"Outward-sensitive phonologically-conditioned suppletive allomorphy vs. first-last tone harmony in Cilungu"

1 Introduction

The topic of allomorphy is a major focal point for linguistic inquiry across morphological frameworks. Most issues remain without consensus, such as what constitutes allomorphy vs. morphologically conditioned phonology (Kiparsky 1996, Paster 2014), and what are the restrictions on directionality and locality between the allomorphic trigger and target (Bobaljik 2000). These discussions are largely based on segmental allomorphy, and absent is allomorphy found in suprasegmental exponence such as grammatical tone. At least half the world's languages are tonal (Yip 2002) and virtually all African tonal languages exhibit something which can be classified as grammatical or morphological tone (Hyman *et al*. 2021). Tone is also known to be different from other phonological phenomena both quantitatively and qualitatively (Hyman 2011), as well as computationally (Jardine 2016). These factors conspire to make tone a ripe area for developing empirically rich yet constrained morphological theories, and ideal grounds for testing them.

This paper seeks to incorporate grammatical tone into these theoretical debates, presenting a case study of grammatical tone (GT) allomorphy in the Bantu language Cilungu (Bickmore 2007, 2014). In this language, tense/aspect/mood (TAM) designations are realized via a combination of segmental and tonal exponence, e.g. the Remote Perfect is realized as a complex /a-...-a Ⓗ$^{2\text{-}F}$/, consisting of a segmental prefix, a segmental suffix (the Bantu final vowel), and a floating tone which docks to specific positions within the stem, in this case from the second to the final moras, the Cilungu tone-bearing unit (TBU). We focus on a class of TAM designations which show grammatical tone alternations which cannot be reduced to the general phonology. For example, the Recent Past is realized as /á-cí-...-il-e Ⓗ^{F} ~ Ⓗ^{2}/ with an alternation between two types of floating tones: one which docks to the final of the stem and the other to the second TBU of the stem. The alternation is conditioned by the tone of the subject agreement markers: if the subject marker (SM) is high-toned the Ⓗ^{F} variant occurs, but if it is toneless then Ⓗ^{2} occurs. An example is in (1), where the grammatical tone and the position it associates to are boxed, and the trigger of the alternation (the subject marker) is bolded and underlined.

(1) Recent Past /á-cí-...-il-e/ grammatical tone alternation

a.	/ **<u>tú</u>**-á-cí- |$_{STEM}$ sópolol-il-e Ⓗ^{F} /		→	**<u>tú</u>**-á-cí-sópolol-il-é
	SM-TAM-TAM-untie-TAM-FV	TAM		'we recently untied'
b.	/ **<u>u</u>**-á-cí- |$_{STEM}$ sópolol-il-e Ⓗ^{2} /		→	**<u>u</u>**-á-cí-sópólol-il-e
	SM-TAM-TAM-untie-TAM-FV	TAM		'he/she recently untied'

Only a few TAM designations exhibit such GT alternations in the language; the majority of other TAM designations either have consistent grammatical tone or no grammatical tone.

We present two possible accounts of these data, one morphological and the other phonological. The morphological account analyzes these contextual realizational rules with suppletive allomorphs, e.g. different exponents for the tense feature [RECENT] are inserted depending on the tone value of the subject marker. In this account, phonology is maximally regular and natural. In contrast, under the phonological account, morphology is maximally regular and there is no suppletive allomorphy. Instead, it is phonology which is irregular, having a phonological operation which only applies in the context of subject markers and a small set of TAM features. Such a phonological operation must capture a striking pattern of (1). If the subject marker is high-toned at the left edge, then there is a grammatical high tone at the right edge; equally, if the left edge subject marker is toneless, then the right edge must also be toneless, requiring that grammatical tone not fall on the right edge. We refer to this pattern as 'first-last tone harmony'.

The goal of this paper is to argue for the morphological account involving suppletive allomorphy. We develop a series of arguments which undermine the phonological account, which largely center around two aspects. First, this tonal alternation is highly restricted, triggered only by a single morphological class (subject markers) and only targeting a subclass of TAM designations which involve exponents of the aspect value [PERFECT] and the tense value [RECENT]. The second concerns the phonological operation 'first-last tone harmony' which would derive the patterns without suppletion. We show that such an operation is cross-linguistically rare if not non-existent, and phonologically unnatural from the view of laboratory and computational phonology (e.g. with respect to the Chomsky Hierarchy and

the 'Subregular Hypothesis'). The result is that a morphological account with suppletion emerges as a superior analysis compared to a purely phonological account without it.

Under this morphological account, Cilungu GT suppletive allomorphy constitutes phonologically-conditioned suppletive allomorphy (PCSA) because it references the tonal value (a phonological feature) of the subject marker (the trigger). An important ramification is that because the target (the TAM tone) is inward compared to the trigger (the subject marker tone), this pattern constitutes PCSA which is outward-sensitive, a rare type often claimed to be unattested/impossible (Bobaljik 2000, Paster 2006, 2009, 2015, Embick 2010, 2015, *inter alia*). If we are correct that this is outward-sensitive PCSA, this requires us to reevaluate theories whereby exponence proceeds strictly inside-out, and instead allow for exponence to be simultaneous within a given domain. At the same time, if the alternative phonological account involving first-last tone harmony were adopted (against our analysis), this forces phonological theory to reevaluate the kinds of phonological operations which are possible, permitting a wider set under morphologically-conditioned phonological patterns. Regardless, this case highlights the fact that 'restrictiveness' is not a uniform measurement across a grammar, and arguments relying on restrictiveness must take into account concomitant changes to other modules.

This paper is structured as follows. Section 2 lays out the basic facts on the Cilungu language to understand the morphological patterns, and section 3 describes the details of the grammatical tone alternations. Section 4 presents the two accounts of these facts, one morphological and the other phonological. Section 5 debates the two accounts and concludes that the morphological account is superior. Section 6 discusses the implications. After our conclusion and references, we include two appendices summarizing some data complications.

2 Preliminaries on Cilungu

Cilungu [IPA: tʃílúúŋgù; ISO 639-3: mgr] is a Bantu language spoken in Zambia and Tanzania (Bantu zone M14). The data in this paper come from Bickmore (2007, 2014); each data point is accompanied by its relevant source. This section provides the necessary background to understand the allomorphic patterns, such as basic facts about the verbal template, the tone system, tense/aspect/mood (TAM) designations, and tone specification of subject markers.

2.1 Verbal template

As stated, our empirical focus is the set of grammatical tone patterns which are part of tense/aspect/mood (TAM) inflection. To explain these patterns, we introduce the Cilungu verbal template, familiar across Bantu languages:

(2) Verbal template of Cilungu

[$_{V}$ **SM** (NEG) **TAM** [$_{MS}$ (OM) [$_{STEM}$ **ROOT** (DERIV) **TAM FV**]]]

(V = verb , SM = subject marker , TAM = tense/aspect/mood , MS= macro-stem , OM = object marker , NEG = negative , DERIV = derivational suffixes, FV = final vowel)

The more or less obligatory parts of the template (in bold) are the initial position for subject markers (agreement with the subject), tense/aspect/mood in one of several TAM positions, the root, and the Bantu final vowel whose shape co-varies with specific inflectional contexts. Note two important boundaries within the verbal template. The macro-stem boundary (MS) is between TAM and OM, and plays an important role in demarcating tone spreading domains (discussed immediately below). The other is the stem boundary (STEM) between the OM and the root, which will be important in understanding grammatical tone assignment.

2.2 Basics of tone system

Cilungu is classified as a privative tone system (Hyman 2001), contrasting /H/ vs. Ø (toneless). Low tone is realized by default on toneless tone-bearing units (TBUs) after all phonological operations; no /L/ toneme exists. The position of /H/ tone is not predictable, and thus must be pre-associated to specific TBUs in the underlying representation.

Surface forms exhibit a number of phonological processes. Most relevant to this paper is high tone spreading. There are three main types of high tone spreading which are general across the language (i.e. not morphologically conditioned): PWord spreading, MStem spreading, and binary spreading. Each is sensitive to whether the domain of spreading is final within the intonational phrase (ιP). These are shown in Table 1. Note that MS = macro-stem, τ = tone bearing unit (TBU) which in Cilungu is the mora, ω = phonological word, and ι = intonational phrase.

PWord spreading	**Input**		**Output**
a. Final in ɪP (Unbounded spreading)	(**τ́** τ |MS τ τ τ)ω]ɪ	→	(**τ́ τ́** |MS **τ́ τ́** τ)ω]ɪ
b. Non-final in ɪP (Bounded spreading)	(**τ́** τ |MS τ τ τ)ω (τ τ τ)ω]ɪ	→	(**τ́ τ́** |MS τ τ τ)ω (τ τ τ)ω]ɪ
MStem spreading			
c. Final in ɪP (Unbounded spreading)	(τ τ |MS **τ́** τ τ τ τ)ω]ɪ	→	(τ τ |MS **τ́ τ́ τ́ τ́** τ)ω]ɪ
d. Non-final in ɪP (Unbounded spreading)	(τ τ |MS **τ́** τ τ τ τ)ω (τ τ τ)ω]ɪ	→	(τ τ |MS **τ́ τ́ τ́ τ́ τ́**)ω (τ τ τ)ω]ɪ
Binary spreading			
e. Bounded spreading:	(τ |MS τ τ **τ́**)ω (τ τ τ)ω]ɪ	→	(τ |MS τ τ **τ́**)ω (**τ́** τ τ)ω]ɪ

Table 1: Major tonological spreading rules (not morphologically conditioned)

PWord spreading is illustrated in (3).[1] If a high tone originates before a macro-stem boundary |MS within a phonological word ω, it spreads unbounded up to the penultimate syllable (a.). However, it shows bounded spreading up to the final syllable before the macro-stem boundary if the word is non-final in the ɪP (b.).

(3) PWord spreading – Unbounded in final ω of ɪP, bounded otherwise

a. / **tú**-ku- |MS mu-sukilil-a / → (**tú-kú**-|MS **mú-súkílíl**-à)ω]ɪ
we-TAM-OM-accompany-FV 'we are accompanying him/her' [B07:148]

b. / **tú**-ku- |MS mu-ful-a ningó / → (**tú-kú**-|MS mù-fùl-à)ω (nìingó)ω]ɪ
we-TAM-OM-wash-FV well 'we are washing him/her well' [B07:156]

Next, MStem spreading is shown in (4). If a high tone originates after a MStem boundary, it spreads unbounded up to the penultimate syllable if the word is final within the ɪP (a.), but to the ultimate syllable of the word if non-final (b.)

(4) MStem spreading – Always unbounded

a. / tú-ku- | mu-**pá**apaatik-a / → (tú-kú-| mù-**páápáátík**-à)ω]ɪ
we-TAM-OM-flatten-FV 'we are flattening him/her' [B07:148]

b. / tú-ku- | **yá**-suel-il-a ningó / → (tú-kú-| ꜜ**yá-swéél-él-á**)ω (nìingó)ω]ɪ
we-TAM-them-brew-APPL-FV well 'we are brewing for them well' [B07:158]

The final type is Binary spreading, which is always bounded. A high tone will spread one syllable to the right, even crossing phonological word boundaries, shown in (5).

