Udi Infixation in Information-based Morphology

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1 Introduction

In this paper, we shall discuss infixation of subject agreement and related markers in the Udi verb. The main aim of this study is threefold: First, the subject agreement markers show a hybrid status between attachment to the edge of a focused phrase and attachment to the verb, where infixation may occur. Thus, the present paper shall complement the recent morphosyntactic analysis of Udi hybrid clitics by Crysmann & Luís (to appear) with an account of morphology proper. Second, in contrast to infixation in e.g. Sorani Kurdish (Bonami & Samvelian, 2008; Walther, 2012; Bonami & Crysmann, 2013; Salehi & Koenig, 2023), Udi infixation does not always occur at morph boundaries (intermorphic), but may be inserted into the root, depending on the class of stem (intramorphic). Third, Udi constitutes another case where infixation does not optimise prosodic structure (cf. Yu, 2007): we shall argue that the ultimate decision for intramorphic infixation is morphological, not phonological in nature.

Building on the empirical description in Schulze (1982) and Harris (2002), we shall discuss the specific morphotactics of Udi subject agreement with respect to simple/complex stems, as well as TAM classes, including the trapping effect induced by tenses based on the future stem. we shall propose an analysis with Information-based Morphology (Crysmann & Bonami, 2016; Crysmann, 2021), that crucially associates infixation with the morphological stem. To that end, we shall formulate classes of stem realisation rules that may or may not let stem phonology wrap around the infixal marker.

2 Morphotactics of Udi subject agreement

Udi subject agreement is well-known for its paradoxical status as a lexical infix to the verb, as in (1), and a phrasal affix to negation, wh-phrases and focused constituents, as in (2).

(1) äyel-en a-**t'u**-k'-e k'uč'an-ax
child-ERG see$_1$-3SG.INV-see$_2$-AORII puppy-DAT
'The child saw the puppy.' (Harris, 2002)

(2) met'in-al burim sa yärävgä q'əzəl-**le** aq'sa
this.ERG-AND apparently one bag.ABS gold.ABS-3SG take
'She also apparently takes a BAG OF GOLD.' (Harris, 2002)

While Harris (2000, 2002) and Anderson (2005) propose analyses in terms of endocliticisation, Crysmann (2003); Spencer & Luis (2012); Crysmann & Luís (2023) reject this line of analysis for its violation of lexical integrity. They further argued that proponents of endoclisis have glossed the evidence in favour of a status as morphological affixes. Instead, Spencer & Luis (2012) and Crysmann & Luís (to appear) suggest an approach in terms of hybrid clitics/affixes, showing lexical attachment to verbal hosts and phrasal attachments when realised as displaced morphology on a non-verbal host. These works have mainly concentrated on the featural interface to relate lexical and phrasal realisation, which actually stand in complementary distribution.

		General	Question	Inversion	Possession
SG	1	-zu,-z		-za	-bez,-bes
	2	-nu,-n,-ru,-lu		-va	-vi
	3	-ne, -re, -le	-a	-t'u	-t'a
PL	1	-yan		-ya	-beš
	2	-nan,-ran, -lan		-va, -vạn	-ẹf
	3	-q'un		-q'o	-q'o

Table 1: Udi subject agreement markers (Harris, 2002, p. 28)

In this paper we shall focus on the morphotactic interactions of subject agreement markers within the Udi verb, in particular the different cases of infixation, thus complementing the morphosyntactic analysis with an account of morphology proper.

Udi subject agreement is expressed by the markers given in Table 1, providing distinct forms for the six cells of the paradigm (three persons times 2 numbers). The different sets can be considered allomorphic variants, their choice being conditioned lexically by the verb.[1] With respect to their morphotactics, markers from all these sets behave equivalently.

