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Verbal plural allomorphy in Hunzib and its implications for the cyclicity of the morphosyntax-phonology interface

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This paper investigates morphosyntactic and phonological aspects of the verbal plural in the Northeast Caucasian language Hunzib (van den Berg 1995). Verbal plural marking in Hunzib may be infixal or suffixal, and interacts in illuminating ways with morphological and phonological aspects of the verbal complex, especially with respect to establishing ordering among operations. In particular, we will see (i) that suppletive allomorphy of the verbal plural must be adjudicated at the rightmost edge of the stem, *before* both infixation of the infixal exponent and (morpho) phonology targeting that exponent, and (ii) that infixation of this exponent must take place *after* the stem of the verbal plural is fully built and has undergone a cycle of (morpho)phonology. This case study has a number of implications for modeling the morphosyntax-phonology interface, in particular, providing evidence for the precedence of exponent choice over infixation and (morpho)phonology within a cycle (Paster 2006; Bye & Svenonius 2012; Pak 2016; Kalin 2020; To appear a; Kalin & Rolle To appear; Stanton 2021, *i.a.*), and for bottom-up cycles in the realization of a morphosyntactic structure (Bobaljik 2000; Embick 2010; Myler 2017, *i.a.*).

1 Introduction

This paper is an exploration of the morphosyntax and phonology related to verbal plural marking in the endangered Northeast Caucasian language Hunzib, spoken by between 600 and 1,000 people in western Daghestan (Salminen 2007: 249, Eberhard et al. 2021). Verbal plural marking may be infixal or suffixal, and interacts in intricate, illuminating ways with morphological and phonological aspects of the verbal complex. In particular, we will see (i) that suppletive allomorphy of the verbal plural must be adjudicated at the rightmost edge of the stem, *before* both infixation of the infixal exponent and (morpho)phonology targeting that exponent, and (ii) that infixation of this exponent must take place *after* the stem of the verbal plural is fully built and has undergone a cycle of (morpho)phonology. This case study has a number of implications for modeling the morphosyntax-phonology interface, in particular, providing evidence for the precedence of exponent choice over infixation and (morpho)phonology within a cycle (Paster 2006; Bye & Svenonius 2012; Pak 2016; Kalin 2020; To appear a; Kalin & Rolle To appear; Stanton 2021, *i.a.*), and for bottom-up cycles in the realization of a morphosyntactic structure (Bobaljik 2000; Embick 2010; Myler 2017, *i.a.*).

All of the data in this paper come from Berg 1995 (henceforth B95), which is based on fieldwork conducted in the early 1990s and includes a grammar sketch, a set of 25 transcribed and morphologically-analyzed texts, and a Hunzib-English lexicon. Nonetheless, some of the basic morphological analysis, many of the observations, and all of the implications drawn are my own.

The paper is laid out as follows. In §2, I give some brief background on the phonology and morphosyntax of Hunzib, including an introduction to the verbal plural. §3 turns to allomorphy of the verbal plural morpheme (§3.1) and its immediate implications (§3.2). §4 considers the morphology and phonology of complex verb stems that take the infixal allomorph of verbal plural marking (§4.1), and synthesizes the findings of §3 with those of §4.1 to motivate bottom-up cycles of exponent choice, infixation, and (morpho)phonology (§4.2). §5 concludes.

2 Background on Hunzib grammar

2.1 Basic morphology and phonology

Hunzib has a large phonemic inventory. There are 35 consonants, including plosives (voiced, voiceless/aspirated, and ejective), affricates (voiceless/aspirated and ejective), fricatives (voiced and voiceless), and sonorants (B95:19). There are 8 plain vowels: front /i, e/, central /ɨ, ə, a/, and back /u, o, ɑ/ (B95:21). All of these vowels have a phonemically-contrastive nasalized counterpart. All vowels can also occur long, but length is only robustly contrastive for /a/ versus /aa/, as most other long vowels occur only (or nearly only) as a result of morphological

concatenation of two short vowels (B95:22). I adopt B95's orthography for Hunzib, with the exception of the back low vowel, which I represent as *a*.[1]

Syllables must have a single consonant onset,[2] and may have a single consonant coda, deriving the syllable template CV(C). Sequences of consonants may occur straddling a syllable boundary (B95:24–25), e.g., *k'ɨrbən* (thread). Native roots are maximally disyllabic (B95:27), and affixes range from sub-syllabic to disyllabic.

Hunzib is an ergative/absolutive language with a rich system of agglutinating morphology, of which we will be particularly interested in verbal morphology (see B95:74 for an overview). At the left edge of the verb are so-called class prefixes, agreeing with the absolutive argument in class/animacy and number.[3] At the right edge of the verb are derivational and inflectional suffixes, as well as the verbal plural affix, which is sometimes a suffix and sometimes an infix. An example of a complex verb (without a verbal plural) is given in (1).[4]

(1) r- əc' -k'ə -č
5- be.filled -CAUS -PRES
'fills' (B95:196)

We will cover more specific aspects of verbal morphology as relevant throughout the paper.

Stress is in general predictable, falling on the penultimate vocalic mora of the word, regardless of morphological complexity/boundaries in the word (B95:28–30), as shown in the words in (2) (stress indicated with an accent).

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[1] B95 writes the low back vowel as *α*, and describes it as phonetically "lower and more retracted than IPA [ɑ]" (B95:21).

[2] Unlike syllables in any other position, word-initial syllables may appear to lack an onset consonant, and it is unclear to me how to treat such cases. Many words are orthographically written as beginning with a vowel, but such words begin (phonetically at least) with a weak glottal stop onset (B95:19). This weak glottal stop is in some cases due to the underlying presence of a phonemic glottal stop (which is weakened in initial position) and is in other cases due to phonetic insertion of a glottal—confusingly, though, this distinction is neutralized word-initially in the orthography (see B95:19–20). Regardless of the proper treatement of the initial syllable, it is still true that all other syllables in the word must have an onset consonant.

[3] There are 5 noun classes based in part on gender, number, and animacy (B95:35): class 1 is for singular human males; class 2 is for singular human females; class 3 is for some singular inanimates; class 4 is for some singular animates and inanimates, as well as plural humans; and class 5 is for some singular inanimates, the noun "child", and plural non-humans and inanimates. As in a number of other related languages, class prefixes—which are all monoconsonantal—appear overtly only on vowel-initial verb roots. A small set of verbs mark class agreement via apophony, in addition to or instead of prefixal class marking. The details of class agreement will not be of much further relevance/interest here.

[4] I use the following abbreviations: 1 through 5 = noun classes; AP = antipassive; CAUS = causative; DEM = demonstrative; ERG = ergative; GER = past gerund; IDEO = ideophonic verbalizer; INCH = inchoative; NEG = negative; NMLZ = nominalizer; OBL = oblique; PPT = past participle; PRES = present tense; PAST = past tense; VBLZ = idiosyncratic verbalizer; VPL = verbal plural, WHEN = subordinator of time.

(2) a. íyu ‘mother’
b. k’išáa ‘play’
c. ɨs-ná-la-s ‘siblings (genitive)’
d. qoqó-o ‘house (dative)’

Exceptions to the penultimate stress rule are found with a handful of underlyingly stressed affixes (which bear stress no matter their position in the word) and with a few loanwords. There can only be one main stress in the word. Stress is realized on the stressed vowel as higher intensity, as well as (sometimes) a higher tone and/or lengthening (B95:29).[5] Henceforth, I will indicate stress in words only when it is associated with an underlyingly stressed affix (like NEG in (3c) below) or when the position of stress is relevant to the discussion at hand.