(5) Binary spreading: / tú-ku- |STEM **sí**-a Choola / → (tú-kú-ꜜ**shá**)ω (**Chóó**là)ω]ɪ
we-TAM-leave-FV Chola 'we are leaving Chola' [B07:172]

Bounded spreading occurs even if it were to incur an OCP violation, which is repaired by a downstep. Downstep is indicated throughout by a raised exclamation point.

As stated, these three spreading rules are phonologically general and orthogonal to the grammatical tone allomorphy which is the focus of this paper. We identify them because they alter the tone of the surface form, sometimes drastically. For each example in this paper, they are 'factored out' in order to reveal underlying tone and morphologically assigned tones (such as the relevant ones from tense and aspect).

[1] The Cilungu data are presented in the language's conventional orthography, which differs from the IPA only in the following: <sh> = [ʃ], <c> = [tʃ] (or <ch> in names), <j> = [dʒ], and <y> = [j].

2.3 The trigger of allomorphy: Subject markers and their underlying tone

Subject markers (SMs) agree with the subject in class (and in number/person where applicable). Individual SMs either have inherent high tone (H) or are toneless (Ø). The toneless SMs are in bold below, and boxed for emphasis. Note that class 1 (3SG) has two allomorphs, both of which are toneless. (We return to this allomorphy in §6.4.)

Classes	1SG	2SG	**3SG**	1PL	2PL	3PL										
1/2:	ń-	ú-	**a- ~ u-**	tú-	mú-	yá-										
Other	3	**4**	5	6	7	8	**9**	10	11	12	13	14	15	16	17	18
classes:	gú-	**i-**	lí-	yá-	cí-	ví-	**i-**	zí-	lú-	ká-	tú-	gú-	kú-	pá-	kú-	mú-

Table 2: Subject markers (SMs) appear on verbs, and agree in noun class with the subject

Most SMs are high-toned and consonant-initial, while the toneless SMs are onsetless. However, notice that CL1 (2SG) 'you (sg.)' is high-toned /ú-/ while CL1 (3SG) 'he/she' is toneless /u-/. This creates minimal pairs such as in (6).

(6) Subject marker tonal minimal pair

a. / **ú**-a-mu-fuk-il-il-e / → [**wáá**múfùkíílé]
SM-TAM-OM-harvest-APPL-TAM-FV '**you (sg.)** harvested for him/her' [B07:8]

b. / **u**-a-mu-fuk-il-il-e / → [**wàà**mùfùkíílé]
SM-TAM-OM-harvest-APPL-TAM-FV '**he/she** harvested for him/her' [B07:8]

Toneless SMs as a class trigger grammatical tone allomorphy. They form a phonological natural classes based on their tonal properties, but do not form a natural morphosyntactic class (there is no common morphological, syntactic, or semantic feature unifying CL1 (3SG) /a-/~/u-/, CL4 /i-/, and CL9 /i-/).[2]

2.4 The target of allomorphy: The TAM system and grammatical tone

In Cilungu, individual categories of tense/aspect/mood are expressed by a unique combination of TAM morphs. These consist of prefixes, suffixes, the final vowel, and/or tone, shown in (7) (recall the positions from (2) above). We refer to unique combinations of morphs as 'TAM designations'.

(7) Component morphs of TAM designations:

a. 0, 1, or 2 prefixes in pre-radical TAM position
b. 0 or 1 suffix in post-radical TAM position
c. Shape of the final vowel (-a/-e)
d. A grammatical tone which associates within the stem

[2] While we refer to these as 'toneless' SMs, there is conflicting evidence whether they in fact sponsor a floating tone. Consider the data in (i.-ii.) below involving the present progressive /ku-...-a/ which has no inherent or grammatical tone, used with toneless verb roots /ziik/ 'bury'. Tone from the H-toned SM /tú-/ in (i.) undergoes unbounded PWord spreading. In comparison, although the SM /a-/ itself is realized without high tone in (ii.), the same unbounded PWord spreading takes place. One straightforward analysis is that toneless SMs sponsor a floating high Ⓗ which docks immediately to the right.

(i.) / **tú**-ku-mu-ziik-a Ø / → [tú-kú-mú-zíík-à] '**we** are burying him/her' [B07:153]

(ii.) / **a**$^{Ⓗ}$-ku-mu-ziik-a Ø / → [à-kú-mú-zíík-à] '**he/she** is burying him/her' [B07:153]

However, with other TAMs such as the future with the prefix /la-/, toneless SMs do not appear to (consistently) sponsor a floating high. This is shown in (iii.) below with the Remote Future /la-...-a Ⓗ$^{2\text{-F}}$/.

(iii.) / **a**-la-mu-ziik-il-a Ⓗ$^{2\text{-F}}$ / → [à-là-mù-zìík-íl-á] '**he/she** will bury for him/her' [B07:287] (cf. *[à-lá...])

Further complications with toneless SMs exist when they appear before an onsetless root (and only a root) in certain TAMs, such as the Perfect and Narrative Past (see Bickmore 2007:519).

Despite these complications, what remains is a unique phonological criterion which unifies these SMs: either tonelessness, or the fact that they sponsor a floating tone but do not have pre-associated tone themselves. In either case, they remain a grammatically unnatural class.

For example, consider the TAM designation 'Yesterday Past Progressive' /á-...-ang-a Ⓗ^{F}/, in (8). This is composed of a prefix morph /á-/ (with inherent high tone), a suffix /-ang/, the final vowel /-a/, and a grammatical high tone which docks to the final vowel of the stem, Ⓗ^{F}. In this example and throughout, we use the following conventions: forward slashes / / indicate the underlying forms of morphs, backslashes \ \ indicate the concatenated forms after grammatical tone becomes associated (essentially an intermediate form), and [ ] brackets indicate surface forms after all phonological rules have applied (such as the general spreading rules in Table 1 above).

(8) / tú-**á**-mu-ziik-il-**ang**-**a** Ⓗ^{F} / → \ tú-**á**-mu-ziik-il-**ang**-**á** \ → [twáámúzììkìlààngá]
SM-**TAM**-OM-root-DER-**TAM**-**FV** **TAM** 'we were burying for him/her' [B07:258]

This TAM grammatical tone is referred to as 'Melodic Tone' or 'Melodic Highs' in the Bantu literature (e.g. Odden & Bickmore 2014, and papers therein), which we analyze as floating tones not pre-associated to a TBU in the input. Following Yip (2002) and others, we circle floating tones to differentiate them from pre-associated high tone.[3]

There is four-way contrast for TAM grammatical tone in Cilungu, shown in Table 3. Individual TAM designations may have either no grammatical tone (denoted with Ø), a grammatical high tone on the final TBU of the stem (Ⓗ^{F}), high on the second TBU of the stem (Ⓗ^{2}), or high which stretches from the second to the final TBUs of the stem (Ⓗ$^{2\text{-}F}$). These are illustrated below (recall that τ stands for the TBU).

a.	Ø	No grammatical tone	($_{V}$ τ τ $\|_{STEM}$ τ τ τ τ)
b.	Ⓗ^{F}	H on final TBU of stem	($_{V}$ τ τ $\|_{STEM}$ τ τ τ **τ́**)
c.	Ⓗ^{2}	H on 2nd TBU of stem	($_{V}$ τ τ $\|_{STEM}$ τ **τ́** τ τ)
d.	Ⓗ$^{2\text{-}F}$	H from 2nd to final TBU	($_{V}$ τ τ $\|_{STEM}$ τ **τ́ τ́ τ́**)

Table 3: Inventory of grammatical tone patterns co-exponing TAM

Grammatical tone patterns are consistent in both toneless verb roots and high-toned roots. In (9), forms in the Remote Perfect TAM designation show a Ⓗ$^{2\text{-}F}$ pattern with both toneless roots (a.) and high-toned roots (b.).

(9) Remote Perfect TAM designation with consistent Ⓗ$^{2\text{-}F}$ GT pattern
a. / yá-**a**-sukilil-**a** Ⓗ$^{2\text{-}F}$ / → \ yá-a-su**kílíl-á** \ → [yáásù**kílílá**]
'they have already accompanied' [B14:48]
b. / tú-**a**-sópolol-**a** Ⓗ$^{2\text{-}F}$ / → \ tú-a-só**pólól-á** \ → [twáàsó**pólólá**]
'we have already untied' [B07:290]

An important observation is that while the general tonal spreading rules are sensitive to the macro-stem boundary (Table 1 above), the domain to which grammatical tone is assigned is the stem rather than the macro-stem. For example, the Far Past TAM designation /a-...-il-e Ⓗ$^{2\text{-}F}$/, in (10). Its grammatical tone targets the second TBU of the stem (a.), rather than the second of the macro-stem (cf. b.).

(10) GT pattern targets the stem, not the macro-stem
a. / tú-**a**- $|_{MS}$ mu- $|_{STEM}$ londolol-**il**-**e** Ⓗ$^{2\text{-}F}$ / → \ tú-a-mu-$|_{STEM}$ lon**dólól-íl-é** \ → [tw-áá-mú-lòòn**dólw-ííl-é**]
SM-**TAM**-OM-explain-**TAM**-**FV** **TAM** 'we explained to him/her' [B07:278]
b. Cf. *\ tú-a-$|_{MS}$ mu-**lóndólól-íl-é** \ *[tw-áá-mù-**lóóndólw-ííl-é**]

2.5 Local summary

We summarize the Cilungu TAM designations in Table 4, split into five groups based on their tonal behavior. The first group has no grammatical tone (Ø), the second group has a final grammatical tone (Ⓗ^{F}), and the third group has

[3] Numerous other rules exist, some of which can be seen here such as gliding, pre-nasal lengthening, consonant changes due to imbrication, tone shifting due to eliminating rises on syllables, and downstepping. All of these are orthogonal to the allomorphy patterns under focus.

grammatical tone from the second to the final TBU of the stem (Ⓗ$^{2\text{-}F}$). The patterns of these groups are invariant. In contrast, the fourth group (in bold) shows three patterns of grammatical tone allomorphy. It is this group which is the focus of our study. Group five shows a different kind of grammatical tone allomorphy with Subjunctive and Imperative moods, allomorphy which is both grammatically- and phonologically-conditioned. Crucially, allomorphy in this last group is not conditioned by the tonal designation of the SM, and is thus outside of the scope of this paper.

Further, certain TAMs change the tone of subject markers, e.g. in the Past Inceptive the subject marker is always high (regardless of its underlying value; cf. Table 2). We indicate this with a superscript $^{Ⓗ}$ before the TAM prefix. Further, in the Potential with /ngá-/ the subject marker is always toneless, which we indicate with a superscript ^{Ø} before the prefix. These tonal changes on the subject marker do not interact with the allomorphy of focus, and we will not treat them further.

