelt for this observation.
[4] I do not mean in any way here to deny the robustness of Holmberg's Generalization with regard to Object Shift.

b. Hon har ingenting sett.
she has nothing seen

Now while (24)a is acceptable, so is (24)b, at least in colloquial Swedish. Christensen's analysis cannot generate (24)b, as *inte* and *någonting* are not adjacent, and only *inte* is allowed to raise up. (15)b/c, (16)a, and (19) also have this property.

Similar facts are shown in (25). The a example is ungrammatical as the NegQP phrase is inside VP, but b is relatively acceptable in colloquial registers (if disfavored in prescriptive grammars, and not quite as acceptable as (24)b).

(25) a. *Jag har läst inga romaner.
I have read no books

b. ?Jag har inga romaner läst.
I have no books read

A natural update of Christensen's analysis is to say that the NegQP starts out in structures like (25)a and moves to SpecNegP, its position in (25)b, to the left of VP. Setting aside the problem the apparent violations of Holmberg's Generalization,[5] this account accounts for the problematic examples discussed so far in this section.

However, for oblique objects, the fact that topicalization of a NegQP is grammatical while medial positioning of it is not (as shown again in (26) below) argues very strongly against a derivational analysis and for a representational analysis of the NegQP phenomenon. Recent derivational approaches are found in Jónsson (1996), Kayne (1998), and Platzack (1998), who claim that negative *inte* is in SpecNegP, the medial position just external to VP, and that NegQPs overtly raise from a VP-internal argument position to SpecNegP. This amounts to a 'positive' licensing condition on negative elements—at some point in the derivation, they must be in SpecNegP. Assuming that all arguments orginate with VP, an argument expressed by a NegQP would first raise to SpecNegP, to be licensed, and then may move on further up if it is a subject or a topic. This would account for the distribution of NegQPs as described in (13), except that it involves a contradiction under a derivational approach.[6] Let us consider the examples in (26). The contradiction for the derivational approach is that the first derivational step for (26)d is impossible: a NegQP phrase cannot move from its base object position to the medial position (SpecNegP, by assumption here). Yet this step (from b to c in (26)) is crucial in the licensing of the NegQP.

(26) a. Jon har inte berättat om några romaner.
John has not told about any novels

b. *Jon har berättat om inga romaner.
John has told about no novels

c. *Jon har inga romaner berättat om.
John has no novels told about

d. Inga romaner har Jon berättat om.
No novels has John told about

[5]This problem is noted in e.g., Kayne (1998, 132, fn. 5).
[6]This is discussed in part as a case of improper movement in the analysis of Jónsson (1996).

There are two separate but related facts about the distribution of NegQPs: (i) in the medial position, only objects (non-obliques) are licensed, and hence c is bad; and (ii), in the initial position, any topicalizable phrase is licensed. Hence, the medial position is rather restricted compared to the initial position, but as the NegP analysis necessarily assumes that all movements must pass through the medial position, it cannot account for the acceptability of examples like (26)d.

So far then, the distribution of negative elements is clear: they cannot be within the surface VP, and the function they have in the clause is entirely determined by their surface position. These are fully representational generalizations which at best are unexpected and at worst inexpressible in a derivational approach.

3. The Distribution of Negative Elements in LFG

The LFG analysis has two parts: first, the possibilities for generating objects external to VP, and second, the association of sentential negative scope with morphologically negative elements.

3.1. Structure-Function Associations

Even when a NegQP corresponds to a clausal object, as in (24)b and (25)b, it appears in the same position as the negative adverb, external to VP (in the same place as Neg in (1)). This medial positioning for NPs is restricted to (in)direct objects: hence the key contrast between (26)c and (24)b, for in the former the medial NegQP correponds to an oblique's object, not a clausal object. However, topicalizing such an oblique's object, as in (26)d, is fully grammatical, and the NegQP is correctly external to VP. The contrast between the c and d examples in (26) is a consequence of the structure-function association principles: for arguments, the medial position in c can only be associated with (in)direct objects, while the initial topic position in d can be associated with any clause-internal function, and may potentially be a long-distance dependency.

The LFG principles of structure-function annotation for Swedish should conform to the descriptions in (27).

