Reconstructing HPSG Morphology

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Introduction

- While there is quite a bit of interesting work done on morphology in HPSG, little connection with current theoretical, typological or empirical discussions in the morphology community.
- This is a missed opportunity:
  - Morphological descriptions are often in need of more formally explicit analyses
  - While there are formally explicit frameworks for morphology, these lack a worked-out interface with syntax and semantics
  - HPSG is well-suited to provide such an interface, because of its rich ontology.
- Goal of this talk:
  - Illustrate by example the challenges of the description of complex inflectional systems
  - Propose a way of integrating an inferential-realizational approach to inflection with HPSG

Outline

1. HPSG and Inflection
2. Laz conjugation
3. Laz morphology in PFM
4. Inferential-realizational morphology in HPSG

Stump's typology of frameworks

- Stump (2001) introduces a two-dimensional typology of morphological frameworks
  - inferential: uses syncategorematic rules to deduce a word's form from more basic stems
  - lexical: treats morphologically complex words as the combination of lexically listed formatives
  - realizational: deduces the phonological form of a word from its syntactic and semantic description
  - incremental: builds the syntactic and semantic description of a word form compositionally in parallel with its phonological form
- Examples
  - Traditional Item-and-Arrangement approaches, including most generative approaches, are lexical and incremental
  - Traditional Item-and-Process approaches are inferential and incremental
  - Distributed morphology (Halle and Marantz, 1993) is lexical and realizational
  - Word and Paradigm approaches (Robins (1959), Matthews (1972), Anderson (1992), Zwicky (1992), Corbett and Fraser (1993), Aronoff (1994), Stump (2001), Brown and Hippisley (in press)) are inferential and realizational

HPSG and Stump's typology

It seems that an inferential-realizational approach is most likely to be combined with HPSG:

- Strong lexicalism implies that morphology and syntax are different, and HPSG syntax is decidedly lexical-incremental
- Realizational approaches presuppose a feature-based interface between inflection and syntax based on a rich feature system.
- There are extant IR approaches, most prominently Paradigm Function Morphology (Stump, 2001) and Network Morphology (Corbett and Fraser, 1993; Brown and Hippisley, in press) that are formally explicit enough that an interface can easily be designed or analytic techniques be imported.
- Sociological factor: extant IR approaches focus on in-depth high precision descriptions of complex linguistic systems, which (hopefully) HPSG is also committed to.

HPSG and Stump's typology

In actual practice:

- Much work in HPSG morphology presupposes an IR approach but does not spell it out in any detail.
  - ☞ E.g. Kupść and Tseng (2005); Bonami and Boyé (2006); Bonami and Samvelian (2009); Samvelian and Tseng (2010); Bonami and Webelhuth (in press)
- Since Riehemann (1998) and Koenig (1999), most explicit work on morphology in HPSG is decidedly inferential rather than lexical
  - ☞ Borderline case: (Crysmann, 2002)'s morph-based approach
- However there is a tendency to be incremental rather than realizational:
  - The few extant descriptions of complex inflectional systems (e.g. Crysmann, 2002; Goodman and Bender, 2010) rely on cascades of lexical rules with the formal power of nonmonotonously and incrementally modifying syntactic and semantic descriptions.
  - Some explicit proposals, e.g. Müller (2003); Sag (in press), explicitly rely on the introduction of semantic predicates by inflection rules.

On the dangers of incrementality

- Multiple exponence: in inflectional systems of any complexity, the exponence of semantically potent features can be distributed over multiple morphs

(1) Ils aime-r-ont
They love-FUT-FUT.3PL
'They will love.' (French)

- If inflectional rules directly introduce semantic predicates, the **future** predicate will be introduced twice.
- Of course there could be workarounds, i.e. *-ont* suffixation could be defined to merge its semantic contribution with the input semantics if possible, or to be semantically empty but dependent on the application of a prior rule introducing the **future** predicate.
- Yet given the widespread nature of multiple exponence, the more general and elegant solution is to interpret the tense feature at word-level rather that intepret each exponent of the feature.

On the dangers of incrementality

- Semantically-potent features typically correspond to phrase-level predicates.
- Example: French aspectually-sensitive tenses (de Swart, 1998)
  - Tense must scope above aspectual modifiers: the choice of a tense can be influenced by an aspectual transition introduced by the modifier.

(2) a. Jean était content.
Jean be.PST.IPFV happy
'Jean was happy.'

b. # Pendant une heure, Jean était content.
For an hour Jean be.PST.IPFV happy

c. Pendant une heure, Jean a été content.
For an hour Jean has been happy
'Jean was happy for an hour.'

- Bonami (2002)'s MRS solution:
  - Tense is introduced lexically with type (**evy** $\rightarrow$ **prop**) $\rightarrow$ **prop**, with underspecified scope.
  - Aspectual operators are of type (**evy** $\rightarrow$ **prop**) $\rightarrow$ (**evy** $\rightarrow$ **prop**) ans thus have to scope below tense.

On the dangers of incrementality

- Not general enough. In the following examples, a single tense predicate scoping over the shared modifier must be introduced, despite the occurrence of two independent tense-carrying words.

(3) a. Pendant une heure, [Jean a été content et Marie a boudé]
For an hour Jean has been happy and Marie has sulked
'For an hour, Jean was happy and Mary sulked.'

b. # Pendant une heure, [Jean était content et Marie boudait]

- Once again, there can be workarounds; e.g. semantic composition in coordination might be defined so as to fuse tense predicates
- Yet a simpler, more standard solution is to assume that:
  - Tense exponents realize a morphosyntactic tense feature.
  - The tense feature is transmitted along the head path.
  - Tense is interpreted at clause level, above any clause-internal operators.

A diagnosis and a plan

- The issues discussed above in the context of HPSG correspond to well-known debates within morphology that are considered as settled by many.
- The fact that they still need to be discussed in the context of HPSG shows that we have not been focusing enough on the description of complex inflectional systems, rather than showing that something is wrong with the way morphologists think about the issues.
- My plan for the rest of this section:
  - Sketch the description of an inflection system that is complex enough to illustrate the concerns of practicing morphologists.
  - Illustrate how extant morphological frameworks can account for such systems, provided they are combined with an adequate interface to syntax and semantics.
  - Outline a way of integrating Paradigm Function Morphology with HPSG that precisely provides for such an interface.
  - Discuss conceptual and practical virtues of that type of strategy for the modeling of inflection within HPSG.

