Establishing Order in Type-Based Realisational Morphology

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Abstract

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 paper 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 Introduction

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. The following example from Moro (Rose, forthcoming) illustrates a typical such situation: object markers such as 2SG *ŋá* occur right before the stem in some tense/aspect/mood configurations (here in the proximal imperfective), and at the end of the word in other configurations (here in the perfective).[1]

(1) a. g-a-**ŋá**-ʧombəð-a
3SG.HUM-FIN-**2SG**-tickle-PROX.IPFV
'He is about to tickle you.'

b. g-a-ʧombəð-á-**ŋá**
3SG.HUM-FIN–tickle-PFV-**2SG**
'He tickled you.'

These situations can not be elegantly described under a 'templatic' view of morphotactics, where morphs are assumed to fall in a strictly ordered sequence of position classes. They also present a challenge to a-morphous approaches to morphological composition (Anderson, 1992) such as Paradigm Function Morphology (PFM; Stump, 2001), where morphotactic order is a direct consequence of the order of rule application; this leads proponents of PFM to relax strict ordering by means of metadescriptions and enrichments of the descriptive vocabulary for realisation rules.

This paper is an attempt to evaluate how we can maintain the basic insights of realisational approaches while capturing variable morph ordering at the description

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Authors' names are listed in alphabetical order. We sometimes take liberty, though, to sort by first names rather than last names.

[1]As Rose (forthcoming) shows, object marker placement correlates strictly with the type of tone assignment associated with a TAM configuration.

level, using only simple rules of exponence. We will argue that the a-morphous hypothesis can be maintained if the traditional notion of position class is analysed as a cluster concept: by distinguishing PARADIGMATIC OPPOSITION CLASSES from SYNTAGMATIC POSITION CLASSES, exponents can be introduced in a single paradigmatic slot while getting realised in variable linear positions.

In section 2, we review the typology of variable morph ordering phenomena, and of current approaches to these phenomena within realisational morphology. Starting from canonical position class systems, we present the four types of deviation (portmanteau classes, parallel classes, ambifixal classes and reversible classes) discussed in (Stump, 1993), and the strategies developed by Stump to accomodate them within PFM. We then discuss two further types, affix clusters and freely ordered classes, that are not easily dealt with using the same kinds of strategies.

In section 3, we devise an inflectional component for HPSG grammars that shares most design features of PFM, a realisational framework for inflectional morphology that is renowned for striking a balance between conceptual soundness and formal explicitness. Previous research has assumed PFM to be broadly compatible with HPSG (Bonami and Samvelian, 2009; Bonami and Webelhuth, in press; Sag, in press); we will show here that the crucial properties of PFM, including its use of rule comparison for arbitrating the choice of exponents, can be implemented within a monotonous grammar formalism. In addition we show how the use of multiple inheritance hierarchies of realisation rules facilitates the flexible separation of morphotactics from exponence, with canonical position class systems corresponding to the limiting case where the two dimensions can be collapsed into one.

2 Aspects of a typology of variable morphotactics

2.1 Canonical 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 (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.

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				
...	...					

Table 1: French prefixal pronominal affixes

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.

2.2 Classical challenges: Stump (1993)

Stump (1993) identifies four deviations from the situation 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.

<table>
<tr><th>1
POL</th><th>2
SUBJ
MRKR</th><th>3
TAM/
POL</th><th>4
REL.
MRKR</th><th>5
OBJ
MRKR</th><th>6
STEM</th><th>7
REL.
MRKR</th><th>translation</th></tr>
<tr><td></td><td>a</td><td>ta</td><td></td><td>ku</td><td>taka</td><td></td><td>‘He will pay you’</td></tr>
<tr><td>ha</td><td>a</td><td>ta</td><td></td><td>ku</td><td>taka</td><td></td><td>‘He won’t pay you’</td></tr>
<tr><td></td><td>ni</td><td>ta</td><td></td><td>ku</td><td>taka</td><td></td><td>‘I will pay you’</td></tr>
<tr><td colspan="2">si</td><td>ta</td><td></td><td>ku</td><td>taka</td><td></td><td>‘I won’t pay you’</td></tr>
<tr><td></td><td>a</td><td>na</td><td>ye</td><td></td><td>soma</td><td></td><td>‘who is reading’</td></tr>
<tr><td></td><td>a</td><td></td><td></td><td></td><td>soma</td><td>ye</td><td>‘who reads’</td></tr>
</table>

Table 2: Swahili position classes

Parallel position classes are pairs of classes that contain the same affixes expressing different but related feature combinations in two different positions. Subject and object person markers in Swahili are a typical case: as Table 3b 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 2. These markers register on the verb agreement with a gap on that verb’s argument structure. They are usually

PER	GEN	SUBJECT		OBJECT	
		SG	PL	SG	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	—

Table 3: Swahili subject and object person markers

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 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 (subject markers are highlighted).

