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Anette Frank
XRCE Grenoble

Syntax and Morphology of Tense in LFG

We look at a contrasting picture where some piece of functional/semantic information, namely TENSE, may be defined morphologically by tense inflection, or else compositionally in syntax (in conjunction with inflection on syntactic items). The question that is at issue is how to represent analytic tense formation to obtain a uniform functional structure for analytic and synthetic tense formation.

Several approaches have been proposed, which we briefly review, in particular two proposals which posit a new level of grammatical representation, morphological/morpho-syntactic (m-)structure, which represents morphosyntactic information in an attribute-value structure. It has been shown that this move can solve the problem of how to represent analytic and synthetic tense formation in a uniform way in f-structure (see Butt et al (1996) and Frank and Zaenen (1998,2000)). However, by positing a novel level of representation, m-structure, these proposals raise fundamental questions and issues.

Which are the criteria for the conceptual division between functional-syntactic and morpho-syntactic features? Is the particular way we set up the projection architecture compatible with data and phenomena that involve morphological processes in a variety of languages? Is an avm structure an appropriate representation format for morphological information (and processes)? Which kinds of morphological information/processes do we want to represent in this way? What about lexical integrity in such a scenario?

1 Synthetic and Analytic Tense Formation

Synthetic and analytic tense formation may contribute the same funtional/semantic information to f-structure: e.g. French *parla* (passé simple), *a parlé* (passé composé).

(1) a. Il parla.
b. Il a parlé.

Variation in synthetic vs. analytic tense formation also occurs across languages: e.g. synthetic future in French *tournera* vs. analytic future in German *wird drehen* and English *will turn*.

(2) a. The driver *will turn* the lever.
b. Der Fahrer *wird* den Hebel *drehen*.
c. Le conducteur *tournera* le levier.

Should these differences in morphological/syntactic form (synthetic vs. analytic) be reflected in f-structure? Do they represent distinctions in terms of functional information?

Following Bresnan(1995, 2000), King(1995), Schwarze(1996), Butt et al(1996), and others, who treat tense auxiliaries as non-pred-bearing elements, the distinction between analytic and synthetic tense formation should not be reflected in f-structure, but rather in c-structure. I.e. we aim at structurally identical f-structure representations for (2).

(3) a./b./c. ϕ
$$\begin{bmatrix} \text{PRED} & \text{'turn/drehen/tourner } \langle (\uparrow \text{SUBJ}) (\uparrow \text{OBJ}) \rangle \text{'} \\ \text{TENSE} & \text{FUT} \\ \text{SUBJ} & \begin{bmatrix} \text{PRED} & \text{'driver/Fahrer/conducteur'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \\ \text{SPEC} & \text{DEF} \end{bmatrix} \\ \text{OBJ} & \begin{bmatrix} \text{PRED} & \text{'lever/Hebel/levier'} \\ \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \\ \text{SPEC} & \text{DEF} \end{bmatrix} \end{bmatrix}$$

Structurally identical f–structures for English, German, French (2)

Yet, if the relevant morpho-syntactic information is not encoded in f-structure, how to define wellformedness constraints for the syntax and morphology of analytic tense forms?

(4) a. The driver will have turned the lever.
* The driver will *has turn* the lever.
b. Der Fahrer wird den Hebel gedreht haben.
* Der Fahrer wird den Hebel *drehen* haben.
c. Le conducteur aura tourné le levier.
* Le conducteur aura *tourner* le levier.

2 Possible approaches

1. Parameterized c-structure Defining wellformedness constraints for analytic tense formation via configurational constraints in parameterized c-structure rules.

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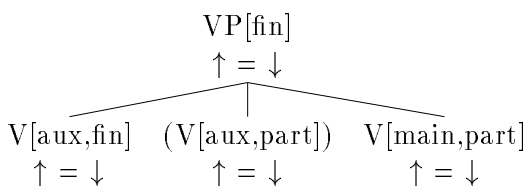


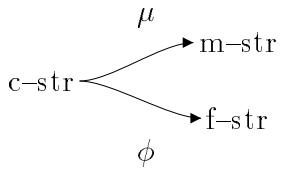
Parameterization of c-structure rules is a viable solution, but must – in some cases – be pushed quite far.