Stress interacts with vowel combination/length in a few ways. First, long vowels—whether present underlyingly or derived by morphological concatenation of short vowels—can only surface in a stressed syllable; otherwise, long vowels are shortened (B95:22). This is illustrated in (3) for various forms of the root *iyaa* (cry). (Note that I follow B95’s convention of marking stress precisely on the penultimate mora, but it is not clear whether there are any phonetic repercussions to the placement of stress on the first or second mora of a long vowel.)

(3) a. iyáa-n (cry-GER) (B95:76)
b. iyaá-ru (cry-PPT) (B95:76)
c. iya-č-át’ (cry-PRES-NEG) (B95:77)
d. iya-báa-n (cry-VPL-GER) (B95:240)

When *iyaa* takes a suffix that is underlyingly stressed, like it does in (3c), or when it takes a bimoraic suffix, like it does in (3d), the long *aa* of the root is shortened to *a*.

Second, sequences of *unlike* vowels are completely prohibited (B95:33), in contrast to sequences of *like* vowels (which form a long vowel, like in (2d)). When unlike vowels appear in hiatus, a number of repair strategies come into play. If two unstressed plain vowels are in hiatus, the first vowel is deleted, (4a). If either vowel in a vowel sequence is long or stressed, then this vowel will be retained (though may be shortened), with hiatus repair via glide insertion, glide conversion, vowel merger, or deletion of the other vowel in the sequence, depending on various factors; see, e.g., (4b-c) (B95:33–34):

(4) a. héhe (hit) + -oλ (WHEN) → heh-oλ
b. iyáa (cry) + -oλ (WHEN) → iyaa-λ
c. níi (come.2) + -oλ (WHEN) → niy-oλ

[5] A reviewer raises the interesting possibility that stress always corresponds to phonological (and in certain positions, phonetic) length, even though stressed vowels are not orthographically long (except if underlyingly long, in addition to being stressed). This could have a number of repercussions for details of my data analysis in upcoming sections, in particular with respect to the placement and underlying form of the verbal plural exponents. Importantly, the reanalysis would not impact the larger conclusions this paper aims to make, and I do not pursue this alternative here.

Stress, vowel length, and repairs for vowel hiatus are all highly relevant in the study of verbal plural marking in Hunzib, as will become evident in §3.1.

2.2 The verbal plural

Verbal plural marking in Hunzib indicates plurality of the absolutive argument and/or iterativity/habituality of an event (B95:81–83). Consider the examples in (5), which display infixal (in angled brackets) and suffixal verbal plural marking, both bolded.

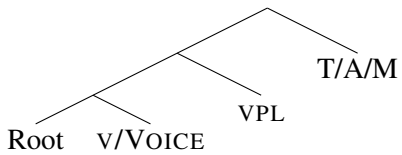
(5) a. oλu-l b-u<**wά**>č'e-r baba
DEM.OBL-ERG 4-cut<**VPL**>-PAST bread.4
'(s)he cut bread all the time' or '(s)he cut several loaves of bread' (B95:82)

b. əg-ra ʕadam-la b-u<**wά**>t'-oλ xo-ra-**baa**-∅
that-PL person-PL 4-sleep<**VPL**>-WHEN snore-AP-**VPL**-PRES
'after these people have gone to bed, they snore' (B95:92)

Verbal plural marking overlaps partially, but not fully, with prefixal class/number marking (see §2 and fn. 3 above on class/number agreement)—note that in (5a), the class agreement that appears is that for *singular* inanimates (*b-*; nb. this is also the form that appears for plural humans in (5b)) because the noun *baba* itself does not distinguish singular from plural; but nevertheless the verbal plural marker may appear, with an interpretation of pluralizing the object or event. I therefore take the verbal plural to be a pluractional marker, distinct from class/number agreement. Around half of the verb roots in Hunzib are compatible with the verbal plural marker.[6]

The verbal plural occupies a position in the verbal complex outside of the root and some voice-related and verbalizing derivational suffixes, and inside of tense, aspect, and mood marking. (Though this position in the verbal complex is transparent only for the suffixal verbal plural, §4.1 will show that it is also true abstractly for the infixal verbal plural.) I take this ordering to motivate the basic structure that we'll be concerned with in this paper, schematized in (6) (which puts aside the class/number agreement prefix):

(6)



Note that the verbal complex is rigid, allowing for a single derivational suffix on the root (represented as v/Voice in (6)), the verbal plural marker, and a single inflectional suffix (T/A/M).

[6] B95 does not attempt to delineate what determines whether a verb can take the verbal plural marker or not, and I also will not do so. At a first glance, it does not *seem* that there are any motivating semantic, morphological, or phonological factors governing this, but I leave it as an open question for future research. It is worth noting that derivational morphology on the verb root—which will be taken up in detail in §4.1—seems to regularize verbal plural marking, allowing it to appear on just about any verb (though this is not stated explicitly in the grammar).

Though not represented in the structure in (6), further suffixes may appear outside of T/A/M inflection, including negation and switch reference, and an inflected verb can also undergo nominalization, e.g., (7).

(7) q'əra qo-da-**baa**-r-ƛi
child study-AP-**VPL**-PPT-NMLZ
'a children's study' (B95:89)

In (7), *-ƛi* takes an inflected verb bearing the verbal plural and derives a noun.

The coming sections will look more closely at different aspects of verbal plural marking: §3 is concerned with the form of the verbal plural, while §4 turns to the interaction of the infixal verbal plural with the low derivational suffixes mentioned above.

3 Allomorphy of the verbal plural marker

This section will show that the nature of allomorphy of the verbal plural morpheme (§3.1) presents an argument for the precedence of exponent choice over infixation and (morpho) phonology (§3.2).

3.1 Data and preliminary observations

In this section we will be concerned with the *form* of verbal plural marking, which has already differed across several examples above. There are two suppletive allomorphs of the verbal plural, and they have a phonologically-conditioned distribution—the verbal plural is realized as a suffix *-baa*, (8a), on stems that end in a long vowel, and as an underlyingly stressed infix *-á-* on all other stems, (8b).[7]

(8) Suppletive allomorphs of the verbal plural marker
a. **-baa** / V:__
b. **-á-** / elsewhere (infix: precedes final consonant of the stem)

Note that *-á-* retains its stress, whether it is in ultimate, penultimate, or antepenultimate position, whereas *-baa* does not. Hence, only *-á-* is notated as underlyingly stressed.[8] We'll go through the profile of each suppletive allomorph in turn.

The examples in (9) show a verbal stem that ends in a long vowel and thus takes the *-baa* allomorph. As can be seen, the stem of infixation may be morphologically simplex, (9a), or complex, (9b,c).

[7] There is also a small handful of verbs that, idiosyncratically, take *baa* as an infix, e.g., *laxƛe* 'move, crawl', *tadaax*, ' get tired', and *āgaš*, 'talk'. Nothing phonological or morphological unites this class of exceptional verbs, and so I put this sub-pattern aside as unproductive/lexically listed.

[8] Further, when the verbal plural infix combines with other underlyingly stressed affixes, it is generally the verbal plural that retains its stress while the other affixes lose it (B95:29).