(2) 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'

2.3 Paradigm Function Morphology and the classical challenges

We now show how Paradigm Function Morphology (PFM) deals with the classical challenges to morph ordering. PFM is an evolving framework, but has a core of design features that can be outlined as follows.

(3) a. Inflection is inferential (no lexical listing of morphological formatives) and realisational (exponents are partial realisations of the morphosyntactic features of the word).

b. The description of a language's inflection system is the statement of its PARADIGM FUNCTION, a function mapping pairs of a lexeme and a morphosyntactic property set to surface phonological forms.
c. Rules are organised in mutually exclusive and rigidly ordered BLOCKS; a word is well-formed only if its phonological makeup follows from using exactly one rule from each block.
d. Realisation rules are expressed under the assumption of Pāṇinian competition: within a block, rules expressing more specific property sets block the application of rules expressing less specific property sets.
e. Each block contains an instance of the IDENTITY FUNCTION DEFAULT (IFD) rule, making sure that in the absence of any rule explicitly expressing some features of the paradigm cell, the phonology of the input is not modified.

Under assumption (3c), if all realisation rules introduce a prefixal or suffixal exponent, the relationship between rule blocks and position classes will be as outlined in Fig. 1: successive blocks introduce exponents in positions that are more and more distant from the stem, on either side. Because there is no expectation that a rule block must contain only prefixal or suffixal rules, ambifixal exponents can be introduced in a single block; the postulation of two independent rules introducing the same exponent in different positions can be avoided by positing a metarule (Stump, 1993, 146–152).

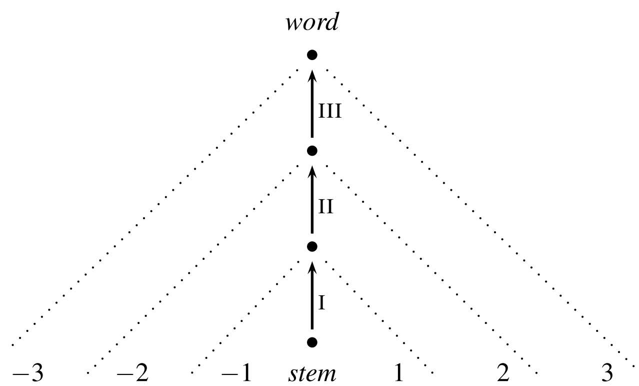
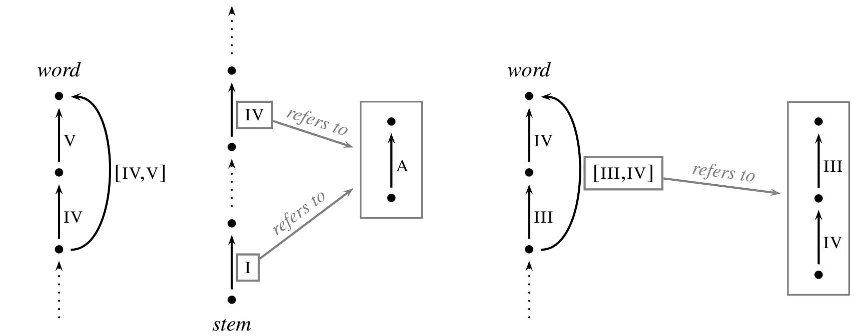


Figure 1: The relation between rule blocks and positions in PFM

Other deviations from a canonical position class system are captured in PFM by enrichments of the economy of rule blocks or the inventory of rule types. To account for portmanteau morphs in general, (Stump, 2001, 139–144) assumes that rules may be indexed for a sequence of successive blocks instead of an individual block (see Fig. 2(a)). Such PORTMANTEAU RULES entail the existence of a PORTMANTEAU BLOCK (here labeled [IV,V]) most of whose members are simply deduced by composition of the rules indexed for the successive blocks: thus in Swahili *si* is in paradigmatic opposition to sequences of prefixes such as *ha-a*.



(a) Portmanteau (b) Parallel (c) Reversible

Figure 2: Noncanonical rule blocks in PFM

Parallel position classes are dealt with using a different mechanism. In PFM, realisation rules come in two guises: RULES OF EXPONENCE introduce an exponent directly through some morphophonological operation, while RULES OF REFERRAL (Zwicky, 1985) state that some morphosyntactic property set σ in rule block α borrows its exponence from the expression of some (related) property set τ in block β. Rules of referral are central to the PFM theory of (directional) syncretism, but can also be used for other purposes. In the case of parallel classes, (Stump, 2001, 144–149) assumes that parallel exponents are introduced by rules in a special, unordered rule block, and that this block is accessed from two different rules in successive blocks through rules of referral. Fig. 2(b) provides a schematic view of the Swahili situation: assuming that block I introduces object markers and block IV introduces subject markers, both blocks contain a rule of referral (symbolised in gray) to unordered block A, where shared exponents are introduced.

