Rule composition and rule interaction in Information-based Morphology: morphotactic competition in Murrinh-Patha

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1 Introduction

Ten years ago, Bonami & Crysmann (2013) presented Information-based Morphology (IbM), a theory of inflectional morphology closely inspired by HPSG (Pollard & Sag, 1987, 1994) that was cast entirely in terms of type hierarchies of realisation rules. The main focus at the time was on variable morphotactics (Crysmann & Bonami, 2016; Diaz et al., 2019; Crysmann, 2020), but since then, the framework has been applied to a wider array of inflectional phenomena, including multiple exponence (Crysmann, 2017, 2021a), overabundance (Bonami & Crysmann, 2018; Crysmann & Bonami, 2017b), reversals (Crysmann & Kihm, 2018), and gestalt exponence (Crysmann & Bonami, 2017a). Despite the diversity of phenomena being covered, the framework has remained quite stable over the years, the architecture being essentially unchanged.

As discussed in detail in Crysmann (2021b), IbM assumes a set of realisation rules, organised in a Koenig/Jurafsky-style type hierarchy (Koenig & Jurafsky, 1994; Koenig, 1999): this means that in addition to vertical abstraction (=underspecification), dimensions permit horizontal abstraction by means of cross-classification of rule types in different dimensions. Rules are minimally pairings of morphosyntactic properties to be expressed (MUD) and the list of morphs (MPH) that serve as exponents.

In order to ensure that rules of exponence are actually applied (completeness) and do not over-apply (coherence), IbM imposes a very general well-formedness constraint that dictates that the set of rules being applied must "consume" the entire morphosyntactic property set (MS): in essence, union of the MUD values to yield the entire MS set ensures completeness, while non-trivial set-union ($\uplus$) provides coherence. The particular choice of non-trivial over ordinary set union is meant to ensure that no rule can be applied twice, which may result in unwarranted repetition of morphs.

(1)
$$\textit{word} \rightarrow \begin{bmatrix} \text{MPH} & \boxed{e_1} \bigcirc \cdots \bigcirc \boxed{e_n} \\ \text{MS} & \boxed{0} \left(\boxed{m_1} \uplus \cdots \uplus \boxed{m_n}\right) \\ \text{RR} & \left\{ \begin{bmatrix} \text{MPH} & \boxed{e_1} \\ \text{MUD} & \boxed{m_1} \\ \text{MS} & \boxed{0} \end{bmatrix}, \ldots, \begin{bmatrix} \text{MPH} & \boxed{e_n} \\ \text{MUD} & \boxed{m_n} \\ \text{MS} & \boxed{0} \end{bmatrix} \right\} \end{bmatrix}$$

Furthermore, the well-formedness constraint exposes the entire MS set to every rule, such that rules can be (allomorphically) conditioned on properties they do not express themselves.

Two things are noteworthy about this well-formedness constraint: first, despite its crucial status for the theory, the exact notion of non-trivial set-union has never been defined in a precise way. In common practice, it seems, complete disjointedness of MUD sets was assumed ($\mu_1 \uplus \mu_2 \equiv \mu_1 \cup \mu_2 \wedge \mu_1 \cap \mu_2 = \emptyset$), although less strict notions are conceivable, e.g. partial overlap ($\mu_1 \uplus \mu_2 \equiv \mu_1 \cup \mu_2 \wedge \mu_1 \not\subseteq \mu_2 \wedge \mu_2 \not\subseteq \mu_1$). However, even the relaxed version will not allow two rules to combine that express different features of the same MUD member, such as e.g. person/number vs. number/gender.

Second, there is an asymmetry between form features and function features, in the context of rules: for morphosyntactic function, rules have access to both local (MUD) and global properties (MS). For form, however, there is only access to local properties (MPH). Incidentally, the first IbM paper (Bonami & Crysmann, 2013), already made use of "pivot" features in order to capture placement relative to the edge, or to a designated element, such as the stem.

In this paper, I shall propose a revised version of IbM that (i) provides for a more flexible way of dealing with overlapping rules on the one hand (coherence) and (ii) generalises morphotactic dependencies ("pivot" features).