	Group	TAM designation		Prefix	Suffix	FV	GT
1.	No grammatical tone	Past Inceptive	$^{Ⓗ}$	aa-		-a	Ø
		Contrastive Habitual		ma-áa-		-a	Ø
		Persistive Potential	^{Ø}	ngá-aa-		-a	Ø
		Future Continuative		ka-áa-		-a	Ø
		Future Progressive		la-áa-		-a	Ø
		Hortative	$^{Ⓗ}$	áa-		-a	Ø
		Immediate Future		máa-		-a	Ø
		Present Progressive		ku-		-a	Ø
		Habitual		káa-		-a	Ø
		Persistive		cí-líi-		-a	Ø
2.	High on final	Potential	^{Ø}	ngá-		-a	Ⓗ^{F}
3.	High 2nd to final	Far Past		a-	-il	-e	Ⓗ$^{2\text{-}F}$
		Far Past 2		a-cí	-il	-e	Ⓗ$^{2\text{-}F}$
		Far Past Progressive		a-	-ang	-a	Ⓗ$^{2\text{-}F}$
		Remote Perfect		a-		-a	Ⓗ$^{2\text{-}F}$
		Narrative Past				-a	Ⓗ$^{2\text{-}F}$
		Remote Future		la-		-a	Ⓗ$^{2\text{-}F}$
4.	**GT allomorphy** **(conditioned by SM)**	**Yesterday Past**		**á-**	**-il**	**-e**	**Ⓗ^{F} / Ø**
		Yesterday Past Progressive		**á-**	**-ang**	**-a**	**Ⓗ^{F} / Ø**
		Recent Perfect		**á-**		**-a**	**Ⓗ^{F} / Ø**
		Recent Perfect 2		**á-cí-**		**-a**	**Ⓗ^{F} / Ø**
		Recent Past Progressive		**á-cí-**	**-ang**	**-a**	**Ⓗ^{F} / Ø**
		Recent Past		**á-cí-**	**-il**	**-e**	**Ⓗ^{F} / Ⓗ^{2}**
		Perfect			**-il**	**-e**	**Ⓗ$^{2\text{-}F}$ / Ⓗ^{2}**
5.	Other GT allomorphy	Subjunctive	$^{Ⓗ}$			-e	Ⓗ$^{2\text{-}F}$ / Ⓗ^{F}
		Imperative				-a ~ -e	Ⓗ$^{2\text{-}F}$ / Ⓗ^{F}

Table 4: TAM designations grouped by grammatical tone patterns

It is not possible to associate an individual grammatical tone pattern with a consistent semantic meaning by itself in the absence of segmental co-exponents. Bickmore in fact is explicit on this point, stating "it does not seem possible to assign the [grammatical tone] any consistent meaning that it contributes the form" (Bickmore 2007:314). For example, Ⓗ^{F} appears in the Potential but also in temporally more recent situations (e.g. Yesterday Past) and in certain Subjunctive/Imperative contexts; Ⓗ$^{2\text{-}F}$ appears is temporally more remote situations but also the Perfect and some Subjunctive/Imperative contexts as well. These do not form natural classes such that we can say the GT by itself indicates any semantic meaning. All relevant generalizations appear to involve covariation between specific segmental morphs and specific GT patterns, e.g. the prefix /a-/ co-varies with Ⓗ$^{2\text{-}F}$, the prefix /á-/ with Ⓗ^{F}, and morphs with a long /áa-/ or /aa-/ with Ø.

3 **The allomorphy patterns:**

With this background established, we now present the basics of the allomorphic patterns involving grammatical tone. From Table 4, the only TAM designations showing allomorphy triggered by the subject marker are those that appear with a prefix /á-/ or with the suffix /-il/. All other comparable TAM designations – hereafter simply called 'TAMs' – are unaffected.

3.1 Allomorphy pairing Ⓗ^{F}/Ø

We begin by examining TAM allomorphy pairing Ⓗ^{F} with Ø, such as Yesterday Past (YP) /á-...-il-e/. Examples are in (17) with the toneless root /fuk/ 'harvest'. In the context of a high-toned subject marker (SM) /ú-/ 'you (sg.)', this TAM is co-exponed with a Ⓗ^{F} grammatical tone (a.), while in the context of a toneless subject marker /u-/ 'he/she' there is no TAM grammatical tone, Ø (b.). In this example and thereafter, the trigger of GT allomorphy is in bold and underlined (the SM), and the relevant TAM morph which is the target of allomorphy is in a dotted box. Recall that / / indicates the underlying form, \ \ the intermediate form after grammatical tone associates, and [ ] the surface form after general tonal rules (e.g. regular tone spreading).

(11) Yesterday Past with toneless root [B07:8]

a. H-toned SM /ú-/ triggering Ⓗ^{F}

/ **ú**-á-mu- $\|_{STEM}$	fuk-il-il-e	Ⓗ^{F} /	\ **ú**-á-mu-fuk-il-il-é \	[**wá**ámúfùkììlé]
SM-TAM-OM-	harvest-APPL-TAM-FV	TAM	'you (sg.) harvested for him/her (yesterday)'	

b. Toneless SM /u-/ triggering Ø

/ **u**-á-mu- $\|_{STEM}$	fuk-il-il-e	Ø /	\ **u**-á-mu-fuk-il-il-e \	[**wà**àmúfùkììlè]
SM-TAM-OM-	harvest-APPL-TAM-FV	TAM	'he/she harvested for him/her (yesterday)'	

These examples illustrate 'first-last tone harmony', introduced above. This refers to the fact that if the verb form begins with a high tone then it ends with a (grammatical) high tone /Ⓗ^{F}/, as well. However, if it begins with a toneless SM, it ends with no grammatical tone (realized in the surface form with default low tone). At this juncture, we only employ the term 'first-last tone harmony' to capture this descriptive generalization; in §4-§5, we debate whether it should be interpreted as a *bona fide* phonological harmony operation in the language.

These allomorphy facts are replicated across the full range of Yesterday Past contexts. The same allomorphy patterns are shown with the H-toned root /fúk/ 'turn up hem' in (12), which forms a minimal pair with (11).

(12) Yesterday Past with H-toned root [B07:8]

a. H-toned SM /ú-/ triggering Ⓗ^{F}

/ **ú**-á-mu- $\|_{STEM}$	fúk-il-il-e	Ⓗ^{F} /	\ **ú**-á-mu-fúk-il-il-é \	[**wá**ámúˈfúkíìlé]
SM-TAM-OM-	turn.up.hem-TAM-FV	TAM	'you (sg.) turned up hem for him/her (yesterday)'	

b. Toneless SM /u-/ triggering Ø

/ **u**-á-mu- $\|_{STEM}$	fúk-il-il-e	Ø /	\ **u**-á-mu-fúk-il-il-e \	[**wà**àmúfúkììlè]
SM-TAM-OM-	turn.up.hem-TAM-FV	TAM	'he/she turned up hem for him/her (yesterday)'	

As above, the form with SM /ú-/ surfaces with high on the initial and final TBU (a.), while the form with SM /u-/ surfaces with low on both (b.).

Furthermore, all and only toneless SMs trigger the special allomorphy. Table 5 lists SMs of classes 3-15 with the toneless verb /ful/ 'wash' in the Yesterday Past. Like toneless class 1 /a-/~/u-/, toneless SMs /i-/ (class 4) and /i-/ (class 9) trigger the Ø form of the Yesterday Past (rows shaded gray). All other classes are high-toned and trigger the Ⓗ^{F} form.

CL	Yesterday Past: **X**-á-ful-il-e X 'it/they washed'		
3	/ **gú**-á-ful-il-e Ⓗ^{F} /	\ **gú**-á-ful-il-é \	[wááfúzìlé]
4	/ **i**-á-ful-il-e Ø /	\ **i**-á-ful-il-e \	[yààfúzílè]
5	/ **lí**-á-ful-il-e Ⓗ^{F} /	\ **lí**-á-ful-il-é \	[lyááfúzìlé]
6	/ **yá**-á-ful-il-e Ⓗ^{F} /	\ **yá**-á-ful-il-é \	[yááfúzìlé]
7	/ **cí**-á-ful-il-e Ⓗ^{F} /	\ **cí**-á-ful-il-é \	[cááfúzìlé]
8	/ **ví**-á-ful-il-e Ⓗ^{F} /	\ **ví**-á-ful-il-é \	[vyááfúzìlé]
9	/ **i**-á-ful-il-e Ø /	\ **i**-á-ful-il-e \	[yààfúzílè]
10	/ **zí**-á-ful-il-e Ⓗ^{F} /	\ **zí**-á-ful-il-é \	[zyááfúzìlé]
11	/ **lú**-á-ful-il-e Ⓗ^{F} /	\ **lú**-á-ful-il-é \	[lwááfúzìlé]
12	/ **ká**-á-ful-il-e Ⓗ^{F} /	\ **ká**-á-ful-il-é \	[kááfúzìlé]
13	/ **tú**-á-ful-il-e Ⓗ^{F} /	\ **tú**-á-ful-il-é \	[twááfúzìlé]
14	/ **gú**-á-ful-il-e Ⓗ^{F} /	\ **gú**-á-ful-il-é \	[wááfúzìlé]
15	/ **kú**-á-ful-il-e Ⓗ^{F} /	\ **kú**-á-ful-il-é \	[kwááfúzìlé]

Table 5: Parallel behavior of toneless SMs: Class 1 (3SG), class 4, and class 9

Parallel patterns are seen with other Ⓗ^{F}/Ø TAMs from Table 4, namely the Yesterday Past Progressive, the Recent Perfect and Recent Perfect 2, and the Recent Past Progressive. All of these also contain the TAM morph /á-/, denoting more recent situations. A representative example set is in (13) with the Recent Perfect (a.) and Recent Past Progressive TAM designations (b.).

(13)

a. Ⓗ^{F}/Ø allomorphy with Recent Perfect /á-...-a/
   / **yá**-á-sukilil-a Ⓗ^{F} / → \ **yá**-á-sukilil-á \ [yáásúkìlìlá] 'they have just accompanied' [B14:45]
   / **u**-á-sukilil-a Ø / → \ **u**-á-sukilil-a \ [wààsúkílìlà] 'he/she has just accompanied' [B07:269]

b. Ⓗ^{F}/Ø allomorphy with Recent Past Progressive /á-cí-...-ang-a/
   / **yá**-á-cí-ful-ang-a Ⓗ^{F} / → \ **yá**-á-cí-ful-ang-á \ [yáácífúlààngá]
   'they were recently washing' [B14:45]
   / **u**-á-cí-mu-ful-ang-a Ø / → \ **u**-á-cí-mu-ful-ang-a \ [wààcímúfùlààngà]
   'he/she was recently washing him/her' [B14:45]

Taken all together, Ⓗ^{F}/Ø allomorphy is consistent across (*i*) different TAMs (*ii*) different toneless subject markers, (*iii*) different root types (H-toned vs. toneless), as well as (*iv*) several other morphological contexts (not shown) such as in relative clauses, with intervening object markers, with the passive extension /-u/, *inter alia*. See Bickmore (2007, 2014) for full details on these other contexts.[4]

There is one further complication relevant to our discussion concerning the Ⓗ^{F}/Ø allomorphy: regular PWord spreading is unexpectedly blocked with the Ø allomorph. Table 1 above schematized PWord spreading whereby a high tone originating outside of the macro-stem spreads to the penult TBU if the word it is contained within is final in the ιP, i.e. (**ŧ** τ $|_{MS}$ τ τ τ)$_{ω}$]$_{ι}$ → (**ŧ ŧ** $|_{MS}$ **ŧ ŧ** τ)$_{ω}$]$_{ι}$. With TAMs which do not sponsor any grammatical tone (group 1 from Table 4), high tone from outside of the macro-stem undergoes PWord spreading. However, in contexts of the Ⓗ^{F}/Ø pairing, a high before the macro-stem undergoes only bounded binary spreading (i.e. spreading one TBU to the right. This is shown in (14), with the allomorph Ø of the Recent Perfect TAM designation.