When attached to the verb, the subject agreement marker can be found in one of several positions, depending on the TAM category and the makeup of the stem. Schulze (1982, 169) lists the five patterns in Table 2 for verbal attachment.[2]

1.	V-T-Agr	pi-ne	'he said'
2.	V-T^1-Agr-T^2	pe-ne-i	'he has said'
3.	V^1-Agr-V^2-T	ba-ne-k-i	'he was
4.	Vn-Agr-Aux/V-T	aš-ne-biq'-e	'he took work
5.	Vn-Aux/V-T-Agr	lašq'o-bak-a-nan	'you (pl) should marry'

Table 2: Morphotactic placement patterns for Udi subject agreement (Schulze, 1982, 169)

As should be evident, infixation into the root as in (1) is only one of several patterns for verb-internal realisation, i.e. pattern 3. Another factor that is illustrated by these pat-

[1] The exception is the question marker *-a* for third singular in the generic set. This form is indeed triggered syntactically. See Harris (1992) for details.

[2] Hyphenation of examples and glosses follows the original. In patterns 1 and 2, stem and (inner) tense marker are not segmented off.

terns is which morphological elements display morphotactic interaction with the agreement markers: namely tense or more generally TAM markers (cf. patterns 1 and 2, well as patterns 4 and 5) and the stem (cf. patterns 3 and 4). We shall look into these in turn, building on the descriptions by Schulze (1982) and the (ordered) placement rules proposed in Harris (2002).

2.1 TAM marking

As stated by Harris (2002), cf. also Schulze (1982, 157), some TAM categories, namely the Future II[3], Subjunctive I and II, and the Imperative enforce suffixation of the agreement markers to these (primary) TAM markers, cf. pattern 5 in Table 2. It is of note that this TAM-related placement constraint trumps all the stem-related effects that we shall discuss below.

(3) ič turinlek'er-ax nut' tämiz-b-al-**le**
self's shoe-DAT NEG clean-DO-FUTII-3SG
'She won't clean her shoes.' (Harris, 2002, 96)

(4) gel-enk' ek'a yaq'a-b-al-**lu**
Gela-for what.ABSL road-DO-FUTII-2SG
'What will you send to Gela.' (Harris, 2002, 118)

Furthermore, this placement restriction even preempts phrasal attachment to negation (3), or to a focused or wh constituent (4).

In addition to primary TAM markers, Schulze (1982) recognises secondary tense markers that combine with the primary ones. Among these, the past marker *-i/-y* may serve to form derived TAM categories based on every primary TAM (Schulze, 1982, 160). Placement of the past marker *-i* is at the right edge, as illustrated by pattern 2.

2.2 Complex and simple stems

All remaining *morphological* restrictions on affix placement are related to the structure and shape of the stem, as hinted at by the contrast between patterns 3 and 4.

2.2.1 Complex bases

A considerable part of the Udi verb lexicon is derived by means of incorporation of nouns or adjectives with a light verb. As argued convincingly by Harris (2002, ch. 4.4), these complex verbs are not syntactically transparent construction synchronically, but must be considered as lexically composed. With complex bases such as these, the agreement marker gets infixed between the light verb and the incorporated element.

(5) a. zavod-a aš-**ne**-b-sa
factory-DAT work-3SG-DO-PRES
'She works in a factory.'

b. me pasčaɣ-en eč-es-**ne**-st'a ... kul
this king-ERG bring-INF-3SG-CAUS.PRES earth.ABS
cip-es-*ne*-st'a pak-i
spread-INF-3SG-CAUS.PRES garden-DAT
'This king has earth brought ...; he has it spread in the garden.'

This placement corresponds to pattern 4.

2.2.2 Simple bases

While placement with complex bases is comparatively straightforward, simple bases harbour most of the morphotactic complexity. Superficially, we observe three patterns: realisation as an infix before the final consonant of the root (cf. pattern 3), infixation between the root and the (primary) tense markers, and suffixation to the primary tense markers (cf. pattern 1).