(9) Suffixal allomorph **-baa**

a. ãqáa (be.thirsty) + **VPL** → ãqa-**báa** ‘be thirsty (pl)’ (B95:283)
b. ũcu-láa (hide-AP) + **VPL** → ũcu-la-**báa** ‘hide (pl, intrans)’ (B95:338)
c. miyaw-dáa (mew-IDEO) + **VPL** → miyaw-da-**báa** ‘mew (pl)’ (B95:320)

The long vowel at the end of the verbal stem (prior to suffixation of the verbal plural) is *aa* in all the examples in (9); this is due to the dominance of *aa* over all other long vowels (especially morpheme-internally), and the apparent absence of any verbs that end in any other long vowel, apart from a very small list of common verbs, none of which combine with the verbal plural morpheme.

Suffixation of *-baa* always leads to opacity: for *-baa* to be chosen as the allomorph of the verbal plural, it must combine with a stem ending in a long vowel; but, after suffixation and stress assignment, that stem-final long vowel is shortened (see §2.1, (3), on stress and length). A derivation for (9a) is given in (10). (I separate exponent choice from exponent insertion for reasons that will become clear by the end of this subsection.)

(10) *Derivation of opaque allomorph selection of -baa*

Input	root ‘be thirsty’:	ãqaa
Morphology	choose exponent for VPL:	ãqaa + -baa
	insert chosen VPL exponent:	ãqaa-baa
Phonology	stress assignment:	ãqaa-báa
	shortening:	ãqa-báa
Output		ãqa-báa

The choice of allomorph is opaque, since, on the surface, the stem of *-baa* looks like it ends in a short vowel.

With all stems that *don’t* end in a long vowel, we find the elsewhere allomorph of the verbal plural, (8b), which is an infix and has a number of non-suppletive variants: *-á-, -á-, -wá-*, and *-yá-*, as shown in (11). It is for the most part easy to understand these variants as sharing an underlying form, *-á-*, and undergoing changes motivated by the general phonology of Hunzib, as will be discussed at length below. Note again that the verbal stem may be simplex, (11a-d), or complex, (11e-f). (§4 will examine more closely the morphologically-complex cases.)

(11) Infixal allomorph ***-á-*** and its non-suppletive variants

a. ɑhu (take) + **VPL** → ɑ<**á**>hu ‘take (pl)’ (B95:284)
b. ek (fall) + **VPL** → e<**yá**>k ‘fall (pl)’ (B95:295)
c. šoše (bandage) + **VPL** → šo<**wá**>še ‘bandage (pl)’ (B95:334)
d. čax (write) + **VPL** → ča<**á**>x ‘write (pl)’ (B95:292)
e. ɨx-lə (warm-VBLZ) + **VPL** → ɨx<**á**>-le[9] ‘warm (pl)’ (B95:308)
f. reλe-k’ (straight-CAUS) + **VPL** → reλ<**á**>-k’ ‘straighten (pl)’ (B95:330)

[9] §4.1 will address the change of the final vowel from *e* to *ə* in the verbalizing suffix.

Before looking more closely at the derivation of these non-suppletive allomorphs, it's important to establish the infix's position. Following Yu 2007: 128–130, I take the placement of the verbal plural infix in Hunzib to be before the final consonant of the verbal stem, which correctly predicts its distribution in all the examples in (11) (and which no other characterization does). Following Kalin & Rolle To appear, I assume that an infix's placement comes from a combination of (i) an underlying position at the stem edge, with (ii) minimal displacement from this edge to satisfy a phonological subcategorization restriction that governs an exponent's position. In the case of the verbal plural infix, the starting edge is the right edge (in line with the position of the other allomorph, the suffix *-baa*), and the subcategorization frame is that shown in (12).

(12) Condition on *-á-*'s position: __C

What (12) says is that the exponent *-á-* must be before a consonant; since the starting edge of the morpheme is the right side of the stem, the exponent will displace minimally from this edge, to precede the rightmost consonant. (See Kalin To appear a for extensive argumentation for a displacement account of infixation.)

In its infixal position before the final consonant, the infix *-á-* may yield a phonotactically illicit hiatus configuration. Just in case the infix lands after another *a*, like it does in (11a), *a<á>hu*, the infix undergoes no phonological changes, and surfaces just as *-á-*. When the infix's placement puts *-á-* in hiatus with a central low vowel, *a*, as in (11d), *ča<á>x*, there is assimilation of the infixal vowel to the first vowel, producing the long vowel *aa*. With a low vowel in the stem, then, hiatus gives rise to a long vowel.

When the vowel in hiatus with the infix is not low, as in (11b) and (11c), repeated in (13), hiatus is instead resolved by glide insertion. (I represent the inserted glide inside the angled brackets so that the glide is easier to pick out, and so it's easier to reconstruct the form of the pre-infixation stem; and, I sometimes informally refer to the glide + the infix as a non-suppletive allomorph of the infix. But, strictly speaking, the glide is not actually *part* of the infix itself.)

(13) a. ek (fall) + **VPL** → e<**yá**>k 'fall (pl)' (B95:295)
b. šoše (bandage) + **VPL** → šo<**wá**>še 'bandage (pl)' (B95:334)

The glide's form is sensitive to the frontness of the preceding vowel—after a front vowel, the inserted glide is *y* (IPA /j/), (13a), and after a non-front vowel, the inserted glide is *w*, (13b). One might wonder why the first vowel in hiatus is not simply deleted, as might be expected from the general hiatus resolution strategies discussed in §2.1. I hypothesize that the vowel in hiatus with the infix in these cases is protected from deletion by having been stressed on a prior cycle. The role of earlier stress can be verified by considering where stress would fall in the pre-inflection stems; in all cases where glide insertion takes place, stress would be on the vowel that will be next to the infix after verbal plural marking. Adopting this early stress hypothesis, (14) shows how the derivation of (13b) unfolds.

(14) *Hiatus resolution via glide insertion*

Input	root ‘bandage’:	šoše
Phonology	stress assignment:	šóše
Morphology	choose exponent for VPL:	šóše + -á-
	insert chosen VPL exponent:	šó<á>še
Phonology	hiatus resolution:	šó<wá>še
	stress (re-)assignment:	šo<wá>še
Output		šo<wá>še

Stress on an early cycle, on the *o* of *šoše*, protects that *o* from later deletion. I assume that stress on *o* disappears at the next cycle of stress assignment, since only one main stress is permitted per word (and *-á-* is underlyingly and thus stubbornly stressed).

The final piece of the puzzle for the infix’s various forms in (11) is to recognize a rule of centralization of *-á-* to *-á-* when the infix is in between two consonantal segments (i.e., between two non-glide consonants). This process accounts for the appearance of *a* rather than *a* in (11e) and (11f), repeated below.

(15) a. ɨx-lə (warm-VBLZ) + **VPL** → ɨx<**á**>-le ‘warm (pl)’ (B95:308)
b. reλe-k’ (straight-CAUS) + **VPL** → reλ<**á**>-k’ ‘straighten (pl)’ (B95:330)

Centralization is the only aspect of the infix’s shape that doesn’t follow naturally from Hunzib’s general phonology—it is *not* the case that all instances of an interconsonantal *a* (even stressed *a*) centralize to *a*; rather, this process is peculiar to the verbal plural infix. Centralization in (15) could be interpreted as a morphophonological rule (i.e., the result of phonology that is morpheme-specific), or could point to the need for a more abstract representation of the infix itself, as a low vowel underspecified for backness. I will not adjudicate between these two possibilities here, and will continue to represent the infix’s underlying form as *-á-*.

Putting it all together, now, let’s consider the derivation of (15b), where the infix is in hiatus with a vowel that is *not* protected by earlier stress assignment, (16). (The derivation starts from the causativized stem; for detail about the composition of this stem, see §4.1.)