Finally, (Stump, 2001, 149–156) models reversible position classes by combining the use of portmanteau rules and referrals, as illustrated in Fig. 2(c). The exceptional order is obtained by positing a portmanteau rule spanning two blocks, which then refers to the output of the composition of those same two blocks in the opposite order.

2.4 Combinations of variably positioned morphs

As the previous subsection showed, the analytic apparatus of (Stump, 2001) is flexible enough to deal with many, and probably most, types of variable morphotactics. However, the design of the theory embodies a disputable set of expectations about the markedness of different types of variable order.

One such expectation concerns the behaviour of combinations of morphs with variable order. Because of the relationship between rule blocks and linear position schematised in Fig. 1, if two affixes can appear simultaneously on either side of the stem, it is expected that their relative position on one side will be the mirror image of their relative position on the other side. Such situations are not unheard of;[2] however, as Luís and Spencer (2005) note, the opposite situation, where sequences of affixes are linearised in the same order on either side of the stem, is well documented, and typical of Romance pronominal affix clusters. We illustrate here with Italian data (Monachesi, 1999).

(4) 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!'

Such data can be accomodated within PFM while maintaining the a-morphous assumption by a combination of reversible and ambifixal rule blocks; however their existence calls into question the validity of the expectation on marked orders embodied by the PFM view. In the absence of relevant typological evidence to the contrary, there is no reason to assume that some types of variable morphotactics are more natural than others.

A separate prediction of the PFM theory of morphotactics is that for any cell in the paradigm, there should be a single possible morph order. This is a consequence of the fact that inflection is a function generating phonological strings, and that no mechanism allows for underspecification of order in the description of these strings.

The recent literature clearly shows this prediction to be falsified. The neatest example[3] is found in 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.

(5) 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

[2] See (Stump, 1993) on Fula subject and preterite markers, and (Kim, 2010) on Huave subject and TAM markers.

[3] See also Luutonen (1997) on Mari declension.

2.5 Taking stock

In this section we have outlined the PFM theory of morphotactics and shown that while it fails to satisfactorily address all variable morph ordering phenomena. In recent but yet unpublished work, Stump (2012) amends the analytic apparatus of (Stump, 2001) by introducing CONDITIONAL AFFIXATION OPERATORS in the language of rule descriptions and CONDITIONAL COMPOSITION OPERATORS in the language of paradigm function descriptions; in addition he provides for the possibility of free ordering by redefining paradigm functions as outputting sets of forms rather than individual forms. While further work is needed to evaluate the merits of these changes, they do not affect the conception of morphotactics on which the previous proposals within PFM are grounded.

In this paper we defend a different approach, and contend that the existing PFM approach is based on an unwarranted presumption that some types of variable placement are more natural than others. This presumption is what motivates 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 or other devices to *modify* the placement of exponents. In the following section we develop a view of morphotactics that does away with presumptions on relative naturalness of variable morphotactic situations, and thus allows for a more uniform account of the phenomena at hand.

3 An HPSG architecture for morphotactics

3.1 Basic assumptions

We now turn to the description of an HPSG approach to variable morph ordering. Our intention is to implement within HPSG an approach to inflection that is as similar as possible to PFM except with regards to morphotactics. Thus we keep the assumptions in (3), except for (3c), and introduce those in (6).

(6) a. Realisation rules process phonological strings from left to right, rather than starting from the stem.

b. Realisation rules are classified separately for paradigmatic opposition and syntagmatic succession.

(6a) breaks with common assuptions in both morphology and neighbouring linguistic areas, like syntax, where the notion of the head plays a central role. Once we take into account,however, common practice in word and paradigm approaches to inflectional morphology, we find that stems are inserted by special stem introduction rules, in order to model stem allomorphy (Stump, 2001; Bonami and Boyé, 2006). Besides stem allomophy, introduction of discontinuous stems (Crysmann, 2002) will require dedicated rules for the introduction of the pieces. Finally, some languages feature zero stems, taking regular inflectional markings, such as the Basque copula (Hippisley et al., 2004). Given the fact that stems do not come for granted but need to be introduced by rules anyway, it is a fairly modest extension to delay the point at which such introduction shall occur.