Suffixation Placement to the right of the primary tense markers in TAM categpries other than the one's discussed in Section 2.1 above, occurs with stems that consist of a single C (or maximally: CV) plus a few irregular verbs (see Harris, 2002, 130). See, the present tense example for pattern 1 in Table 2. The phonological minimality condition can easily be motivated, since these bases do not permit infixation before the final C.

Infixation The default placement of subject agreement markers is right before the final C of a simple verbal root. A particular class of verb stems (class M) shows an alternation between this intramorphic infixation and intermorphic placement, where the agreement marker ends up between the root and the primary TAM marker, a pattern not listed by Schulze (1982).

INTRA		INTER	
a-**t'u**-k'-sa	'sees (TR)'	ak'-**ne**-sa	'is visible (INTR)'
bi-**ne**-t'-sa	'sows (TR)'	bit'-**t'e**-sa	'is sown (INTR)'
bo-**ne**-x-sa	'boils (TR)'	box-**ne**-sa	'boils (INTR)'
u-**ne**-k-sa	'eats (TR)'	uk-ne-sa	'is edible (INTR)'
ụ-**ne**-ɣ-sa	'drinks (TR)'	ụɣ-**ne**-sa	'is drinkable (INTR)'

Table 3: Intra- and intermorphic agreement (Harris, 2000, 127)

Harris (2002) observes that the intransitive verbs, given in the present tense in Table 3 show an overt light verb in other tenses, e.g. *box-eɣ-al-le* 'it will boil' in the Future II, or *box-ne-c-e* 'it boiled' in the Aorist II. As shown by the latter example, infixation occurs between the lexical stem *box* and the light verb, as expected for complex verb stems. In the present tense, characterised by placement of agreement between root and tense marker, she postulates a zero allomorph of the inchoative light verb.

To close our discussion of the empirical patterns, Udi infixation also provides one of the counter-examples to the claim made in Prosodic Morphology (McCarthy & Prince, 1993)

[3]The numbering of future tenses differs between Harris (2002) and Schulze (1982). We shall use the the term Future II for the TAM in *-al*, as in Harris (2002).

that infixation results from optimisation of syllable structure: first, as witnessed by the surface strings *uknesa* 'it is edible' and *uneksa* 's/he eats', infixed and suffixed versions are equally acceptable (they just men different things). Second, in contrast to e.g the textbook case of Tagalog <*um*> infixation (*s<um>ulat* vs. **um-sulat*), infixed and suffixed variants have exactly the same number of codas (=closed syllables).

We conclude that phonology cannot be regarded the driving force in Udi infixation and therefore propose an approach in terms of templatic morphology.

3 Analysis

The analysis we propose in this paper is couched in Information-based Morphology (=IbM; Crysmann, 2021; Crysmann & Bonami, 2016), an inferential-realisational theory of infection that implements a flat, neo-templatic approach to morphotactics using rule descriptions represented as typed feature structures.

3.1 Informal sketch

We shall start by sketching a positional template for the Udi verb and the flesh out, by means of morphological realisation rules, the exact conditions under exponents will be assigned these positional indices.

-2	-1	0	1	2	3	4	5	6
STM4	STM3	STM2	TNS1	*OPT*	**AGR**	STM1	TNS2	PST

Figure 1: Udi verb position classes

We shall first provide a characterisation of the elements that shall fill the ordered positions, and then provide instantiated sample templates, corresponding to the major empirical patterns. Finally, we give a sketch of the formal constraints that will license these patterns.

Starting with the agreement markers, we assign them a fixed position class index (PC 3). That means that variable linearisation will be the effect of alternate placement of stems and tense markers. [4] This is in fact quite similar to the approach for Italian pronominal affix clusters in Crysmann & Bonami (2016).

Turning to exponents of TAM next, we reserve a verb-final slot for the secondary past marker *-i/-y* (PC 6). Most primary tense markers will surface to the right of the agreement markers (PC 5) by default. There are two exceptions: the Future II, Subjunctive I/II and Imperative markers surface between the rightmost stem and the agreement marker. Other primary tense markers surface in this slot (PC 1), if the simple base consists of a single consonant only, cf. pattern 1.