Outline

1. HPSG and Inflection
2. Laz conjugation
3. Laz morphology in PFM
4. Inferential-realizational morphology in HPSG

Laz

- Belongs to the South Caucasian language family, which also includes Georgian, Mingrelian and Svan
- Spoken in North-East Turkey and South-West Georgia

- Approximately 250,000 speakers (Feurstein 1983).
- Endangered : speakers under the age of ca. 25 do not speak Laz.
- Four dialect areas. The data presented here are from the dialect of Arhavi. They are taken from published sources and from René Lacroix's fieldwork (e.g. Lacroix, 2009).

Position classes

- 10 mutually exclusive position classes
- Some position classes may host lexical, derivational or inflectional exponents

aff. pvb	locative pvbs	person marking	valency/aspect	stem	thematic suffix	TAM	TAM	person marking	TAM/evidentiality
−4	−3	−2	−1	0	1	2	3	4	5
ko-	*go-*	*m-*	*o-*	*k'untsx-in*	*-am*	*-t'*	*-i*	*-t*	*-doe*
PV	PV	OBJ.1	VAL1	wake_up-CAUS	TH	PST.IPFV	PST	SBJ.12PL	EVD

‘you(pl.) were waking me up, I’m told’

Multiple exponence

- The prefix b- realizes (among other things) agreement with a first person subject
- The suffix -t realizes (among other things) agreement with a plural non third person subject

1SG	b-lal-um
2SG	lal-um
3SG	lal-um-s
1PL	b-lal-um-t
2PL	lal-um-t
3PL	lal-um-an

Present of *lal* 'bark'

		OBJECT					
		1SG	2SG	3SG	1PL	2PL	3PL
SUBJECT	1SG	—	g-dzir-om	b-dzir-om	—	g-dzir-om-t	b-dzir-om
	2SG	m-dzir-om	—	dzir-om	m-dzir-om-t	—	dzir-om
	3SG	m-dzir-om-s	g-dzir-om-s	dzir-om-s	m-dzir-om-an	g-dzir-om-an	dzir-om-s
	1PL	—	g-dzir-om-t	b-dzir-om-t	—	g-dzir-om-t	b-dzir-om-t
	2PL	m-dzir-om-t	—	dzir-om-t	m-dzir-om-t	—	dzir-om-t
	3PL	m-dzir-om-an	g-dzir-om-an	dzir-om-an	m-dzir-om-an	g-dzir-om-an	dzir-om-an

Present of *dzir* 'see'

Fused exponence

- In the future there is a specific set of person markers occurring in slot 4

–4	–3	–2	–1	0	1	2	3	4	5	
		m-		*dzir*	*-om*			*-t*		‘You (sg) see us’
		OBJ.1		see	TH			SBJ.12		present
		m-		*dzir*			*-i*	*-t*		‘You (sg) saw us’
		OBJ.1		see	TH		PST	SBJ.12		past perfective
		m-		*dzir*	*-om*	*-t’*	*-i*	*-t*		‘You (sg) were seeing us’
		OBJ.1		see	TH	IPFV	PST	SBJ.12		past imperfective
		m-		*dzir*				*-aten*		‘You (sg) will see us’
		OBJ.1		see				FUT.SBJ.12		future

Portmanteau morphs

- In the past perfective, some paradigm cells use portmanteau morphs occupying two position classes simultaneously.

OBJECT

SUBJECT	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	g-dzir-om	b-dzir-om	—	g-dzir-om-t	b-dzir-om
2SG	m-dzir-om	—	dzir-om	m-dzir-om-t	—	dzir-om
3SG	m-dzir-om-s	g-dzir-om-s	dzir-om-s	m-dzir-om-an	g-dzir-om-an	dzir-om-s
1PL	—	g-dzir-om-t	b-dzir-om-t	—	g-dzir-om-t	b-dzir-om-t
2PL	m-dzir-om-t	—	dzir-om-t	m-dzir-om-t	—	dzir-om-t
3PL	m-dzir-om-an	g-dzir-oman	dzir-om-an	m-dzir-om-an	g-dzir-om-an	dzir-om-an

Present of *dzir* 'see'

OBJECT

SUBJECT	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	gdzir-i	b-dzir-i	—	g-dzir-i-t	b-dzir-i
2SG	m-dzir-i	—	dzir-i	m-dzir-i-t	—	dzir-i
3SG	m-dzir-u	g-dzir-u	dzir-u	m-dzir-es	g-dzir-es	dzir-u
1PL	—	g-dzir-i-t	b-dzir-i-t	—	g-dzir-i-t	b-dzir-i-t
2PL	m-dzir-i-t	—	dzir-i-t	m-dzir-i-t	—	dzir-i-t
3PL	m-dzir-es	g-dzir-es	dzir-es	m-dzir-es	g-dzir-es	dzir-es

Past perfective forms of *dzir* 'see'

Discontinuous stems

- In addition to a (possibly derived) stem, lexical phonological information associated with a lexeme may consist of:
  - A locative preverb in slot −3
  - A valence marker in slot −1
  - A thematic suffix in slot 1
- These have a complex distribution:
  - Thematic suffixes are used only in some TAM combinations.
  - Some TAM combinations realize an inflectional exponent in the slot normally used by the thematic suffix

−4	−3	−2	−1	0	1	2	3	4	5	
		m-		*dzir*	*-om*			*-t*		'You (sg) see us'
		OBJ.1		see	TH			SBJ.12		present
		m-		*dzir*			*-i*	*-t*		'You (sg) saw us'
		OBJ.1		see	TH		PST	SBJ.12		past perfective
		m-		*dzir*	*-om*	*-t'*	*-i*	*-t*		'You (sg) were seeing us'
		OBJ.1		see	TH	IPFV	PST	SBJ.12		past imperfective
		m-		*dzir*	*-a*	*-t'*	*-i*	*-t*		'If only you had seen us!'
		OBJ.1		see	PST.OPT	IPFV	PST	SBJ.12		past optative

Discontinuous stems

- Valence markers usually reflect a derivational operation
- However, many underived verbs begin with the valence marker *o-*
- In the perfect, whatever marker would be expected is replaced by an inflectional exponent cumulating subject person marking and aspect.

