Establishing order in type-based realisational morphology

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Recent years have witnessed a renewal of interest in variable morph ordering, the situation where the position of a morph in the word is not constant. These situations present a challenge to extant inferential-realisational approaches to morphology (Stump, 2001), insofar as these adopt implicitly or explicitly an a-morphous approach to morphological composition (Anderson, 1992). In this talk we will first review the typology of known variable morph ordering phenomena in inflection. We then argue that the challenges can be met by making a distinction between *paradigmatic opposition classes* and *syntagmatic position classes*, and show that this distinction can readily be implemented in HPSG while keeping the amorphous assumption.

1 Position class morphology

We start with a canonical position class (or 'templatic') morphological system. French pronominal prefixes as used in e.g. indicative tenses provide a good example—see Table 1. In such a system, affixes cluster in groups that (i) stand in paradigmatic opposition, and (ii) are rigidly ordered with respect to all other groups and to the stem. Such groups of affixes are called position classes.

Table 1: French prefixal pronominal affixes

1 'NOM'	2 'POL'	3 'REFL'	4 'ACC'	5 'DAT'	6 'LOC'	7 'GEN'
je	ne	me	le	lui	y	en
tu		te	la	leur		
il		se				
...	...					

Notice that French exhibits three well-known features of position class systems: (i) affixes that express different values for the same features may occur in different positions; for instance direct objects may be realised in positions 3 (if reflexive or non-third person), 4 (if definite, 3rd person and nonreflexive) or 7 (if indefinite); (ii) some feature combinations, such as positive polarity, have no affixal realisation; (iii) there sometimes are arbitrary gaps in the system: here positions 3 and 5 cannot be filled simultaneously. All of these properties except the last can readily be modelled, as Anderson (1992) shows, by assuming that inflection rules are organised in successive blocks of disjunctively ordered rules, each block corresponding to a position.

1.1 Classical challenges: Stump (1993)

Stump (1993) identifies four deviations from the situations illustrated by French that call for a more elaborate view of the organisation of inflection rules.

Portmanteau morphs span two position classes, typically expressing synthetically a combination of features that is otherwise expressed by two separate affixes. Swahili conjugation illustrates: negative forms use the portmanteau *si* to express subject marking and negation, where the sequence *ha-ni* is expected.

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Table 2: Swahili position class morphology

(a) Swahili position classes

1 POL	2 SUBJ MRKR	3 TAM/ POL	4 REL. MRKR	5 OBJ MRKR	6 STEM	7 REL. MRKR
	a	ta		ku	taka	
					'He will pay you'	
ha	a	ta		ku	taka	
					'He won't pay you'	
	ni	ta		ku	taka	
					'I will pay you'	
	si	ta		ku	taka	
					'I won't pay you'	
	a	na	ye		soma	
					'(person) who is reading'	
	a				soma	ye
					'(person) who reads'	

(b) Swahili subject and object prefixes

PER	GEN	SUBJECT SG	SUBJECT PL	OBJECT SG	OBJECT PL
1		ni	tu	ni	tu
2		u	m	ku	wa
3	M/WA	a	wa	m	wa
	M/MI	u	i	u	i
	KI/VI	ki	vi	ki	vi
	JI/MA	li	ya	li	ya
	N/N	i	zi	i	zi
	U	u	—	u	—
	U/N	u	zi	u	zi
	KU	ku	—	ku	—

Parallel position classes are pairs of classes that contain the same affixes expressing different but related feature combinations in two different positions. Swahili subject and object person markers are a typical case: as Table 2b illustrates, most person-number-gender combinations are expressed by the same affixes in both functions, but occurring in the distinct positions 2 and 5.

Ambifixal position classes are pairs of positions that realise the same features through the same affixes but on either side of the stem. Swahili relative markers illustrate, as can be seen at the bottom of Table 2a. These markers register on the verb agreement with a gap on that verb's argument structure. They are usually linearised in prefixal position 4, but do occur in position 7 if position 3 is empty, e.g. in the present tense.