Turning now to the linearisation of stems, simple stems can be realised in two positions (PC 0 and/or PC 4). Since stems only surface to the left of primary tense markers, PC 4 is unavailable for sub-minimal bases (C/CV) or with TAM categories that always precede the agreement markers, such as the Future II (PC 1). Otherwise, the final C of the simple base is realised to the right of agreement (PC 4), while the initial part of the base precedes it (PC 0).

Turning, finally, to complex bases, we find two possible placements for the light verb, again before (PC 0) or after agreement (PC 4), the choice depending once more on the tense markers: in the Future II, e.g., the light verb surfaces to the left (PC 0) of the tense marker *-al* (PC 1), which itself precedes agreement (PC 3). In other tenses (PC 5), the light verb surfaces to the right of agreement as well (PC 4). The stems and incorporated elements that are "embedded" under the light verb precede position 0, iconically in the order of embedding

-2	-1	0	1	2	3	4	5	6
		p	i		ne			

(a) Pattern 1, Table 2

-2	-1	0	1	2	3	4	5	6
		p	e		ne			i

(b) Pattern 2, Table 2

-2	-1	0	1	2	3	4	5	6
		ba			ne	k	i	

(c) Pattern 3, Table 2

-2	-1	0	1	2	3	4	5	6
	aš				ne	biq'	e	

(d) Pattern 4, Table 2

-2	-1	0	1	2	3	4	5	6
	yaq'a	b	al		lu			

(e) Pattern 5, ex. (4)

Figure 2: Position class analysis of Udi surface patterns

The five major patterns from Table 2 are summarised schematically in Figure 2, showing specific instantiations of the general template from Figure 1.

3.2 Formal constraints

Having just described how a templatic approach will capture the fundamental morphotactic patterns in the Udi verb, we shall now briefly look into key aspects of the formal analysis that show how the template will be suitably constrained.

3.2.1 Exponence rules

Rules of exponence in IbM pair morphological properties to be expressed with exponents that serve to express them. Properties to be expressed are represented as members of the set-valued feature MUD. Rules specify a list of morphs MPH (possibly empty) that realise the features in MUD. Morphs are typically pairings of a phonological shape with a positional index. Rules can be further conditioned on properties they do not strictly express by placing constraints on the word's morphosyntactic property set (MS), and they may also impose

[4] This decision will facilitate an account of the fixed cluster formed by agreement and e.g. the optative and coordination markers, see Harris (2002); Crysmann & Luís (2023). Accordingly, the optative marker is assigned to the adjacent slot (PC 2).

constraints on the position or presence of other morphs in the word (via MPS; cf. Crysmann, 2023). Rules are organised into inheritance hierarchies to capture generalisations.

A straightforward rule for 3rd singular subject agreement is given in (6)

(6) $$\begin{bmatrix} \textsc{mud} & \left\{\begin{bmatrix} \textit{agr} & \\ \textsc{per} & \textit{3} \\ \textsc{num} & \textit{sg} \\ \textsc{set} & \textit{inv} \end{bmatrix}\right\} \\ \textsc{mph} & \left\langle\begin{bmatrix} \textsc{ph} & \text{t'u} \\ \textsc{pc} & \textit{3} \end{bmatrix}\right\rangle \end{bmatrix}$$

Similarly, we can underspecify position class, e.g. for the present tense rule, like in (7).

(7) a. $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{tns} \quad \textit{prs}\right]\right\} \\ \textsc{mph} & \left\langle\left[\textsc{ph} \quad \text{(e)sa}\right]\right\rangle \end{bmatrix}$$ b. $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{tns} \quad \textit{fut2}\right]\right\} \\ \textsc{mph} & \left\langle\left[\textsc{ph} \quad \text{al}\right]\right\rangle \end{bmatrix}$$

We can extract interesting generalisation into supertypes: e.g., that primary tense markers are adjacent to a stem exponent, as given in (8).