(27) a. SpecCP expresses a DF (TOP or FOC), and associates that DF with any clausal GF via $(\uparrow \text{GF}^{+}) =\downarrow$.

b. Within IP, only direct functions (SUBJ, IOBJ, OBJ) are assigned. SpecIP only expresses the SUBJ. Object functions appear within I′, either in the object position 'Pro' adjoined to I or as a NegQ in the medial position.

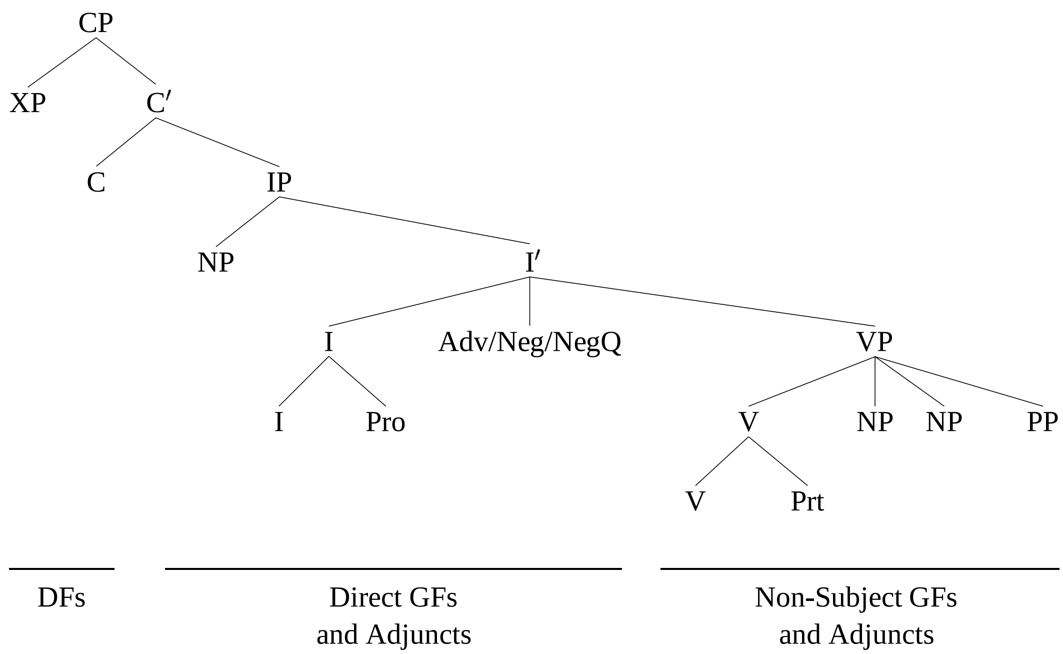
c. Within VP, only non-subject GFs are assigned.

We can think of these in a slightly different way: in the Swedish clause, only direct (argument) functions are possible in the immediate IP projection, and there is a subject $>$ object hierarchical asymmetry, in that subject is structurally higher than object. Hence, subject can never be lower than I′, and a (non-DF) object can never be higher than I′.

As such, these principles would allow objects freely inside or outside VP; however, the only VP-external objects that Swedish allows are shifted pronominals or NegQPs. Although I will not build it into the analysis, the right insight for this situation seems to be that objects are normally within VP, and that only under certain circumstances are they external—specifically, only when they can be X^0 pronominal objects, or when the dictates of sentential scope force NegQPs to be VP-external (see below).

The positions for expression of functions in Swedish is summarized in (28).

(28)



3.2. Scope

The adverb *inte* may appear inside various constituents, but when it does it expresses constituent negation. In fact, the real generalization is that a negative element cannot take clausal scope out of VP, to get a sentential negation reading. As noted by Svenonius (1998), (29) is grammatical, even though *ingenting* is within VP. The example is grammatical as a case of double negation with narrow scope for *ingenting* (it must have narrow scope as it is within VP).

(29) Ingen har gjort ingenting.
noone has done nothing = ‘Everyone has done something.’