Reversible position classes are classes that sometimes appear in one order and sometimes in the opposite order depending on some independent condition. Fula subject and object markers illustrate. Where the subject markers are suffixal, they normally immediately precede the object markers. If however the subject is 1SG and the object is SG, the order is reversed.

(1) a. mball-u-ɗon-mo
help-REL.PST-2pl-3sg
'You (pl.) helped him'

b. mball-u-mi-ɓe
help-REL.PST-1sg-3pl
'I helped them'

c. mball-u-moo-mi
help-REL.PST-2sg-1sg
'I helped him'

1.2 Further challenges

Since the publication of Stump (1993), further types of deviations from simple position class morphology have been identified.

Affix clusters As Luís and Spencer (2005) note, when more than one affix may appear on either side of the stem, they typically are linearised in the same order on both sides, rather than in opposite orders, as predicted by the variant of Paradigm Function Morphology (PFM) presented in Stump (1993). Italian pronominal affix clusters illustrate.

(2) a. me-lo-dai
DAT.1SG-ACC.3SG.M-give.PRS.2SG
'You give it to me.'

b. dá-me-lo!
give.IMP.2SG-DAT.1SG-ACC.3SG
'Give it to me!'

Freely ordered position classes are neatly exemplified by Chintang conjugation (Bickel et al., 2007). In this language, prefixes on verbs realizing subject marking, object marking and negation can be freely reordered, with no semantic or sociolinguistic contrast. Crucially, this does not mean that the language has no morphotactics: these affixes are always prefixal, and suffixes occur in strictly ordered position classes.

(3) a. u-kha-ma-cop-yokt-e
3NS.A-1NS.P-NEG-see-NEG-PST
'They didn't see us.'
b. u-ma-kha-cop-yokt-e
c. kha-u-ma-cop-yokt-e
d. ma-u-kha-cop-yokt-e
e. kha-ma-u-cop-yokt-e
f. ma-kha-u-cop-yokt-e

1.3 Taking stock

Stump (1993) accounted for the data from section 1.1 by combining the use of layered morphological structures and of metarules. Stump (2001) shows that most of the classical challenges can be met without positing explicit morph boundaries, but oddly does not include any discussion of ambifixal position classes. It turns out however that there is no easy way of modeling them in Stump's (2001) a-morphous approach: in the absence of morph boundaries, there is no way of relating prefixal and suffixal realisation of the same morph. This same problem extends to the modeling of affix clusters. In addition, Stump (2001) still presents no account of arbitrary gaps in position class systems, and does not allow for a general solution to the problem of variable morph ordering of the kind exemplified by Chintang: free order can only arise through the postulation of rules of referral enumerating all possible reorderings of a postulated basic order.

We argue that the inadequacy of PFM as stated in Stump (2001) to satisfactorily address variable morph ordering boils down to two design properties of the model. The first and most important one is the use of a single device, rule blocks, to model paradigmatic opposition and syntagmatic placement. Because of this assumption, it is not possible for a single realisation rule to allow for the realisation of a morph in more than one position—hence the use of rules of referral to *modify* the placement of exponents. The second problematic property is the assumption that the morphological recursion starts with the application of rules of stem insertion, to which later rules either prefix or suffix exponents. Because of this, and in the absence of morph boundaries, it is not possible for a single rule to introduce the same exponent both prefixally and suffixally, a situation which becomes even more critical once we are confronted with prefixal vs. suffixal clusters.