(14) Lack of MWord spreading with Ø allomorph of Recent Perfect /á-...-a Ø/
   / u-á-$|_{MS}$ sukilil-a Ø / → \ u-á-sukilil-a \ → [wàà**súkí**lìlà]
   'he/she has just accompanied' [B07:269] (cf. unattested unbounded spreading *[wàà**súkílí**là])

[4] In Appendix 1, however, we discuss one morphological context which does systematically disrupts normal GT allomorphy, namely negative clauses.

These data warrant at least two possibilities. One is that allomorphy here is not between Ⓗ^{F} and Ø, but rather between Ⓗ^{F} and another special floating tone which *never* docks, e.g. Ⓗ^{0} where the superscript 0 indicates that it cannot dock to a TBU. While this floating tone wouldn't dock, it does block MWord spreading. A second is that Ø should be replaced with a grammatical L tone, which would also block MWord spreading. This would, however, complicate the fact that Cilungu is otherwise a straightforward H vs. Ø Bantu language. We do not provide an account of these data in this paper. What is important is that regardless of the interpretation, there is complementary allomorphy between Ⓗ^{F} versus some other GT allomorph.[5]

3.2 Allomorphy pairings Ⓗ^{F}/Ⓗ^{2} and Ⓗ$^{2\text{-}F}$/Ⓗ^{2}

Let us now examine the other two relevant allomorphic pairings from Table 4, occurring in the Recent Past (segmentally: /á-cí-...-il-e/) and the Perfect (/-il-e/). In these cases, the trigger of allomorphy is the same – the tone value of the subject marker – but the allomorphic patterns are different. The Recent Past shows a Ⓗ^{F}/Ⓗ^{2} allomorphy pairing, while the Perfect shows a Ⓗ$^{2\text{-}F}$/Ⓗ^{2} pairing. Examples with the Recent Past are in (15), with a high-toned root (a.-b.) and a toneless root (c.-d.).

(15) Recent Past /á-cí-...-il-e/ with allomorphy pairing Ⓗ^{F}/Ⓗ^{2}

a.	/ **tú**-á-cí- |$_{STEM}$ sópolol-il-e	Ⓗ^{F} /	\ **tú**-á-cí-sópolol-il-é \	[twáácísópólwìílé]	
	SM-TAM-TAM-untie-TAM-FV	TAM	'we recently untied'		[B14:49]
b.	/ **u**-á-cí- |$_{STEM}$ sópolol-il-e	Ⓗ^{2} /	\ **u**-á-cí-sópólol-il-e \	[wàácísópólwíílè]	
	SM-TAM-TAM-untie-TAM-FV	TAM	'he/she recently untied'		[B14:49]
c.	/ **tú**-á-cí-mu |$_{STEM}$ ziik-il-e	Ⓗ^{F} /	\ **tú**-á-cí-mu-ziik-il-é \	[twáácímúzìsìlé]	
	SM-TAM-TAM-OM-bury-TAM-FV	TAM	'we recently buried for him/her'		[B07:262]
d.	/ **u**-á-cí-mu |$_{STEM}$ sukilil-il-e	Ⓗ^{2} /	\ **u**-á-cí-mu-sukílil-il-e \	[wàácímúsùkílíílè]	
	SM-TAM-TAM-OM-accompany-TAM-FV	TAM	'he/she recently untied'		[B07:262]

Analogous data are provided in (16) with the Perfect /-il-e/ with Ⓗ$^{2\text{-}F}$/Ⓗ^{2} allomorphy, one of the few TAM designations with no prefix morph.

(16) Perfect /-il-e/ with allomorphy pairing Ⓗ$^{2\text{-}F}$/Ⓗ^{2}

a.	/ **tú**- |$_{STEM}$ ful-il-e Ⓗ$^{2\text{-}F}$ /	\ **tú**-ful-íl-é \	[túfúzˈílé]	'we have washed'	[B07:293]
b.	/ **a**- |$_{STEM}$ ful-il-e Ⓗ^{2} /	\ **a**-ful-íl-e \	[àfùzílè]	'he/she has washed'	[B07:294]
c.	/ **tú**-yá |$_{STEM}$ léet-il-e Ⓗ$^{2\text{-}F}$ /	\ **tú**-yá-léét-íl-é \	[túyáléésílé]	'we have brought them'	[B07:294]
d.	/ **a**-yá |$_{STEM}$ lás-il-e Ⓗ^{2} /	\ **a**-yá-lás-íl-e \	[àyálásílè]	'he/she has hit them'	[B07:294]

As seen, the Perfect is exponed with Ⓗ$^{2\text{-}F}$ if the SM is high-toned (a. and c.), but exponed with Ⓗ^{2} if the SM is toneless (b. and d.). In both of these example sets, we see the same first-last tone harmony generalization: if the first TBU is toneless then the last one is also toneless.

3.3 Non-local conditioning

All three of these SM-conditioned tone allomorphy pairings apply regardless of the phonological or morphological locality of the trigger and target. The trigger is always the value of the SM at the left edge, and the target is always grammatical tone which appears towards the right edge. Intervening morphemes and/or intervening tonemes are transparent and do not disrupt this allomorphy relationship, shown in (17) with a Recent Past example. Here, high tone on intervening TAM morphs, object markers, or roots neither blocks nor triggers the allomorphy relation.

[5] Cilungu is not the only Bantu language where bounded spreading takes place in certain contexts where unbounded spreading is expected given other facts of the tonal system. For example, consider closely related M Zone languages Aushi [auh] and Copperbelt Bemba [bem]. In these languages there is no evidence of grammatical tone allomorphy triggered by toneless SMs. In both, the TAMs corresponding to those here are exponed segmentally as /á-cí-/ but without grammatical tone. And in both of those languages, the H on /cí-/ exceptionally undergoes bounded rather than the expected unbounded spreading (second author's field notes).

(17) Non-local trigger and target – Ⓗ^{F}/Ⓗ^{2} pairing in Recent Past [B14:49]

a. **H** H H H Ⓗ^{F}
| | | | |
tú-á-cí-sópolol-il-é [twáácísópólwìílé] 'we recently untied'

b. **Ø** H H H Ⓗ^{2}
| | | |
u-á-cí-sópólol-il-e [wàácísópólwíílè] 'he/she recently untied'

3.4 Other TAMs are unaffected by tone of SM

Other TAMs which are co-exponed with grammatical tone do not show allomorphy triggered by the tone of the subject marker. For these TAMs, no first-last tone harmony is observed. For example, the Remote Perfect /a-...-a Ⓗ$^{2\text{-}F}$/ is consistently realized with a Ⓗ$^{2\text{-}F}$ grammatical tone in all SM contexts, shown in (18).

(18) No allomorphy with Remote Perfect /a-...-a Ⓗ$^{2\text{-}F}$/ [B07:289]

a. / tú-a-ziik-a Ⓗ$^{2\text{-}F}$ / \ tú-a-zíík-á \ [twáázìíká] 'we have already buried'

b. / u-a-ziik-a Ⓗ$^{2\text{-}F}$ / \ u-a-zíík-á \ [wàázìíká] 'he/she has already buried'

The same facts hold for other non-allomorphic TAM designations with Ⓗ$^{2\text{-}F}$ in Table 4, such as the Far Past /a-...-il-e Ⓗ$^{2\text{-}F}$/, and the Narrative Past /-a Ⓗ$^{2\text{-}F}$/.

Further, Table 4 mentioned several TAMs which have an idiosyncratic tonal effect on the subject marker. For example, the Potential /^{Ø}ngá-...-a Ⓗ^{F}/ has a special property of making all SMs toneless regardless of their underlying value (see Table 2), while the Past Inceptive /$^{Ⓗ}$aa-...-a Ø/ makes all SMs high tone. Despite the neutralization of SM tone, neither TAMs show any tonal allomorphy.

(19) No allomorphy with Potential /^{Ø}ngá-...-a Ⓗ^{F}/

a. / tú-^{Ø}ngá-pón-a Ⓗ^{F} / \ **tu**-ngá-pón-á \ [tùùngápóná] 'we can fall' [B07:513]

b. / a-^{Ø}ngá-pón-a Ⓗ^{F} / \ **a**-ngá-pón-á \ [ààngápóná] 'he/she can fall' [B07:513]

(20) No allomorphy with Past Inceptive /$^{Ⓗ}$aa-...-a Ø/

a. / tú-$^{Ⓗ}$aa-ful-a Ø / \ **tú**-aa-ful-a \ [twááfúlà] 'and then we started to wash' [B07:195]

b. / a-$^{Ⓗ}$aa-ful-a Ø / \ **á**-aa-ful-a \ [ááfúlà] 'and then he/she started to wash' [B07:196]

3.5 Local summary

We summarize the allomorphic TAM patterns of focus in Table 6. Allomorphy in grammatical tone is conditioned by whether the subject marker is high-toned or toneless. Allomorphy only affects GT; without exception, the segmental morphs in the same TAM designation do not change.

TAM designation	Segmental exponents				GT if SM=H		GT if SM=Ø
Yesterday Past	á-		-il	-e	Ⓗ^{F}	/	Ø
Yesterday Past Progressive	á-		-ang	-a	Ⓗ^{F}	/	Ø
Recent Perfect	á-			-a	Ⓗ^{F}	/	Ø
Recent Perfect 2	á-	cí-		-a	Ⓗ^{F}	/	Ø
Recent Past Progressive	á-	cí-	-ang	-a	Ⓗ^{F}	/	Ø
Recent Past	á-	cí-	-il	-e	Ⓗ^{F}	/	Ⓗ^{2}
Perfect			-il	-e	Ⓗ$^{2\text{-}F}$	/	Ⓗ^{2}

Table 6: Interim summary GT allomorphy in the TAM system

Based on these allomorphy patterns we established a number of observations, summarized in (21).

(21) Core observations of the allomorphic patterns:
   a. Restricted trigger set: it is the phonological identity of SMs and only SMs which trigger allomorphy
   b. Restricted target set: the GT of certain TAMs and only these TAMs are the target of allomorphy
   c. Morphosyntactic insensitivity: allomorphy applies regardless of morphosyntactic context (e.g. matrix vs. embedded clauses, with and without object markers, presence or absence of derivation such as passive, *etc*.)
   d. Non-locality: allomorphy is insensitive to intervening tones; these do not trigger nor block allomorphy
   e. First-last tone harmony: in allomorphic TAMs, the first and last TBUs have the same tonal value (either both are H or both are toneless)

A major focus of the next chapter is on the interpretation of first-last tone harmony. Is it an incidental aspect of the allomorphic pairings, or is it a constraint driving the patterns in the first place?

Our discussion of the allomorphic patterns was necessarily brief. At the end of this paper, we provide two appendices which detail some further complications involving these allomorphy. Appendix 1 discusses the one morphosyntactic context which does systematically disrupt regular allomorphy, namely negation. Further, Appendix 2 includes additional complicating data for full transparency, particularly with very short roots.

4 **Morphology or Phonology?**

We can now begin to address the central question of this paper: should these patterns be treated as morphology or phonology? And what are the implications upon choosing one over the other? As stated in the introduction, we argue that this is morphology, i.e. that the patterns emerge based on a claim we make about the morphological component of Cilungu grammar. In this section, we wish to neutrally present the case for both morphology and phonology, to the best of our ability. In §5 we will turn to our arguments in favor of morphology.