(16) *Hiatus resolution via deletion and subsequent centralization*

Input	root ‘straight’ + CAUS:	reλe-k’
Phonology	stress assignment:	réλe-k’
Morphology	choose exponent for VPL:	réλe-k’ + -á-
	insert chosen VPL exponent:	réλe<á>-k’
Phonology	hiatus resolution:	réλ<á>-k’
	centralization:	réλ<á>-k’
	stress (re-)assignment:	reλ<á>-k’
Output		reλ<á>-k’

This derivation confirms the hypothesis that vowel deletion is moderated by presence/absence of stress from an earlier cycle. In (16), since the vowel in hiatus with the infix (the second *e* of the root) did not receive stress on an earlier cycle, this vowel is deleted; vowel deletion, in turn, feeds centralization.

The important thing to take away from the above discussion of non-suppletive alternations of the infix is that all these variants of the infix are conditioned locally, by the immediately surrounding phonological environment. Notably, too, non-suppletive variation in form is *not* influenced by the edge of the stem: even though the hypothesized starting position of the infix is the rightmost edge of the stem (see discussion surrounding (12), and upcoming discussion in §3.2), it is *only* the infixed (stem-internal) environment that conditions non-suppletive alternations of the infix; similarly, the infix has no phonological influence on the stem from its hypothesized stem-final position. It is for this reason that I separate exponent choice and exponent insertion in the derivations—even though the edge of the stem influences exponent choice, the infix does not have a phonological life anywhere but its infixed position.

I summarize the suppletive and non-suppletive variants of the verbal plural marker in (17) (including forms with the inserted glide), for easy reference, with the suppletive allomorphs in (17a) and (17b), and the non-suppletive variants of the infix in (17b-i) through (17b-iv).

(17) Allomorphs of the verbal plural marker (summary)

a. **-baa** / V:__

b. **-á-** / elsewhere (condition on infixal position: __C)

(i) -á- (after /ɑ/)

(ii) -yá- (after a non-low front vowel)

(iii) -wá- (after a non-low non-front vowel)

(iv) -á- (after /a/ and interconsonantally)

3.2 Implications: Exponent choice precedes infixation and phonology

The crucial observation about this data—which was made originally by Kalin To appear a and is significantly expanded on here—is that suppletive and non-suppletive allomorphy of the verbal plural marker have starkly distinct profiles. While suppletive allomorphy (in this case and more generally) is conditioned at the *stem edge* and is *non-optimizing*, non-suppletive allomorphy is conditioned in the *stem-internal* (infixed) position and is generally *optimizing*. This subsection looks more closely at these findings and considers their implications.

Let's start with the suppletive allomorphs, *-baa* and *-á-*. The choice between the two allomorphs is necessarily made with respect to the rightmost edge of the stem: the relevant factor is whether the stem ends with a long vowel or not (i.e., a short vowel or a consonant). There are three notable observations to make about the nature and outcome of this suppletive allomorphy.

The first, demonstrated above in (10) and repeated below (with an added step of early stress assignment, for consistency), is that the choice between the two suppletive allomorphs is surface opaque: suffixation of *-baa* will necessarily lead to shortening of the stem-final vowel, and it was this vowel's length that conditioned the choice of *-baa* in the first place.

(18) *Derivation of opaque allomorph selection of -baa*

Input	root 'be thirsty':	ãqaa
Phonology	stress assignment:	ãqáa
Morphology	choose exponent for VPL:	ãqáa + -baa
	insert chosen VPL exponent:	ãqáa-baa
Phonology	stress (re-)assignment:	ãqaa-báa
	shortening:	ãqa-báa
Output		ãqa-báa

Shortening of the final vowel of the verb stem, which is fed by the choice of the VPL suffix (and subsequent stress assignment), removes the environment for the choice of *-baa*. This can thus be seen as an example of "self-destructive feeding"—see e.g. Bakovic 2007. Opacity effects like this suggest *ordering* among operations, in this case that exponent choice (*-baa* vs. *-á-*) precedes phonology (shortening).

The second important observation to make about suppletive allomorphy of VPL is that, in its infixed position, *-á-* may not be immediately local to the conditioning edge. Consider again (11a):

(19) ahu (take) + **VPL** → ɑ<**á**>hu 'take (pl)' (B95:284)

It is the final segment of the stem—the short vowel *u*—that is responsible for the choice of the infixal exponent *-á-* rather than the suffixal exponent *-baa*. But, the infixal exponent itself is not immediately local to that stem-final short vowel—it is separated from *u* by a consonant, the consonant that defines the placement of the infix. This non-locality between suppletive allomorph and conditioner suggests yet another ordering relation, where exponent choice for the verbal plural morpheme (which happens at the right edge, as per above) precedes infixation (of the infixal exponent of the verbal plural morpheme).

Third, suppletive allomorph choice for the verbal plural morpheme is not optimizing. The conditioned allomorph, *-baa,* would be a perfectly fine suffix on any stem, whether that stem ends in a long vowel, a short vowel, or a consonant.[10] The only "repair" needed after suffixation of *-baa* would be shortening of a stem-final long vowel, precisely the repair that's already a part of the *actual* distribution of *-baa*, as seen in (18). On the other hand, the elsewhere allomorph *-á-*

[10] See B95:24–25 for an enumeration of allowable cross-syllable consonant sequences, where *b* is shown to be just fine as the second consonant in such a sequence, no matter the nature of the first consonant.

typically creates a phonotactic issue (hiatus) that needs repairing (see (11) and the derivations in (14), (16)). And, importantly, *-á-* would not be any *worse* with long-vowel-final stems than any others, as demonstrated in (20).

(20) koxaa (be.dirty) + **VPL** → hypothetical: *ko<**wá**>xa
→ attested: koxa-**báa** (B95:311)

The two potential output forms entertained in (20) have the same syllable count, and both have penultimate stress. In both, the stem-final long vowel must be shortened, because it does not bear stress. The attested form, with *-baa* suffixation, indeed does avoid stem-interruption by an infix and subsequent vowel hiatus, but, both of these marked configurations are generally permitted in the exponence of verbal plural (see again (11)), so it doesn't seem that these considerations could motivate the choice of *-baa* over *-á-* here.[11] The non-optimizing nature of exponent choice confirms the finding above that exponent choice precedes phonology, and is in line with similar findings of non- and anti-optimizing exponent choice in other languages (see, e.g., Paster 2006; Pak 2016; Kalin 2020; To appear a; To appear b; Stanton 2021).

In contrast to suppletive allomorphy, non-suppletive alternations of/around the verbal plural marker, enumerated in (11) and (17), are determined stem-internally and purely locally—the non-suppletive variants of the infix are fully predictable from the infix's surface, infixed position. The rightmost edge of the stem (which is implicated in suppletive allomorph choice) has no influence on the infix's non-suppletive alternations. Thus while suppletive allomorphy is opaque, non-optimizing, and conditioned at the rightmost edge of the stem, non-suppletive allomorphy of the infix is transparent, generally optimizing, and conditioned by its infixed (stem-internal) environment. The implication is clear: non-suppletive allomorphy, unlike suppletive allomorphy, is a part of (morpho)phonology.

So far, based on the discussion above, allomorphy of the verbal plural motivates the orderings in (21), which are consistent with the orderings in the derivations given above. (Note that I use

[11] There are a few ways to stipulatively motivate the choice of *-baa* over *-á-* with long-vowel-final stems. One possibility is to say that stems that end in a long vowel want to also end in a long vowel in their inflected form. However, many further suffixes (which do not have long vowels) can pile up after the verbal plural, so such a constraint would have to *only* hold of the step involved in verbal plural marking and nowhere else in the language.