2 An HPSG architecture for morphotactics

2.1 Basic assumptions

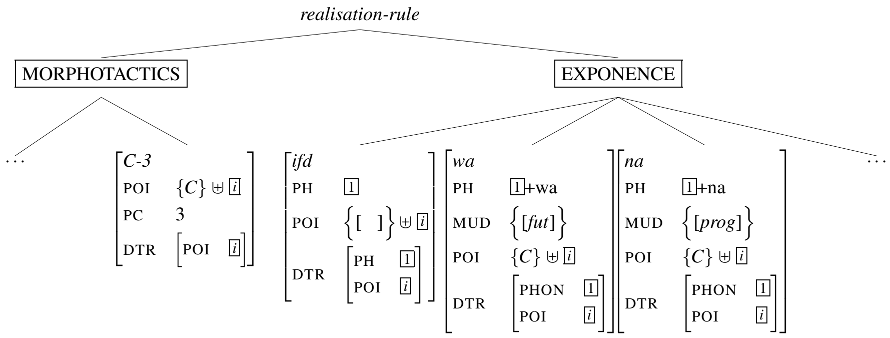
We now turn to the description of an HPSG approach to variable morph ordering. We will be making the following general assumptions regarding the way inflectional morphology should be modelled:

- Inflection is inferential (no lexical listing of morphological formatives) and realisational (exponents are partial realisations of features of the word) (Stump, 2001).
- Realisation rules are a-morphous: they operate on morphologically unstructured phonological representations (Anderson, 1992).
- Inflection realises *morphosyntactic property sets* (MORSYN) that are interfaced but not equated with lexical-level syntactic representations (Anderson, 1992; Bonami, 2011). In particular (i) MORSYN is less structured than SYNSEM, and (ii) there can be mismatches.
- Realisation rules process phonological strings from left to right, rather than starting from the stem.[1]

[1] This proposal departs from standard assumptions, but is actually less stipulative. Within inferential-realisational approaches, there is a consensus that stems need to be introduced by explicit rules, rather than simply being the

- Realisation rules are expressed under the assumption of Pāṇinian competition: rules expressing more specific property sets block the application of rules expressing less specific property sets.

Figure 1: Partial hierarchy of Swahili realisation rules



2.2 Separating paradigmatic opposition from placement

The key to a more general approach to morph-ordering is the dissociation of paradigmatic opposition, as captured by rule blocks in PFM, from position class information. In order to represent these two properties of morphological rules, we postulate two features, one indicating paradigmatic opposition (PARADIGMATIC OPPOSITION INDEX = POI), the other syntagmatic position (POSITION CLASS =PC). While POI will ensure that exactly one morphological rule has to be applied for every paradigmatic opposition, but underspecifies the order in which rules have to apply, PC constrains order of application.

Realisation rules will therefore be subject to the following constraint, requiring that at least one paradigmatic opposition needs to be expressed and that rule application must apply in the order of position class indices.[2] A morphological root condition will specify, by means of the POI set, which paradigmatic choices have to be made for a word to be morphologically well-formed. This is sufficient to ensure that uninflected stems cannot serve to express just any morpho-syntactic feature combination in the general case.

(4)
$$\begin{bmatrix} \textit{realisation-rule} & \\ \text{MORSYN} & \boxed{m}\left(\boxed{u} \cup \textit{set}\right) \\ \text{MUD} & \boxed{u} \\ \text{POI} & \left\{[\,]\,,\ldots\right\} \uplus \boxed{p} \\ \text{PC} & i+j \\ \text{DTR} & \begin{bmatrix} \text{MORSYN} & \boxed{m} \\ \text{POI} & \boxed{p} \\ \text{PC} & i \end{bmatrix} \end{bmatrix}$$

In order to describe aspects of exponence (selection of shapes) and morphotactics in the most general way, we suggest, following Koenig (1999); Koenig and Jurafsky (1994), that realisation rules be modeled as types organised into the two cross-cutting dimensions of MORPHOTACTICS and EXPONENCE. Recall that according to Koenig's online type construction, a well formed category (here: a realisational rule instance) must inherit from exactly one

lexeme's phonology. This is necessary to account for (i) idiosyncratic stem allomorphy (e.g. Bonami and Boyé, 2006; Stump, 2001); (ii) discontinuous stems (e.g. Crysmann, 2002); (iii) the existence of words with empty stems but regular affixation (Hippisley et al., 2004). The usual strategy is to postulate that the stem insertion rules are applied before any rule of exponence. Our alternative makes the point of insertion of stems nonarbitrary, and reduces the potential for spurious ambiguity, since there is a single and definite point at which each rule can apply.