Here, a negative concord reading would have a different interpretation, ‘It is not the case that anyone has done anything’, which is effectively ‘No one has done anything’. (30) does not have this interpretation. The following examples, from Teleman et al. (1999, vol. 4, p. 201), illustrate the same point:[7]

(30) a. Inte bara de yngre har ingenting att göra.
not only the younger have nothing to do
‘It is not only the younger (people) who have nothing to do.’

b. Inga svenskar går väl aldrig i kyrkan.
no Swedes go ?? never to church
‘For no Swedes is it true that they never go to church.’

These are again double negative interpretations; the negative concord interpretations would be ‘It is not only the younger who have anything (something) to do’ and ‘It is not true that there are Swedes who ever go to church’. Consequently, we need to account for the following distributions of forms and interpretations:

[7] I am not sure how to translate *väl* in (30)b.

(31) a. The negative adverb *inte* takes sentential scope when it is generated within the IP or CP projection; it cannot be directly dominated by VP. If generated within a smaller constituent (NP, PP, etc.), it may indicate constituent negation or clausal negation, depending on the position of the containing constituent (see (35)).

b. A NegQP takes sentential scope only if generated external to VP. If generated within VP, it takes narrow scope under another negation.

So, the right analysis is not a matter of simply dictating the c-structure distribution of negative elements; rather it is a matter of assigning constituent or clausal negation relative to the c-structure position of the negative element(s).

3.3. Mechanisms

The key to capturing the generalizations above about NegQPs is to consider the relation between the morphological features and the syntactic features. What we know is that a NegQP that is subject or object and external to VP actually negates the whole clause; when it is VP-internal, this is not possible. Nevertheless, a VP-internal NegQP still has (narrow scope) negative force. As noted above, this means that we have two cases: one, where each element with negative form is interpreted as narrow negation on that constituent, and two, where an element with negative form constributes clausal negation. It is this latter case that is restricted to VP-external positions in Swedish.

It will be useful to think of what kind of analysis we need in terms of a (partial) typology of negation types in (33); recall that FP covers IP and CP. First, I define a predicate 'contained-in', to help express the generalizations.

(32) 'Contained-in': α is contained-in βP iff α is immediately dominated by a node of category β.

(33) A Partial Typology of Negation Types

Assuming that *not* etc. expresses an ADJ(unct) function, negation of the clause is expressed <u>within</u> a GF of that clause.

a. English: any negative argument, or *not* at the clausal level, can license sentential negation.

b. Swedish: only a negative argument contained-in FP, or *inte* contained-in FP, can license sentential negation.

Following Frank and Zaenen (1998) and Spencer and Sadler (1999), I take it that morphological expression is projected from f-structure information: there are principles of morphological expression of the f-structure attributes and values (see also Ackerman and Webelhuth (1998)). I assume that sentential scope for negation is indicated by [NEG +] in the clausal f-structure, and that this information is projected into morphological information according to the principles in (34). Following Spencer and Sadler (1999), I represent c-structure information using capitalized lowercase words for names and a colon separating a feature from its value.

(34) Negative Syntactic and Morphological Features:

Let f_i be an f-structure and c_i be the set of corresponding c-structure nodes, by the reverse mapping ϕ^{-1}. Each c-structure node is a set of attribute-value pairs.

a. Constituent Negation
[NEG +]$_i \Longrightarrow c_j$ has [NegForm:+], where c_j occurs anywhere in the clause, and $c_j \in c_i$.

b. Clausal Negation
$\begin{bmatrix} \text{NEG} & + \\ \text{GF} & [\ ]_j \end{bmatrix}_i \Longrightarrow c_k$ has [NegForm:+], where c_k does not occur within VP, and $c_k \in c_j$.

The first part just says that a negative form in the c-structure can express semantic negation of that constituent. The second part says that certain negative forms in the c-structure can express clausal negation. English is the same as Swedish, except it lacks the external-to-VP restriction in (34)b.

There are various reasons to adopt this kind of constructional approach, rather than simply annotating each negative element with a defining equation $(\uparrow \text{NEG})$=+. First, a NegQP like *ingen* does not normally negate its own constituent, but rather, it negates the clause containing it. So instantiating [NEG +] within the f-structure corresponding to the NegQP itself has little use.

Second, it might be argued that at least the negation *inte* should carry $(\uparrow \text{NEG})$=+, and if analyzed as a co-head, directly negate the clause nucleus. However, this leads to a loss of generality: in (35), *inte* is constituent-internal, yet the whole negative constituent provides clausal negation, as that constituent is VP-external. Again, setting things up so that the SUBJ itself has [NEG +] is not of any obvious use.