−4	−3	−2	−1	0	1	2	3	4	5	
		p-		*ç'op*	*-um*					‘I catch it’
		1>3		catch	TH					
		m-	*a-*	*ç'op*	*-er*			*-n*		‘I am able to catch it’
		SUBJ.1	POT	catch	TH			OBJ.3SG		
		b-	*o-*	*gn*	*-am*					‘I hear it’
		1>3		hear	TH					
		m-	*i-*	*ç'op*	*-u*			*-n*		‘I have caught it.’ or
		SUBJ.1	PRF	catch	PRF			OBJ.3SG		‘I have been able to catch it.’
		b-	*u-*	*ç'op*	*-u*			*-t*		‘He has caught us.’ or
		3>1	PRF.SUBJ.3SG	catch	PRF			OBJ.PL		‘He has been able to catch us.’

Inflection classes

- Laz verbs come in inflection classes, which manifest themselves mostly by the choice of person marking suffixes in the present.

<table>
<tr><td></td><td></td><td colspan="6">OBJECT</td></tr>
<tr><td></td><td></td><td>1SG</td><td>2SG</td><td>3SG</td><td>1PL</td><td>2PL</td><td>3PL</td></tr>
<tr><td rowspan="6">SUBJECT</td><td>1SG</td><td colspan="3" rowspan="2">A</td><td colspan="2" rowspan="2">D</td><td rowspan="2">A</td></tr>
<tr><td>2SG</td></tr>
<tr><td>3SG</td><td colspan="3">C</td><td colspan="2">B</td><td>C</td></tr>
<tr><td>1PL</td><td colspan="6" rowspan="2">D</td></tr>
<tr><td>2PL</td></tr>
<tr><td>3PL</td><td colspan="6">B</td></tr>
</table>

$$A: \begin{cases} \mathit{are} \text{ in the future} \\ \emptyset \text{ elsewhere} \end{cases}$$

$$B: \begin{cases} \mathit{anoren} \text{ in the future} \\ \text{portmanteau } \mathit{es} \text{ in the past} \\ \mathit{nan} \text{ in the present, classes II and III} \\ \mathit{an} \text{ in the present, class I} \\ \mathit{n} \text{ elsewhere} \end{cases}$$

$$C: \begin{cases} \mathit{asen} \text{ in the future} \\ \text{portmanteau } \mathit{u} \text{ in the past} \\ \mathit{n} \text{ in the present, class III} \\ \mathit{s} \text{ elsewhere} \end{cases}$$

$$D: \begin{cases} \mathit{aten} \text{ in the future} \\ \mathit{t} \text{ elsewhere} \end{cases}$$

- Thematic suffixes are predictors of inflection class, but not the other way around

Inverse constructions

- There are two types of constructions for Laz verbs:
  - In the plain constructions, the subject is ergative and the object is dative or absolutive
  - In the inverse constructions, the subject is dative and the object is absolutive

(4) a. *Bere-k otsxodž me-tk'oč-u*
child-ERG comb[ABS] PV-throw-AOR.SBJ.3SG
'The boy threw the comb.' (Dumézil 1937, text 1)

b. *K'oči-s čxomi va a-č'op-u*
man-DAT fish[ABS] NEG VAL_A-take-AOR.SBJ.3SG
'The man could not catch fish.' (Lacroix, 2009)

NB: As Lacroix (2009) shows at length, the plain-inverse distinction is not a matter of variation of alignment between semantic roles and grammatical functions: the dative argument in inverse constructions has all syntactic properties of a subject.

Inverse constructions

- The plain/inverse distinction cuts across the inflection/derivation boundary:
  - Most verbs use the plain construction in all TAM combinations except the present perfect and the past perfect.

TAM	1PL>3SG form of *dzir* 'see'
present	bdziromt
past imperfective	bdziromt'it
aorist	bdzirit
future	bdziraten
present perfect	midzirunan
past perfect	midzirut'es
subjunctive	bdziromt'at
optative	bdzirat
past optative	bdzirat'it

Inverse constructions

- The plain/inverse distinction cuts across the inflection/derivation boundary:
  - A few underived verbs always use the inverse construction, irrespective of TAM
  - Some derivation operations output a verb which always uses the inverse construction, irrespective of TAM

(5) *k'oči-s a-škuin-u*
man-DAT VAL_A-fear-AOR.CPL.3SG
'The man was scared.' (Lacroix, 2009)

(6) *k'oči-s čxomi va a-č'op-u*
man-DAT fish NEG VAL_A-take-AOR.CPL.3SG
'The man could not catch fish.' (Lacroix, 2009)

ICs as morphological reversals

- The distribution of person markers in the two constructions are (almost) mirror images

☞ Morphological reversal (Baerman, 2007)

plain construction

	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	g-∅	b-∅	—	g-t	b-∅
2SG	m-∅	—	∅-∅	m-t	—	∅-∅
3SG	m-n	g-n	∅-n	m-nan	g-nan	∅-n
1PL	—	g-t	b-t	—	g-t	b-t
2PL	m-t	—	∅-t	m-t	—	∅-t
3PL	m-nan	g-nan	∅-nan	m-nan	g-nan	∅-nan

inverse construction

	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	m-∅	m-n	—	m-t	m-n
2SG	g-∅	—	g-n	g-t	—	g-n
3SG	b-∅	∅-∅	∅-n	b-t	-t	∅-n
1PL	—	m-t	m-nan	—	m-	m-nan
2PL	g-t	—	g-nan	g-t	—	g-nan
3PL	b-∅	∅-∅	∅-nan	b-t	∅-t	∅-nan