[2] We use positive integers here for ease of exposition. Note, though, that underlyingly, position class information will be represented as lists.

leaf type in every dimension. Synchronisation between exponence and morphotactic statements is facilitated by means of the feature MUD (="morphology under discussion"), which characterises the subset of the entire MORSYN a particular rule type is about.

Figure 1 gives an excerpt of the rule type hierarchy we assume for Swahili. The main task of rule types in the MORPHOTACTICS dimension is to define an association between classes of paradigmatic opposition (i.e. rule blocks) with position class information. In a system with completely fixed order, position classes and paradigmatic opposition will stand in a one-to-one correspondence. Types in the EXPONENCE dimension will typically specify phonological material to be added to the PHON list depending on the morpholosyntactic properties to be expressed (described by the MUD value).

In addition to affixational rule types, there is exactly one additional type in the EXPONENCE dimension expressing Stump's (2001) Identity Function Default (IFD). This expresses the fact that in any rule block, in the absence of listed exponents, the default option is to just pass on the input phonology.

2.3 Pāṇini's Principle

Pāṇini's Principle (Stump, 2001), also known as Morphological Blocking (Andrews, 1990), is generally regarded as a fundamental organising principle of morphological systems. In this section, we outline how Pāṇinian competition can be made formally precise within the confines of online type construction. Following Koenig (1999), there are two possible interpretations of the Morphological Blocking Principle: a grammar-internal or static perspective pertaining to knowledge representation, and a dynamic interpretation based on knowledge use where competition is established at run time. In what follows we shall adopt the grammar-based view, since it integrates more readily with the monotonic perspective on constraint satisfaction employed elsewhere in HPSG grammars.

The central assumption behind Pāṇinian competition is that narrower descriptions block the application of broader descriptions. When applied to the and/or hierarchies given above, sister types are always interpreted as disjoint, even if the descriptions stand in a subsumption relation.

Thus, by combining the information contained with the feature structure descriptions themselves with information about sisterhood in a type hierarchy, competition can be made explicit by means of compilation (see Malouf (2005) for an analogous proposal for encoding Pāṇinian competition in the context of a Finite-State Morphology).

Consider two sister types τ and τ' whose MUD values stand in a subsumption relation, e.g., ϕ and $\phi \wedge \psi$. Since Pāṇinian competition assumes disjointness, we can make this explicit in the feature structure descriptions by conjoining the more general description ϕ of τ with the negation of the more narrow description $\phi \wedge \psi$ of τ', giving us the expanded description $\phi \wedge \neg(\phi \wedge \psi)$ which simplifies to $\phi \wedge \neg\psi$ by the laws of statement logic. This generalises to n types by sorting the types on the basis of subsumption relations of MUD values and then adding to the description of each type the negation of the conjuction of the description of all more specific types. Performing this expansion as part of a closure on the underspecifed type hierarchy not only frees us from stating these negations manually over and over again in the type hierarchy but it also establishes Pāṇinian competition as an organising principle of inflectional morphology.

So far, we have made the simplifying assumption that sisterhood alone is sufficient in establishing competition between types. While this may be true in case there is only a single dimension of paradigmatic opposition, it does not hold for more complex inflectional systems where a word inflects along different independent dimensions: to give a simple example from Swahili, the interpretation of zero affixation (identity function default) depends on which rules of exponence it is in competition with, which can be relative marking or negative marking. Thus, morphological competition must apply between sister rule types that stand in paradigmatic opposition, i.e., that add a compatible index to the POI set. Since constraints on MUD are actually existential statements on the MORSYN set, translating competition between rules whose MUD, and therefore, MORSYN descriptions stand in a proper subsumption relation amounts to the introduction of negative existential constraints on the MORSYN of the more "general" rule type. As a result, a Morphological

Blocking Principle that establishes competition on the basis of POI values and subsumption of MORSYN descriptions will be as expressive as Pāṇinian competition in morphological theories such as PFM, while still maintaining compatibility with the general monotonic nature of HPSG.