The main a priori reason for substituting stem-based composition with left-to-right composition is the fact that the latter, but not the former, can systematically avoid the potential for spurious ambiguity entailed by the mere possibility of having both prefixation and suffixation. For instance, in a system featuring 3 prefixal and 2 suffixal position classes, there are 10 different but equivalent ways of ordering the rule blocks that can be entertained (see Fig. 3). To avoid spurious ambiguity, one needs to make an arbitrary choice between these possibilities, since, under the hypotheses of realisational morphology, derivation trees in inflection have no theoretical interpretation (unlike what happens in syntax or lexeme formation). By contrast, strict left-to-right processing systematically avoids the spurious ambiguity problem at the simple (Fig. 4) and uncostly expense of likening stem selection to other rules of exponence by depriving it of the special status to apply first.

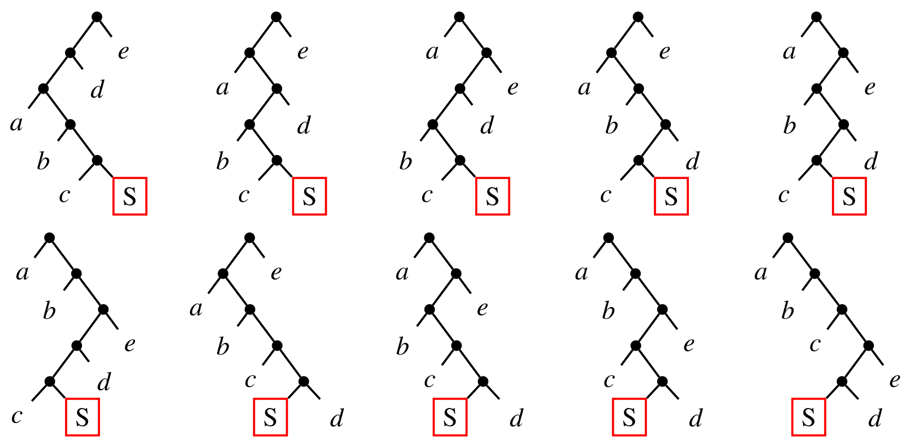


Figure 3: 10 possible composition orders under a stem-first strategy

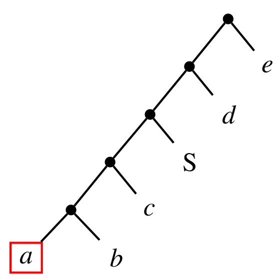


Figure 4: Single possible composition order under a left to right strategy

(6b) is the key to a more general approach to morph-ordering. To dissociate paradigmatic opposition from position class information, we substitute to the PFM notion of rule block two separate 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 be expressed and that rule application apply in the order of position class indices.[4] 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 morphosyntactic feature combination in the general case.

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

Figure 5: Realisation rule type

In order to describe aspects of exponence (selection of shapes) and morphotactics in the most general way, we suggest 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 (Koenig and Jurafsky, 1994; Koenig, 1999), a well formed category (here: a realisational rule instance) must inherit from exactly one 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.

The upper part of figure 6 illustrates this analytic setup through a partial type hierarchy 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-