Morphosyntactic mismatch

- Systematic syncretism common to all subparadigms of all verbs
- Bonami and Lacroix (forthcoming): The distribution can be explained by assuming a **morphosyntactic mismatch** (Hippisley, 2007): morphology treats 3PL objects as 3SG

plain construction

	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	g-∅	b-∅	—	g-t	b-∅
2SG	m-∅	—	∅-∅	m-t	—	∅-∅
3SG	m-n	g-n	∅-n	m-nan	g-nan	∅-n
1PL	—	g-t	b-t	—	g-t	b-t
2PL	m-t	—	∅-t	m-t	—	∅-t
3PL	m-nan	g-nan	∅-nan	m-nan	g-nan	∅-nan

inverse construction

1SG	—	m-∅	m-n	—	m-t	m-n
2SG	g-∅	—	g-n	g-t	—	g-n
3SG	b-∅	∅-∅	∅-n	b-t	-t	∅-n
1PL	—	m-t	m-nan	—	m-t	m-nan
2PL	g-t	—	g-nan	g-t	—	g-nan
3PL	b-∅	∅-∅	∅-nan	b-t	∅-t	∅-nan

Morphosyntactic mismatch

- The morphological reversal is complete, although the OBJ.3PL cells in the morphological paradigm are never used directly.

plain construction (form paradigm)

	1SG	2SG	3SG	1PL	2PL	3PL
1SG	—	g-∅	b-∅	—	g-t	b-∅
2SG	m-∅	—	∅-∅	m-t	—	∅-∅
3SG	m-n	g-n	∅-n	m-nan	g-nan	∅-nan
1PL	—	g-t	b-t	—	g-t	b-t
2PL	m-t	—	∅-t	m-t	—	∅-t
3PL	m-nan	g-nan	∅-nan	m-nan	g-nan	∅-nan

inverse construction (form paradigm)

1SG	—	m-∅	m-n	—	m-t	m-nan
2SG	g-∅	—	g-n	g-t	—	g-nan
3SG	b-∅	∅-∅	∅-n	b-t	-t	∅-nan
1PL	—	m-t	m-nan	—	m-t	m-nan
2PL	g-t	—	g-nan	g-t	—	g-nan
3PL	b-∅	∅-∅	∅-nan	b-t	∅-t	∅-nan

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A synopsis of PFM

- The inflection system of a language is stated as a paradigm function mapping a lexeme and morphosyntactic property set to an appropriate phonological form.
- The paradigm function itself is stated using realization rules that map an input stem indexed for the lexeme it instantiates and a set of morphosyntactic properties to a phonological form.
- Realization rules are of two types:
  - Rules of exponence specify directly the output form as a phonological function of the input stem, i.e. as an affixed form.
  - Rules of referral refer the realization of some morphosyntactic property set to that of another morphosyntactic property set.
- The rules are organized into a sequence of rule blocks (Anderson, 1992)
- Competition between rules in the same block is arbitrated by specificity (Pāṇini's Principle).
- A rule may span multiple blocks at once: this gives rise to portmanteau morphs.

Laz conjugation in PFM

-4 $X_{\text{verb}}, \sigma : \{\textsc{aff}\ +\} \longrightarrow$ koX

-3 $X_{\text{verb}}, \sigma : \{\} \longrightarrow$ **loc-pvb**(X)

-2 $X_{\text{verb}}, \sigma : \{\textsc{agr2}\ \mathit{1}\} \longrightarrow$ mX

$X_{\text{verb}}, \sigma : \{\textsc{agr2}\ \mathit{2}\} \longrightarrow$ gX

$X_{\text{verb}}, \sigma : \{\textsc{agr1}\ \mathit{1}, \textsc{agr2}\ \mathit{3}\} \longrightarrow$ bX

-1 $X_{\text{verb}}, \sigma : \{\} \longrightarrow$ **val-mk**(X)

$X_{\text{verb}}, \sigma : \{\textsc{prf}\ +\} \longrightarrow$ iX

$X_{\text{verb}}, \sigma : \{\textsc{prf}\ +, \textsc{agr2}\ \mathit{3sg}\} \longrightarrow$ uX

1 $X_{\text{verb}}, \sigma : \{\textsc{pfv}\ -\} \longrightarrow$ **ths**(X)

$X_{\text{verb}}, \sigma : \{\textsc{prf}\ +\} \longrightarrow$ Xu

$X_{\text{verb}}, \sigma : \{\textsc{tns}\ \mathit{pst}, \textsc{mood}\ \mathit{opt}\} \longrightarrow$ Xa

2 $X_{\text{verb}}, \sigma : \{\textsc{tns}\ \mathit{pst}, \textsc{pfv}\ -\} \longrightarrow$ Xt'

3 $X_{\text{verb}}, \sigma : \{\textsc{tns}\ \mathit{pst}, \textsc{prf}\ -\} \longrightarrow$ Xi

4 $X_{\text{verb}}, \sigma : \{\} \longrightarrow \langle X, \sigma \rangle : \mathit{A}$

$X_{\text{verb}}, \sigma : \{\textsc{agr1}\ \mathit{3}\} \longrightarrow \langle X, \sigma \rangle : \mathit{B}$

$X_{\text{verb}}, \sigma : \{\textsc{agr1}\ \mathit{3sg}, \textsc{agr2}\ \mathit{sg}\} \longrightarrow \langle X, \sigma \rangle : \mathit{C}$

$X_{\text{verb}}, \sigma : \{\textsc{agr1}\ \mathit{12pl}\} \longrightarrow \langle X, \sigma \rangle : \mathit{D}$

$X_{\text{verb}}, \sigma : \{\textsc{agr1}\ \mathit{12sg}, \textsc{agr2}\ \mathit{12pl}\} \longrightarrow \langle X, \sigma \rangle : \mathit{D}$

5 $X_{\text{verb}}, \sigma : \{\textsc{mood}\ \mathit{ind}, \textsc{evid}\ \mathit{ind}\} \longrightarrow \langle X, \sigma \rangle :$ Xdoren

Laz conjugation in PFM

Block sequence $-1 \to 1 \to 2 \to 3 \to 4 \to -2 \to -3 \to -4 \to 5$

Portmanteau $3 > 4$ rules

$$\mathrm{X_{verb}}, \sigma : \{\mathrm{AGR1}\ \mathit{3}, \mathrm{TNS}\ \mathit{pst}, \mathrm{PFV}\ +\} \longrightarrow \mathrm{Xes}$$
$$\mathrm{X_{verb}}, \sigma : \{\mathrm{AGR1}\ \mathit{3sg}, \mathrm{AGR2}\ \mathit{sg}, \mathrm{TNS}\ \mathit{pst}, \mathrm{PFV}\ +\} \longrightarrow \mathrm{Xu}$$