2. Representing morpho-syntactic features in an f-structure attribute MORPH

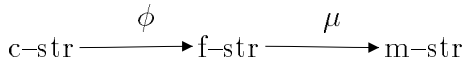
Introduce an (artificial?) f-structure feature MORPH (with recursive embedding) whose only purpose is to define wellformedness constraints for analytic tense formation in parsing. After parsing, MORPH can be pruned from the f-structure.

3. Positing a new representation level in projection architecture: m-structure

a. in a parallel projection architecture (Butt et al 1996)



b. in a sequenced projection architecture (Frank and Zaenen 1998, 2000)



More on ... 1. C-structure parameterization

Morphological features (VFORM = part, fin, inf or AUX = etre, avoir (or AUX = unacc, unerg)) are pushed into the c-structural part of grammar. They are not represented in the f-structure, to allow for uniform functional description of analytic/synthetic tense. Wellformedness constraints on analytic tense formation are encoded in appropriately constrained parameterized c-structure rules.

e.g. `VP[_fin] --> V[aux,_fin] (V[aux,part]) V[main,part].`

Looking at the French tense system, this strategy can be successfully applied, but leads to an overloaded c-structure if we want to capture the full variety of analytic tense formation: if the f-structure features VFORM, INF, FIN, PART, AUX and AUX-SELECT are eliminated from f-structure, not only verb type (aux,main) and verb form (part,fin,inf), but also auxiliary selection have to be encoded as c-structure parameters. Is this what we want?

```
VP[_fin] --> { V[aux,avoir,_fin] (V[aux,avoir,part]) V[main,avoir,part]
                     %a travaille, a eu travaille, * a ete travaille
             |V[aux,avoir,_fin] V[aux,etre,part] V[main,etre,part]
                     %a ete arrive, a ete fait (passive), * a eu fait
             |V[aux,etre,_fin] V[main,etre,part]
                     %est fait (passive) }
```

More on ... 2. Morpho-syntactic features in f-structure feature MORPH

Morpho-syntactic features are represented in f-structure, but set apart in a feature MORPH. The recursively embedded feature space in MORPH defines wellformedness constraints on analytic tense formation.
This allows for an otherwise uniform f-structure representation of analytic and synthetic tense. The (functionally irrelevant?) features can be pruned after parsing.

More on ... 3. M-structure as an independent level of representation

In contrast to (2.) this proposal involves a clear conceptual division between functional and morphological/morpho-syntactic(?) structure.

3.a Parallel m-/f-structure projection architecture (Butt et al 1996)

The parallel architecture of (Butt et al 1996) was specifically designed for the problem of synthetic/analytic tense formation. M-structure is genuinely used to get those features "out of the way" which are not parallel between languages, or which seem to be irrelevant at the functional level. The parallel m-structure is used to state wellformedness constraints on analytic tense formation in parsing.

(6) a. The driver will have turned the lever.
b. Der Fahrer wird den Hebel gedreht haben.
c. Le conducteur aura tourné le levier.

$$\phi\begin{bmatrix}\text{PRED} & \text{'turn/drehen/tourner } \langle\ (\uparrow \text{SUBJ})\ (\uparrow \text{OBJ})\ \rangle\text{'}\\ \text{TENSE} & \text{FUTPERF}\\ \text{SUBJ} & \begin{bmatrix}\text{PRED} & \text{'driver/Fahrer/conducteur'}\\ \text{GEND} & \text{MASC}\\ \text{NUM} & \text{SG}\\ \text{SPEC} & \text{DEF}\end{bmatrix}\\ \text{OBJ} & \begin{bmatrix}\text{PRED} & \text{'lever/Hebel/levier'}\\ \text{GEND} & \text{MASC}\\ \text{NUM} & \text{SG}\\ \text{SPEC} & \text{DEF}\end{bmatrix}\end{bmatrix}$$

Structurally identical f–structures for English, German, French

(7) a.–b.

