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On the Geometry of Morphological Systems

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Proposal:
Marker inventories are structured. The distribution of exponents is restricted by accessibility relations between each other: The choice of exponents at step n conditions the markers available at step $n + 1$. Empirically, this move provides a unified treatment of several phenomena that have so far been accounted for by invoking unrelated machinery.

(1) *Standard assumption:*
The distribution of a marker is only conditioned by its morpho-syntactic features (and, perhaps, its position class).

Consequence:
Empirically, (1) has made necessary the postulation of various unrelated operations affecting the morpho-syntactic feature set, additional diacritics on morpho-syntactic features, and the postulation of otherwise unmotivated features:
- feature introduction via redundancy rules or incremental marker specifications (Halle & Marantz 1993, 1994; Noyer 1998; Harbour 2003)
- feature duplication (Müller 2007)
- 'DISCHARGED' diacritic (Noyer 1992)
- inflection class features
- '[–lexical insertion]' features (for paradigmatic gaps; Halle 1973)

(2) *Claim:*
In addition to their morpho-syntactic specification, exponents are restricted by *accessibility relations* among each other.
The exponent chosen at step *n* affects the set of markers available at *n*+1.

Consequence:
(2) yields a unified account for cases problematic for (1). It therefore allows us to dispense with the additional operations above.

1 Proposal

Central concept: ***Channels***
Channels define accessibility relations among markers. Only a derivationally determined subset of all markers enter competition for insertion into a given head.

(3) Accessibility
A marker M_1 is accessible from marker M_2 iff there is a direct upward channel from M_2 to M_1.

(4) Subset Principle
A vocabulary item V is inserted into a functional morpheme M iff (i), (ii), and (iii) hold:
(i) V is accessible,
(ii) The morpho-syntactic features of V are a subset of the morpho-syntactic features of M,
(iii) V is the most specific vocabulary item that satisfies (i) and (ii).

(5) Specificity (Lumsden 1992; Noyer 1992, 1997; Müller 2004)
A vocabulary item V_i is more specific than a vocabulary item V_j iff there is a class of features $\mathbb{F}$ such that (i) and (ii) hold.
(i) V_i bears more features belonging to $\mathbb{F}$ than V_j does,
(ii) there is no higher-ranked class of features $\mathbb{F}'$ such that V_i and V_j have a different number of features in $\mathbb{F}'$.

(6) *Notational conventions*
a. $\mu_a \equiv$ the morpho-syntactic features of the marker a
$\pi_a \equiv$ the phonological features of the marker a
b. $\mu'_A \equiv$ the morpho-syntactic features of the state A
$\pi'_A \equiv$ the phonological features of the state A

(7) State
A state at a given point in the derivation is an ordered pair $\langle \pi', \mu' \rangle$ such that π' is a phonological string and μ' a set of morpho-syntactic features.

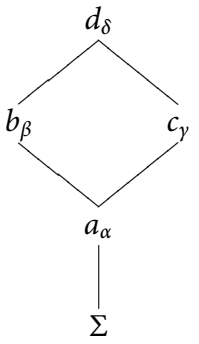
(8) Vocabulary insertion[1,2]
a. *Initial State Σ:*
$\Sigma = \langle \pi', \mu' \rangle$ with $\pi' = \varnothing$, $\mu' = \sigma$, σ any well-formed feature matrix
b. *Transition* $\vdash$:
$X \vdash a \Rightarrow \langle \pi'_X \oplus \pi_a, \mu'_X \ominus \mu_a \rangle = A$
c. *Output:*
A state X is an *output state* if there is no accessible marker a. A derivation terminates if an output state is reached.

Remarks:
'$\oplus$' refers to phonological concatenation; '$\ominus$' designates set reduction, i.e. $a \ominus b = a - b$.
Marker insertion applies until there is no more marker left for insertion, i.e. there is multiple marker insertion per head (cf. Noyer 1992, 1997; Halle 1997).