Unordered rule blocks

$$A : \left\{\ \mathrm{X_{verb}}, \sigma : \{\mathrm{TNS}\ \mathit{fut}\} \longrightarrow \mathrm{Xare}\right.$$

$$B : \left\{\begin{array}{l} \mathrm{X_{verb}}, \sigma : \{\mathrm{TNS}\ \mathit{fut}\} \longrightarrow \mathrm{Xanoren} \\ \mathrm{X_{verb}}, \sigma : \{\mathrm{TNS}\ \mathit{prs}\} \longrightarrow \mathrm{Xnan} \\ \mathrm{X_{I}}, \sigma : \{\mathrm{TNS}\ \mathit{prs}, \mathrm{PRF}\ -\} \longrightarrow \mathrm{Xan} \\ \mathrm{X_{verb}}, \sigma : \{\} \longrightarrow \mathrm{Xn} \end{array}\right.$$

$$C : \left\{\begin{array}{l} \mathrm{X_{verb}}, \sigma : \{\mathrm{TNS}\ \mathit{fut}\} \longrightarrow \mathrm{X\ asen} \\ \mathrm{X_{III}}, \sigma : \{\mathrm{TNS}\ \mathit{prs}\} \longrightarrow \mathrm{X\ n} \\ \mathrm{X_{verb}}, \sigma : \{\} \longrightarrow \mathrm{Xs} \end{array}\right.$$

$$D : \left\{\begin{array}{l} \mathrm{X_{verb}}, \sigma : \{\mathrm{TNS}\ \mathit{fut}\} \longrightarrow \mathrm{Xaten} \\ \mathrm{X_{verb}}, \sigma : \{\} \longrightarrow \mathrm{Xt} \end{array}\right.$$

Portmanteau $-1 > 5$ rule

$$\mathrm{X_{verb}}, \sigma : \{\mathrm{INV}\ +, \mathrm{AGR1}\ \varphi, \mathrm{AGR2}\ \psi\} \longrightarrow \langle \mathrm{X}, \sigma/\{\mathrm{INV}\ -, \mathrm{AGR2}\ \psi, \mathrm{AGR1}\ \varphi\}\rangle : -1 > 5$$

Sample analysis: plain construction

Input $\left\langle dzir_{\text{DZIR}} \left\{ \text{PRF } -, \text{TNS } \textit{prs}, \text{MOOD } \textit{ind}, \text{AFF } -, \text{INV } -, \text{AGR1 } \textit{1pl}, \text{AGR2 } \textit{3sg} \right\} \right\rangle$

-1 Applicable rules: $X_{\text{verb}}, \sigma : \{\} \longrightarrow$ **val-mk**(X)

As it happens, **val-mk**(X_{DZIR})=X_{DZIR}

$\rightsquigarrow$ $dzir_{\text{DZIR}}$

1 Applicable rules: $X_{\text{verb}}, \sigma : \{\text{PFV } -\} \longrightarrow$ **ths**(X)

As it happens, **ths**(X_{DZIR})=Xom_{DZIR}

$\rightsquigarrow$ $dzirom_{\text{DZIR}}$

2 Applicable rules: none $\rightsquigarrow$ $dzirom_{\text{DZIR}}$

3 Applicable rules: none $\rightsquigarrow$ $dzirom_{\text{DZIR}}$

4 Applicable rules: $X_{\text{verb}}, \sigma : \{\} \longrightarrow \langle X, \sigma \rangle : A$

$X_{\text{verb}}, \sigma : \{\text{AGR1 } \textit{12pl}\} \longrightarrow \langle X, \sigma \rangle : D$

$\rightsquigarrow$ Referred to block D

Applicable rules: $X_{\text{verb}}, \sigma : \{\} \longrightarrow Xt$

$\rightsquigarrow$ $diromt_{\text{DZIR}}$

Sample analysis: plain construction

Input $\left\langle dzir_{\mathrm{DZIR}} \left\{\textsc{prf}\ -, \textsc{tns}\ \mathit{prs}, \textsc{mood}\ \mathit{ind}, \textsc{aff}\ -, \textsc{inv}\ -, \textsc{agr}1\ \mathit{1pl}, \textsc{agr}2\ \mathit{3sg}\right\}\right\rangle$

...

$\rightsquigarrow$ $dziromt_{\mathrm{DZIR}}$

-2 Applicable rules: $\mathrm{X}_{\mathrm{verb}}, \sigma : \{\textsc{agr}2\ \mathit{1}\} \longrightarrow \mathrm{mX}$

$\mathrm{X}_{\mathrm{verb}}, \sigma : \{\textsc{agr}1\ \mathit{1}, \textsc{agr}2\ \mathit{3}\} \longrightarrow \mathrm{bX}$

$\rightsquigarrow$ $bdziromt_{\mathrm{DZIR}}$

-3 Applicable rules: $\mathrm{X}_{\mathrm{verb}}, \sigma : \{\} \longrightarrow$ **loc-pvb**(X)

As it happens, **loc-pvb**($\mathrm{X}_{\mathrm{DZIR}}$)=$\mathrm{X}_{\mathrm{DZIR}}$

$\rightsquigarrow$ $bdziromt_{\mathrm{DZIR}}$

-4 Applicable rules: none $\rightsquigarrow$ $bdziromt_{\mathrm{DZIR}}$

5 Applicable rules: none $\rightsquigarrow$ $\boxed{bdziromt_{\mathrm{DZIR}}}$

Sample analysis: inverse construction

Input $\left\langle dzir_{\text{DZIR}} \left\{ \text{PRF } +, \text{TNS } \textit{prs}, \text{MOOD } \textit{ind}, \text{AFF } -, \text{INV } +, \text{AGR1 } \textit{1pl}, \text{AGR2 } \textit{3sg} \right\} \right\rangle$

$-1 > 5$ Applicable portmanteau rule:

$\text{X}_{\text{verb}}, \sigma : \{\text{INV } +, \text{AGR1 } \varphi, \text{AGR2 } \psi\} \longrightarrow$
$\langle \text{X}, \sigma / \{\text{INV } -, \text{AGR2 } \psi, \text{AGR1 } \varphi\} \rangle : -1 > 5$

$\rightsquigarrow$ referred to:

$\left\langle dzir_{\text{DZIR}} \left\{ \text{PRF } +, \text{TNS } \textit{prs}, \text{MOOD } \textit{ind}, \text{AFF } -, \text{INV } -, \text{AGR1 } \textit{3sg}, \text{AGR2 } \textit{1pl} \right\} \right\rangle$

-1 Applicable rules: $\text{X}_{\text{verb}}, \sigma : \{\text{PRF } +\} \longrightarrow \text{iX}$

$\rightsquigarrow$ $idzir_{\text{DZIR}}$

1 Applicable rules: $\text{X}_{\text{verb}}, \sigma : \{\text{PRF } +\} \longrightarrow \text{Xu}$

$\rightsquigarrow$ $idziru_{\text{DZIR}}$

2 Applicable rules: none $\rightsquigarrow$ $idziru_{\text{DZIR}}$

3 Applicable rules: none $\rightsquigarrow$ $idziru_{\text{DZIR}}$

Sample analysis: inverse construction

Input $\left\langle dzir_{\text{DZIR}} \left\{ \text{PRF} +, \text{TNS } prs, \text{MOOD } ind, \text{AFF} -, \text{INV} -, \text{AGR1 } 3sg, \text{AGR2 } 1pl \right\} \right\rangle$

...

$\rightsquigarrow$ $idzirunan_{\text{DZIR}}$

4 Applicable rules: $X_{\text{verb}}, \sigma : \{\} \longrightarrow \langle X, \sigma \rangle : A$

$X_{\text{verb}}, \sigma : \{\text{AGR1 } 3\} \longrightarrow \langle X, \sigma \rangle : B$

$X_{\text{verb}}, \sigma : \{\} \longrightarrow X\text{n}$

$\rightsquigarrow$ Referred to block B

Applicable rules: $X_{\text{verb}}, \sigma : \{\text{TNS } prs\} \longrightarrow X\text{nan}$

$X_{\text{verb}}, \sigma : \{\} \longrightarrow X\text{n}$

$\rightsquigarrow$ $idzirunan_{\text{DZIR}}$

-2 Applicable rules: $X_{\text{verb}}, \sigma : \{\text{AGR2 } 1\} \longrightarrow \text{m}X$

$\rightsquigarrow$ $midzirunan_{\text{DZIR}}$

-3 Applicable rules: $X_{\text{verb}}, \sigma : \{\} \longrightarrow$ **loc-pvb**(X)

As it happens, **loc-pvb**(X_{DZIR})=X_{DZIR}

$\rightsquigarrow$ $midzirunan_{\text{DZIR}}$

-4 Applicable rules: none $\rightsquigarrow$ $midzirunan_{\text{DZIR}}$

5 Applicable rules: none $\rightsquigarrow$ $\boxed{midzirunan_{\text{DZIR}}}$

Outline

1. HPSG and Inflection
2. Laz conjugation
3. Laz morphology in PFM
4. Inferential-realizational morphology in HPSG

The strategy

- As the preceding example shows, the elegant description of complex inflectional systems often relies on mechanisms that could only cumbersomely be modeled using HPSG lexical rules:
  - Pāṇinian competition between rules
  - Rule blocks and portmanteau rules
  - Rules of referral
- On the other hand, the analysis is in need of an explicit interface with a well worked-out syntactic description
- The strategy used here:
  - Rephrase the ontology of PFM using typed feature structures.
  - Model a Paradigm Functions as a relational constraint linking a lexical morphological information, morphosyntactic descriptions, and phonological forms.
  - Embed that relational constraint in an HPSG grammar as a constraint on possible words.

A (less than satisfactory) first try

- Bonami and Webelhuth (in press) implements such an approach directly in SBCG:

(7)

Definition of *synthetic-infl*:

$$\left[\begin{array}{ll} \textit{lexeme} & \\ \text{SYN} & \left[\text{CAT} \; \left[\text{LID} \; \boxed{1}\right]\right] \end{array}\right] \mapsto \left[\begin{array}{ll} \textit{word} & \\ \text{PHON} & \textbf{pdgm-fn}(\boxed{1},\boxed{2}) \\ \text{SYN} & \left[\text{CAT} \; \left[\begin{array}{ll} \text{LID} & \boxed{1} \\ \text{MORSYN} & \boxed{2} \end{array}\right]\right] \end{array}\right]$$

- Oddly enough:
  - Under such an approach, there is a single, and presumably universal, synthetic inflection rule
  - The presence of an object of type *lexeme* actually plays no role in the analysis: words and lexemes never need to disagree on the value of any feature.

Inflection and locality

- For at least 10 years, Ivan Sag (e.g. Sag, 2010, in press) has been arguing that HPSG grammars should be set up so as to constrain the accessibility between different components of linguistic analysis

☞ Strict seperation between the *sign* and *construct* hierarchies in SBCG

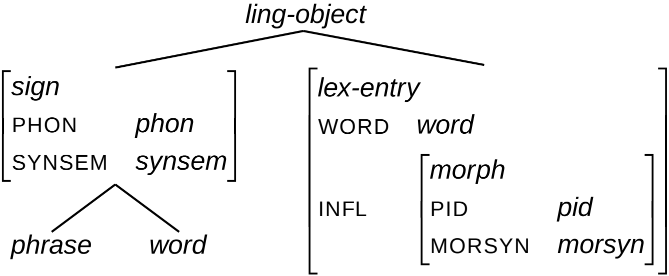
- The feasability of such a move within syntax has been disputed (e.g. Richter and Sailer, 2009)
- Locality arguments clearly favor a strict separation between inflection and syntax of the type implemented in SBCG:

☞ No rule of syntax is ever sensitive to purely morphological properties of the words it combines, such as their individual phonological form, inflection class, inflectional (ir)-regularity, participation in a suppletive stem alternation, etc.