Starting with the more straightforward issue, we can easily expose the morphotactic structure of the word (MPS) to the individual rules:

(2)
$$\textit{word} \rightarrow \begin{bmatrix} \text{MPS} & \boxed{1}\ (\boxed{e_1} \bigcirc \cdots \bigcirc \boxed{e_n}) \\ \text{MS} & \boxed{0}\ (\boxed{m_1} \cup \cdots \cup \boxed{m_n}) \\ \text{RR} & \left\{ \begin{bmatrix} \text{MPH} & \boxed{e_1} \\ \text{MPS} & \boxed{1} \\ \text{MUD} & \boxed{m_1} \\ \text{MS} & \boxed{0} \end{bmatrix}, \dots, \begin{bmatrix} \text{MPH} & \boxed{e_n} \\ \text{MPS} & \boxed{1} \\ \text{MUD} & \boxed{m_n} \\ \text{MS} & \boxed{0} \end{bmatrix} \right\} \end{bmatrix}$$

This provides a general mechanism for morphotactic conditioning: in addition to referring to the edge (3) or the stem (4), it will be possible to insist that some other morphotactic position be filled.

(3) Second position placement

$$\begin{bmatrix} \text{MPH} & \left\langle \boxed{1} \right\rangle \\ \text{MPS} & \left\langle \begin{bmatrix} \text{PC} & \boxed{i} \end{bmatrix}, \boxed{1} \begin{bmatrix} \text{PC} & \boxed{i}+1 \end{bmatrix}, \dots \right\rangle \end{bmatrix}$$

(4) Stem-relative placement

$$\begin{bmatrix} \text{MPH} & \left\langle \boxed{1} \right\rangle \\ \text{MPS} & \left\langle \dots, \begin{bmatrix} \textit{stem} & \\ \text{PC} & \boxed{i} \end{bmatrix}, \dots, \boxed{1} \begin{bmatrix} \text{PC} & \boxed{i}+2 \end{bmatrix}, \dots \right\rangle \end{bmatrix}$$

The second issue, trivial set union, stems from the fact that the desired effect of banning repeated application of the same rule was achieved indirectly by a restriction on the combination of MUD values. Since this rules out perfectly legitimate cases of rule combinations as well, I suggest instead that trivial set union should be replaced by ordinary set union. The pathological case of repeated application will be addressed by a restriction on rule combination, insisting that no two rule instances can combine whose MUD and MS descriptions mutually subsume each other.

To demonstrate the usefulness of these revisions, I shall discuss positional competition between subject and object agreement markers in Murrinh-Patha, a polysynthetic Non-Pama-Nyungan language of Australia. The data discussed here are taken from Nordlinger (2010, 2015).

2 Murrinh-Patha

1	2	3	4	5	6	7	8	9
CS.SUBJ.TAM	SUBJ NUM/OBJ	RR	IBP	**LEX-STEM**	TAM	ADV	SUBJ/OBJ NUM	ADV

Figure 1: Murrinh-Patha position classes (Nordlinger, 2015)

			1		2	3
			INCL	EXCL		
SG			N/A	-ngi	-nhi	∅
DU	NSIB	M	-nhi	-nganku+nintha	-nanku+nintha	-(pu)nku+nintha
		F	-nhi	-nganku+ngintha	-nanku+ngintha	-(pu)nku+ngintha
	SIB		-nhi	-nganku	-nanku	-(pu)nku
PC	NSIB	M	-nhi+neme	-nganku+neme	-nanku+neme	-(pu)nku+neme
		F	-nhi+ngime	-nganku+ngime	-nanku+ngime	-(pu)nku+ngime
	SIB		-nhi	-ngan	-nan	-(pu)n
PL			-nhi	-ngan	-nan	-(pu)n

Table 1: Object agreement markers

Verbs in Murrinh-Patha minimally consist of a lexical stem (open class) and a classifier stem (CS) from a set of 38 classifier stem paradigms. Together, these two stems express basic lexical meaning. While the lexical stem (in slot 5) is uninflected, the classifier stem (in slot 1) differentiates TAM as well as subject agreement.