1 Of course, instead of vocabulary insertion *discharging* morpho-syntactic features, we may just as well treat the operations as *adding* morpho-syntactic features to the state. This would yield an incremental theory (e.g. Wunderlich 1996, 1997a,b). It is, however, not clear how inflection classes could be captured in a purely incremental theory.

2 It is insubstantial whether the exponents are taken to be lexical pieces or exponence rules, as in inferential grammars (Anderson 1992; Stump 2001).

(9) Example:

a. 

b. *Initial State:*
$\Sigma = \langle \varnothing, \{\alpha, \beta, \delta\} \rangle$

c. *Derivation:*
(i) $\Sigma \vdash a_\alpha \Rightarrow A = \langle \varnothing \oplus a, \{\alpha, \beta, \delta\} \ominus \alpha \rangle = \langle [a], \{\beta, \delta\} \rangle$
(ii) $A \vdash b_\beta \Rightarrow B = \langle [a] \oplus b, \{\beta, \delta\} \ominus \beta \rangle = \langle [ab], \{\delta\} \rangle$
(iii) $B \vdash d_\delta \Rightarrow D = \langle [ab] \oplus d, \{\delta\} \ominus \delta \rangle = \langle [abd], \varnothing \rangle$

Locality:
The system is completely derivational. Only the actual position and state are available information. No look-ahead or look-back.

Consequence:
Given the algorithm in (9), the system does not allow for context features, i.e. features that are not discharged when encountered. We call this notion *Radical Feature Discharge*.

(10) *Radical Feature Discharge Corollary*
Every morpho-syntactic feature can be active only once. All features are discharged if a marker refers to them, being then inretrievably deleted for the rest of the derivation.

Postsyntactic operations:
- There are *no* postsyntactic operations apart from vocabulary insertion, specifically no feature-introducing mechanisms (cf. (11)).
- Impoverishment is conceived of insertion of a zero marker with non-zero morpho-syntactic features (cf. Trommer 1999, 2001). This captures the similarity between impoverishment and marker insertion in that both render features invisible for further computation (Bonet 1991; Halle & Marantz 1993, 1994; Bobaljik 2002; Frampton 2002).[3]

(11) *Inclusiveness Condition* (Chomsky 1995, 2000)
No new features are introduced by C_{HL}.

3 This, however, does not exclude the possibility that impoverishment applies syntactically, thus affecting which feature specifications may be input to the morphological component in the first place (see Keine to appear).

2 Extended Exponence

The phenomenon (Matthews 1972, 1974):
A single feature is apparently realized by more than one exponent.

Previous proposals:
- secondary exponence (Noyer 1992, 1997)
- non-discharge of features (Anderson 1992; Stump 2001)
- feature copying ('enrichment'; Müller 2007)

2.1 Case morphology in Archi

Refs.: Kibrik (1991, 1998, 2003); Mel'čuk (1999); Corbett (2007)

The phenomenon:
In Archi, the plural is realized by one of several plural markers, the singular is unmarked. The basis for oblique cases (all but NOM) is formed by attaching *-li* in the singular and *-čaj/-če* in the plural. All oblique cases except for the ergative are then formed by attaching additional suffixes that do not distinguish between singular and plural (cf. (12)).

(12) Partial paradigms of *aInš* 'apple' and *qIn* 'bridge'