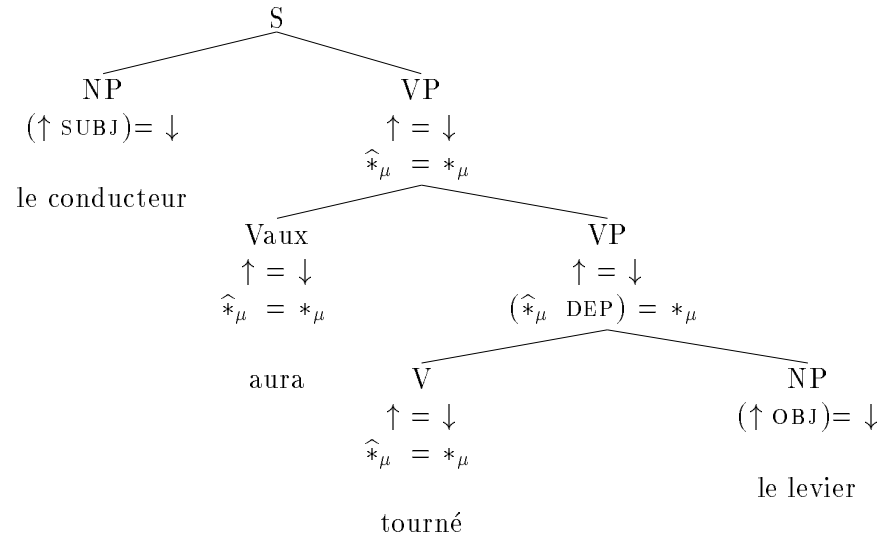
$$\mu\begin{bmatrix}\text{FIN} & +\\ \text{AUX} & +\\ \text{DEP} & \begin{bmatrix}\text{AUX} & +\\ \text{VFORM} & \text{BASE}\\ \text{DEP} & \begin{bmatrix}\text{AUX} & -\\ \text{VFORM} & \text{PERFP}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

c. $$\mu\begin{bmatrix}\text{FIN} & +\\ \text{AUX} & +\\ \text{DEP} & \begin{bmatrix}\text{AUX} & -\\ \text{VFORM} & \text{PERFP}\end{bmatrix}\end{bmatrix}$$

Structurally distinct m–structures for English, German (a./b.) vs. French (c.)

The technical details

(8)



(9)

Vaux: (↑ SUBJ NUM) = SG
(↑ SUBJ PERS) = 3
(↑ TENSE)= FUTPERF
$(\widehat{*}_\mu$ FIN)= +
$(\widehat{*}_\mu$ AUX)= +
$(\widehat{*}_\mu$ DEP VFORM)$=_c$ PERFP.

V: (↑ PRED) = 'tourner⟨(↑ SUBJ)(↑ OBJ)⟩'
$(\widehat{*}_\mu$ AUX)= −
$(\widehat{*}_\mu$ VFORM)= PERFP.

The parallel architecture taken seriously...

The introduction of an m-projection in Butt et al (1996) raises the issue of the conceptual distinction between f- and m-structure. We could take the conceptual distinction between f- and m-structure seriously, and consider representing, besides inflected tense auxiliaries, other morphologically marked features like CASE, NUM, GEND, INF, etc. in the separate m-projection.[1]
This would for example allow us to define subject-verb agreement at the level of m-structure:

Subject-verb agreement (3rd sg): $(\widehat{*}_\mu$ EXT-ARG NUM)= SG and $(\widehat{*}_\mu$ EXT-ARG PERS)= 3

[1]If morphological features like GEND, NUM, or CASE are represented in m-structure, immediate feature mismatches between distinct verb arguments can only be avoided by introducing a "blueprint" of f-structure grammatical functions within the m-structure (e.g. by use of features EXT-ARG, INT-ARGS). Still, there are limits to this remedy. This parallel m-structure architecture fails to capture long distance dependencies, as e.g. past participle OBJ agreement in French (see below). The main reason being that completeness and coherence constraints are not operational on grammatical function "blueprints" in m-structure.