4.1 Interpretation as morphology: Phonologically-conditioned suppletive allomorphy (PCSA)

Let us first establish the basics of the morphological solution. As our starting point, we assume a realizational model of morphology whereby exponents are made up of phonological substance which 'realize' the already present morphosyntactic features, rather than introducing these features themselves (Stump 2001, Trommer 2012). We model this with simple realizational rules of the type familiar to item-based realizational models such as Distributed Morphology (Halle & Marantz 1993, Embick 2015).

For example, the Narrative Past /-a Ⓗ$^{2\text{-}F}$/ consists of the final vowel /-a/ and a grammatical tone Ⓗ$^{2\text{-}F}$ which associates from the second to final TBUs of the stem, shown in (22). No TAM prefixes or suffixes occur in this TAM designation.

(22) Narrative Past: / n-sukilil-a Ⓗ$^{2\text{-}F}$ / → \ n-sukílíl-á \ → [ìn-sùkílíl-á] 'and then I accompanied'

We can write a realizational rule for this TAM as in (23), which states that if there is a morphosyntactic feature which expresses the TAM meaning [NARRATIVE.PAST], this is realized as the phonological object Ⓗ$^{2\text{-}F}$.

(23) Realizational rule: [NARRATIVE.PAST] ↔ Ⓗ$^{2\text{-}F}$

Notice that we do include the final vowel as part of the TAM exponence. The exact morphosyntactic category associated with Bantu final vowels is notoriously difficult, and we choose not to enter this debate here. We follow Pietraszko's (2018) analysis of the Bantu language Ndebele [nde], which posits that the final vowel is an exponent of the verbal functional head *v*, which has various allomorphic shapes depending on the TAM context. Her exponence rules for Ndebele are repeated in (24), where /-ile/ realized [*v*] in the context of remote past [T:RPAST], and /-a/ is realized elsewhere.

(24) Ndebele final vowel exponence (Pietraszko 2018:283): [*v*] ↔ -ile / [T:RPAST] ___
↔ -a

Following this model, we posit the realizational rules for [*v*] in (25) for the Cilungu data introduced already.

(25) Cilungu final vowel exponence: [*v*] ↔ -e / -il___
/ [SUBJUNCTIVE] & [AFFIRMATIVE]
/ [IMPERATIVE] & [OM]/[ANDATIVE]
↔ -a

The contexts which trigger /-e/ are after the perfect suffix /-il/, in affirmative subjunctives, and in imperatives with an object marker (OM) or andative marker. Because these do not form a natural class, we write three disjunctive statements for the exponence rule. The elsewhere form is /-a/. We follow Bickmore (2007) who analyzes /-il-e/ in Cilungu as constituting separate morphs (unlike in Ndebele), since they can be interrupted by the passive morph /-u/.

With this analysis of the Bantu final vowel in mind, let us now examine a subset of complex TAM designations in Table 7. We contrast two sets of TAMs here, one denoting more remote situations (the first set) and one denoting more recent situations (the second). Only the second set shows allomorphy.

Group	TAM designation	Prefix	Suffix	FV	GT
More remote:	Remote Perfect	a-		-a	Ⓗ$^{2\text{-}F}$
Consistent high tone	Far Past Progressive	a-	-ang	-a	Ⓗ$^{2\text{-}F}$
on 2nd to final TBU	Far Past	a-	-il	-e	Ⓗ$^{2\text{-}F}$
	Far Past 2	a-cí	-il	-e	Ⓗ$^{2\text{-}F}$
More recent:	Perfect		-il	-e	Ⓗ$^{2\text{-}F}$ / Ⓗ^{2}
Grammatical tone	Recent Perfect	á-		-a	Ⓗ^{F} / Ø
suppletive allomorphy	Recent Perfect 2	á-cí-		-a	Ⓗ^{F} / Ø
	Yesterday Past Progressive	á-	-ang	-a	Ⓗ^{F} / Ø
	Recent Past Progressive	á-cí-	-ang	-a	Ⓗ^{F} / Ø
	Yesterday Past	á-	-il	-e	Ⓗ^{F} / Ø
	Recent Past	á-cí-	-il	-e	Ⓗ^{F} / Ⓗ^{2}

Table 7: TAMs of more remote vs. more recent situations

We can observe that certain TAM affixes co-vary with specific grammatical tones, e.g. the toneless prefix /a-/ always co-varies with the grammatical tone Ⓗ$^{2\text{-}F}$. We capture this covariation directly by positing that they are 'co-exponents' of a morphosyntactic feature [T:REMOTE], written with a single rule in (26).

(26) [T:REMOTE] ↔ a- Ⓗ$^{2\text{-}F}$

Segmental exponence is linearized at the left edge, while the grammatical tone targets TBUs at the right edge and sensitive to the stem domain. In this way the co-exponents are circumfixal.

Under this morphological approach, we can now define the exponence involved in the allomorphic TAMs. All but one of these TAMs involve the prefix /á-/, which denote a more recent temporal situation (the counterpart to remote /a-/). The prefix /á-/ co-varies with Ⓗ^{F}~Ø allomorphic grammatical tone, and we therefore interpret them as suppletive co-exponents of [T:RECENT]. The suppletive exponence rules are in (27).

(27) [T:RECENT] ↔ á- Ⓗ^{F} / H—τ—[SM] ___
↔ á- Ø

This states that [RECENT] is exponed with a grammatical tone Ⓗ^{F} if it appears in the context of a subject marker ([SM]) whose TBU (τ) is associated to a high tone (H). This suppletive allomorph is sensitive to both morphological information in its context (the features which define the [SM], most straightforwardly subject agreement phi-features) and phonological information (presence/absence of associated H). In the elsewhere case, [RECENT] is exponed with Ø

grammatical tone. Recall from the end of §3.2 that this may be some other type of unassociated GT (e.g. Ⓗ^{0}) based on its blocking of general spreading rules. In either case, it differs from Ⓗ^{F}.

At this juncture, let us present evidence that these circumfixal co-exponents do indeed expone tense. Based on their distribution, /a- Ⓗ$^{2\text{-}F}$/ [REMOTE] and /á- Ⓗ^{F}~Ø/ [RECENT] are in a paradigmatic relationship with a consistent meaning difference. Table 8 organizes the data with /á-/ vs. /a-/ based around the presence or absence of other affixes. Observe that the /a-/ form is used to indicate Remote Perfect without a suffix, and Far Past with /-il/ and Far Past Progressive with /-ang/. Compare the equivalent forms with /á-/ and /á-cí-/, which denote the equivalent meanings but with more recent temporal reference.[6]

	-Ø	/-il/	/-ang/
/a-/	Remote Perfect	Far Past	Far Past Progressive
/á-/	Recent Perfect	Yesterday Past	Yesterday Past Progressive
/á-cí-/	Recent Perfect 2	Recent Past	Recent Past Progressive

Table 8: Remote vs. recent temporal parallels across TAM designations

Let us now analyze the TAM suffixes found in this table, i.e. /-il/ and /-ang/. In TAM designations introduced thus far (Table 4), /-ang/ expresses imperfective aspect. It can also be used to modify certain other TAM designations to indicate continuative meaning, e.g. with the Imperative in (28).

(28) Imperfective /-ang/ used in the Imperative to indicate continuative meaning [B07:306]

a.	/ sukilil-a Ⓗ$^{2\text{-}F}$ /	\ sukílíl-á \	[sùkílílá]	‘accompany!’
b.	/ sukilil-ang-a Ⓗ$^{2\text{-}F}$ /	\ sukílíl-áng-á \	[sùkílíláángá]	‘keep accompanying!’

Based on its consistent meaning contribution, we analyze /-ang/ as directly exponing the aspectual category [IMPERFECTIVE]. Its realizational rule is in (29).

(29) [ASP:IMPERFECTIVE] ↔ -ang

Unlike the temporal prefixes /a-/ and /á-/, aspectual /-ang/ does not consistently co-vary with a specific grammatical tone, and we therefore do not include tone in this realizational rule.

This aspectual suffix is in a paradigmatic relationship with the aspectual suffix /-il/, the only other inflectional morph found in this position. While no TAM designation exists where /-ang/ appears without a TAM prefix, /-il/ may occur without one. In contexts on its own, /-il/ expresses perfect aspect (also called ‘anterior’ aspect, e.g. throughout Nurse 2008).[7] An example set is in (30). When /-il/ [PERFECT] appears on its own, it is co-exponed with Ⓗ$^{2\text{-}F}$ if there is a high-toned SM (a.), but with Ⓗ^{2} if the SM is toneless (b.).

(30) TAM suffix /-il/ expresses perfect aspect

a.	/ tú-Ø-mu-ziik-il-e	Ⓗ$^{2\text{-}F}$ /	\ **tú**-mu-zíík-íl-é \	[túmúzììsílé]	
	SM-T-OM-bury-PERF-FV	PERF	‘we have buried him/her’	[B07:293]	
b.	/ a-Ø-mu-ziik-il-e	Ⓗ^{2} /	\ **a**-mu-zíík-il-e \	[àmùzììsílè]	
	SM-T-OM-bury-PERF-FV	PERF	‘he/she has buried him/her’	[B07:294]	

To capture the covariation of /-il/ and grammatical tone, we posit the realizational rules in (31) (amended in 35).

[6] Their paradigmatic relationship can also be seen in certain compound TAM designations, such as the Obligative formed with a construction [SM-…-lí na INFINITIVE] with the auxiliary verb /lí/. See Bickmore (2007:397-399) for data. We do not discuss compound TAMs in this paper.

[7] Cognates of /-il/ and /-ang/ are widespread across Bantu, with meanings identical or similar to Cilungu. For the morph /-il/ (often referred to as /-ile/), Nurse (2008:24) notes that “at least 66 per cent of Bantu languages have an anterior (‘perfect’) in suffixal -ile”, which “refers predominantly to anterior (aspect) or to various degrees of past (tense) perfective” (Nurse & Philippson 2006:181).

(31) [ASP:PERFECT] ↔ -il Ⓗ$^{2\text{-}F}$ / H—τ—[SM] ___
↔ -il Ⓗ^{2}

A non-trivial issue in interpreting the TAM system of Cilungu is the semantic compositionality of morphs within a single TAM designation. We have proposed thus far that prefixes such as /á-/ and /a-/ express tense, while suffixes /-ang/ and /-il/ express aspect. However, in several cases the meaning of their combination is not transparently composed from their individual meanings. Some examples are provided in Table 9.

Perfect	...	-il	Ⓗ$^{2\text{-}F}$ / Ⓗ^{2}	Perfect		...-il	Ⓗ$^{2\text{-}F}$ / Ⓗ^{2}
Remote Perfect	a-...		Ⓗ$^{2\text{-}F}$	Recent Perfect	á-	...	Ⓗ^{F} / Ø
Far Past	a-...	-il	Ⓗ$^{2\text{-}F}$	Yesterday Past	á-	...-il	Ⓗ^{F} / Ø

Table 9: Issues of compositionality in tense and aspect

On its own, /-il/ indicates Perfect, while /a-/ indicates Remote Perfect, but together they indicate the Far Past. Likewise, /á-/ indicates Recent Perfect, but with /-il/ is Yesterday Past.