In addition to inflection by means of the classifier stem, Murrinh-Patha verbs are inflected with a number of discrete markers, organised into a positional template, as shown in Figure 1. Of particular interest for this paper are slots 2 and 8, where exponents of subject and object agreement can be found.

Agreement marking operates along up to four inflectional dimensions (illustrated by the paradigm of object agreement markers in Table 1): the language distinguishes four numbers (singular, dual, paucal, plural) and three persons, including a distinction between inclusive and exclusive for first person non-singular cells. Additionally, Murrinh-Patha marks a rather unique category of non-sibling in the dual and the paucal. Exponents of this category are differentiated for gender, which is otherwise not marked in the verb. Furthermore, the paucal is only distinguished for non-siblings. With siblings, paucal and plural are non-distinct. Another peculiarity of the non-sibling marker pertains to its morphotactics: while all other exponents of object agreement surface in slot two, the dual and paucal non-sibling markers are realised discontinuously in slot 8 (in the case of direct object agreement).

Subject agreement (cf. Table 2) is quite similar to object agreement, despite the difference in exponence: while object agreement is realised by discrete markers in slots 2 and 8, subject agreement is realised fusionally as part of the classifier stem (slot 1) plus discrete markers for non-sibling (slot 2/8) and for the non-future dual (slot 2). Another difference pertains to dual non-sibling marking: with direct object markers, the person/number exponent (slot 2) is syncretic with the person/number exponent of the sibling dual, whereas for subjects the classifier stem is syncretic with the singular.

			1 INCL	1 EXCL	2	3
SG			N/A	bam	dam	bam
DU	NSIB	M	thubam	(ngu)bam+nintha	(nu)dam+nintha	(pu)bam+nintha
		F	thubam	(ngu)bam+ngintha	(nu)dam+ngintha	(pu)bam+ngintha
	SIB		thubam	ngubam+ka	nubam+ka	pubam+ka
PC	NSIB	M	thubam+neme	ngubam+ka+neme	nubam+ka+neme	pubam+ka+neme
		F	thubam+ngime	ngubam+ka+ngime	nubam+ka+ngime	pubam+ka+ngime
	SIB		thubam	ngubam	nubam	pubam
PL			thubam	ngubam	nubam	pubam

Table 2: Subject agreement (non-future sub-paradigm for classifier stem *see(13)*)

As discussed above (cf. also Figure 1), the positions for the affixal markers of subject agreement overlap with those for object marking, so the central question is to how conflict is actually resolved. Murrinh-Patha witnesses two strategies: displacement of the subject marker, and omission.

The first case of positional competition relates to the subject non-sibling markers *nintha/ngintha*. When marking subject agreement, these markers surface in slot 2, if available, i.e. before the lexical stem.[1]

(5) bam- **-ngintha-** ngkardu
SUBJ.3.SG-CS.SEE(13).NFUT NON-SIB.F.DU see
'They (dual non-sibling) saw him/her.' (Nordlinger, 2010)

However, if object agreement is overtly realised (any cell other than 3rd singular), slot 2 receives the object person/number marker and the subject non-sibling dual marker must surface in slot 8 instead, i.e. after the lexical stem, cf. (6).

(6) [pu]bam- -ngi- ngkardu **-ngintha**
3.SUBJ.SG-CS.SEE(13).NFUT 1SG.OBJ see SUBJ.DU.NON-SIB.F
'They (dual non-sibling) saw me.' (Nordlinger, 2010)[2]

[1] The paucal non-sibling marker *-neme/-ngime* are always realised in slot 8.

[2] The original example in Nordlinger (2010) provides a singular stem. However, as stated in Nordlinger & Mansfield (2021, Table 3), use of this stem instead of the dual stem is marginal, unless the non-sibling is found adjacent in slot 2. See also the discussion at the end of this section.