(10) μ
$$\begin{bmatrix} \text{EXT-ARG} & \begin{bmatrix} \text{GEND} & \text{MASC} \\ \text{PERS} & 3 \\ \text{NUM} & \text{SG} \end{bmatrix} \\ \text{FIN} & + \\ \text{AUX} & + \\ \text{DEP} & \begin{bmatrix} \text{AUX} & - \\ \text{VFORM} & \text{PERFP} \end{bmatrix} \\ \text{INT-ARGS} & \begin{bmatrix} \text{GEND} & \text{MASC} \\ \text{NUM} & \text{SG} \end{bmatrix} \end{bmatrix}$$

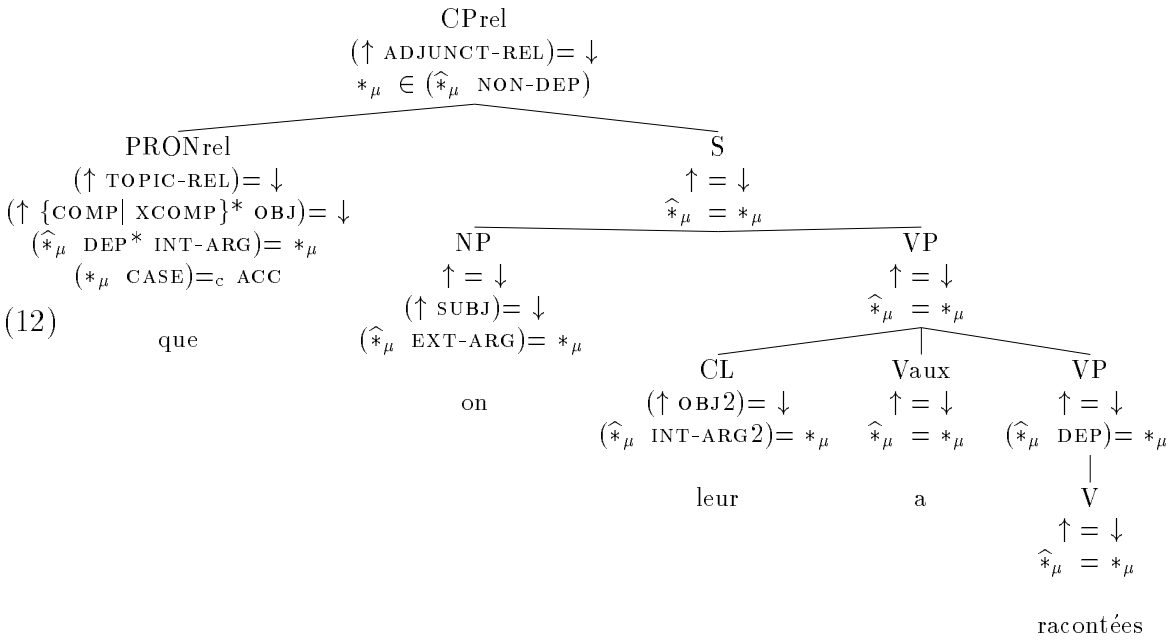
The problem of long distance dependencies

However, with such an extension, the parallel projection architecture of Butt et al (1996) is confronted with difficulties in capturing long-distance morphological agreement phenomena.

(11) a. Les enfants adorent les histoires qu'on leur a raconté*(*es*) mille fois.
'Children admire the stories that one has told them a thousand times'

b. Les enfants adorent les histoires qu'on sait bien qu'on leur a raconté*(*es*) mille fois.
'Children admire the stories that one knows perfectly (that) one has told them a thousand times'

(12)



(13)
racontées: V
(↑ PRED) = 'raconter⟨(↑ SUBJ)(↑ OBJ2)(↑ OBJ)⟩'
(*̂μ VFORM)= PERFP
(*̂μ OBJ) <h ↑
(*̂μ INT-ARG NUM)=c PL
(*̂μ INT-ARG GEND)=c FEM.