- Arguably, this is the main empirical prediction of strong lexicalism
- Separating clearly inflection from syntax is one of the design goals of the approach presented here.

The general architecture

- Lexical entries are not signs, but a new type of object constraining the relation between a syntactic word and a feature structure characterizing the inflectional paradigm that word belongs to:



- **The Lexical Principle**: any object of type *word* used as part of an utterance must correspond to the value of the WORD feature of some lexical entry in the lexicon.

The inflectional component

- The inflectional component is defined by a relation **pdgm-rln** relating objects of type *pid* and objects of type *morsyn* to objects of type *phon*:
- **The Inflection Principle**

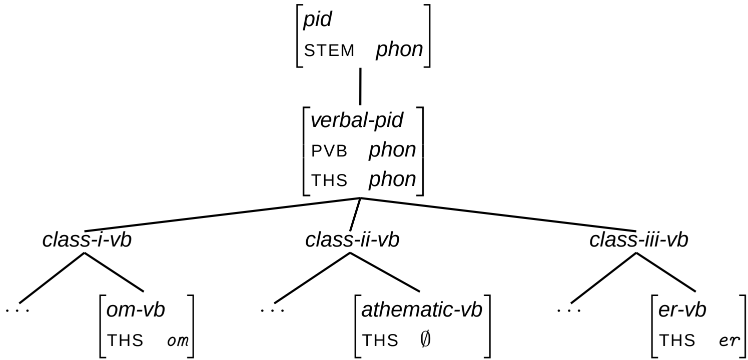
$$\textit{lex-entry} \rightarrow \begin{bmatrix} \text{WORD} & \begin{bmatrix} \text{PHON} \ \boxed{3} \end{bmatrix} \\ \text{INFL} & \begin{bmatrix} \text{PID} & \boxed{1} \\ \text{MORSYN} & \boxed{2} \end{bmatrix} \end{bmatrix} \wedge \textbf{pdgm-rln}(\boxed{1}, \boxed{2}, \boxed{3})$$

- We use a relation rather than a function, because of the phenomenon of *overabundance* (Thornton, in press): there may be more than one form filling a given paradigm cell (e.g. English *dived/dove*.
- Contra Bonami and Boyé (2007), this is still compatible with Pāṇinian rule competition; see (Bonami and Stump, forthcoming) for discussion.

The structure of PID

- PID is the home of all idiosyncratic information characterizing an inflectional paradigm, such as:
  - Minimally, the phonological representation of a STEM
  - Inflection class information, coded as a subtyping of *pid* values
  - In some languages, discontinuous thematic elements (preverbs, theme vowels, etc.)
  - In some languages, indexed collections of allomorphic stems (Bonami and Boyé, 2006)
- The structure of the *pid* hierarchy needs to be fine-grained enough that quasi-homophonous lexemes (e.g. English *lie/lied* vs. *lie/lay* have different *pid* values.
- No need to introduce individual types for paradigm identifiers (contra Spencer, 2010): the inflection of quasi-homophonous lexemes always differ either in terms of inflection class or lexemic phonological information.
- PID is complementary with LID (Sag, in press) but plays a different role: homophonous lexemes will have the same PID value but different LIDS.

The structure of PID in Laz



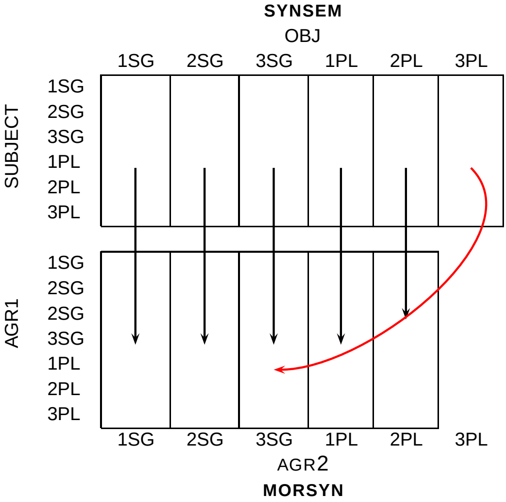
$$\textit{dzir}: \begin{bmatrix} \text{WORD} & \begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{LID} & \textit{see-rel} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{INFL} & \begin{bmatrix} \text{PID} & \begin{bmatrix} \textit{om-vb} & \\ \text{STEM} & \mathit{dzir} \\ \text{PVB} & \emptyset \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

The morphosyntactic interface

- Inflection normally realizes syntactic features residing within WORD. However:
  - Which features are available for inflectional realization is a highly parochial matter
    - Some, but not all, HEAD features
    - In languages with agreement and/or pronominal affixes, some, but not all, aspects of ARG-ST
    - In many languages, some EDGE features (e.g. Kupść and Tseng, 2005; Samvelian and Tseng, 2010)
  - Existence of morphosyntactic mismatches: cases where morphology seems to realize feature values other than those provided by syntax
    - Default agreement to 3sg for non-nominal subject in English or French
    - Deponency phenomena (Stump, 2006; Baerman, 2007)
    - Here: Lack of number agreement in the 3rd person in Laz
- For this reason, it is best to constrain explicitly the relationship between word-level syntactic properties and the input to inflection
- This is done by positing a MORSYN structure whose feature values are related to features in WORD explicitly.