(35) [Inte någon elev] har underrättats.
[not any pupil] has inform.PASS
'No pupil has been informed.'

Additionally, there are two arguments that come from negative concord languages for the approach here. Under the standard defining equation approach, such languages would have to have a different analysis from a language like English, for arguably a negative form does not necessarily contribute [NEG +] in such languages. In the approach here, NegQPs in negative concord languages will have more information in their lexical entries compared to NegQPs in multiple negation languages like English and Swedish, but the information is not qualitatively different (see section 4.2 below). Finally, in that section there is also a theory-internal argument against the defining equation approach.

Let us now consider some simple examples to see how the interpretation is expressed constructionally.

(36)	a.	Ingen såg mig. noone saw me	(34)b is satisfied: [NEG +] at the clausal level corresponds to [NegForm:+] on a constituent external to VP.
	b.	Jag såg ingen. I saw noone	(34)b is satisfied: [NEG +] at the clausal level corresponds to [NegForm:+] on a constituent external to VP.
(37)	a.	*Jag pratade med ingen. I spoke with noone.	(34)b is not satisfied: [NEG +] at the clausal level does not correspond to [NegForm:+] on a constituent external to VP.
	b.	Jag pratade inte med någon. I spoke not with anyone.	(34)b is satisfied: [NEG +] at the clausal level corresponds to [NegForm:+] on a constituent (*inte*) which is external to VP.

(38) a. Inga romaner har jag läst.
no novels have I read

Assuming the DF of *inga romaner* to be FOC, (34)b is satisfied: [NEG +] at the clausal level corresponds to [NegForm:+] on a constituent which is external to VP. The identification of FOC with OBJ in the f-structure in an independent fact.

b. Inga romaner berättade han om.
no novels told he about

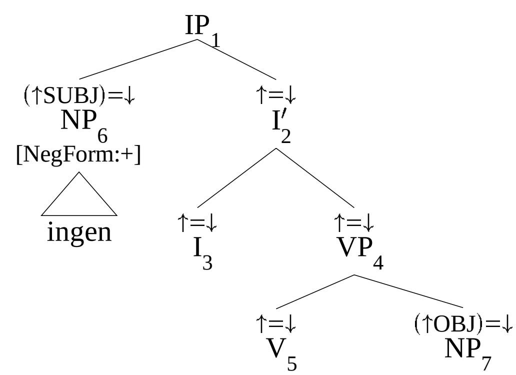
Assuming the DF of *inga romaner* to be FOC, (34)b is satisfied: [NEG +] at the clausal level corresponds to [NegForm:+] on a constituent which is external to VP. The identification of FOC with OBL OBJ in the f-structure in an independent fact.

To get at the parts of the c-structure that we are interested in, we need to pick out a c-structure node, and its mother's category. Then, for example, we can find just those parts of a c-structure that are part of the IP projection (whose category is I). Effectively, we consider different projections of the same information, into the f-structure parts and c-structure parts, perhaps along the lines of Andrews and Manning (1999). I will not try to present a fully formal account here, but will try to show explicitly what needs to be formally expressed.

Consider the schematic pair of structures in (39), using *ingen* 'noone' to illustrate, where I assume that this has [NegForm:+] and the semantics of 'a person'.

(39)

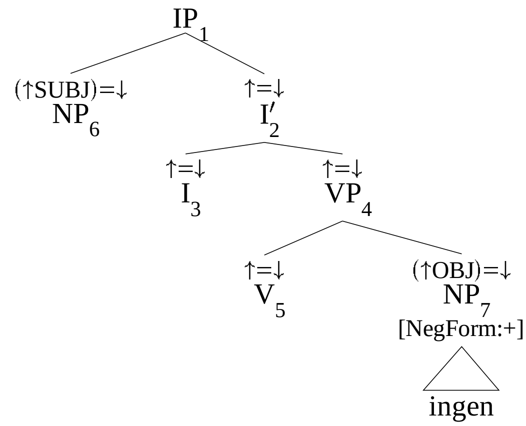
$$\begin{bmatrix} \text{PRED} & \text{`\ldots'} \\ \text{GF}_6 & \begin{bmatrix} \text{PRED} & \text{`a person'} \end{bmatrix} \\ \text{GF}_7 & \begin{bmatrix} \text{PRED} & \text{`\ldots'} \end{bmatrix} \\ \text{NEG} & + \end{bmatrix}_{1,2,3,4,5}$$



Here, GF_6 is mapped back to NP_6, and GF_7 to NP_7. By (34)b, (39) is well-formed in Swedish, with the NegQP in the subject position expressing clausal negation. In contrast, (40) is not a well-formed pair in Swedish, though it would be in English.