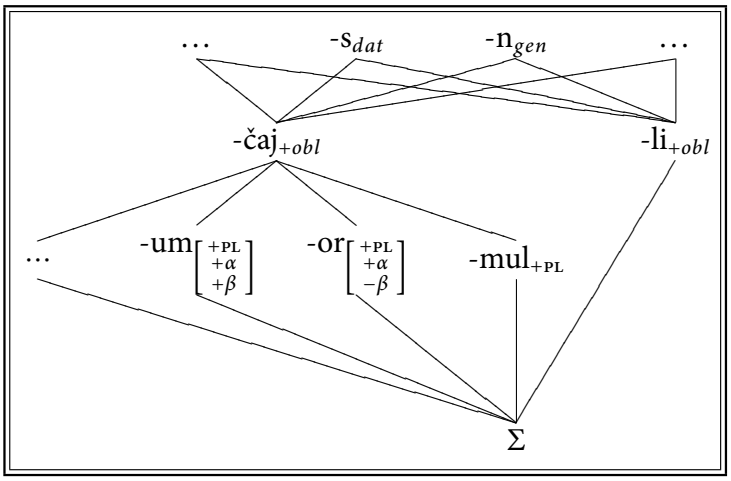
	/aInš/		/qIn/	
	SINGULAR	PLURAL	SINGULAR	PLURAL
NOM	*aInš*	*aInš-um*	*qIin*	*qionn-or*
ERG	*aInš-li*	*aInš-um-čaj*	*qIinn-i*	*qIonn-or-čaj*
GEN	*aInš-li-n*	*aInš-um-če-n*	*qIinn-i-n*	*qIonn-or-če-n*
DAT	*aInš-li-s*	*aInš-um-če-s*	*qIinn-i-s*	*qIonn-or-če-s*
⋮	⋮	⋮	⋮	⋮
		(Kibrik 1998: 471)		(Kibrik 1991: 256)

(13) *Enrichment analysis in Müller (2007):*
   a. [+PL] is duplicated by the enrichment rule in (b) and realized by both the number marker and *-čaj/-če*.
   b. $\varnothing \rightarrow$ [+PL] / [+PL],[ERG]___
   c. /-or/ ↔ [+PL],[+α]
      /-um/ ↔ [+PL],[−α]
      /-čaj/ ↔ [+PL],[ERG]

(14) *Secondary exponence analysis:*
   /-or/ ↔ [+PL],[+α]
   /-um/ ↔ [+PL],[−α]
   /-čaj/ ↔ [ERG] ([+PL])

(15) *Channel analysis*[4]

a.



b. *Ranking:*
CLASS > NUMBER > CASE

Comparison:
In both the enrichment and the secondary exponence approach *-čaj/-če* is specified for [+PL] and thus categorically barred from the singular. In contrast, under the channelling approach in (15), *-čaj/-če* is in principle also compatible with the singular.

Claim:
There is evidence that the latter position is correct: *čaj/-če* may appear in the singular as well. Two nouns, *haˤtəra* 'river' and *cʾaj* 'female goat', take *-čaj/-če* in the ergative singular and plural (see (16)).

(16) Partial paradigms for *haˤtəra* 'river' and *cʾaj* 'female goat'[5]

	/haˤtəra/		/cʾaj/	
	SINGULAR	PLURAL	SINGULAR	PLURAL
NOM	*haˤtəra*	*haˤtər-mul*	*cʾaj*	*cʾohor*
ERG	*haˤtər-čaj*	*haˤtər-mul-čaj*	*cʾej-t̄aj*	*cʾohor-čaj*

(Corbett 2007: 41)

Consequence:
This distribution is completely unexpected under both the secondary exponence and the enrichment approach. To salvage these accounts one might treat *-čaj* as [ERG] and *-li* as [ERG,–PL]. This, however, does not work either as *-li* can actually appear in the ergative plural (see (17)).

4 *-mul/-t̄u* is the elsewhere plural marker. The choice depends on whether the stem ends with a consonant or a vowel (Kibrik 1998: 468).

5 *-čaj* in the ergative singular is clearly the same morpheme as in the plural because it is subject to the same morphological allomorphy: It surfaces as *-če* if non-final. Thus, the locative singular of *haˤtəra* is *háˤtər-če-qˤ*. The locative of *cʾaj* is *cʾěj-t:e-t* (source: *Archi Dictionary*, Surrey Morphology Group, University of Surrey, available at: http://www.smg.surrey.ac.uk/archi/linguists/).