Given the fact that subject and object non-sibling markers are syncretic, and that object non-sibling markers are also realised in slot 8, non-sibling marking may end up ambiguous as to whether it refers to the subject or the object, cf. the examples from Nordlinger (2015) below.

(7) ma- -nanku- -rdarri- purl -nu- **-ngintha**
1.SUBJ.SG-CS.HANDS(8).FUT OBJ.2.DU/PC back wash FUT NON-SIB.F.DU
'I will wash your (female dual non-sibling) backs.' *or*
'We (two exclusive female non-sibling) will wash your (dual sibling) backs.'

In (7), *ngintha* may either refer to the object, leaving subject agreement solely marked by the singular classifier stem, yielding singular. Alternatively, singular stem and dual non-sibling marker jointly express first person exclusive female non-sibling dual, leaving the object marker in slot 2 to express sibling dual.

What is important about realisation of the subject dual non-sibling markers is that realisation in slot 8 is only ever licit when slot 2 is blocked by another exponent. If slot 2 is free, subject *ngintha/nintha* must surface there.

The second case relates to the dual/paucal number marker *ka* which appears in slot 2 in the non-future, as shown in (8a,b) from Nordlinger (2010). Note that in the non-future, as opposed to other TAM categories, the dual and plural stems are syncretic.

(8) a. pubam- **-ka-** -ngkardu
3.DU/PL-CS.SEE(13).NFUT -DU/PC.NFUT see
'They (dual sibling) saw him/her.'

b. pubam- **-ka-** -ngkardu- -ngime
3.DU/PL-CS.SEE(13).NFUT DU/PC.NFUT see PC.NON-SIB.F
'They (paucal, female, non-sibling) saw him/her.'

c. pubam- -ngi- -ngkardu
3.DU/PL-CS.SEE(13).NFUT 1.SG.O see
'They (two siblings/plural) saw me.'

d. pubam- -ngkardu
3.DU/PL-CS.SEE(13).NFUT see
'They (plural) saw him/her.'

Again, in the case of overt object marking (8c), subject marking in slot 2 becomes unavailable. In contrast to the dual non-sibling markers, there is no alternate realisation for *ka*, even if a suitable position (like slot 8) happens to be unoccupied. Instead *ka* is simply dropped, possibly leading to ambiguity between dual and plural, as shown in (8c). Note that without a competitor in slot 2, only a non-dual interpretation is possible (8d).

The last morphotactic complication I shall discuss pertains to the choice of classifier stem for dual non-sibling: if the dual non-sibling marker is found in slot 2, the singular classifier stem is used, however, when the non-sibling marker is displaced by competition with an object marker, the dual stem must be used instead.

(9) a. ba- -ngintha- ngkardu -nu
1SG.SBJ.SEE(13).FUT DU.F see FUT
'We two (non-siblings) will see it/him/her.' (Nordlinger & Mansfield, 2021, 8)

b. nguba- -nhi- ngkardu -ngintha -nu
1SG.SBJ.SEE(13).FUT 2SG.OBJ see DU.F FUT
'We two (non-siblings) will see you.' (Nordlinger & Mansfield, 2021, 8)

As argued by Nordlinger (2010) and Nordlinger & Mansfield (2021), the high degree of overlapping exponence, involving discontinuous surface positions provides evidence against a morpheme-based view, favouring instead a templatic realisational perspective. In the next section, I shall present an analysis in IbM, a formal theory of the morphological template.

3 Analysis

In the previous section, we have seen several morphological dependencies, pertaining to both exponence and morphotactics. First, marking of non-siblings is jointly achieved by a classifier stem or object marker expressing person/number and a non-sibling marker expressing number/gender. Second, placement of dual non-sibling gender markers is morphotactically dependent on position 2 being filled, either by an object marker, or by the dual non-sibling gender marker itself. Third, placement of the dual non-sibling gender marker has an impact on the choice of classifier stem (singular vs. dual stem). Fourth, the dual/paucal marker *ka* is in positional competition with the object markers.