(14) Les enfants adorent des histoires qu'on ne veut pas vraiment leur raconter.
'Children love stories that one doesn't really want to tell them.'

3.b Sequenced projection architecture (Frank and Zaenen 1998, 2000)

The sequenced projection architecture proposed in Frank and Zaenen(1998, 2000) associates (partial) functional structures with local morphological structures by projecting m-structure off f-structure.[2]

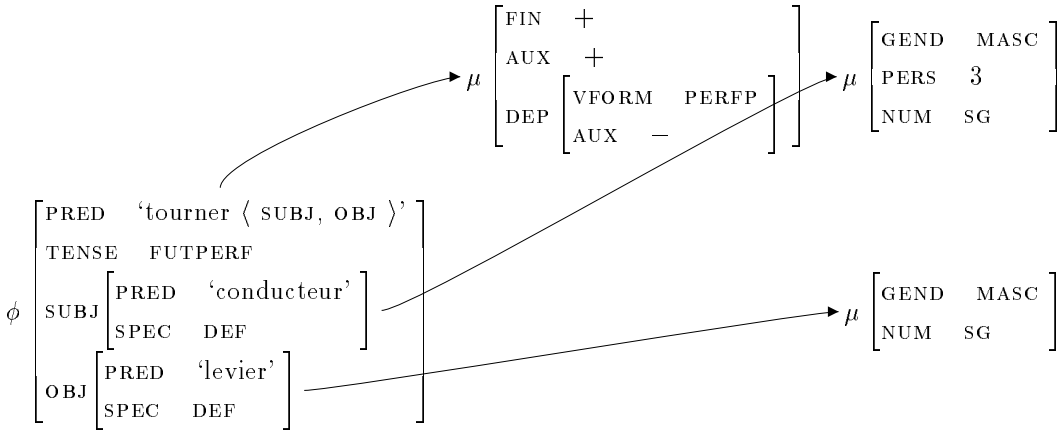
(15) $\text{c–str} \xrightarrow{\phi} \text{f–str} \xrightarrow{\mu} \text{m–str}$

Syntax–morphology interface (sequenced architecture)

This architecture allows us to represent and appropriately constrain synthetic and analytic tense formation while projecting a uniform f-structure. In the sequenced architecture, ordering constraints for analytic tense formation are defined by use of (sparsely) parameterized c-structure rules (cf. Frank and Zaenen for details).

Synthetic and analytic tense

(16)



Le conducteur aura tourné le levier. (The driver will have turned the lever)

(17)

aura: Vaux
$(\uparrow_\mu \text{ AUX}) = +$
$(\uparrow_\mu \text{ FIN}) = +$
$(\uparrow_\mu \text{ DEP AUX}) = -$
$(\uparrow_\mu \text{ DEP AUX-SELECT}) = \text{AVOIR}$
$(\uparrow_\mu \text{ DEP VFORM}) = \text{PERFP}$
$(\uparrow \text{ TENSE}) = \text{FUTPERFP}.$