2.4 Noncanonical morphotactics

In canonical situations such as the one illustrated in Fig. 1, each POI is in a one-to-one correspondence with a position class; hence the MORPHOTACTICS dimension plays little role. In less canonical morphological situations, the correspondence is looser. These cases can be modeled by complementing the MORPHOTACTICS subhierarchy with additional types, either horizontally (providing alternative associations), or vertically (refining the conditions on position class assignment).

The first departure from a canonical system is required by **portmanteau position classes**: since affixation with a single morph may simultaneously satisfy inflectional requirements along two dimensions (in Swahili: negation and subject agreement), adding a morphotactic type for this situation will permit portmanteau position classes to be included into otherwise canonical systems without losing any generality. (5) illustrates schematically the analysis of the Swahili 1st person negative marker.

(5)

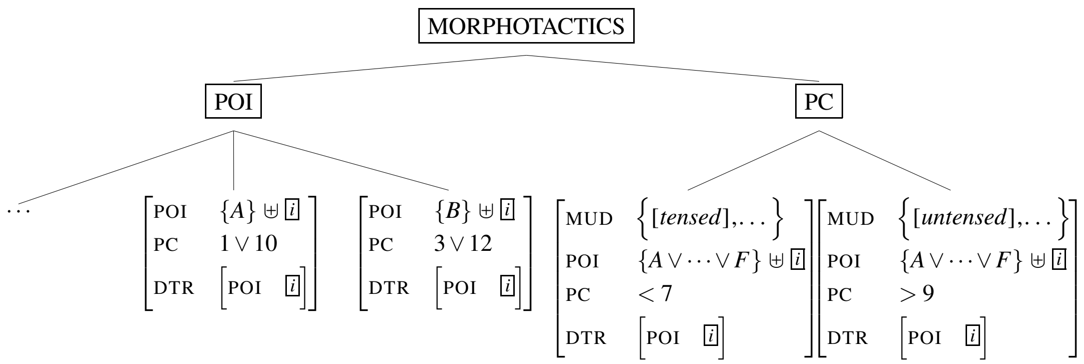
MORPHOTACTICS types

$$\begin{bmatrix} \text{POI} & \{A, B\} \uplus \boxed{i} \\ \text{PC} & \mathit{2} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{POI} & \{A\} \uplus \boxed{i} \\ \text{PC} & \mathit{1} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{POI} & \{B\} \uplus \boxed{i} \\ \text{PC} & \mathit{2} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix}$$

EXPONENCE types

$$\begin{bmatrix} \text{PH} & \boxed{1}\text{+si} \\ \text{MUD} & \left\{ \begin{bmatrix} \mathit{neg} \end{bmatrix}, \begin{bmatrix} \mathit{1sg} \end{bmatrix} \right\} \\ \text{POI} & \{A, B\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \\ \text{PH} & \boxed{1} \end{bmatrix} \end{bmatrix}$$

Figure 2: MORPHOTACTICS subhierarchy for Italian



Ambifixal position classes equally deviate from the one-to-one correspondence between inflectional dimensions and position classes. We express this situation by stating two morphosyntactic types with the same POI but contributing to different position classes. Cross-classification with EXPONENCE types will then allow for a single exponent to be realized in two different positions.