(17) Partial paradigm for *χˤon* 'cow'[6]

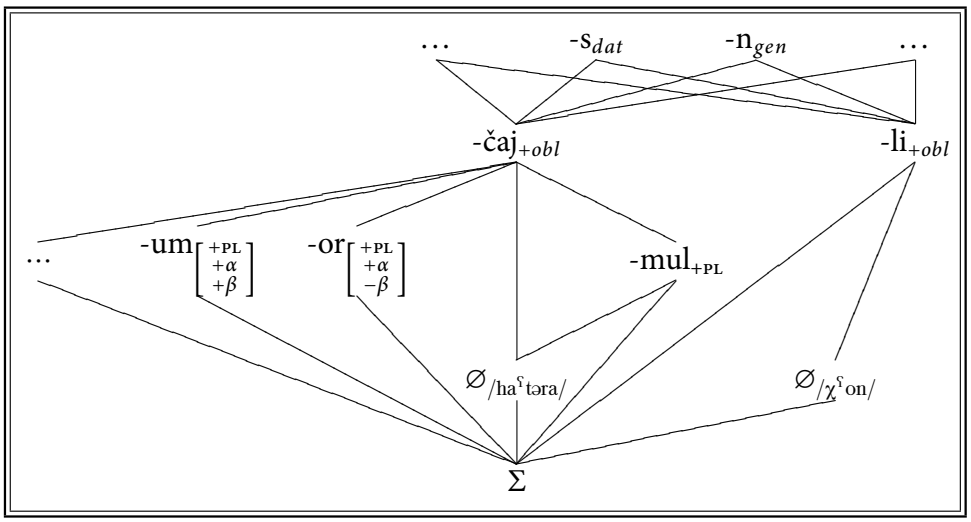
	SINGULAR	PLURAL
NOM	*χˤon*	*būcʾi*
ERG	*χˤini*	*būcʾi-li*

(Corbett 2007: 41)

Bidirectional spreading:
In one case *-čaj* spreads over *-li*, in the other one *-li* spreads over *-čaj*. This cannot be achieved by mere underspecification or impoverishment. The secondary exponence and enrichment approaches thus need additional machinery to capture the syncretisms (see §3).

Proposal:
No special operation is necessary under the channel approach. The marker system in (15) is fully compatible with these spreading patterns, as *-čaj* and *-li* are not specified for number. All that needs to be said is that the items in (16) and (17) have access to special channels, i.e. that they are exceptional.

(18) *Archi marker system including* /haˤtəra/ *'river' and* /χˤon/ *'cow'*



2.2 The domain of extended exponence

Note:
Under the assumption of radical feature discharge, features are deleted immediately. Extended exponence emerges only because of channelling relations among VIs.

Prediction:
Extended exponence may not cross markers that neutralize the relevant channel distinctions.

Example:
– In (18), the plural markers discharge the noun's class features. The marker *-čaj* neutralizes the channel distinctions between the different noun classes.

6 We treat [χˤini] as underlyingly /χˤon-li/ 'cow-OBL'. Locative: /χˤini-t/ (source: *Archi Dictionary*, Surrey Morphology Group, University of Surrey, available at: http://www.smg.surrey.ac.uk/archi/linguists/).

– As a consequence, after processing the marker *-čaj* class distinctions (i.e. features and channels) are irretrievably lost.
– Thus, extended exponence of class features may not cross the neutralizing marker *-čaj*. This prediction is of course not made by either secondary exponence or enrichment.

3 Feature Changing Operations in Nimboran

Refs.: Anceaux (1965); Inkelas (1993); Noyer (1998); Trommer (2001, 2003)

Overview:
In Nimboran, in one environment marker *a* spreads over marker *b*; in another configuration marker *b* spreads over marker *a* (bidirectional spreading). Noyer (1998) argues that underspecification and impoverishment alone are insufficient to account for this distribution. Instead, he proposes *redundancy rules*, which introduce new information. These are similar (though not identical) to *rules of referral* (Zwicky 1985; Stump 1993, 2001).

3.1 Empirical pattern

Number markers:
In Nimboran, the verb agrees with the subject for person and number. Singular is realized by *-Ø*. As for the dual and plural markers *ⁱ* and *-k*, an intricate interaction can be observed.

– In the so-called 'normal' environment /ⁱ/ is used to mark non-2nd plural. *-k* appears in all other dual and plural cells. As the distribution of *-k* does not form a natural class, it is most plausibly seen as the elsewhere marker for non-singular contexts.