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

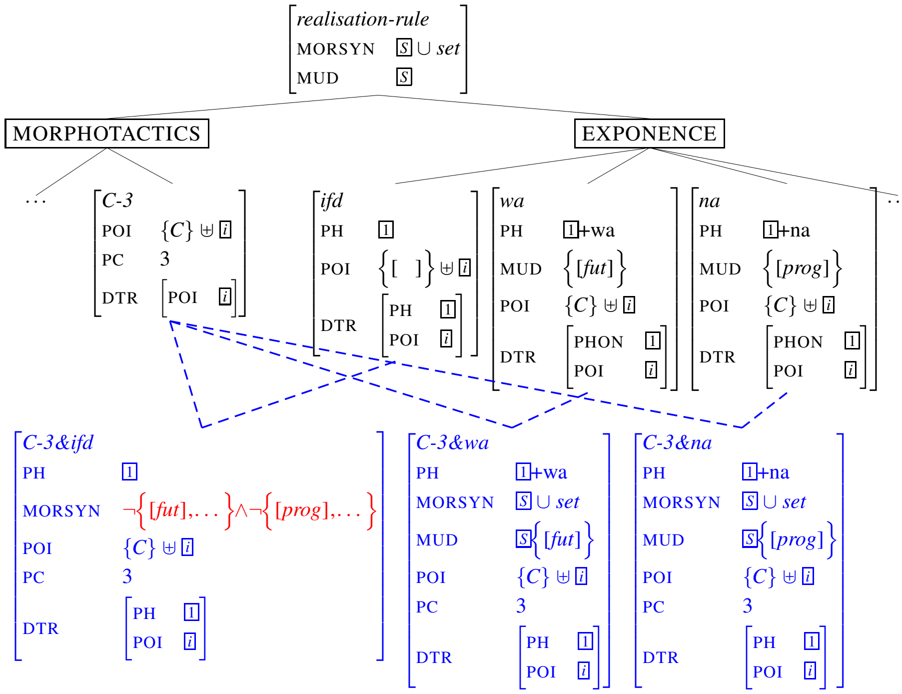


Figure 6: Pāṇini's principle

one correspondence. Types in the EXPONENCE dimension will typically specify phonological material to be added to the PHON list depending on the morphosyntactic 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.

3.2 Pāṇini's Principle

Pāṇini's Principle (Stump, 2001), also known as Morphological Blocking (Andrews, 1990) or the Elsewhere Condition (Kiparsky, 1985), is generally regarded as a fundamental organising principle of morphological systems, by virtue of which more specific rules block the application of more general rules. Before we enter into the discussion of how Pāṇinian competition can be made formally precise within the confines of online type construction, we would like to briefly motivate why an HPSG theory of morphology cannot be considered complete, lest it provide a way to capture this basic insight shared amongst morphological theories as diverse as PFM, Network Morphology (Brown and Hippisley, 2012), Lexical Phonology (Kiparsky, 1985), and Distributed Morphology (Halle, 1997). The central aim of a theory of inflectional morphology is to explain the organisation of morphological paradigms: it is a pertinent observation regarding morphological systems that there is typically a stark contrast between non-default and default realisations: as witnessed e.g. by English regular subject-verb agreement, non-default present tense 3rd person marking can be conjunctively describe as a natural class, whereas default zero realisation cannot. Similar arguments can be made for German 2[nd] declension, where *-s* is used in the genitive singular, *-n* in the dative plural, and the identity function elsewhere. The concept of default realisation can also provide a natural explanation of zero exponence: the fact that many languages can make do without much inflection or that even highly articulate morphological system of the fusional or polysynthetic types feature meaningful zero realisations can easily be captured once we grant the possibility of an identity function default. Stump (2001) even claims that featural coherence in position class systems can be partially explained on the basis of Pāṇini's Principle. Related to its ability to account for what constitutes a natural inflectional system, Pāṇini's Principle, if implemented in the theory of morphology, provides for highly concise morphological descriptions.

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. The line we are taking hare is akin to that of Malouf (2005) who developed an analogous proposal for encoding Pāṇinian competition in the context of a Finite-State Morphology, combining *Ordered Disjunction* (Erjavec, 1994) or *Priority Union* (Karttunen, 1998) with a topological sort on feature structure descriptions.

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 entails 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 the identity function default depends on whether it is in competition with 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. Figure 6 illustrates the effect of Pāṇinian competition in a concrete example.

3.3 Noncanonical morphotactics

3.3.1 Reanalysing Stump's classical challenges in type-based realisational morphology

In canonical situations such as the one illustrated in Fig. 6, each POI is in a one-to-one correspondence with a position class; hence the MORPHOTACTICS dimension plays very 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).

Swahili **ambifixal position classes**, as witnessed by relative agreement markers, constitute the first deviation from a canonical templatic system that militates strongly for a separation of aspects of form (exponence) from position (morphotactics). In order to capture the fact that exponents of relative number and gender agreement are identical independently of how they are linearised, we use partial descriptions of rules of exponence that are crucially underspecified with respect to the position class (PC) index, as illustrated in Figure 7. Systematic alternation between pre-stem and post-stem order is captured by stating two morphosyntactic types with the same POI that restrict the exponents to different position classes: while linearisation in position class 7 is restricted to untensed affirmative verbs, relative markers will be realised in position class 4 in the elsewhere case, by virtue of Pāṇinian competition. Cross-classification with EXPONENCE types will then