A full semantic account of these idiosyncrasies is outside of the scope of this paper. The solution must involve a combination of default temporal and aspectual states, and the Perfect marker /-il/ having some kind of temporal meaning in some contexts. Across Bantu, issues of tense and aspect compositionality are notoriously difficult with cognates of /-il/. Nurse (2008) notes the "difficulty of distinguishing anterior (aspect) [Perfect] and near past (perfective), in which the perfective is also an aspect, but typically unmarked in Bantu", remarking that "in some cases it is clear, in others not" (p. 94). Specifically regarding the sequence /a-...-ile/ across Bantu compared to /-ile/, Nurse states the following:

> "The -Ø-…-*ile* pattern occurs predominantly as a present anterior, where the reference point is the present or some other time established. Where it and -*a*-…-*ile* co-occur, -*a*-…-*ile* always indicates a time further removed, suggesting that -*a*- is added to encode the past component. -*A*-…-*ile* has often has been recategorized from anterior to middle or far past perfective." (Nurse 2008:157)

From the perspective of Bantu, it is not surprising that Cilungu exhibits these complications in compositionality.

There are several responses one could pursue to account for these complexities. One is to say that /-il/ occupies a structurally low grammatical category, but it is some hybrid category fusing tense and aspect. Under this alternative, individual TAM designations realize more complex categories like [FAR PAST PERFECTIVE] and are co-exponed with prefixes, suffixes, and grammatical tones directly. A realizational rule would look like as in (32).

(32) Alternative realizational rule with hybrid category: [FAR PAST PERFECTIVE] ↔ a- -il Ⓗ$^{2\text{-}F}$

Such rules circumvent compositionality in that [FAR PAST PERFECTIVE] would not be derived from two separate exponence rules, one for /a-/ and one for /-il/. However, this sacrifices the transparent semantics as seen e.g. in Table 8. It is important to note that regardless of interpretation, the core properties of allomorphy remain unchanged. The trigger of allomorphy is the tone of the subject marker, and the target of allomorphy is the grammatical tone portion of a TAM designation.

Accepting for our purposes that TAM is indeed compositional, what decides the winning tone pattern when two or more TAM components with GT co-occur? For example, the Yesterday Past combines [RECENT] /á- Ⓗ^{F} ~ Ø/ and [PERFECT] /-il Ⓗ$^{2\text{-}F}$ ~ Ⓗ^{2}/, each with their own GT. As shown in (33), the tone pattern is the one associated with [RECENT] /á-/. If the [PERFECT] GT were to win, we would have expected the surface forms to be *[twáázììsílé] and *[wààzììsílè], respectively.

(33) Toneless root /ziik/ 'bury' in Yesterday Past (YP)

a.	/ **tú**-á-ziik-il-e	Ⓗ^{F} /	\ **tú**-á-ziik-il-é \	[twáázíìsìlé]
	SM-RECENT-bury-PERF-FV	RECENT	'we buried'	[B07:242]
b.	/ **u**-á-ziik-il-e	Ø /	\ **u**-á-ziik-il-e \	[wàázíìsìlè]
	SM-RECENT-bury-PERF-FV	RECENT	'he/she buried'	[B07:245]

We can say that tense /á-/ is 'dominant' over aspect /-il/, following standard interpretation of stress/accent/tone competition in the prosodic literature (Kiparsky & Halle 1977, Kiparsky 1984, Inkelas 1998, *inter alia*).

With these aspects of a morphological account established, we turn to the final and perhaps thorniest issue, namely idiosyncratic effects from the TAM prefix /cí-/ which appears in several TAM designations (see Table 4). Bickmore (2007:287) states /cí-/ is used to emphasize "the recent nature of the action in question", often translated as 'just'. This morph does not co-vary with any specific grammatical tone. We posit the following realization rule:

(34) ['just'] ↔ cí-

This morph /cí-/ has a peculiar tonal effect in one context, shown in Table 10. The allomorphic pairing for /-il/ and /á-/ are provided in rows a.-b. Row c. shows that /cí-/ has no effect on the tonal realization with /á-/. Further, as we stated above when /á-/ and /-il/ co-occur, /á-/ is dominant and its pattern prevails. The quirk comes in row e. When all three morphs co-occur – /á-/, /cí-/, and /-il/ – the allomorph in the context of a high-toned SM is as expected (i.e. Ⓗ^{F}) but its counterpart allomorph is unexpectedly Ⓗ^{2}. Row e. appears to be a 'blending' of the two other allomorphic pairings.

	TAM designation		if SM=H	if SM=Ø
a.	Perfect	...-il-e	Ⓗ$^{2\text{-}F}$	Ⓗ^{2}
b.	Recent Perfect	á-...-a	Ⓗ^{F}	Ø
c.	Recent Perfect 2	á-cí-...-a	Ⓗ^{F}	Ø
d.	Yesterday Past	á-...-il-e	Ⓗ^{F}	Ø
e.	Recent Past	á-cí-...-il-e	Ⓗ^{F}	Ⓗ^{2}

Table 10: Recent Past with /cí-/ 'just' as a unique GT allomorph pairing

There are multiple ways to adjust our analysis to accommodate the last pattern where the GT is unexpected Ⓗ^{2} in the context of a toneless SM. Since all three morphs appear in this construction, we may associate this special GT pattern with either /cí-/ or /-il/; we would not with /á-/ because the patterns are as expected when co-occurring with only /cí-/ (c.) or only /-il/ (d.). To capture this pattern, we posit another allomorph of /-il/ [PERFECT] which occurs in the context of /cí-/ 'just', shown in (35) (an update of 31 above).

(35) [ASP:PERFECT] ↔ -il Ⓗ$^{2\text{-}F}$ / H—τ—[SM] ___
↔ -il Ⓗ^{2} / ['just'] ___
↔ -il Ⓗ^{2}

The first allomorph, which appears in the context of a high-toned SM, remains unchanged. Below that, the new special allomorph Ⓗ^{2} appears in the context of /cí-/ ['just']. The box denotes that it is a special grammatical tone which has exceptional faithfulness and cannot be overridden by dominant tone from the prefix /á-/. This is unlike the other two GTs – Ⓗ$^{2\text{-}F}$ and the elsewhere Ⓗ^{2} – which are overridden.

Notice that the first two allomorphs appear in non-overlapping environments, and therefore based on these realizational rules in (35) we cannot appeal to a subset principle to decide which should be inserted. We can tell that the one inserted is the Ⓗ$^{2\text{-}F}$ GT (in the context of H—τ—[SM]), because the first form in row e. from Table 10 is *not* Ⓗ^{2}, which we would expect if the one inserted were Ⓗ^{2} (in the context of /cí-/ ['just']). In Appendix 1, we discuss a principled reason why the first realizational rule wins over the second when the two conflict. Based on additional data from negative clauses, the first rule actually involves two environment conditions: the clause must be both affirmative

and have a high-toned SM. Because this rule has two conditions but the second has only one (i.e. /cí-/ ['just']), the former is more specific and is therefore inserted.

This concludes the morphological interpretation of the GT patterns as suppletive allomorphy. We further address several aspects of this analysis when we directly compare the morphological versus phonological interpretations in §5, but this serves to establish the basic logic.

4.2 Interpretation as phonology: First-last tone harmony

Let us now compare this morphological account to a phonological one which attributes the allomorphy to a phonological rule/constraint to derive the surface differences. As with the morphological approach we assume realizational rules which map morphosyntactic features to exponents, shown in (36). The important difference is that there is no suppletive allomorphy; exponents are uniform in all phonological/morphological contexts and only later modified. Compare these rules to the previous section above which exhibited grammatical tone allomorphs (Ø and Ⓗ$^{2\text{-}F}$ respectively).

(36) Realization rules (without suppletive allomorphy)
- a. [T:RECENT] ↔ á- Ⓗ^{F}
- b. [ASP:PERFECT] ↔ -il Ⓗ$^{2\text{-}F}$

We illustrate the phonological account with [T:RECENT] only for reasons of space. This is realized with a Ⓗ^{F} GT in both high-toned and toneless SM contexts, shown in (37). Here, the first intermediate form shows Ⓗ^{F} associating to the final TBU of the stem in both; only at a later stage does the Ⓗ^{F} delink in the context of toneless SMs.

(37) Uniform exponence of [RECENT] ↔ /á- Ⓗ^{F}/
- a. / yá-á-sópolol-a Ⓗ^{F} / → yá-á-sópolol-**á** → **yá**-á-sópolol-**á** → [yáásópólòlá]
  'they have just untied' [B14:45]
- b. / u-á-sópolol-a Ⓗ^{F} / → u-á-sópolol-**á** → **u**-á-sópolol-**a** → [wààsópólòlà]
  'he/she has just untied' [B07:269]

Under the phonological account, we interpret the driving force behind the delinking of the final tone as the phonological rule of 'first-last tone harmony', which applies in all of the allomorphic contexts which have been introduced. We define this rule in more formal terms in (38).

(38) First-last tone harmony: For a domain *D*, the first/leftmost TBU τ_{FIRST} (τ_F) has the same tone value as the last/rightmost TBU τ_{LAST} (τ_L)

Tone rules of this nature have been lingering in the Bantu literature at least since Meeussen (1967), under the name 'tonal harmony' or the 'Law of Initials and Finals'. As summarized in Hyman (2012:109), such rules state that "certain verb forms end H if the subject prefix is /H/, but L if the subject prefix is /L/". To exemplify, Hyman states that "this rather unusual tonal agreement [is] often found in [non-subject relative clauses]", e.g. in relative clauses in the Konda variety of Mongo [lol] (Nsuka Nkutsi 1982:189). An example is in (39). The relative clause is in square brackets, and the subject agreement marker on the verb agrees with the relativized noun (denoted by subscripts), and not the embedded subject *mí* 'I' in post-verbal position.

(39) 'Law of Initials and Finals' – Konda dialect of Mongo (Nsuka Nkutsi 1982:189)

a.	bont'	[**o**-lang-**a**	mí]	b.	banto	[**bá**-lang-**á**	mí]
	person$_i$	[**AGR$_i$**-like-**FV**	I]		people$_i$	[**AGR$_i$**-like-**FV**	I]
	'the person that I like'				'the people that I like'		

Here, if the agreement marker has no inherent tone then the final vowel will also have no tone (a.), but if it has an inherent high like *bá-* (b.) then the final vowel also bears high tone. Parallel patterns are reconstructed for Proto-Bantu

(Meeussen 1967:113-114). Hyman in fact cites Meeussen (1971) in linking these patterns to the loss of a grammatical marker between the final vowel of the verb and post-verbal argument which may have left a floating tonal effect.

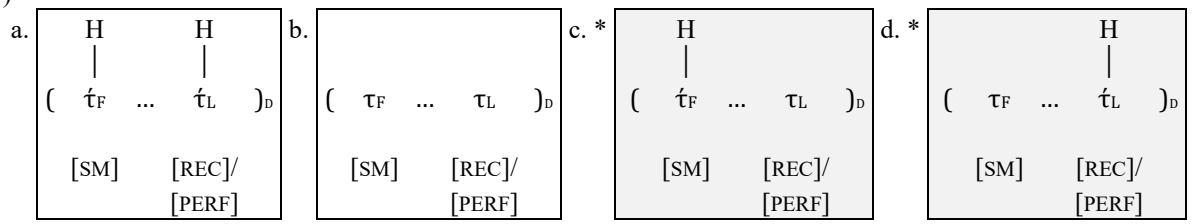
A rule of this type was originally proposed for the Cilungu facts (Bickmore 2007:250,271), called 'Final Vowel Delinking' (FV Delinking). This rule stated that tone on the final mora of the (phonological) word delinks from a H toneme, illustrated in (40). This rule must be qualified to applying "only when the TAM prefix /á-/ is present, as well as a toneless SM" (p. 250), /á-/ being the familiar [RECENT] morph.