– In the 'special' environment (e.g. before the durative affix *-tam*)[7] /ⁱ/ spreads over all non-singular cells. *-k* does not appear here in any cell. That /ⁱ/ may spread over *-k* suggests that /ⁱ/ is the elsewhere marker, in contradiction to the distribution in the 'normal' environment.

This is illustrated in (19).

(19) a. Subject agreement affixes ('normal' environment)

	SINGULAR [+SG,−PL]	DUAL [−SG,−PL]	PLURAL [−SG,+PL]
1	*...u*	*k...u*	*ⁱ...u*
12	*maN...ám*	*k...ám*	
2	*...e*	*k...e*	
3.MASC	*...am*	*k...am*	*ⁱ...am*
3.FEM	*...um*	*k...um*	

(Noyer 1998: 271)

7 The distribution of the special environment appears in the presence of certain particles, the plural object morpheme *dar* and the durative affix *tam*. For expository purposes, we will restrict our attention to the durative.

b. Subject agreement affixes ('special' environment)

	SINGULAR [+SG,−PL]	DUAL [−SG,−PL]	PLURAL [−SG,+PL]
1	*...u*	*^{i}...u*	
12	*maN...ám*	*^{i}...ám*	
2	*...e*	*^{i}...e*	
3.MASC	*...am*	*^{i}...am*	
3.FEM	*...um*	*^{i}...um*	

(Trommer 2001: 152)

Stem change:
The verb root exhibits allomorphy conditioned by the number of the subject. Following Inkelas (1993) and Noyer (1998), we assume the B stem to be the default form. Stem A is formed by metathesis; stem C by ablaut. Interestingly, the distribution of these stems varies in the two environments. This is exemplified in (20) and summarized in (21).

(20) *'Normal' environment*

a. ŋgedúo-d-u
draw[A]-FUT-1
'I will draw here.'

b. ŋgedóu-k-d-u
draw[B]-NONSG-FUT-1
'We (excl, dual) will draw (here).'

c. ŋgedói-^{i}-d-u
draw[C]-PL-FUT-1
'We (excl, plur) will draw (here).' (Noyer 1998: 273)

(21) *'Special' environment (durative)*

a. ŋgedóu-tam-t-u
draw[B]-DUR-PRES-1
'I am drawing.'

b. ŋgedói-^{i}-tam-t-u
draw[C]-PL-DUR-PRES-1
'We (excl, dual/plur) are drawing.' (Noyer 1998: 274)

(22) Root allomorphs in 'normal' and 'special' environment

SUBJECT NUMBER	'normal'	'special'
SINGULAR	A	B
DUAL	B	C
PLURAL	C	C

(Noyer 1998: 274)

Summary:
The distribution of number markers and stem allomorphs to be captured is given in (23).

(23) Distribution of number markers and stem allomorphs

	−DURATIVE			+DURATIVE *(-tam)*		
	SG	DUAL	PL	SG	DUAL	PL
1	∅, A	*k*, B	^{i}, C	∅, B	^{i}, C	^{i}, C
12	∅, A	*k*, B	*k*, C	∅, B	^{i}, C	^{i}, C
2	∅, A	*k*, B	*k*, C	∅, B	^{i}, C	^{i}, C
3	∅, A	*k*, B	^{i}, C	∅, B	^{i}, C	^{i}, C

3.2 Noyer's (1998) account

- *-k* is the elsewhere marker for non-singular ([−SG]), /^{i}/ is restricted to plural ([+PL]). In the normal environment, *-k* spreads over /^{i}/ via an impoverishment operation for 2nd person.
- *-k* being the elsewhere marker, impoverishment does not suffice to extend /^{i}/ to the dual in the 'special' environment.
- Here, the interaction of impoverishment with a redundancy rule effectively transforms the dual into a plural. As a consequence, /^{i}/ fulfills the subset principle and fills all non-singular forms (cf. (24)).