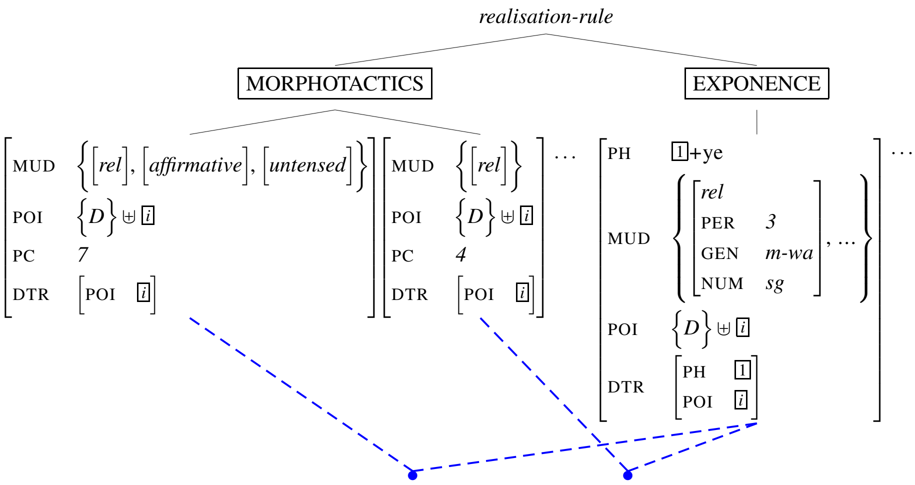


Figure 7: Swahili ambifixal position classes

allow for a single exponent to be realized in two different positions.

The second deviation from the canonical situation we shall address are **reversible position classes**, as witnessed in Fula. Given that rules apply canonically from left to right, there is no significant difference between situations where variable placement targets different sides of the the stem (ambifixals) or affects the relative order of exponents on the same side of the stem. As a consequence, we can invoke the exact same mechanism we used in our analysis of ambifixals to account for reversible position classes.

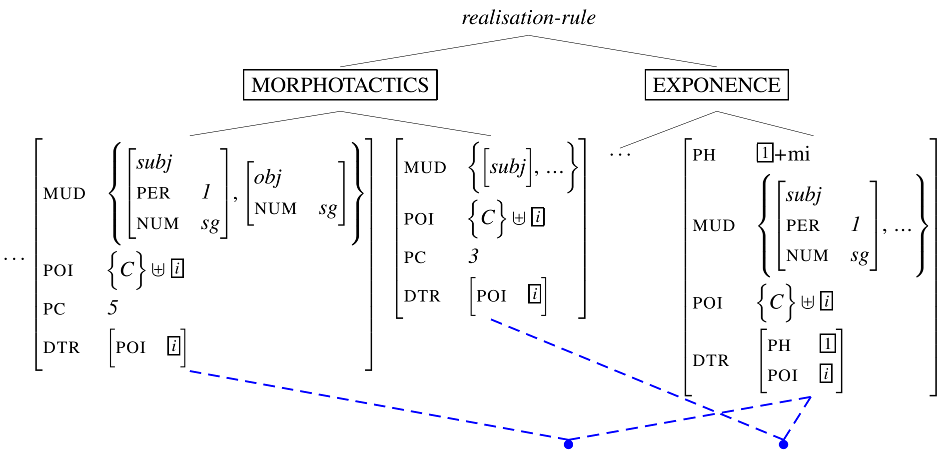


Figure 8: Fula reversible position classes

Specifically, we shall assume that the Fula rules of exponence for subject markers are underspecified with respect to position class. The MORPHOTACTICS dimension provides two alternative schemata for their position: 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 position 4. 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 3.2 above). Observe that this analysis also aligns neatly the more narrow morphological description with non-canonical position class assignment.

The third 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 morphotactic 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, yielding positional disambiguation. 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.

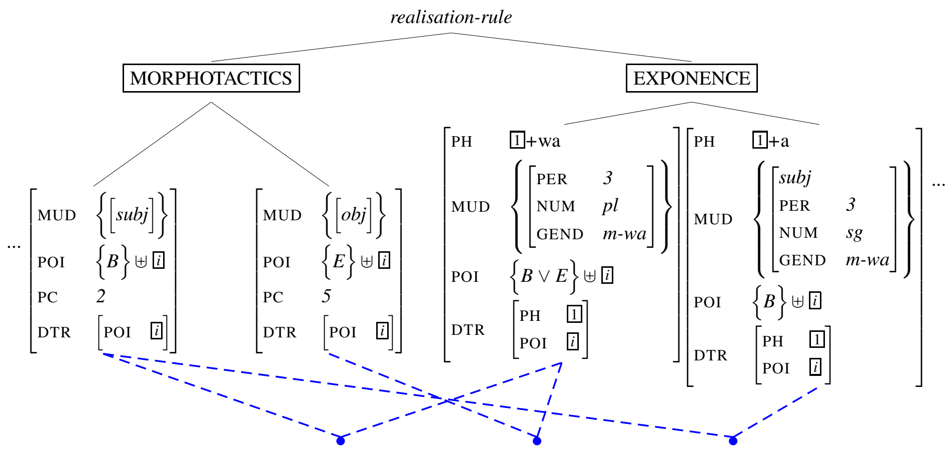


Figure 9: Swahili parallel position classes

The last classical 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. Figure 10 illustrates schematically the analysis of the Swahili

1st person negative marker.