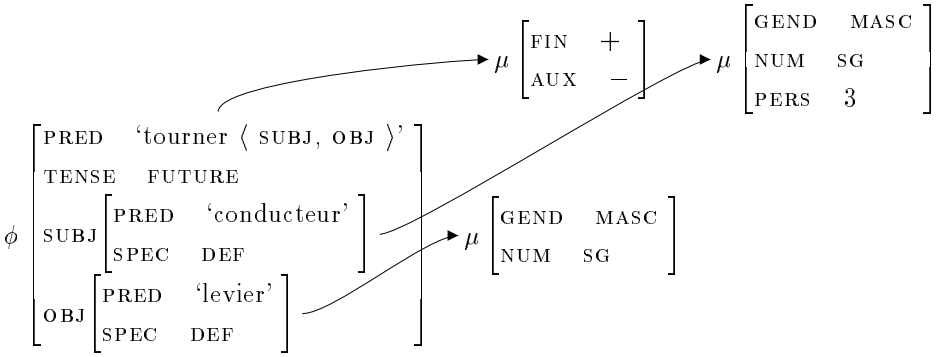
tourné: V
$(\uparrow \text{ PRED}) = \text{'tourner}\langle(\uparrow \text{ SUBJ})(\uparrow \text{ OBJ})\rangle\text{'}$
$(\uparrow_\mu \text{ AUX}) = -$
$(\uparrow_\mu \text{ AUX-SELECT}) = \text{AVOIR}$
$(\uparrow_\mu \text{ DEP}^* \text{ VFORM}) = \text{PERFP}.$

[2] A similar architecture has been proposed by John Maxwell in conversations with the second author.

Subject-verb agreement

Morphological-functional agreement phenomena – both local and long-distance agreement – can be easily represented.

(18)

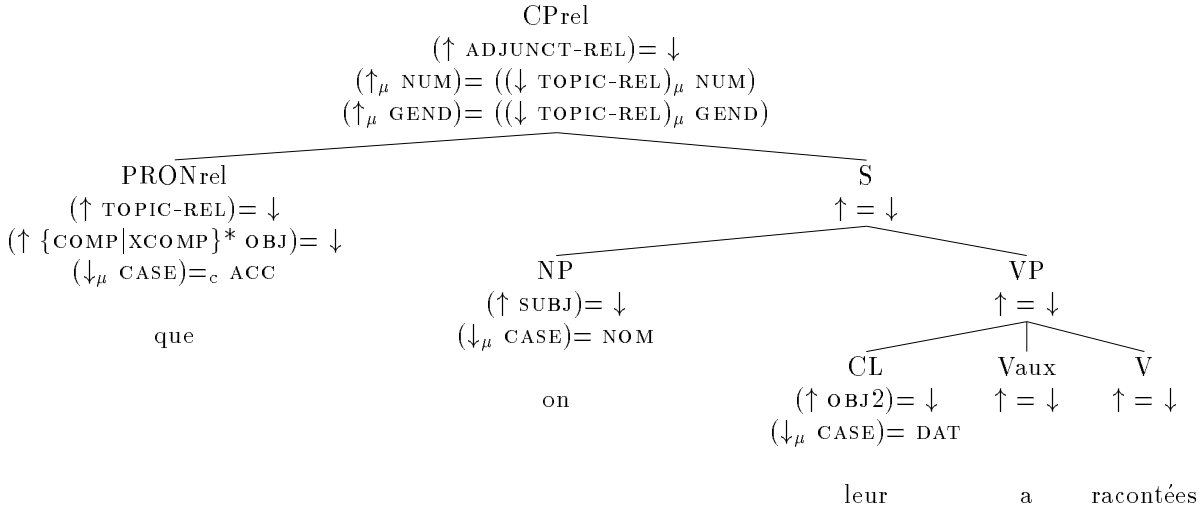


(19)

tournera: V $(\uparrow \text{PRED}) = \text{`tourner}\langle(\uparrow \text{SUBJ})(\uparrow \text{OBJ})\rangle\text{'}$
$(\uparrow_\mu \text{AUX}) = -$
$(\uparrow_\mu \text{FIN}) = +$
$(\uparrow \text{TENSE}) = \text{FUTURE}$
$((\uparrow \text{SUBJ})_\mu \text{NUM}) = \text{SG}$
$((\uparrow \text{SUBJ})_\mu \text{PERS}) = 3.$

Long distance constraints with local m-structures

(20) (Les enfants adorent les histoires) qu'on leur a racontées (mille fois).