(24) *Feature changing in the special environment*
[−SG,−PL] → [+PL] → /^{i}/

3.3 Channel reanalysis

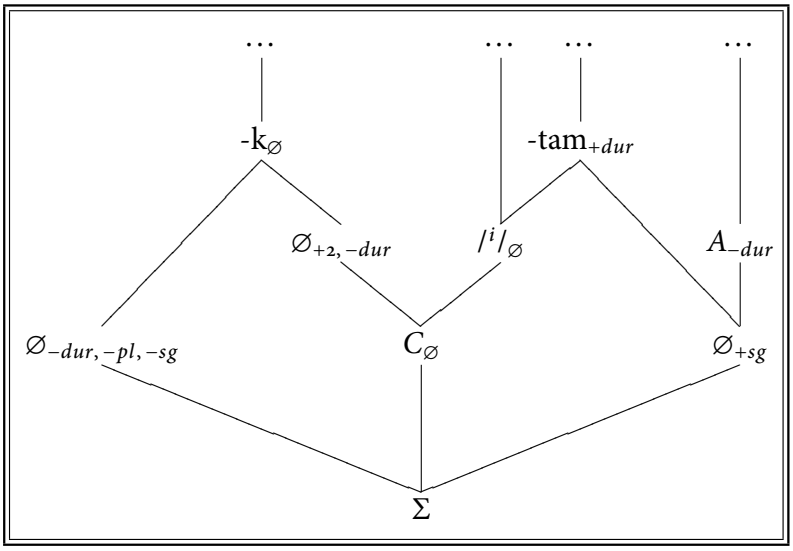
Claim:
Rules that change or introduce features can be dispensed with if marker inventories are structured.

Caveat:
For expository purposes, we will abstract away from the tense and person markers on the verb. The system can however be conservatively expanded to include these markers as well.

Argument:
There may be several equally specific markers without predicting identity of distribution if they differ w.r.t. their accessibility relations.

Analysis:
Both *-k* and /^{i}/ are elsewhere markers. However, they stand in a different channel relation with the previously processed markers and hence have distinct accessibility relations. The two channels leading to *-k* correspond to the two configurations that are marked by *-k*. Since one of these configurations receives the C stem, this distinction seems warranted.

(25) *Marker system for Nimboran*[8]



4 Spanish Object Clitics

Refs.: Bonet (1991, 1995); Halle & Marantz (1994); Harris (1994)

Overview:
Halle & Marantz (1994) propose an analysis of object clitics in Peninsular (and Latin American) Spanish that makes use of several unrelated post-syntactic operations. This machinery is not necessary if marker inventories are structured.

(26) Object clitics in Peninsular Spanish

		3rd		2nd	1st
		MASC	FEM		
SG	ACC	*lo*	*la*	*te*	*me*
	DAT	*le*	*le*	*te*	*me*
	REFL	*se*	*se*	*te*	*me*
PL	ACC	*los*	*las*	*os*	*nos*
	DAT	*les*	*les*	*os*	*nos*
	REFL	*se*	*se*	*os*	*nos*

(Halle & Marantz 1994)

4.1 Halle & Marantz's (1994) analysis

(27) [Det] [Theme] [Number]

8 *A* and *C* are mnemonic for the respective metathesis and ablaut rule, or, alternatively, for zero morphemes triggering these operations. The dots indicate the left out tense and person markers.

(28) Analysis of Peninsular Spanish

a. *Vocabulary items:*

DET:			THEME:			NUMBER:[9]		
/n/$_{[I]}$	↔	[1]/[+PL]	/e/	↔	[III]	/s/	↔	[+PL]
/m/$_{[III]}$	↔	[1]	/a/	↔	[II]	/∅/	↔	[ ]
/∅/	↔	[2]/[+PL]	/o/	↔	[ ]			
/t/$_{[III]}$	↔	[2]						
/l/	↔	[ ]/CASE						
/s/$_{[III]}$	↔	[ ]						

b. *Redundancy rules:*

(i) [ ] → [CLASS II] / [+FEM]

(ii) [ ] → [CLASS III] / [DAT]

c. *Extrinsic ordering:*

Insertion into DET → redundancy rule (i) → redundancy rule (ii) → insertion into THEME and NUM

Note:
The system is *both incremental and realizational* at the same time. To account for the fact that e.g. *t* is invariably followed by *e*, *t* introduces a class feature that is subsequently realized by *e*.