(40)

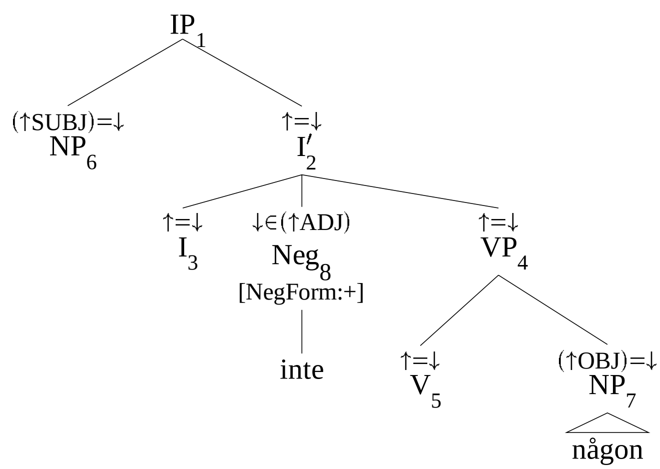
$$\begin{bmatrix} \text{PRED} & \text{`\ldots'} \\ \text{GF}_6 & [\text{PRED} \quad \text{`\ldots'}] \\ \text{GF}_7 & [\text{PRED} \quad \text{`a person'}] \\ \text{NEG} & + \end{bmatrix}_{1,2,3,4,5}$$



Here, (34)b is not satisfied, as the [NegForm:+] constituent is contained-in VP. To express the structure where x_7 is an indefinite quantifier, it is necessary to have *inte* in construction with an indefinite like *någon*. To be parallel with the analysis of arguments, I treat negation as being inside a GF, namely ADJ, though this raises a technical question as to what the nature of the PRED of that GF is. Assuming this problem can be solved, the pair in (41) is well-formed.[8]

(41)

$$\begin{bmatrix} \text{PRED} & \text{`\ldots'} \\ \text{GF}_6 & [\text{PRED} \quad \text{`\ldots'}] \\ \text{GF}_7 & [\text{PRED} \quad \text{`a person'}] \\ \text{ADJ}_8 & [\text{PRED} \quad ??] \\ \text{NEG} & + \end{bmatrix}_{1,2,3,4,5}$$



4. Prospects

I will briefly consider the theoretical differences between multiple negation and negative concord languages that the analysis above leads us to postulate.

4.1. Multiple Negation Languages

As there can only be one instantiation of [NEG +] in each f-structure nucleus, an example with more than one negative element in it must have a schematic f-structure like that in (42), with a negative element in the c-structure corresponding to each [NEG +].

[8] It would be possible to treat negation as a co-head, in which case the clause itself would effectively have [NegForm:+], and then (34)a would apply. In itself, this analysis would work, but would not limit the distribution of negation to VP-external positions.

(42) $$\begin{bmatrix} \text{PRED} & \text{‘...’} \\ \text{GF} & \begin{bmatrix} \text{PRED} & \text{‘...’} \\ \text{NEG} & + \end{bmatrix} \\ \ldots & \ldots \\ \text{NEG} & + \end{bmatrix}$$

There is a strict match between the number of semantic occurrences of [NEG +] and the number of constituents with [NegForm:+] expressing those occurrences. This gives rise to multiple negation in the relevant languages. Perhaps surprisingly, we will see below that a negative concord language like Italian also shows this strict matching, in a restricted domain.