(21)

racontées: V $(\uparrow \text{PRED}) = \text{`raconter}\langle(\uparrow \text{SUBJ})(\uparrow \text{OBJ2})(\uparrow \text{OBJ})\rangle\text{'}$
$(\uparrow_\mu \text{AUX}) = -$
$(\uparrow_\mu \text{DEP}^* \text{ VFORM}) = \text{PERFP}$
$(\uparrow \text{OBJ}) <_h \uparrow$
$((\uparrow \text{OBJ})_\mu \text{NUM}) =_c \text{PL}$
$((\uparrow \text{OBJ})_\mu \text{GEND}) =_c \text{FEM}.$

3 Conceptual issues arising from these scenarios ...

- **Distinction between morphological, functional-syntactic and semantic information**

  Which features are, in a given language, to be considered "functional", "morphological", or both?

  Features like PERS, NUM, GEND, CASE, FIN, INF, TENSE are in many languages marked by inflectional morphology. Should they therefore appear in m-structure?

  How to deal with default morphological marking (null marking) or underspecification?

- **Distribution of features in the projection architecture of grammar**

  Should morphological features (also) appear in f-structure?
  Which are the criteria for features to appear on one and/or the other level of linguistic representation?
  If all morphological features end up in m-projection, what will remain as genuine functional information?

  If features appear on either level, will it always be possible to define the required mappings in a consistent way?
  Do these architectures allow us to capture the various morpho-syntactic phenomena found in languages?

- **Representation format**

  Are attribute-value structures an appropriate representation format for morphological structures?

Some comments by Joan Bresnan (pc):

> A basic question I have concerns the partitioning of features across the various representations... You suggest .. that information encoded by morphology belongs in m-structure, not in f-structure. But I don't think that this characterization uniquely identifies a class of features, because the same types of features that are expressed morphologically may also be expressed syntactically. Number could be expressed syntactically by a number particle or noun classifier that has syntactic independence, or even by phrasal reduplication. ... The same holds for gender, case, person, definiteness, etc. Similarly, 'descriptive content' such as PRED attributes can be expressed both syntactically (e.g. in a lexical head) and morphologically (e.g. in a morphologically incorporated stem). Therefore, being expressed by morphology does [not af] uniquely identify a class of features.
>
> ...
>
> T. Mohanan and A. Wierzbicka have both argued very clearly for the distinction between morphological features (e.g. case features) and morphological forms (e.g. case markers). ... For example, accusative case in Russian masculine nouns is encoded by morphological forms identical to the genitive; yet coordination, modification,

and other syntactic tests show that the genitive *form* is expressing a non-genitive feature. I would assume that the 'form'-type features (e.g. VFORM) belong to m-structure, while 'content'-type features (e.g. NUM) belong to f-structure.

...

Your sequential architecture is appealing, but I found myself wondering whether the mapping from f-structures to m-structures is indeed functional, as you imply. Couldn't two expressions that bear contrasting types of morphological markers still unify their f-structures together? That would give you a one-many relation between f-structures and m-structures. Possible examples: (1) "case attraction" (e.g. a relative pronoun which would normally be accusative because it represents an object, say, appears in the different case of the head noun that it immediately follows; Avery Andrews has some examples of this in his papers on Icelandic. (2) discontinuous nominals in an Australian language with heavily split ergative case marking (so that, say, common nouns are morphologically marked for cases differently from proper nouns, pronouns, etc); I believe that the same f-structure function could be unified together from these differently case-marked parts; some references might be in the Austin and Bresnan paper in NLLT 1996.

Problems to look into:

- Incorporated pronouns

  Object marker: OM $((\uparrow \text{OBJ})_{\mu}\ \text{GEND}) = \ldots$
  $((\uparrow \text{OBJ})_{\mu}\ \text{NUM}) = \ldots$
  $(\uparrow \text{OBJ PRED}) = \text{'PRO'}$

  VP
  |
  V-OM
  $\uparrow = \downarrow$
  $((\uparrow \text{OBJ})_{\mu}\ \text{GEND})$
  $((\uparrow \text{OBJ})_{\mu}\ \text{NUM})$
  $(\uparrow \text{OBJ PRED}) = \text{'PRO'}$

- Syntactic vs. morphological marking of NUM, GEND, DEF ...