Two other possibilities closely related to each other are to (i) require stress to only move in a rightward direction, or (ii) require the verbal plural affix to appear linearly *after* the stress of its stem. Let's assume that the verbal stem, prior to the addition of the verbal plural, has been assigned stress (which we already saw evidence for in §3.1). If this is the case, then a long-vowel-final stem will have stress on the final syllable. If such a stem were to be marked with the infix *-á-*, stress would move to the left (the stressed verbal plural infix would precede its stem's stress). If such a stem were instead to be suffixed with *-baa*, stress would move to the right, onto *-baa* itself. Note that for all stems not ending in a long vowel, infixation of *-á-* will always move stress to the right (the infix will follow its stem's stress). But, it's not clear to me that an ad hoc constraint on the direction of stress shift is plausible, and so I put this possibility aside. As for a requirement that the verbal plural affix follow stress, that would need to be an arbitrary property of this affix, thus still implicating that the choice between exponents is not just about phonological optimization.

"(morpho)phonology" here to subsume all the general phonological processes discussed above, namely stress assignment, shortening, assimilation, glide insertion, and deletion, as well as the morpheme-specific phonological rule of centralization.)

(21) a. exponent choice < (morpho)phonology
b. exponent choice < infixation

The final piece of the puzzle is about the relationship between infixation and (morpho)phonology. It is clear that infixation cannot *follow* (morpho)phonology, as infixation feeds all of the non-suppletive alternations of and around the infix. But, the data don't adjudicate decisively between the two other possibilities: (i) infixation could be the purview of morphology (à la Yu 2007) and so precede all (morpho)phonological processes (as represented in the derivations above), or (ii) infixation could be a part of the phonology, either ordered first among the (morpho) phonological rules, or evaluated simultaneously with all phonological processes (in the style of Optimality Theory, à la the McCarthy & Prince 1993 treatment of infixation).

Even though the present data don't offer a conclusive answer about the ordering of infixation and (morpho)phonology, they are suggestive, on the basis of the observation that infixation of the verbal plural exponent *-á-* is not optimizing. Consider the following hypothetical forms, which entertain suffixation of *á* rather than infixation of *á*:

(22) a. šóše (bandage) + **VPL** → hypothetical (*á* suffix): *šoš-**á**
→ attested (*á* infix): šo<**wá**>še, (11c) (B95:334)
b. ék (fall) + **VPL** → hypothetical (*á* suffix): *ek-**á**
→ attested (*á* infix): e<**yá**>k, (11b) (B95:295)

In (22a), there are two potential places to point to for phonologically/phonotactically preferring the attested (infixed) form over the hypothetical (suffixed) form: (i) the attested form maintains penultimate stress, and (ii) while there is hiatus created by the verbal plural marker in both forms, perhaps deletion of a stem vowel (in the hypothetical form) is "worse" than glide insertion (in the attested form). However, infixation persists in (22b), where the hypothetical (suffixed) form has stress on the final syllable, just like the attested (infixed) form does, and the hypothetical form would avoid hiatus altogether, unlike the attested form. This shows that neither penultimate stress placement nor avoidance of hiatus can motivate infixation of *á*. As a final consideration, it's relevant to note that there are a handful of other underlyingly stressed affixes in Hunzib, some of which consist of a single vowel, and all of which are suffixes (B95:29). Putting all these facts together, the infixal nature of the verbal plural exponent *á* is best seen as an arbitrary and lexically-encoded aspect of this exponent; even though its position is phonologically *determined* (see (12)), this position is not phonologically/phonotactically *motivated*.

Since infixation is not optimizing in Hunzib, there are two ways to deal with this at a theoretical level. The first is to locate infixation *before* phonology, like Yu 2007 does; this approach captures

the phonologically-arbitrary nature of many cases of infixation. Alternatively, non-optimizing infixation could be handled within the phonology via exponent-specific Align constraints. I will not attempt to differentiate these theories here, and simply establish the following precedence from the above data and discussion (where ≤ means "before or simultaneous with"):

(23) exponent choice < infixation ≤ (morpho)phonology

In the following section, we will see an apparently conflicting ordering relationship arise from a different set of data, which will be resolved by positing bottom-up cycles of exponent choice, infixation, and (morpho)phonology.

4 The verbal plural infix with complex stems

In this section, I look more closely at cases where the verbal plural infix combines with a complex verb stem, like it did in (11e) and (11f). In particular, I ask, does the infix disrupt cross-morpheme relationships when it surfaces between a derivational suffix and the root?

4.1 Data and preliminary observations

There are five derivational affixes, all suffixes, that can constitute part of the verbal stem that VPL combines with; these suffixes (bolded) are illustrated in (24):

(24) a. koše (mow) + **-laa** (AP) → koše**-laa** ('mow', intransitive) ANTIPASSIVE[12]
b. lala (sound.of.a.scream) + **-daa** (IDEO) → lala**-daa** ('scream') IDEOPHONIC
c. arče (get.up) + **-k'(e)** (CAUS) → arče**-k'** ('wake up', transitive) CAUSATIVE
d. ƛ̓ini (winter) + **-ke** (INCH) → ƛ̓ini**-ke** ('set in of winter') INCHOATIVE
e. ok'o (call) + **-l(e)** (VBLZ) → ok'o**-l** ('gather') OTHER/IDIOSYNCRATIC

The first two of these suffixes—antipassivizing *-laa* (B95:110) and ideophonic verbalizer *-daa* (B95:111)—end in a long vowel, and so when a verb formed with one of these suffixes takes verbal plural marking, the exponent *-baa* (see §3.1) is chosen for the verbal plural:

(25) a. koše-laa (mow-AP) + **VPL** → koše-la**-baa** (B95:311)
b. lala-daa (sound.of.a.scream-IDEO) + **VPL** → lala-da**-baa** (B95:314)

Since *-laa* and *-daa* don't co-occur with the infixal exponent of the verbal plural, they won't be of further interest here.

The latter three suffixes in (24)—causative *-k'(e)*, inchoative *-ke*, and verbalizer *-l(e)*—appear with the infixal exponent of the verbal plural, *-á-*. When the verbal plural combines with a stem formed with one of these three suffixes, the infix surfaces at the juncture between suffix and root,

[12] The antipassive morpheme has variants *-raa* and *-daa* that each appear with a few verb roots (B95:110–111).

as in (26). (Recall from §3.1 that the final vowel of the verb root is deleted due to hiatus with the infix, and that *-á-* is the interconsonantal non-suppletive variant of the infix.)

(26) ok'o-l (call-VBLZ, 'gather') + **-ɑ́-** (VPL) → ok'<**á**>-l 'gather (pl)' (B95:323)

Since the infix is always placed before the final consonant of its stem, and the derivational suffixes at hand all have the shape -C(V), the infix will in fact *always* appear in between the suffix and the root. It is this intruding position that is of interest in the remainder of the section.

Note that there is still good reason to assume that, at some abstract level, the derivational suffix and the root form a constituent to the exclusion of the verbal plural marker, along the lines of (27).

(27) [[Root DER.SUFF] VPL]

As support for the this structure, consider examples like the one in (28).[13]

(28) ƛ̓ɨrə-ke (under-INCH) + **-ɑ́-** (VPL) → ƛ̓ɨr<**á**>-ke (B95:316)

Verbal plural marking only applies to *verbs*, and so it must be in (28) that *ƛ̓ɨrə* ('under') is first verbalized and then takes the verbal plural.