(8) $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{tns} \quad \top\right]\right\} \\ \textsc{mps} & \left\langle \ldots \left[\textsc{pc} \quad \boxed{n} \text{ - } \textit{1}\right], \boxed{t} \ldots \right\rangle \\ \textsc{mph} & \left\langle \boxed{t}\left[\textsc{pc} \quad \boxed{n}\ \textit{1} \vee \textit{5}\right]\right\rangle \end{bmatrix}$$

Using dynamic cross-classification across multiple dimensions (Koenig & Jurafsky, 1994; Koenig, 1999), we can distribute further morphotactic constraints over these exponence rules, as given in (9): the constraint in (9a) represents the morphotactic default, whereas (9b) and (9c) represent more specific overrides that are conditioned on stem shape or TAM category.

(9) a. $$\left[\textsc{mph} \quad \left\langle\left[\textsc{pc} \quad \textit{5}\right]\right\rangle\right]$$ b. $$\begin{bmatrix} \textsc{mps} & \left\langle \ldots \left[\textsc{ph} \ \text{C(V)}\right], \boxed{t} \ldots \right\rangle \\ \textsc{mph} & \left\langle \boxed{t}\left[\textsc{pc} \quad \textit{1}\right]\right\rangle \end{bmatrix}$$

c. $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{tns} \quad \textit{fut2} \vee \textit{subj} \vee \textit{imp}\right]\right\} \\ \textsc{mph} & \left\langle \boxed{t}\left[\textsc{pc} \quad \textit{1}\right]\right\rangle \end{bmatrix}$$

Together, these constraints already capture a good deal of Udi verb morphotactics, namely the adjacency of TAM markers to an exponent connected to the stem, and the relative placement of TAM markers with respect to agreement.

3.2.2 Complex bases

Before we cam enter the discussion of stem realisation rules, we need to briefly expound how complex bases should be represented as part of the morphological input. The general format of stem realisation rules in IbM is quite simple: as stems serve to mark the identity of a lexeme (*lid*) or flexeme (*pid*; Bonami & Crysmann, 2018), the shapes will be lexically specified. The only function of the realisation rules are selection of a stem from the stem space (allomorphy) and the placement of the stem thus selected as a morph with appropriate morphotactic coconstraints.

One possibility for representing complex stems would be to a single stem-related property with complex stem lists, another would be to have multiple entries that are nested using reentrant features. Since nothing much hinges on this choice for the concrete case at hand, we shall go for the first option.

The representation of the stem space for a complex base shall look like in (10). We are using the example of inchoative *box* (INTR), which has overt light verbs as aorist and future stems, yet a zero light verb for the present stem (see above).[5]

(10) $$\begin{bmatrix} \textit{pid} & \\ \textsc{stm} & [\,] \\ \textsc{stms} & \begin{bmatrix} \textsc{prs-st} & \left\langle \boxed{b}\left[\textsc{ph} \ \text{box}\right], \left[\textsc{ph} \ \text{“ ”}\right]\right\rangle \\ \textsc{aor-st} & \left\langle \boxed{b}, \left[\textsc{ph} \ \text{c}\right]\right\rangle \\ \textsc{fut-st} & \left\langle \boxed{b}, \left[\textsc{ph} \ \text{(e)y}\right]\right\rangle \end{bmatrix} \end{bmatrix}$$

Selection of a stem allomorph from the stem space will typically be achieved as a side effect of a TAM rule, e.g., the present rule from above will be expanded as follows:

(11) $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{tns} \quad \textit{prs}\right]\right\} \\ \textsc{ms} & \left\{\left[\textsc{stm} \quad \boxed{s} \right.\right. \\ & \left.\left. \textsc{stms} \quad \left[\textsc{prs-st} \quad \boxed{s}\right]\right], \ldots\right\} \\ \textsc{mph} & \left\langle\left[\textsc{ph} \quad \text{(e)sa}\right]\right\rangle \end{bmatrix}$$

3.2.3 Stem introduction rules

The next major set of constraints relates to how exactly exponents of the stem are distributed across the available positions. Since tense allomorphy is handled by tense realisation rules, which create the appropriate reentrancy from the stem space into the STM feature, stem introduction rules may abstract away from the stem space by making reference to the STM feature primarily.