The morphosyntactic interface in Laz

- Remember: we need to map ARG-ST into MORSYN so that *3sg* object agreement exponents are used where *3pl* exponents would be expected



The morphosyntactic interface in Laz

- In HPSG parlance:

(8) a.
$$\begin{bmatrix}\text{WORD} & \begin{bmatrix}\cdots|\text{HEAD} & \begin{bmatrix}\textit{verb} & \\ \text{VFORM} & \boxed{1}\end{bmatrix}\end{bmatrix}\end{bmatrix} \rightarrow \begin{bmatrix}\text{INFL} & \begin{bmatrix}\text{MORSYN} & \begin{bmatrix}\text{TAM} & \boxed{1}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

b.
$$\begin{bmatrix}\text{WORD} & \begin{bmatrix}\cdots|\text{HEAD} & \textit{verb} \\ \text{ARG-ST} & \left\langle \begin{bmatrix}\text{IND} & \boxed{1}\end{bmatrix}, \ldots \right\rangle\end{bmatrix}\end{bmatrix} \rightarrow \begin{bmatrix}\text{INFL} & \begin{bmatrix}\text{MORSYN} & \begin{bmatrix}\text{AGR1} & \boxed{1}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

c.
$$\begin{bmatrix}\text{WORD} & \begin{bmatrix}\cdots|\text{HEAD} & \textit{verb} \\ \text{ARG-ST} & \left\langle [\,], \begin{bmatrix}\text{IND} & \begin{bmatrix}\text{PER} & \boxed{1}\end{bmatrix}\end{bmatrix} \right\rangle\end{bmatrix}\end{bmatrix} \rightarrow \begin{bmatrix}\text{INFL} & \begin{bmatrix}\text{MORSYN} & \begin{bmatrix}\text{AGR2} & \begin{bmatrix}\text{PER} & \boxed{1}\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

d.
$$\begin{bmatrix}\text{WORD} & \begin{bmatrix}\cdots|\text{HEAD} & \textit{verb} \\ \text{ARG-ST} & \left\langle [\,], \begin{bmatrix}\text{IND} & \begin{bmatrix}\text{PER} & \textit{non-3} \\ \text{NB} & \boxed{1}\end{bmatrix}\end{bmatrix} \right\rangle\end{bmatrix}\end{bmatrix} \rightarrow \begin{bmatrix}\text{INFL} & \begin{bmatrix}\text{MORSYN} & \begin{bmatrix}\text{AGR2} & \begin{bmatrix}\text{NB} & \boxed{1}\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

e.
$$\begin{bmatrix}\text{WORD} & \begin{bmatrix}\cdots|\text{HEAD} & \textit{verb} \\ \text{ARG-ST} & \left\langle [\,], \begin{bmatrix}\text{IND} & \begin{bmatrix}\text{PER} & \textit{3}\end{bmatrix}\end{bmatrix} \right\rangle\end{bmatrix}\end{bmatrix} \rightarrow \begin{bmatrix}\text{INFL} & \begin{bmatrix}\text{MORSYN} & \begin{bmatrix}\text{AGR2} & \begin{bmatrix}\text{NB} & \text{SG}\end{bmatrix}\end{bmatrix}\end{bmatrix}\end{bmatrix}$$

Congruence as MORSYN typing

- Remember that:
  - All verbs are inverse in the perfect
  - Some verbs are inverse throughout their paradigms
- Such paradigm structure conditions can be modelled as conditions on *morsyn* objects:

morsyn

$$\begin{bmatrix} \textit{congruent} & \\ \text{TAM} & \begin{bmatrix}\text{PRF} & \boxed{1}\end{bmatrix} \\ \text{INV} & \boxed{1} \end{bmatrix} \qquad \begin{bmatrix} \textit{noncongruent} & \\ \text{INV} & + \end{bmatrix}$$

$$\textit{dzir}: \begin{bmatrix} \text{WORD} & \begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \begin{bmatrix} \text{HEAD} & \begin{bmatrix} \textit{verb} & \\ \text{LID} & \textit{see-rel} \end{bmatrix} \end{bmatrix} \end{bmatrix} \end{bmatrix} \\ \text{INFL} & \begin{bmatrix} \text{PID} & \begin{bmatrix} \textit{om-vb} & \\ \text{STEM} & dzir \\ \text{LPVB} & \emptyset \end{bmatrix} \\ \text{MORSYN} & \textit{congruent} \end{bmatrix} \end{bmatrix}$$

A side benefit

- Long-standing issue in the modeling of the inflection of South-Caucasian languages: analysis of person prefixes
  - m- is used whenever there is a 1st person object
  - g- is used whenever there is a 2nd person object
  - b- is used:
    - With intransitive verbs having a 1st person subject
    - With transitive verbs having a 1st person subject and a 3rd person complement

☞ b is generally taken to be a 1st person subject agreement prefix

⇒ extrinsic rule ordering (Anderson 1992, Halle & Marantz 1993), multiple modes of rule application (Stump, 2001), etc.

- Trivial solution: this is a morphological mismatch, where intransitives realize the exponents of a transitive verb with a *3sg* object.

(9) $$\left[\text{WORD}\begin{bmatrix}\cdots|\text{HEAD} & \textit{verb}\\ \text{ARG-ST} & \langle[\,]\rangle\end{bmatrix}\right] \rightarrow \left[\text{INFL}\left[\text{MORSYN}\left[\text{AGR2}\begin{bmatrix}\text{PER} & \textit{3}\\ \text{NB} & \textit{sg}\end{bmatrix}\right]\right]\right]$$

Notable features of this approach

- Strongly lexicalist
  - Words are the only lexical objects known to syntax.
  - Syntactic and inflectional rules are of an entirely different nature.
  - Morphology-internal notions (inflection class, etc.) are inaccessible to the syntactic component.
  - The interface between syntactic-semantic features and morphological exponence is constrained explicitly, on a language-by-language basis.
- Conservative
  - HPSG syntactic analyses need not be altered in any way.
  - ☞ Post-inflectional unary rules can still be used as usual to model syntactic alternations.
  - ☞ Derivation rules can still be modeled as transitions from lexical entries to lexical entries.
  - PFM analyses are only minimally altered to accomodate a different underlying ontology.
  - More conservative vision of the lexeme, as an underspecified notion of word, rather that as a sign distinct from the word.

Conclusions

1. As a community we should worry more about what HPSG has to say about inflection (and morphology in general, and phonology, and . . .)

☞ The design features of HPSG make it ideal to address complex interface issues, not making use of these features is a waste.

2. Yet the right approach is not to reinvent the wheel but to first see how the insights of theoretical morphology from the past 20 years can be integrated in HPSG.
3. One property of inflection systems is that they differ in complexity

☞ Designing a theory of morphology on the basis of French or German is unadvisable; designing one on the basis of English is nonsensical.

4. If we take the modeling of morphology seriously, HPSG can be very helpful both to field/descriptive linguists and to typologists, in a way that less explicit theoretical linguistic approaches can not afford.

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