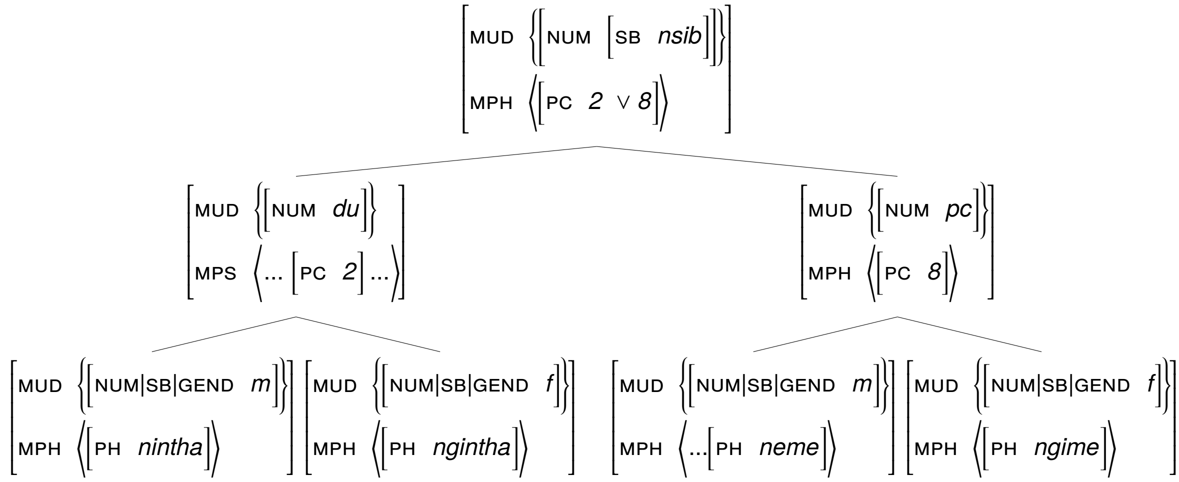

Figure 2: Non-sibling marking

In a non-revised version of IbM, each of these dependencies would have been captured by cross-classifying underspecified rule descriptions to yield rather complex rules that simultaneously talk about up to three morphotactic positions. The analysis I am going to propose instead will take advantage of the revisions laid out at the outset of this paper and reduce complexity by separating the treatment of the gender markers from that of the classifier stems.

The rules for non-sibling gender marking are essentially quite straightforward, as shown in Figure 2: at the top, we find a most general statement about the morphotactics of the entire class of non-sibling gender markers (PC 2∨8), which is in turn narrowed down for paucal and dual by the two subtypes. While paucal markers are always in slot 8, dual markers retain the positional flexibility, yet require slot 2 to be filled. If there is some marker in slot 2, the dual marker will surface in slot 8, given that no two morphs can be assigned to the same positional index within a well-formed word. If, however there is not, placement of *nintha/ngintha* in slot 2 will be the only way to satisfy the constraint on the global morphs list MPS. Note further that the rules are underspecified for grammatical function such that rule application can serve to narrow down the interpretation of either subject or object.

I shall now turn to the admittedly more complex hierarchy of rule for person/number marking of core functions given in Figure 3. This hierarchy is organised into three orthogonal dimensions. As it is standard for IbM, fully expanded rules are obtained from this hierarchy by intersecting each leaf type from one dimension with each leaf type of every other dimension (Koenig & Jurafsky, 1994). Despite the complexity of the hierarchy, most of the properties postulated for the exponence rule types should be rather straightforward. E.g. the rule types in the STEM and SLOT-2 dimensions mostly pair the relevant morphosyntactic property with an exponent and its positional index.

The most straightforward dimension is STEMS: essentially, the rule types capture the expression of subject person number marking by specific forms of a classifier stem. Morphotactically, the stems are restricted to PC 1. Choice of stem form is further conditioned on TAM properties and, of course, lexical specification of the classifier stem (CS). Note, with respect to subject marking, that rule types in this dimension only restrict person in a direct fashion, while number is specified as a stem class property (CLS). This is necessary, given that stem selection and number do not always match up, thereby displaying the kind of morphomic properties we observed with singular stems being used for non-sibling duals.