4.2. Negative Concord Languages

In negative concord languages, certain expressions of negation actually license clausal negation, while other occurrences of negative quantifiers do not license or express negation, but need to find themselves in the presence of a ‘real’ negation. In LFG, this can be expressed by associating a constraining equation with them:

(43) Negative concord quantifiers: (GF $\uparrow$) NEG $=_c$+

This says that a negative quantifier must be in a containing nucleus where [NEG +] is licensed.[9] In fact, due to this, there will be never be a way to express an f-structure like (42) in a negative concord language; in particular, there will never be a way to express constituent negation, for by (43) the quantifier requires [NEG +] not in its own f-structure but in the containing f-structure.

Perhaps surprisingly, the negative licensing conditions in a negative concord language like Italian are essentially the same as the licensing conditions in Swedish. In Italian, true negation is expressed by a negative element contained-in IP, but VP-internal negative quantifiers are only concordial, and need a true negation licensed from the IP domain. Consider the data in (44), from Ladusaw (1992):

(44) a. Nessuno ha visto Mario.
noone has seen Mario

b. *Nessuno non ha visto Mario.
noone not has seen Mario

c. *Mario ha visto nessuno.
Mario has seen noone

d. Mario non ha visto nessuno
Mario not has seen noone

e. Nessuno ha visto nessuno.
noone has seen noone

[9]True negative polarity items would have a similar constraining equation, but would lack the morphological specification [NegForm:+]. The account here is somewhat idealized, as negative concord quantifiers in Italian are licensed in a variety of downward-entailing contexts, of which overtly expressed negation is just one.

The constraints on negative expression are clearly c-structural: although the subject in (44)a can express negation without *non*, and in fact necessarily without *non*, a postposed subject in the VP requires *non*, as in (45).

(45) Non ha telefonato nessuno.
not has telephoned noone

Let us consider (44)a. There is [NEG +] in the clausal nucleus. Assuming the same licensing conditions for Swedish, there should be a [NegForm:+] constituent contained-in IP, and there is, *nessuno*. *nessuno* itself has a constraining equation, namely (43), and this is satisfied. Hence, the example is grammatical. In this way the analysis captures the insight that Ladusaw (1992, 251ff.) argues is important in negative concord languages: that in such a position, *nessuno* both expresses the negation and simultaneously checks for negation. Note that this analysis is formally inexpressible in a defining equation approach: it would be theoretically meaningless for a lexical item to both define and constrain an attribute and its value.

Returning to the examples, (44)c is ungrammatical, as there is no legitimate expression of the [NEG +] in the clause nucleus. Adding in *non*, as in (44)d, provides the expression of [NEG +]. As *non* has the properties of a preverbal clitic, and as it seems to provide true negation when present, we could analyze as a carrier of [NEG +], adjoined to the verb and annotated $\uparrow=\downarrow$.

(46) Italian clausal negation

non: $(\uparrow \text{NEG})$=+, [NegForm:+]

This provides [NEG +] directly to the clausal f-structure, and effectively [NEG +] is licensed as a case of constituent negation, by (34)a.

The ungrammaticality of (44)b is also instructive, for it shows that the language cannot tolerate two 'real' negations: according to (46), *non* expresses a real negation, and by (34)b, *nessuno* in the subject position does too. Hence the one-to-one relation between meanings and expressions seen above for English and Swedish also shows up in this restricted context in Italian.

Finally, the parallels with Swedish are even greater when we consider the constrast in (47), examples from Rizzi (1982):

(47) a. Mario non ha parlato con nessuno.
Mario not has spoken with noone

b. Con nessuno ho parlato!
with noone I-have spoken

Within VP, the PP *con nessuno* requires a licensing *non*, but when it is topicalized—one cannot tell whether it is adjoined to IP or contained-in CP—*con nessuno* needs no other licensing element.

Although somewhat sketchy, I think this section shows how the overall approach here can correctly analyze the expression of negation at the same time as allowing for the constraining effects of negative concordial elements. Further issues to be given a more detailed account include the percolation of [NegForm] features in a PP like *con nessuno* above, the constraining of clausal negation from phrases with embedded quantifiers such as *the mother of noone*,[10] which suggests that (43) should be modified, and, a better characterization of exactly what attribute it is that (43) is constraining for.

[10] Thanks to Ivan Sag for this observation.