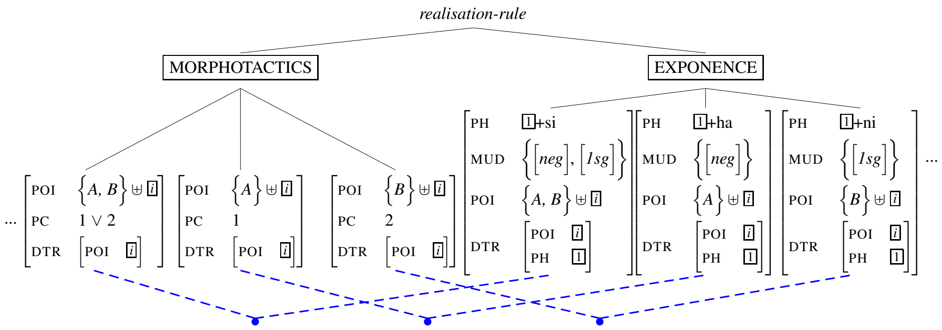


Figure 10: Swahili Portmanteau position classes

3.3.2 Extending the analysis to non-classical cases of variable order: Italian and Chintang

The type-based realisational approach to variable morph order we have sketched in the previous sections can be straightforwardly extended to phenomena which have hitherto not yet received a fully satisfactory formal treatment in standard realisational morphological theories, such as Paradigm Function Morphology, namely ambifixal clusters and freely ordered position classes.

Affix clusters The crucial observation regarding Italian mobile clusters pertains to the fact that relative order within the cluster is maintained regardless of the cluster's position relative to the stem, a situation not well handled by theories that apply rules of exponence from the stem outward. Under our perspective, where rule application canonically applies from left to right and stems can be inserted at any point, this is not an issue.

When confronted with mobile clusters of the type witnessed by Italian, there are two possible perspectives on the data: either, we assume that the stem (and associated non-mobile affixes) are assigned to fixed positions and the cluster elements are variable (="ambifixal clusters"), or else, the cluster elements are in a fixed position and the stem (and associated non-mobile affixes) are assigned to variable positions.

To encode the idea of an "ambifixal cluster" without positing that it forms a morphological constituent (unlike Luís and Spencer, 2005), one may underspecify in parallel the position of each element in the cluster. Although such an analysis will certainly be able to derive the facts, it amounts to treating consistent ordering of the cluster on either side of the stem as a mere coincidence. Nothing would distinguish, in terms of complexity, an order-preserving mobile clusters from some hypothetical system where only odd-numbered slots preserve relative order, yet even-numbered slots invert their order.

This situation can be improved by changing the perspective from “ambifixal clusters” to “ambifixal stems”: not only is the number of affected position classes considerably smaller in the case of mobile stems and TAM/agreement affixes, but also is there less overlap between TAM/agreement affixes that can appear on either side of the cluster, given the fact that only non-finite, and imperative stems can appear in pre-cluster position, and that the number of TAM/agreement exponents found attached to these stems is greatly reduced. Furthermore, under the assumption of mobile stems, the properties conditioning the alternation are actually properties relevant to the selection of exponence as well, e.g. stem selection, whereas under the assumption of mobile affixes, variable placement is conditioned on properties that otherwise play no role for these elements. Still, with our current indexing scheme in terms of alternation between absolute position, even the mobile stem approach cannot avoid picturing remnant cases of order preservation as merely accidental, since we do observe systematic syncretism between agreement markers in the imperative and finite verb forms, suggesting that without a more refined indexing scheme, we will miss an important generalisation: TAM and agreement markers are always linearised at some fixed distance from the stem.