I will now investigate further the impacts of the incidental *intermorphemic* position of the infix in complex verb stems like (26) and (28): Does the infix disrupt interactions/relationships between the two morphemes whose surface locality is disrupted, i.e., between the root and the derivational suffix? I will focus on four particular relationships/interactions: (i) selection and productivity, (ii) compositionality (predictability of the derived meaning), (iii) morphophonology, and (iv) surface phonology. Notably, only surface phonology is disrupted by the infix.

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[13] An extremely observant reviewer notes that this example presents a hiatus resolution puzzle: it is surprising that the phonological form here is *ƛ̓ɨr<á>-ke* (with hiatus of *ə* + infix resolved by deletion of *ə*) rather than **ƛ̓ɨrə<wá>-ke* (with hiatus of *ə* + infix resolved by glide insertion). The reason this is surprising is because there is evidence that stress assignment applies to the stem of the verbal plural prior to infixation of *-á-* and subsequent hiatus resolution—see the discussion around (14). If this is correct, then there should be stress on *ə* in *ƛ̓ɨrə-ke*, protecting this vowel from deletion in the verbal plural. Note that this puzzle arises for all instances of the inchoative *-ke* suffix on vowel-final roots (when subsequently combining with the verbal plural), and is not peculiar to this example.

I'd like to suggest that the solution to this puzzle comes from recognizing that the vowel *e* in the inchoative suffix *-ke* is already exceptional—it is the only instance of *e* that I could find in all of B95 that does not harmonize to a preceding non-low central vowel (see the upcoming discussion of vowel harmony, around (36)). If the *e* in *-ke* is extrametrical for some reason, this may give us a common explanation for the two puzzles: (i) with respect to the unexpected form *ƛ̓ɨr<á>-ke*, perhaps the (deleted) root-final *ə* is not stressed prior to infixation, because the stem of the verbal plural is (for stress-assigning purposes) really *ƛ̓ɨrə-k*, not *ƛ̓ɨrə-ke*; and (ii) as for vowel harmony, perhaps the *e* in *-ke* does not harmonize because it is not present at the right level of representation to do so. Note that the hiatus resolution puzzle does not arise with the other derivational suffixes, for reasons that will become clear in the discussion of vowel epenthesis below; see fn. 14.

The three derivational suffixes at hand, (24c)–(24e), differ in selectional properties/productivity and compositionality. The causative suffix, *-k'(e)*, (24e), derives transitive verbs from adjectives and adds a causer argument to intransitive and transitive verbs; it is highly productive, and its meaning is totally regular and predictable (B95:107–108). The inchoative suffix, *-ke*, (24d), takes an adverb, postposition, or expression of time and turns it into an intransitive verb; it is not productive, but its meaning contribution is fully predictable (B95:111). Finally, the verbalizing suffix *-l(e)*, (24e), combines with adjectives and verbs, and sometimes derives an inchoative, sometimes a causative, and sometimes just changes the meaning of the verb in an unpredictable way; it is not productive (it is very lexically picky), and its meaning contribution is unpredictable/idiomatic (B95:108–110).

It's reasonable to wonder whether the different suffixes' selectional properties and meaning (in)stability interact at all with the infix—when the infix intrudes between the suffix and the root, does it disrupt their selectional relationship or the derived meaning? No, the infix does *not* disrupt these relationships. Each of the following (a) examples shows suffixation of one of the derivational suffixes and the resultant meaning; the (b) example adds the (linearly intruding) verbal plural infix to the complex verb stem from (a). As can be seen by the persistence of form and meaning in (b), the infix does not alter the meaning of the stem nor interrupt the selectional relationship between suffix and root.

(29) a. ɨq' (grow) + **-k'(e)** (CAUS) → ɨq'-**k'ə** ('grow (transitive)') (B95:308)
b. ɨq'-k'ə (grow-CAUS) + **-ɑ́-** (VPL) → ɨq'<**ɑ́**>-k'e ('grow (transitive, pl)')

(30) a. ƛɨrə (under) + **-ke** (INCH) → ƛɨrə-**ke** ('go under') (B95:316)
b. ƛɨrə-ke (under-INCH) + **-ɑ́-** (VPL) → ƛɨr<**ɑ́**>-ke ('go under (pl)')

(31) a. ɨq' (grow) + **-l(e)** (VBLZ) → ɨq'-**lə** ('grow up') (B95:79,308)
b. ɨq'-lə (grow-CAUS) + **-ɑ́-** (VPL) → ɨq'<**ɑ́**>-le ('grow up (pl)')

Selection and (non-)compositionality in the stem of infixation seem impervious to the intrusion of the infix.

Let's turn now to (morpho)phonology in the stem of infixation. The careful reader may already be wondering, what is behind the appearance/disappearance of the vowel in *-k'(e)* (e.g., (24c) vs. (29b)) and *-l(e)* (e.g., (24e) vs. (31b))? And why does this vowel sometimes get realized as *ə* rather than *e*? The answer to the first question is that the vowel in the suffix comes and goes depending on whether the preceding segment is a consonant or vowel (B95:107–108); when following a vowel, the suffix vowel is absent, (32), and when following a consonant, the suffix vowel is present, (33).

(32) a. haldu (white) + **-k'(e)** (CAUS) → haldu-**k'** ('make white') (B95:301)
b. haldu (white) + **-l(e)** (VBLZ) → haldu-**l** ('be white')

(33) a. ɨx (warm) + **-k'(e)** (CAUS) → ɨx**-k'e** ('warm up') (B95:308)
b. ɨx (warm) + **-l(e)** (VBLZ) → ɨx**-le** ('warm oneself')

While there is clearly a phonological explanation for the appearance of the suffix vowel in (33)—namely, epenthesis to avoid a complex coda—vowel appearance/disappearance is specific to these two morphemes, and is not a general property of the phonology of the language. There are suffixes with the shape CV that do not alternate between having and not having a vowel, and conversely, there are suffixes with the shape C that have the shape VC in certain phonotactic configurations, rather than the conditioned C/CV shape of *-k'(e)* and *-l(e)*. The *quality* of the vowel that appears in these other suffixes varies, too—it is not always *e* that comes and goes. I therefore take the appearing/disappearing vowel in *-k'(e)* and *-l(e)* to be morphophonological in nature.

We can now ask, is morphophonological vowel epenthesis in the suffix impacted by the verbal plural infix? The infix is vocalic, and so we might reasonably expect that the presence of the infix before the suffix will *always* end up bleeding vowel epenthesis in the suffix, i.e., the suffix will always be vowel-less, like it is in (32) with vowel-final roots. Surprisingly, however, this is not the case—the shape of the *stem* of the suffix (i.e., the shape of the root) conditions the presence/absence of the suffix vowel, regardless of the intrusion of the infix. The obliviousness of vowel epenthesis to the presence of the infix can be verified by comparing (34)/(35) with the infixless (32)/(33):

(34) a. haldu (white) + **-k'(e)** (CAUS) + -á- (VPL) → hald<á>**-k'**
b. haldu (white) + **-l(e)** (VBLZ) + -á- (VPL) → hald<á>**-l**

(35) a. ɨx (warm) + **-k'(e)** (CAUS) + -á- (VPL) → ɨx<á>**-k'e** (*ɨx<á>**-k'**)
b. ɨx (warm) + **-l(e)** (VBLZ) + -á- (VPL) → ɨx<á>**-le** (*ɨx<á>**-l**)