(40) Final Vowel Delinking (in context of toneless SMs and TAM /á-/) [B07:250,271]

Under this account in Cilungu as in the other Bantu languages, there is no appeal to suppletive grammatical tone.

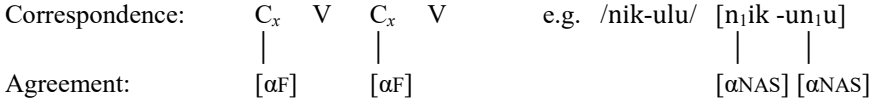
Because such a phonological rule cannot be attributed to the general tonology of Cilungu, it must be understood as 'morphologically-conditioned phonology' (Inkelas 2014 for an overview). The representations in (41) illustrate sequences which are allowed (a.-b.) and those which are not allowed (c.-d.) according to the first-last tone harmony constraint from (38) above stating that the first TBU (τ_F) must have the same tone value as the last (τ_L). Crucially, these representations must also make reference to the morphological contexts where it applies, i.e. with subject markers (i.e. [SM]) and the two relevant TAM morphs [T:RECENT] and [ASP:PERFECT]. In (41), we capture this morphological conditioning directly by placing these features within the representations themselves.[8]

(41)



Let us continue to formalize a phonological account using a prominent model developed to capture long-distance phonological agreement between phonological units, namely Agreement by Correspondence (ABC – Rose & Walker 2004) couched within Optimality Theory (Prince & Smolensky 2004 [1993]). Under this model, individual phonological units are in correspondence with each other if they are sufficiently similar. The basic ABC configuration is in (42), illustrating two consonants in a correspondence relation (C_x) which consequently enter an agreement relationship along some additional dimension ([αF]). Data from Kikongo exemplifies this configuration (Rose & Walker 2004:510). Here, underlying /n/ and /l/ are sufficiently similar in both being alveolar and sonorant, and therefore must be in correspondence, indicated by a subscripted '1'. Parasitic on this, units in correspondence must additionally agree in nasality which causes changes to the input form, i.e. /l/→[n]. Other segments are not similar enough to be in correspondence (e.g. /k/), and therefore do not show nasal agreement.

(42)



For these Kikongo data, Rose & Walker propose a grammar with highly ranked correspondence constraint CORR-N↔L and agreement constraint enforcing identity ID-C_LC_R(NAS), ranked above a faithfulness constraint for nasality.

[8] There are numerous ways to capture morphologically-conditioned phonology of the type here, e.g. via lexical morphology and phonology (Kiparsky 1982), stratal OT (Bermúdez-Otero 2008), cophonologies (Anttila 2002), indexed constraints (Pater 2007), *inter alia*. We will not go through the predictions of each of these for the Cilungu data, in light of the fact that we ultimately do not support an interpretation of GT allomorphy as phonology.

We choose to model the phonological account *via* ABC because it is a leading model in the theoretical literature on harmony, which first-last tone harmony would be a type of. Further, general tonal processes have recently been incorporated into a unified theory of ABC in Shih & Inkelas (2018), extending the model to capture tone spreading, tone plateauing, tone absorption, tone polarity, contour tone copying, among other phenomena. For example, for the unbounded tone spreading rule in Cilungu, they posit that (adjacent) vowels must be in correspondence with each other, notated as 'CORR-VV'. Parasitic on this correspondence, all vowels which are in correspondence must also agree for their tone value – in Cilungu H or toneless – using a constraint 'IDENT-VV[Tone]'. This ensures that an input like /kú-fulumy-<a>/ 'to boil over' (where final <a> is extraprosodic) is mapped to an output [kú$_1$-fú$_{1,2}$lú$_2$my-<à>], where vowels exist in correspondence chains and therefore must all agree for tone value.

Let us now apply Shih & Inkelas' proposal to first-last tone harmony, using the constraints in (43). The first two (a.-b.) are parallel to ones discussed above, while the latter two (c.-d.) involve faithfulness to underlying tone structure.

(43) Constraints for Cilungu first-last tone harmony
- a. CORR-$\tau_F\tau_L$: the first (τ_F) and last (τ_L) TBUs within a domain *D* are in correspondence
- b. ID-$\tau_F\tau_L$(T): TBUs in correspondence have identical tone values (both H or both toneless)
- c. DEP-IO(H): all H tonemes in the output have correspondents in the input (i.e. don't insert H)
- d. MAX-IO(H): all H tonemes in the input have correspondents in the output (i.e. don't delete H)

Under this analysis, we must assume that edge TBUs by virtue of being at a domain edge are sufficiently similar to one another, to the exclusion of intermediate TBUs. Domain edges are cross-linguistically prominent positions, and it is therefore reasonable that they could be in correspondence parasitic on their similarity in prominence.

We illustrate these constraints with the example in (44) showing the Ⓗ^{F}/Ø alternation in the Recent Perfect /á-...-a/. Example (a.) has a high-toned subject marker and a toneless root, while (b.) has a toneless subject marker but with a high-toned root. The first and last TBU's in the word are in correspondence (the subscripted numeral). TBUs and tones between the first and last positions are ignored by these correspondence relations.

(44) First-last tone harmony in TAM Recent Perfect /á-...-a/
- a. / yá-á-sukilil-a Ⓗ^{F} / → **yá$_1$**-á-sukilil-**á$_1$** → **yá$_1$**-á-sukilil-**á$_1$** → [yáásúkìlìlá]
  'they have just accompanied' [B14:45]
- b. / u-á-sópolol-a Ⓗ^{F} / → **u$_1$**-á-sópolol-**á$_1$** → **u$_1$**-á-sópolol-**a$_1$** → [wààsópólòlà]
  'he/she has just untied' [B07:269]

We can use the constraints from (43) to derive the mapping between the two intermediate forms for each example in (44). This mapping is shown in the tableaux in Table 11, illustrated with a sample of candidates. The input contains both phonological structure and the morphological conditioners (but for space reasons, they are only implied in the output candidates). The tableau on the left matches (a.) from (44) rendered in τ notation, while the tableau to the right matches (b.). Structure in output candidates in bold indicates inserted structure, while that structure in gray indicates structure deleted from the input.

(=44a)	H H (τ́…τ…τ́)$_D$ [SM] [REC]	CORR-$\tau_F\tau_L$	ID-$\tau_F\tau_L$(T)	DEP-IO(H)	MAX-IO(H)
☞ a.	H H (τ́$_1$…τ…τ́$_1$)$_D$				
b.	H **H** H (τ́$_{1,3}$…τ́$_{1,2}$…τ́$_{2,3}$)$_D$			*!	
c.	H H (τ́$_1$…τ…τ$_1$)$_D$		*!		*
d.	H H (τ́…τ…τ)$_D$	*!			*
e.	H **H** H (τ́$_1$…τ́$_1$…τ́)$_D$	*!		*	
f.	H **H** H (τ́…τ́$_1$…τ́$_1$)$_D$	*!		*	
g.	H **H** H (τ́$_1$…τ́$_{1,2}$…τ́$_2$)$_D$	*!		*	
h.	H H (τ́$_1$…τ$_{1,2}$…τ́$_2$)$_D$	*!	**		

(=44b)	H H (τ…τ́…τ́)$_D$ [SM] [REC]	CORR-$\tau_F\tau_L$	ID-$\tau_F\tau_L$(T)	DEP-IO(H)	MAX-IO(H)
☞ a.	H H (τ$_1$…τ́…τ$_1$)$_D$				*
b.	H H (τ$_1$…τ…τ$_1$)$_D$				**!
c.	H H (τ$_{1,3}$…τ$_{1,2}$…τ$_{2,3}$)$_D$				**!
d.	**H** H H (τ́$_1$…τ́…τ́$_1$)$_D$			*!	
e.	**H** H H (τ́$_{1,3}$…τ́$_{1,2}$…τ́$_{2,3}$)$_D$			*!	
f.	H H (τ$_1$…τ́…τ́$_1$)$_D$		*!		
g.	H H (τ…τ́…τ́)$_D$	*!			
h.	H H (τ…τ́$_1$…τ́$_1$)$_D$	*!			

Table 11: Tableaux for (τ́…τ…τ́)$_D$ and (τ…τ́…τ́)$_D$ inputs (**bold** is inserted structure; gray is deleted structure)

In the tableau at the left, high-ranked CORR-$\tau_F\tau_L$ eliminates candidates d.-h. because the first and last TBUs are not in correspondence (i.e. they are not co-indexed). While candidate c. shows correspondence, it violates ID-$\tau_F\tau_L$(T) because the relevant TBUs do not agree in their tonal value (the second H is deleted, indicated in light gray). Candidate b. shows both correspondence and agreement, but superfluously: intermediate TBUs also agree resulting in violations of DEP-IO(H). Candidate a. is optimal. In this case, no changes take place to the input other than establishing first-last correspondence.

Consider now the tableau at the right. Candidates g.-h. do not show first-last correspondence and are therefore eliminated. Next, f. shows correspondence but not agreement, and so is also eliminated. All remaining candidates show both correspondence and agreement. Candidates d.-e. accomplish agreement by adding H tonemes to the outputs, in violation of DEP-IO(H). Finally, candidates a.-c. all violate MAX-IO(H) by deleting H's in the input. Candidate a. does so only for the final TBU, whereas b.-c. also gratuitously eliminate the root's H tone. This derives the fact that first-last harmony is a non-local process which leaves intermediate tone structure unaffected.

In total, the tableaux in Table 11 using ABC mechanics constitute a straightforward way to derive delinking of the H tone on the final TBU, and could be equally applied to the other allomorphic GT patterns (not shown).

4.3 Local summary

To summarize this section, we have compared two ways to account for the grammatical tone allomorphy seen in Cilungu, one morphological, the other phonological. This is summarized in Table 12. Under the first account, we appeal to irregular morphology in the form of contextual realizational rules with multiple suppletive allomorphs, i.e.

different exponents for the tense feature [RECENT] are inserted depending on its environment (e.g. the presence of absence of a high-toned subject marker). In this account, phonology is maximally regular and general, without appeal to morphologically-conditioned statements.

Under the second account, morphology is maximally regular by having no stored suppletive allomorphs. Instead, it is phonology which is irregular in that it has morphologically-conditioned phonology in the context of subject markers [SM] and [RECENT]/[PERFECT]. We called the rule deriving the surface alternations first-last tone harmony, and formalized it via Agreement by Correspondence with constraints CORR-$\tau_F\tau_L$ requiring correspondence between the first (τ_F) and last (τ_L) TBUs, and IDENT-$\tau_F\tau_L$(T) requiring TBUs in correspondence to have the same tone value. This results in the deletion/delinking of final H tones in these contexts, e.g. mapping an input $(\tau\ldots\acute{\tau}\ldots\acute{\tau})_D$ to an output $(\tau_1\ldots\acute{\tau}\ldots\tau_1)_D$ but leaving intermediate tone structure unaltered.