- Morphological vs. syntactic case markers

  gen-marker: $(\uparrow_{\mu}\ \text{CASE}) = \text{GENITIVE}$
  $(\uparrow \text{CASE}) = \text{ACC.}$

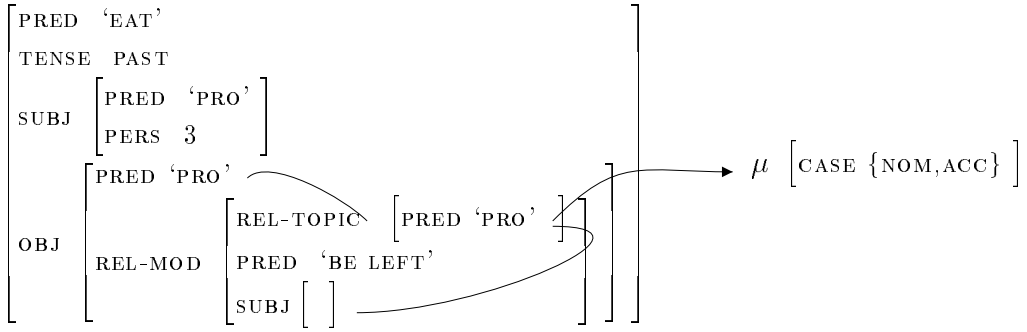
- Case attraction

  Dalrymple and Kaplan (1997,1999)'s treatment of case mismatches in German free relative clauses in terms of feature indeterminacy could be integrated within an m-structure proposal.

  (22) Ich habe gegessen was übrig war.

Ich	habe gegessen	was	übrig war.
I	have eaten	what	was left.
	OBJ=ACC		SUBJ=NOM

  was: $(\uparrow_\mu \text{ CASE}) = \{\text{NOM, ACC}\}$.
  essen: $\text{ACC} \in ((\uparrow \text{OBJ})_\mu \text{ CASE})$
  übrig sein: $\text{NOM} \in ((\uparrow \text{SUBJ})_\mu \text{ CASE})$



- Discontinuous nominals with distinct morphological marking
- Complex predicate formation
- ...

[1] Bresnan, J. 1995. *Lexical-Functional Syntax.* Lecture Notes, ESSLI 7, Barcelona.

[2] Bresnan, J. 2000. *Lexical-Functional Syntax.* Manuscript, Stanford University, to be published by Blackwell.

[3] Butt, M., Niño, M.E., Segond, F. 1996. "Multilingual Processing of Auxiliaries in LFG". In: D. Gibbon (ed.): *Natural Language Processing and Speech Technology: Results of the 3rd KONVENS Conference*, Bielefeld, October, 111-122.

[4] Dalrymple, M and Kaplan, R.M. 1997: "A Set-based Approach to Feature Resolution". in: *Proceedings of the LFG97 Conference*, University of California-San Diego, June 1997.

[5] Frank, A., Zaenen, A. 1998. "Tense in LFG: Syntax and Morphology", submitted for: Hans Kamp and Uwe Reyle: "Tense and Aspect Now. Contributions to the Theroy of Tense and Aspect in 1998." (Festschrift for Prof. Christian Rohrer), Manuscript, XRCE Grenoble.

[6] Frank, A., Zaenen, A. 2000. "Tense in LFG: Syntax and Morphology", in: Hans Kamp and Uwe Reyle: "Tense and Aspect Now. Contributions to the Theroy of Tense and Aspect in 1998." (Festschrift for Prof. Christian Rohrer).

[7] King, T.H. 1995. *Configuring Topic and Focus in Russian.* Stanford California, CSLI Publications.

[8] Schwarze, Ch. 1996. "The syntax of Romance Auxiliaries" in: Butt, M. and King, T.H. (eds): *Proceedings of the first LFG conference*, Rank Xerox Research Centre, Grenoble, `http://www-csli.stanford.edu/publications/`.