(6)

MORPHOTACTICS types

$$\begin{bmatrix} \text{MUD} & \left\{ \begin{bmatrix} \mathit{rel} \end{bmatrix}, \begin{bmatrix} \mathit{affirmative} \end{bmatrix}, \begin{bmatrix} \mathit{untensed} \end{bmatrix} \right\} \\ \text{POI} & \{D\} \uplus \boxed{i} \\ \text{PC} & \mathit{7} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{MUD} & \left\{ \begin{bmatrix} \mathit{rel} \end{bmatrix} \right\} \\ \text{POI} & \{D\} \uplus \boxed{i} \\ \text{PC} & \mathit{4} \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix}$$

EXPONENCE types

$$\begin{bmatrix} \text{PH} & \boxed{1}\text{+ye} \\ \text{MUD} & \left\{ \begin{bmatrix} \mathit{rel} & \\ \text{PER} & \mathit{3} \\ \text{GEN} & \mathit{m\text{-}wa} \\ \text{NUM} & \mathit{sg} \end{bmatrix}, \ldots \right\} \\ \text{POI} & \{D\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix} \text{PH} & \boxed{1} \\ \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix}$$

Affix clusters can then be accounted for by ensuring covariation between the position class of series of affixes. In the case of the Italian examples in (2): the MORPHOTACTICS type for *me* is underspecified between positions 1 and 10, that for *lo* between 4 and 13. Redundancy is avoided by assuming a subdivision of the MORPHOTACTICS hierarchy as outlined in Figure 2: types in the POI dimension specify ambifixal positioning while types in the PC dimension constrain the relative position of the cluster elements and the nonclustering material.

The fourth departure from the canonical system, which pertains to **parallel position classes**, is of a slightly different nature: in order to express the massive parallelism between exponents of subject and object agreement, rules of exponence should be underspecified not only with respect to grammatical function, but also with respect to paradigmatic opposition and position class. Yet, interpretation of grammatical function is intimately linked to positional realisation. Thus, by introducing specialised subtypes of our canonical morphosyntactic supertype, we can establish the link between grammatical function and position class within the MORPHOTACTICS dimension.

The majority of rules of exponence for subject and object agreement will then be underspecified with respect to paradigm opposition and position class: interpretation of grammatical function is solely imposed by morphotactics. In those cases (2nd and 3rd person MA/WA gender) where grammatical function is also distinguished by the choice of exponent schemata in the EXPONENCE dimension will have a determinate POI.

(7)

MORPHOTACTICS types

$$\begin{bmatrix} \text{MUD} & \left\{\begin{bmatrix} subj \end{bmatrix}\right\} \\ \text{POI} & \left\{B\right\} \uplus \boxed{i} \\ \text{PC} & 2 \\ \text{DTR} & \begin{bmatrix}\text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix} \begin{bmatrix} \text{MUD} & \left\{\begin{bmatrix} obj \end{bmatrix}\right\} \\ \text{POI} & \left\{E\right\} \uplus \boxed{i} \\ \text{PC} & 5 \\ \text{DTR} & \begin{bmatrix}\text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix}$$

EXPONENCE types

$$\begin{bmatrix} \text{PH} & \boxed{1}\text{+a} \\ \text{MUD} & \left\{\begin{bmatrix} subj & \\ \text{PER} & 3 \\ \text{NUM} & sg \\ \text{GEND} & m\text{-}wa \end{bmatrix}\right\} \\ \text{POI} & \left\{B\right\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix}\text{PH} & \boxed{1} \\ \text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix} \begin{bmatrix} \text{PH} & \boxed{1}\text{+wa} \\ \text{MUD} & \left\{\begin{bmatrix} \text{PER} & 3 \\ \text{NUM} & pl \\ \text{GEND} & m\text{-}wa \end{bmatrix}\right\} \\ \text{POI} & \left\{B \vee E\right\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix}\text{PH} & \boxed{1} \\ \text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix}$$

Reversible position classes, as witnessed in Fula, can be treated by means of the dissociation of position from paradigmatic opposition. Recall that the relative ordering of subject and object agreement markers depends on the featural combinations: first singular subject markers follow singular object markers, whereas the order is reversed for all other combinations. Despite the difference in linearisation, exponence is the same regardless of position. We shall therefore assume that rules of exponence for subject and object markers are underspecified with respect to position class. In the MORPHOTACTICS dimension, however, we provide two alternative schemata for the position class of subject markers: a canonical association with position class 3, and an exceptional assignment to class 5, conditioned by the featural combination for subject (1SG) and object (SG). Object markers will always be assigned to their canonical position (4).