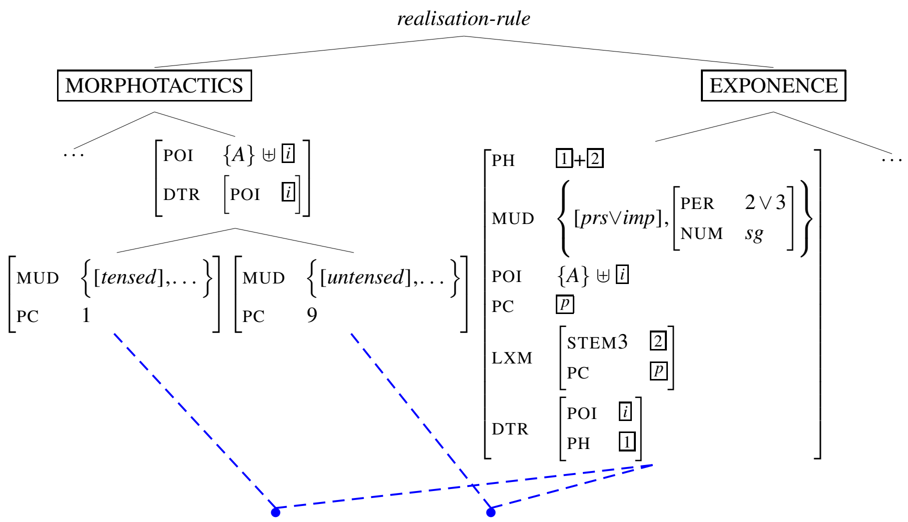


Figure 11: Mobile stems in Italian

To provide a fully satisfactory account of the Italian data we shall take serious the above-made observation that some inflectional markers appear in positions relative to the stem, whereas others are linearised in a stem-independent fashion. This observation regarding position correlates nicely with observations regarding exponence: since stem selection and rules of exponence for TAM/agreement markers already draw on lexeme properties (e.g. inflection class), while rules of exponence for pronominal affixes do not, it is a straightforward extension to record the positional index of the stem as a property of lexemic information. As illustrated in Figure 11, exponence rules of stem selection will redundantly record the position of the stem as a property of LXM. Intersecting with one of the types in the MORPHOTACTICS dimension will then instantiate this index accordingly.

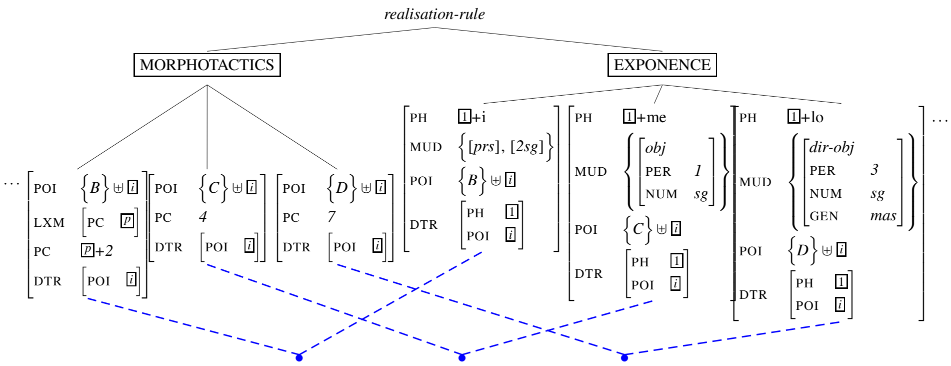


Figure 12: Absolute and relative positioning in Italian

Once the position of the stem is recorded, rules of exponence for TAM and agreement markers can easily specify their position relative to the stem (cf. Figure 12), independently of where that stem happens to be linearised.

As shown in Figure 12, members of the pronominal affix cluster are assigned to fixed positions: depending on the position the stem is realised in, TAM/agreement markers will "move" along, ultimately giving the effect of an "ambifixal cluster".

Thus, at the expense of a single reentrancy in stem introduction rules, we are able to integrate two independent indexing schemes, enabling us to give a redundancy-free and principled account of Italian mobile affix clusters in terms of variable stem placement.

Freely ordered position classes The second non-classical deviation from canonical strict ordering concerns Chintang freely ordered position classes, which 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, as capture by the POI values in Figure 13, while only position class is relaxed.

4 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-

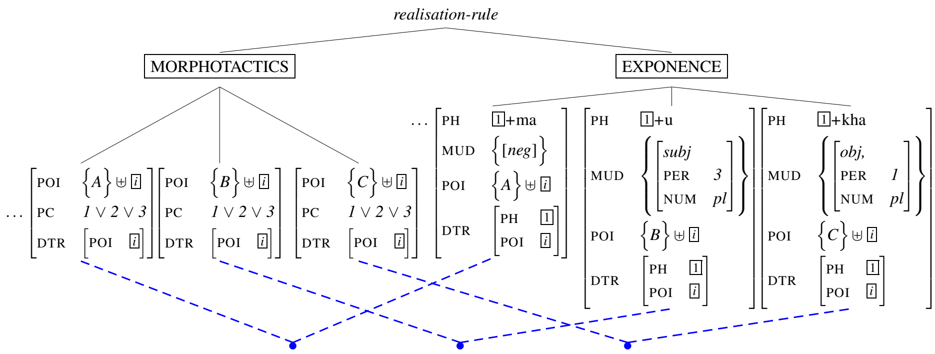


Figure 13: Chintang freely ordered position classes

classification of underspecified rule type schemata from the orthogonal dimensions of EXPONENCE and MORPHOTACTICS.

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