Starting with simple bases, we need to consider two situations: sub-minimal bases with C(V) shape, and regular bases where the final consonant is split off.

(12) a. $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{stm} \quad \left\langle \boxed{s}\left[\textsc{ph} \ \text{C(V)}\right]\right\rangle\right]\right\} \\ \textsc{mph} & \left\langle \boxed{s}\left[\textsc{pc} \quad \textit{0}\right]\right\rangle \end{bmatrix}$$

b. $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{stm} \quad \left\langle \boxed{s}\left[\textsc{ph} \quad \boxed{i}\ \textit{nestring} + \boxed{f}\ \text{“C”}\right]\right\rangle\right]\right\} \\ \textsc{mph} & \left\langle \begin{bmatrix} \textsc{ph} & \boxed{i} \\ \textsc{pc} & \textit{0} \end{bmatrix}, \begin{bmatrix} \textsc{ph} & \boxed{f} \\ \textsc{pc} & \textit{4} \end{bmatrix}\right\rangle \end{bmatrix}$$

Both rules express lexemic identity by taking a stem phonology and inserting it into the morphotactic structure, complete with a position class index.

Finally, rules for complex bases will generally need to perform two tasks: insert the stem list-final light verb stem in position 0 or 4, depending on the TAM category, and insert the preceding stem material, including incorporated elements, to the left of position 0.

[5] The derivational side of this can be handled by description-level lexical rules that perform the shift in semantics and valency, as well as augment the stem information of the base verb with that of the light verb, to yield the *pid* representation in (10).

(13) $$\begin{bmatrix} \textsc{mud} & \left\{\left[\textsc{stm} \quad \boxed{s} \oplus \left\langle \boxed{p}, \boxed{f} \right\rangle\right]\right\} \\ \textsc{mph} & \boxed{s} \oplus \left\langle \boxed{p}\left[\textsc{pc} \quad \textit{-1}\right], \boxed{f}\left[\textsc{pc} \quad \textit{0} \vee \textit{4}\right] \right\rangle \end{bmatrix}$$

This rule captures the stem placement witnessed in patterns 4 and 5: the light verb surfaces in position 0 or 4, depending on the TAM category to which it has to be adjacent. The embedded stems will all precede position 0. As a result, agreement will surface exactly between incorporated elements and the light verb. Following Harris (2002), we regard the zero realisation of the inchoative light verb as present tense stem allomorphy. Accordingly, position 4 can be filled by overt and null stems. Thus, we shall treat present tense inchoatives on a par with aorist inchoatives.

4 Conclusion

In this paper, we have presented a templatic analysis of the morphotactics of Udi subject agreement, including intricate patterns of infixation. We have argued, in particular, that OT-style constraints are conceptually less suited for infixation patterns that fail to optimise prosody. Instead, the approach advanced here is morphological in nature, formalised in Information-based Morphology, an inferential-realisation model of inflectional morphology, which is couched in the same formalism as HPSG and which has been specifically developed for the treatment of complex morphotactics (Crysmann & Bonami, 2016).

The analysis presented here complements previous work on the morphosyntax of Udi subject agreement in HPSG. Together, these analysis show that the full range of patterns exhibited by hybrid clitics, from infixation into roots to phrasal attachment can be addressed in a principled and constrained fashion, without invoking concept like endocliticisation that seriously undermine Lexical Integrity.

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