Accordingly, the MORPHOMIX dimension associates morphomic CLS properties with actual number (NUM): while the general rule type just equates the two, there are specific rule types for non-sibling dual stems, which also capture the morphotactic side effects: the rule type for choosing a singular stem is

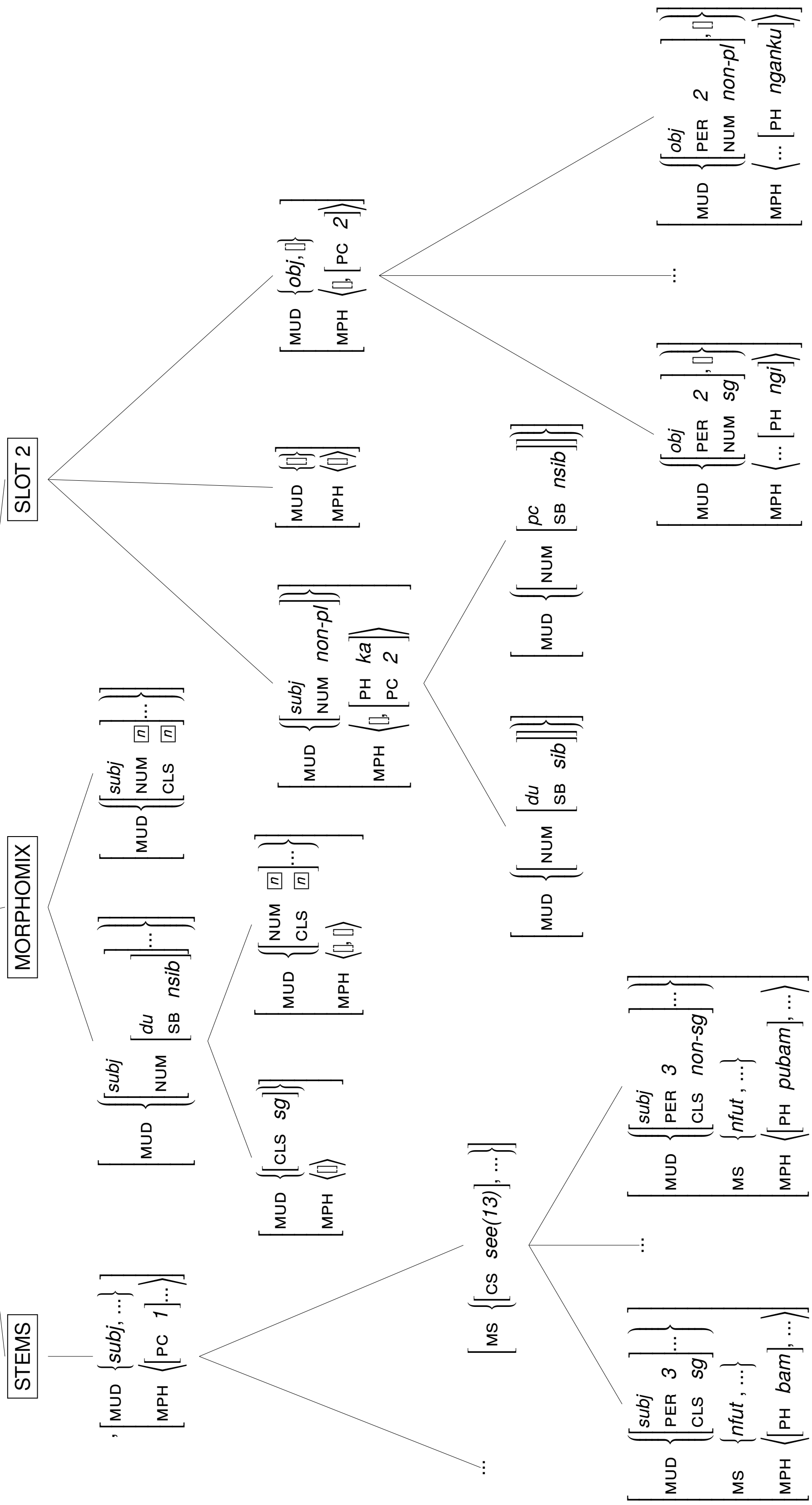

Figure 3: Person/number marking

constrained to be monomorphic, which means it will never unify with any rule types introducing another marker (in slot 2). As a consequence, slot 2 will be left free to host the non-sibling gender marker (cf. Figure 2). Conversely, the rule type for the more regular dual stem is bi-morphic, so it will only unify with rule types that are also bi-morphic, such as the object markers. Since the object markers occupy slot 2, this means that the non-sibling gender marker can only surface in slot 8. These two rule types thus account for the interaction between morphotactics and stem choice shown in (9).[3]

The SLOT-2 dimension on the right finally provides constraints on exponents in slot 2. On the very right, we find rules of exponence for object agreement. Crucially, these rules introduce a marker in slot 2, for every cell in the paradigm, except third singular, which has zero exponence. On the left are the exponence rule for the *ka* marker, with where the supertype fixes shape and position and the two subtypes specify the feature combinations being expressed. Finally, in the centre of this dimension, we find rule type that serves as a target for any stem rule used without any of the aforementioned markers.

Now we have all the ingredients, we can see how they play together to derive the empirical patterns. Two morphotactic patterns are of concern here: the placement alternation of the non-sibling gender markers and the presence vs. absence of the *ka* marker.

The morphotactics of non-sibling marking are almost entirely contained within the rule hierarchy of the gender markers (Figure 2): the paucal markers, with their fixed position in slot 8 are trivial, but the mobile dual markers are dependent on a marker in slot 2, which we capture using the MPS feature. This latter condition for dual non-sibling can either be met by any of the exponents introduced by a rule type from the SLOT-2 dimension in Figure 3. Yet, if none of these markers is present, the positionally flexible dual non-sibling marker itself has to satisfy the requirement. These two situations correlate with stem selection: an object marker in slot 2 satisfies the morphotactic requirement for a dual non-sibling marker to surface in slot 8 and, by being part of a bi-morphic person-number marking rule, it selects the dual stem. Conversely, if no object marker is present, only the mono-morphic dual non-sibling person/number rule can be selected, introducing the singular stem. And, as already stated above, slot 2 can and must be filled by the non-sibling gender marker.