In (34), we'd expect the vowel-less version of the suffix regardless of whether the infix's vocalic shape is taken into account or not, since the root also ends in a vowel; and indeed, the suffix lacks a vowel in these cases. The more informative—and interesting—examples are in (35). If epenthesis were conditioned *after* infixation (by the string that precedes the suffix on the surface, *ɨxá*), then the suffix vowel should be absent, because this string ends in a vowel. Instead, the suffix vowel is in fact present. The presence of the suffix's vowel in (35) is only understandable if epenthesis is conditioned *before* the intrusion of the infix, on the basis of the pre-infixation stem.[14]

[14] It should now be clear why the hiatus resolution puzzle induced by *-ke*, discussed in fn. 13, does not apply to *-k'(e)* and *-l(e)*. With the suffixes *-k'(e)* and *-l(e)*, there will only ever be hiatus created by the infix when the root ends in a vowel, like it does in (34). And, if the root ends in a vowel, then there is no epenthesized vowel in the suffix, i.e., the suffixes will appear as *-k'/-l*. Since there is no epenthesized vowel in the suffix, early stress assignment (applying to the stem of the verbal plural) will fall on the *first* vowel of the root, not the second. So, putting it all together, that means we would precisely expect deletion of the root-final vowel as the repair to vowel hiatus, since it is not protected by earlier stress.

Finally, we turn to vowel quality—sometimes the CV forms of the two suffixes at hand are realized as *-k'e/-le*, and sometimes as *-k'ə/-lə*. This alternation is due to a harmony process, given in (36): when an *e* follows a non-low central vowel (*ə, ɨ*) in an immediately preceding syllable, *e* harmonizes to *ə*; elsewhere, the suffix vowel remains *e*.

(36) /e/ → [–front,–back] / [–low,–front,–back] C (C) __

The examples in (37) show both suffixes with harmonizing *ə* (following a root with a non-low central vowel); the examples in (38) feature the underlying *e* vowel in the suffix, with a preceding back vowel, (38a), and a preceding front vowel, (38b).

(37) a. ɨx (warm) + **-k'(e)** (CAUS) → ɨx-**k'ə** ('warm up') (B95:308)
b. ɨx (warm) + **-l(e)** (VBLZ) → ɨx-**lə** ('warm oneself')

(38) a. uɬ' (end) + **-k'(e)** (CAUS) → uɬ'-**k'e** ('make end') (B95:337)
b. ek (fall) + **-l(e)** (VBLZ) → ek-**le** ('let fall, drop') (B95:295)

While B95 treats the harmony rule as special to these two suffixes (B95:75), it is actually more broadly applicable—a systematic scan of the grammar, texts, and lexicon shows that in general, an *e* cannot follow a non-low central vowel in an immediately preceding syllable; this generalization holds within roots as well as in morphologically complex words. There is one systematic exception to this rule: the inchoative suffix *-ke* never harmonizes. (See also fn. 13.) Nevertheless, the harmony of *e* with a preceding non-low central vowel is surface true (with the single exception of *-ke*) and is language-general. I therefore categorize this vowel harmony as surface phonology. A derivation for (37a) is given in (39), with vowel epenthesis as a morphophonological step prior to vowel harmony.

(39) *Derivation of vowel harmony*

Input	root 'warm':	ɨx
Phonology	stress assignment:	ɨ́x
Morphology	choose exponent for CAUS:	ɨ́x + -k'
	insert chosen CAUS exponent:	ɨ́x-k'
Morphophonology	vowel epenthesis:	ɨ́x-k'e
Phonology	vowel harmony:	ɨ́x-k'ə
Output		ɨ́x-k'ə

What happens when the infix appears between a non-low central vowel (*ə, ɨ*) and the suffix *-k'(e)* or *-l(e)*? Importantly, the infix is *not* a non-low central vowel, and so the infix itself would not motivate an *e* to *ə* shift. If vowel harmony were to take place *before* infixation, like vowel epenthesis does (see above), then we'd expect the *ə* vowel to appear; if vowel harmony were to take place *after* (or simultaneous with) infixation, we'd expect no vowel harmony, and thus

the elsewhere *e* vowel. The latter expectation is borne out, (40) (adapted from (35); cf. the harmonizing suffix vowel in (37) with this same root):

(40) a. ɨx (warm) + **-k'(e)** (CAUS) + -á- (VPL) → ɨx<á>**-k'e** (*ɨx<á>**-k'ə**)
b. ɨx (warm) + **-l(e)** (VBLZ) + -á- (VPL) → ɨx<á>**-le** (*ɨx<á>**-lə**)

When the infix intervenes between the suffix and the root, vowel harmony is bled by infixation, and underlying *e* surfaces. Unlike every other relationship we've seen so far, including the morphophonological process of vowel epenethesis (see (35)), phonological vowel harmony *is* disrupted by the presence of the infix. (A complete derivation of (40a) will be given in §4.2.)

If infixation precedes (or is simultaneous with) phonology, as suggested by the vowel harmony facts, then it's relevant, too, to confirm that the infix not only bleeds phonological processes in its stem but also feeds them. And indeed it does, as is visible through two additional phonological processes. The first is vowel fronting—the vowels /e, ə, o/ are all fronted before the glide *y*, to [i, e, ø], respectively (B95:23) (though this is not represented orthographically). Infixation, and subsequent hiatus repair via insertion of the glide *y* (see §3.1), feeds this vowel fronting. For example, consider the root *ek'e* (burn); when this root takes the verbal plural infix, the first /e/ fronts phonetically to [i], bolded in (41).

(41) [r**i**ják'er] (from *r-e<yá>k'e-r*, 5-burn<VPL>-PAST) (B95:23)

The second phonological process that can be fed by infixation is nasal insertion. In trisyllabic verb forms, [n] may optionally be epenthesized after the second vowel of the verb (B95:22) (though like vowel fronting in (41), this is not represented orthographically). When the verbal plural infix adds a syllable to a disyllabic verb, the environment for nasal insertion is met, and [n] can be inserted, bolded in (42):

(42) [buwá**n**t'en] (from *b-u<wá>t'-en*, 4-sleep<VPL>-GER) (B95:22)

All of this comes together to confirm that infixation precedes (or happens in concert with) phonology.

In (43), I summarize all of the processes we've seen taking place in the stem of infixation, along with their order relative to infixation of the verbal plural. (Note that I have not included here any processes for which we lack relevant evidence, which includes most of the processes involved in non-suppletive allomorphy of the infix itself from §3.1. Accordingly, vowel fronting and nasal insertion are not included because—even though it's clear they apply at least after infixation—they might also apply to the stem of infixation.)

(43) Processes that apply in the stem of the VPL infix
  a. Before infixation of VPL:
    (i) selection
    (ii) semantic composition
    (iii) stress assignment (see §3.1)
    (iv) vowel epenthesis (morphophonological)
  b. After infixation of VPL:
    (i) vowel harmony

4.2 Implications: Bottom-up cyclicity

The (non-)persistence of different relationships/interactions around the site of infixation come together to support the following set of derivational orders, (44), which can be collapsed into a single ordering chain, (45):

(44) a. morphosyntax $<$ infixation
  b. morphophonology $<$ infixation
  c. infixation $\leq$ phonology

(45) morphosyntax, morphophonology $<$ infixation $\leq$ phonology

The infix, when incidentally surfacing (due to its infixal position) between a derivational suffix and the root, does not disrupt relationships of selection, compositionality, or morphophonology between suffix and root, (44a-b) (see (29) through (35)), but *does* disrupt purely phonological interactions between suffix and root, (44c) (see (37) through (40)).