(8)

MORPHOTACTICS types

$$\begin{bmatrix} \text{MUD} & \left\{\begin{bmatrix} subj & \\ \text{PER} & 1 \\ \text{NUM} & sg \end{bmatrix}, \begin{bmatrix} obj & \\ \text{NUM} & sg \end{bmatrix}\right\} \\ \text{POI} & \left\{C\right\} \uplus \boxed{i} \\ \text{PC} & 5 \\ \text{DTR} & \begin{bmatrix}\text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix} \begin{bmatrix} \text{MUD} & \left\{\begin{bmatrix} subj \end{bmatrix}, \ldots\right\} \\ \text{POI} & \left\{C\right\} \uplus \boxed{i} \\ \text{PC} & 3 \\ \text{DTR} & \begin{bmatrix}\text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix}$$

EXPONENCE types

$$\begin{bmatrix} \text{PH} & \boxed{1}\text{+mi} \\ \text{MUD} & \left\{\begin{bmatrix} subj & \\ \text{PER} & 1 \\ \text{NUM} & sg \end{bmatrix}, \ldots\right\} \\ \text{POI} & \left\{C\right\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix}\text{PH} & \boxed{1} \\ \text{POI} & \boxed{i}\end{bmatrix} \end{bmatrix}$$

Since both canonical and non-canonical position class assignments for subject markers bear the same paradigmatic opposition index, they are in paradigmatic competition, subject to morphological blocking (see section 2.3 above). Observe that this analysis also aligns neatly the more narrow morphological description with non-canonical position class assignment.

Finally, **Freely ordered position classes** constitute the ultimate reason for distinguishing between paradigmatic opposition and position class. In Chintang, since any of the three prefixes can appear at most once, and every verb must be inflected according to all three dimensions (positives and intransitives with null affixation, by virtue of the identity function default), it is clear that the classes of paradigmatic opposition must be clearly distinguished while only position class is relaxed (illustrated here for person markers).

(9)

MORPHOTACTICS types | EXPONENCE types

$$\begin{bmatrix} \text{POI} & \{A\} \uplus \boxed{i} \\ \text{PC} & 1 \vee 2 \vee 3 \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{POI} & \{B\} \uplus \boxed{i} \\ \text{PC} & 1 \vee 2 \vee 3 \\ \text{DTR} & \begin{bmatrix} \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix}$$

$$\begin{bmatrix} \text{PH} & \boxed{1}\text{+u} \\ \text{MUD} & \left\{ \begin{bmatrix} \textit{subj} & \\ \text{PER} & 3 \\ \text{NUM} & pl \end{bmatrix} \right\} \\ \text{POI} & \{A\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix} \text{PH} & \boxed{1} \\ \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix} \quad \begin{bmatrix} \text{PH} & \boxed{1}\text{+ma} \\ \text{MUD} & \left\{ \begin{bmatrix} \textit{obj,} & \\ \text{PER} & 1 \\ \text{NUM} & pl \end{bmatrix} \right\} \\ \text{POI} & \{B\} \uplus \boxed{i} \\ \text{DTR} & \begin{bmatrix} \text{PH} & \boxed{1} \\ \text{POI} & \boxed{i} \end{bmatrix} \end{bmatrix}$$

3 Conclusion

In this paper, we have investigated properties of position class systems and argued for a treatment of inflectional morphology that combines basic insights from Paradigm Function Morphology with mulitple inheritance hierarchies, as used in HPSG. We have shown in particular that a dissociation of linear position and paradigmatic opposition paves the way for a highly general account of canonical and non-canonical properties of position class systems, based on the cross-classification of underspecified rule type schemata from the orthogonal dimensions of EXPONENCE and MORPHOTACTICS.

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