The other morphotactically interesting case pertains to the *ka* marker. If no object marker is present, position 2 is available and the marker is obligatory in the sibling dual and the non-sibling paucal. As can be verified from Figure 3, the combination of a non-singular stem rule type with any of the *ka*-rule types will be more specific than the monomorphic classifier stem rule: as a result, Paninian competition will select the *ka*-inflected classifier stem over the bare one. With a direct object marker in slot 2, the situation changes: since object markers equally combine with classifier stems into complex rules with equally complex MUD values specifying both subject and object properties, they are not preempted by the *ka*-rule types via Paninian competition. To summarise, rule combination by cross-classification achieves the correct behaviour with respect to Panini's principle here.

4 Conclusion

We have discussed complex morphotactic dependencies in Murrinh-Patha and shown how these can be modelled in IbM, a formal neo-templatic approach to morphology built on multiple inheritance hierarchies of type feature structures. The analysis of Murrinh-Patha has prompted me to propose two revisions to IbM theory, both in the interest of facilitating modular analyses: (i) to provide for a more general way of capturing morphotactic dependencies and (ii) to permit a more flexible way in which independent rules can contribute to the expression of morphosyntactic properties. In the concrete case at hand, we have seen that these revisions help to provide for a more parsimonious description, something that has been one of the design goals of the theory from the very start. The intricacy of morphotactic interactions in Murrinh-Patha have also helped to highlight that two different cases of morphotactic competition may require different answers: independent rules in case of pure morphotactic dependency and complex rules built by cross-classification, to capture cases where morphotactic dependency interacts with Paninian competition.

[3] If one wants to rule in the marginal acceptability of a singular stem with a dual non-sibling marker in slot 8, all it takes is to remove the constraint on MPH to be monomorphic.

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