4.2 Channel reanalysis

Claim:
The data can be accounted for with marker insertion alone if markers are not always accessible.

(29) a. *Ranking:*

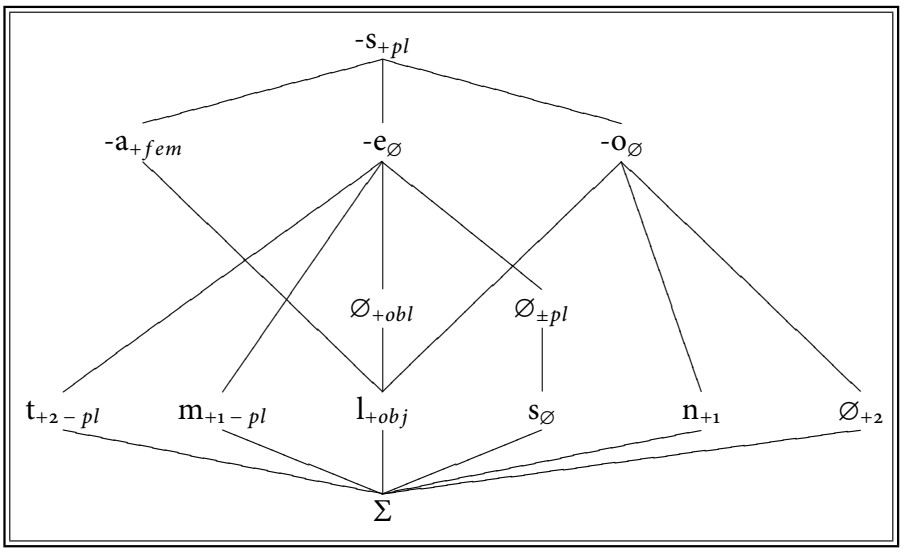
PERSON > CASE

b. *Decomposition:*

ACC: [+obj,–obl]

DAT: [+obj,+obl]

(30) *Marker system for Peninsular Spanish*



9 It remains unclear how the distribution of the number markers in the reflexive is derived in this analysis.

Remarks:
The marker *t* is always followed by *e* because (i) *e* is the only accessible marker at this point, (ii) *e* fulfills the subset principle trivially. Thus channels obviate the need for incremental marker specifications. The effects of the extrinsic ordering (28c) follow from the hierarchy (29a) and the bottom-up nature of marker insertion.

5 Conclusion and Outlook

- Marker inventories are not unordered sets but involve *channel structures*, that restrict marker accessibility.
- Consequently, the set of markers competing for insertion at step n is a function of the marker inserted at step $n - 1$.
- This device provides a unified account for otherwise puzzling phenomena such as extended exponence, bidirectional spreading, obligatory marker co-occurence etc.
- **Possible extensions:**
  1. *Inflection classes:*
     If there is more than one entry point, different stems may start at different points and have different markers to choose from. This accounts for the observation that markers signalling inflection classes cease to do so in different environments (Stump 2006) and that inflection markers may overwrite the class specification of a stem (Lieber 1980; Williams 1981).
  2. *Paradigmatic gaps:*
     If one does not by stipulation rule out loops, a loop on an elsewhere marker leads to infinite regress, giving rise to paradigmatic gaps. This accounts for the fact that such gaps can be very systematic (Halle 1973; Albright 2003; Pertsova 2005)
  3. *Morphological segmentation:*
     Given channel restrictions on marker distributions, subanalysis of inflection markers can be executed to a much greater degress, uniformly reducing the size of exponents. Every morpheme then has a fixed size (say, a phoneme). This may contribute to models of morphological learning (cf, e.g., Pertsova 2007).

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