5. Conclusion

I have argued for several related points: first, that Swedish negation is restricted in terms of which interpretations are possible from which c-structure positions, regardless of the grammatical function of the negative element itself. Second, I noted that the irrelevance of the grammatical function effectively forms a strong argument against a derivational approach to the statement of constraints on the distribution of negative forms. Third, I argued that a constructional approach to the expression of negation provides the simplest and most general analysis, and fourth, that the approach extends to negative concord languages, an extension that would be impossible under a standard defining equation approach.

The analysis here gives up the idea from standard LFG that the f-structure is fully described by defining equations in the c-structure, in favor of a kind of correspondence model, as is implicit in the arrows in (34). This revised view of LFG has been argued for on other empirical grounds by Ackerman and Webelhuth (1998) and Spencer and Sadler (1999), and it accords well with the Optimality Theoretic instantiations of LFG, in particular the model in Kuhn (2000).

References

Ackerman, Farrell, and Gert Webelhuth. 1998. *A Theory of Predicates*. Stanford, CSLI Publications.

Andrews, Avery, and Chris Manning. 1999. *Complex Predicates and Information Spreading in LFG*. Stanford, CSLI Publications.

Christensen, Kirsti Koch. 1986. Norwegian *ingen*: A case of post-syntactic lexicalization. In Östen Dahl and Anders Holmberg (eds.), *Scandinavian Syntax*, 21–35. University of Stockholm, Institute of Linguistics.

Christensen, Kirsti Koch, and Knut Tarald Taraldsen. 1989. Expletive chain formation and past participle agreement in Scandinavian dialects. In Paola Benincà (ed.), *Dialect Variation and the Theory of Grammar*, 53–83. Dordrecht, Foris Publications.

Faarlund, Jan Terje, Svien Lie, and Kjell Ivar Vannebo. 1997. *Norsk referanse-grammatikk.* Oslo, Universitetsforlaget.

Frank, Anette, and Annie Zaenen. 1998. Tense in LFG: Syntax and morphology. Ms. Xerox Research Centre Europe.

Holmberg, Anders. 1986. *Word Order and Syntactic Features in the Scandinavian Languages and English*. Stockholm, University of Stockholm, Department of Linguistics.

Holmberg, Anders. 1993. Two subject positions in IP in Mainland Scandinavian. *Working Papers in Scandinavian Syntax* 52, 29–41.

Holmberg, Anders. 1997. The true nature of Holmberg's generalization. In Kiyomi Kusumoto (ed.), *Proceedings of NELS 27*, 203–217. Amherst, GLSA.

Holmberg, Anders. 1999. Remarks on Holmberg's generalization. *Studia Linguistica* 53, 1–39.

Holmberg, Anders, and Christer Platzack. 1995. *The Role of Inflection in Scandinavian Syntax*. New York, Oxford University Press.

Holmes, Philip, and Ian Hinchliffe. 1994. *Swedish: A Comprehensive Grammar*. London and New York, Routledge.

Jónsson, Johannes Gísli. 1996. *Clausal Architecture and Case in Icelandic*. Doctoral dissertation, University of Massachusetts, Amherst.

Kayne, Richard S. 1998. Overt vs. covert movement. *Syntax* 1, 128–191.

Kuhn, Jonas. 2000. Two ways of formalizing OT syntax in the LFG framework. Ms. University of Stuttgart.

Ladusaw, William. 1992. Expressing negation. In Chris Barker and David Dowty (eds.), *Proceedings of the Second Conference on Semantics and Linguistic Theory*, 237–259. Columbus, Dept. of Linguistics, The Ohio State University.

Platzack, Christer. 1998. *Svenskans inre grammatik – det minimalistiska programmet.* Lund, Studentlitteratur.

Rizzi, Luigi. 1982. Negation, *wh*-movement and the null subject parameter. In *Issues in Italian Syntax*, 117–184. Dordrecht, Foris.

Spencer, Andrew, and Louisa Sadler. 1999. Syntax as an exponent of morphological features. Ms. University of Essex.

Svenonius, Peter. 1998. The expression of negation in Germanic. Handout, 14th Comparative Syntax Workshop, Lund.

Teleman, Ulf, Staffan Hellberg, and Erik Andersson. 1999. *Svenska Akademiens grammatik.* Stockholm, Svenska Akademien.