At first glance, there seems to be a conflict between the ordering motivated by §4.1, given in (45), and that motivated in §3.2 on the basis of allomorphy, repeated from (22) in (46):

(46) exponent choice $<$ infixation $\leq$ (morpho)phonology

In particular, how can infixation both *follow* morphophonology, as per (45), and precede (or be simultaneous with) morphophonology, as per (46)? The conflict is resolved easily by positing *cycles* of exponent choice, infixation, and morphophonology, which start from the bottom of a morphosyntactic structure (à la Bobaljik 2000; Embick 2010; Myler 2017). In brief, the idea of the cycle (which dates back to Chomsky & Halle 1968) is that a particular set of operations can apply multiple times, starting with a small string/constituent and then applying to larger (and larger) strings/constituents. Cycles make it possible to tease apart what is happening in the *stem* of infixation—which motivates (45)—from what is happening to the infix itself—which motivates (46). Put another way, the ordering in (45) occurs *across* cycles, while the ordering identified in (46) occurs *within* a cycle. I assume, following other work (Kalin To appear a and

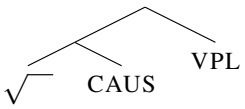
Kalin To appear b), that every morpheme (morphosyntactic node) defines its own cycle of the operations in (46) (even the root, though that won't end up being consequential here). There are also larger cycles (e.g., phases) that define junctures for surface phonology.[15]

I will demonstrate the utility of the cycle by deriving the verb form in (47) (taken from (35)):

(47) ɨx (warm) + -k'(e) (CAUS) + -ɑ́- (VPL) → ɨx<á>-k'e

A morphosyntactic structure like that in (48) underlies (47), where the adjectival root is first causativized and then pluralized.

(48)



In (49) through (51), node-based cycles of exponent choice, infixation, and (morpho)phonology proceed from the most embedded node, the root, upward. Cycle-internally, the ordering in (46) is the relevant one, with exponent choice preceding infixation, which in turn precedes (morpho) phonology. Note that I include in each cycle only the relevant (morpho)phonological processes at hand, though all of the following fall under this category: stress assignment, shortening, assimilation (of *ɑ* to *a*), hiatus resolution (via glide insertion or deletion), centralization (of *-ɑ́-*), and vowel epenthesis (for CAUS, VBLZ). Not included in the cyclic (morpho)phonology are: shortening, vowel harmony, vowel fronting, and nasal insertion; these instead apply later, as part of surface phonology.

In the root cycle, (49), the root is exponed, and not much else happens.[16]

(49) *Cycle 1*

Input		$\sqrt{\text{WARM}}$
Morphology	choose exponent:	$\sqrt{\text{WARM}}$ → ɨx
	insert chosen exponent:	ɨx
(Morpho)phonology	stress assignment:	ɨ́x
Output		ɨ́x

On the next cycle, (50), CAUS is exponed, and morphophonology relevant to this morpheme—vowel epenthesis (see (33))—applies locally, in the same cycle.

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[15] See also Kiparsky 1982 as an early example of separating early ("lexical") phonology from late ("post-lexical") phonology.

[16] It might be that there is no cycle for the root on its own, but rather the root undergoes a cycle of operations only in conjunction with v/Voice (CAUS here)—as far as I can tell, the data considered in this paper are not decisive in one way or another. However, I include the root cycle for completeness and consistency with my earlier work.

(50) *Cycle 2*

Input		íx + CAUS
Morphology	choose exponent:	CAUS → -k’
	insert chosen exponent:	íx-k’
(Morpho)phonology	vowel epenthesis:	íx-k’e
	stress assignment:	íx-k’e
Output		íx-k’e

Next, VPL is exponed, (51). Since the verb stem, *ix-k’e*, does not end in a long vowel, the elsewhere exponent *-á-* is chosen (see (17)). This exponent is infixal, and so is placed in its specified position, before the final consonant of its stem. Then the infix undergoes a morphophonological rule of vowel centralization (see the discussion around (15)).

(51) *Cycle 3*

Input		íx-k’e + VPL
Morphology	choose exponent:	VPL → -á-
	insert chosen exponent:	íx<á>-k’e
(Morpho)phonology	centralization:	íx<á>-k’e
	stress assignment:	ix<á>-k’e
Output		ix<á>-k’e

Finally, surface phonology applies to the output of the final cycle, but there are no relevant changes, and so the surface form comes out as *ixák’e*, crucially *with* the suffix vowel and *without* vowel harmony (see §4.1).

Bottom-up cycles thus capture all of the empirical observations of §3.1 and §4.1. The ordering in (46) applies within cycles (as represented in all the cycles detailed above), while (45) reflects what happens *across* cycles: morphosyntax and cyclic (morpho)phonology in the stem of infixation apply *before* the cycle that introduces the infix itself; and infixation of that infix happens both before cycle-internal (morpho)phonology as well as before surface phonology, which applies late. Infixation happens *too late* to affect the inner-workings of earlier cycles.

I want to address two final predictions made by the cyclic derivation laid out above. First, infixation should not disrupt exponent choice in earlier cycles. While not observable in Hunzib, this is indeed observable in other languages, and has been shown to be borne out by Embick (2010: 104–107) and Kalin (2021). Second, if infixation is immediate (within the same cycle as exponence of the infix, as modeled in (51)), then infixal position should not be able to be influenced by exponence of morphosyntactically less-embedded (further out) morphemes. This too is borne out, in Hunzib—while many further suffixes can pile up after the verbal plural (see §2.2), they never affect its position. This is especially notable when an outer suffix begins in a consonant, since the infix itself wants to be before a consonant (see discussion around (12)).

One might think that a consonant-initial suffix would allow the infix to stay in its "underlying" (morphosyntactically-motivated, non-infixed) position. And yet it can't:

(52) r-i<**yá**>ƛe-n (5-kill<VPL>-GER) (B95:82)

Even though the infixal exponent would be before a consonant if it surfaced at the rightmost edge of the root (hypothetical **r-iƛ<á>-n*), it nevertheless must infix *into* the root (deriving *i<yá>ƛe*). This follows straightforwardly if infixation is cycle-internal, and cycles proceed from the bottom up: at the point of infixation of the verbal plural, the gerundive suffix has not yet been exponed (its cycle has not yet been reached). If, on the other hand, the gerundive suffix *-n* had been exponed *before* infixation of *-á-*, the infix should be able to surface at the right edge of the verbal stem, since in that position, it will precede a consonant. But of course, as (52) shows, this is not possible.

Summing up, then, positing bottom-up cycles accounts naturally for the full set of data surrounding verbal plural marking in Hunzib. Given the multiple examples of ordering and opacity, accounting for this data without bottom-up cycles would be a serious challenge, one I do not attempt here.

5 Conclusion

This paper discussed the verbal plural in Hunzib with respect to its exponence/realization, §3, and its impact on its surroundings, §4. The findings provide evidence for derivational ordering among morphosyntax, exponence, infixation, early/cyclic phonology and morphophonology, and late/surface phonology. More specifically, the findings implicate bottom-up cycles in realizing a morphosyntactic structure, where each cycle begins with exponent choice/insertion and ends with (morpho)phonology; surface phonology is late, after all the cycles (within some domain) have been completed.

Of course, the Hunzib case study on its own does not tell us what is true *universally*, just what must be true for Hunzib. An investigation of the cross-linguistic generalizability of these results is ongoing.

Competing interests

The authors have no competing interests to declare.

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