Account 1: Interpretation as morphology	Account 2: Interpretation as phonology
Irregular morphology – Suppletive allomorphy [RECENT] ↔ á- Ⓗ^{F} / H—τ—[SM] ___ ↔ á- Ø [PERFECT] ↔ -il Ⓗ$^{2\text{-}F}$ / H—τ—[SM] ___ ↔ -il Ⓗ^{2}	Regular morphology – No suppletive allomorphy [RECENT] ↔ á- Ⓗ^{F} [PERFECT] ↔ -il Ⓗ$^{2\text{-}F}$
Regular phonology – Phonological rules/constraints are fully general (i.e. not morphologically-conditioned)	Irregular phonology – Morphologically-conditioned phonology, i.e. 'first-last tone harmony' in context of [SM] & [REC]/[PERF]

Table 12: Summary of two accounts

5 **In support of the morphological account**

In this section, we argue for the morphological account (involving suppletion) over the phonological account. Our support for the morphological account is based on three considerations: (*i*) empirical complications from relative clauses, (*ii*) the morphological restrictedness of GT allomorphy, and (*iii*) the phonological unnaturalness of first-last tone harmony.

5.1 Empirical complications from relative clauses

One empirical complication for the phonological account comes from relative clauses. Recall that under first-last tone harmony, the first TBU and last TBU of the word must agree in tone value. In the data we have seen, the first TBU is always occupied by a subject marker (SM). In general, SM's are the initial morph of the word, but one exception are relative clauses.

Relative clauses have the basic structure of matrix clauses, but before the SM there is a relativizer prefix, which is a H-toned copy of the subject marker's vowel. An example of relative clause structure is in (45), where we notate the relativizer prefix as /V́-/ REL.

(45) Relative clause structure

/ í-ci-ungú	**V́**-cí-ku-pón-a /	→	[í-cí-ùùngú **í**-cí-kù-pón-à]	
AUG-CL7-caterpillar	**REL**-SM7-TAM-fall-FV		'the caterpillar **which** is falling'	[B07:187]

What happens to the allomorphic TAMs in this context? A relativized version of the Yesterday Past TAM designation (/á-...-il-e/ with Ⓗ^{F}/Ø allomorphy) is in (46). This example shows that it is still the tone value of the SM which conditions GT allomorphy; the high tone of the relativizer prefix plays no role. Here, the high-toned SM /yá-/ triggers the Ⓗ^{F} form (a.), while the toneless SM /u-/ does not (b.).

(46) Relative form in Yesterday Past – SM still triggers the allomorphy

a.	/ Ṽ-**yá**-á-yá-lás-il-e	Ⓗ^{F} /	\ á-**yá**-á-yá-lás-il-é \	[ááˡáyálásíˡlé]	
	REL-**SM**-TAM-OM-hit-TAM-FV	TAM	'those who hit them'	[B07:254]	
b.	/ Ṽ-**u**-á-yá-lás-il-e	Ø /	\ ú-**u**-á-yá-lás-il-é \	[úwáàyálásílè]	
	REL-**SM**-TAM-OM-hit-TAM-FV	TAM	'one who hit them'	[B07:257]	

Equivalent data for the other allomorphic TAMs show parallel patterns. Such data reveal that it is not strictly speaking the left-edge value which is important but rather it is truly what the value of the SM is. Therefore, the domain (*D*) for first-last tone harmony is not an independently-supported prosodic constituent, e.g. the phonological word.[9]

5.2 Morphological restrictedness of GT allomorphy

The relative clause examples just presented illustrate our next consideration: it is specifically the tone of a single morpheme class (the subject marker) which conditions GT allomorphy, and not a class which could be defined purely phonologically (e.g. the initial morpheme of the word). This illustrates how the GT patterns are morphologically restricted in two ways. First, as stated the trigger of allomorphy is restricted to tone of the SM, and not other morphs in similar positions. Second, the target of allomorphy is also restricted to the GT of TAM designations with /á-/ RECENT and /-il/ PERFECT only. We saw explicitly that other comparable TAMs are not subject to allomorphy – e.g. the Remote Perfect /a-...-a Ⓗ$^{2\text{-}F}$/, the Potential /^{Ø} ngá-...-a Ⓗ^{F}/, and the Past Inceptive /$^{Ⓗ}$aa-...-a Ø/ (§3.4). For both the trigger and target to be so severely restricted fits the signature of suppletive allomorphy.

The restrictedness of any first-last tone harmony operation would be distinct from classic examples of morphologically-conditioned phonology, numerous cases of which are documented in Inkelas (2014). Consider the case of the Mayan language Mam (England 1983, Willard 2004) in Table 13. Mam contrasts short vs. long vowels. By default, suffixes do not alter the length of the stem to which they attach (classified as 'recessive' by Willard), e.g. the instrumental suffix /-b'il/ in (a.). In contrast, another set of suffixes systematically shorten preceding long vowels ('dominant' in Willard), e.g. /-na/ an adjectival participle (b.).

	Input			Output	
a.	ooq-b'il	cry-INSTRUMENTAL	→	[ooq-b'il]	'something which causes crying'
	luk-b'il	pull.up-INSTRUMENTAL	→	[luk-b'il]	'instrument for pulling up'
b.	tooq-na	break-PARTICIPLE	→	[**toq**-na]	'broken'
	yuup-na	put.out.fire-PARTICIPLE	→	[**yup**-na]	'put out'

Table 13: Example of morphologically-conditioned phonology in Mam

Vowel shortening constitutes morphologically-conditioned phonology because its application cannot be attributed to any regular phonological rule of Mam. The number of suffixes like /-na/ which trigger vowel shortening is restricted, and hence we can consider the trigger as restricted, as we do in the Cilungu case. However, within the context of the trigger /-na/, vowel shortening is a regular process and we expect it to apply regularly; in other words the *target* of allomorphy should not be restricted. This is indeed the case, with both England (p. 126) and Willard (p. 10) describing /-na/ as quite productive.

Such regularity is not a quirk of Mam. Rather, the bulk of cases in Inkelas (2014) as in many other works illustrate that the target of morphologically-conditioned phonology by default is not a restricted set. If the Cilungu grammatical tone alternations were morphologically-conditioned phonology, we would expect it to apply in a much larger set of

[9] One way to retain the domain as the phonological word is to claim that the relativizer is actually a proclitic which appends to a phonological word (ω) and together form a clitic group (CG), i.e. a structure (Ṽ=(u-á-yá-lás-il-e)$_{ω}$)$_{CG}$. Evidence supporting this parsing is not apparent. In Bickmore (2007), the arguments for a class of proclitics cannot be applied here due to their different tonal environments.

contexts than the restricted set of those TAMs involving [RECENT] /á-/ and [PERFECT] /-il/. That this is not the case supports suppletion.[10]

5.3 Phonological unnaturalness of the alternation

The best evidence for the suppletion view comes from our final consideration: the phonological naturalness of the alternation under the phonological account (i.e. first-last tone harmony). Logically, if an alternation does not constitute suppletion – i.e. distinct stored allomorphs – then it must be derived via some phonological rule, whether morphologically conditioned or not. As Paster (2016) aptly points out, this requires us to assess "the plausibility of the proposed rule" which serves as the alternative to suppletion, embedded within "a commitment to some formal model for which it is clear what constitutes an allowable operation, trigger, target, and so forth, so that the plausibility of a rule can be assessed" (p. 113). To that end, we assess the phonological naturalness of first-last tone harmony along three dimensions: typological precedence, computational complexity, and (to a lesser extent) learnability in a laboratory setting.

First, we expect a phonological rule of this type to also be attested in some grammar where it is a fully general. In our experience of tone systems, we know of no established tonological rule of this type in any language. Nothing resembles this in any of the surveys of tone (Pike 1948, Fromkin 1978, Yip 2002, Hyman 2011, Wee 2019), or in common historical changes affecting tones (Hyman & Schuh 1974, Hyman 2007). In the Bantu literature, a phonologically general first-last tone harmony is not found, e.g. not found in the recent survey of approximately 20 Bantu languages (Odden & Bickmore 2014). The literature on computational complexity and learnability in fact accepts that such a pattern is unattested (literature we return to shortly). To quote Heinz (2018:144), "there are no known phonotactic patterns where the last sound in a word depends in some fashion on its first sound".

A morphologically restricted version of first-last tone harmony (not fully general) is found, but is exceedingly rare in the tone/Bantu literature. We introduced a few of these in §4.2 above. We believe the best example other than Cilungu comes from Kikamba [kam] (Roberts-Kohno 2000, 2014, Jones & Freyer 2019). In a minority of TAM contexts, the final vowel of the verb must have the same tone value as the subject marker, either high or low/toneless. TAM designations include the Hodiernal Perfective and Stative (Assertive-nonfinal and Relative, but not Object-Focus), the Immediate Past, among a few others. An example is in (47) (Jones & Freyer 2019:186). The SM is in bold and underlined (tó-/o-), which the final vowel 'harmonizes' with. Notice like in Cilungu that the tone of a preceding suffix at the left edge does not disrupt the harmony (§5.1), nor do any intervening tones disrupt it (§3.3).

(47) Kikamba Hodiernal Perfective

a. né-**<u>tó</u>**-[kon-ááng-i-**ɛ́**]$_{\text{STEM}}$ 'we hit (today)'

b. nó-**<u>o</u>**-[kon-ááng-í-**ɛ**]$_{\text{STEM}}$ 'he hit (today)'

While we do not take a position on Kikamba, in its small literature there is a parallel debate whether to treat this as morphology or phonology. Roberts-Kohno (2014) proposes a morphological account, with a grammatical tone melody /Ⓗ^{2} Ⓛ$^{\text{PEN}}$ Ⓗ$^{\text{F}}$/ for (a.) in the context of a H-toned SM, but /Ⓗ^{2} Ⓛ$^{\text{F}}$/ for (b.). This essentially involves two distinct inputs and as such constitutes suppletion. In contrast, Jones & Freyer (2019) respond with a phonological account involving a rule of 'final lowering' which is morphologically-conditioned, applying in forms "with 3$^{\text{rd}}$ singular personal subject agreement" (p. 186), and also requiring the specific TAM environments list above. Like in Cilungu, 3$^{\text{rd}}$ singular systematically differs from other subject markers in tone. Under this phonological account, Jones & Freyer

[10] Relatedly, we agree with the mounting criticism of 'readjustment rules' (Bermúdez-Otero 2012:79ff., Merchant 2015:282, Haugen & Siddiqi 2016:349ff., Paster 2016:110ff., *etc.*), which constitute a DM variation on morphologically-conditioned phonology involving both a restricted target set and restricted trigger set. A common example is a ɪ → æ readjustment (e.g. *sing* → *sang*), where the trigger is restricted to [PAST] and the target restricted to a small number of irregular roots (√SING, √RING, √SINK, √DRINK, √STINK, √BEGIN, √SWIM, √SIT, √SPIT).

posit uniform tonal exponence for these TAMs in all contexts, /Ⓗ² Ⓗᶠ/ (p. 188). The fact that this is probably the best case of (morphologically restricted) first-last tone harmony speaks to it being a typological anomaly.[11]

Second, there is a principled reason why first-last tone harmony should not exist in phonological systems, namely that its computational properties exceed that of the established catalogue of phonological patterns. This can be assessed thanks to a large amount of recent work dedicated to examining phonological patterns computationally (see Heinz 2018 for a recent overview). To illustrate, let us situate first-last tone harmony within what is known as the Chomsky Hierarchy (Chomsky 1956, *inter alia*), which demarcates linguistic patterns into nested regions of complexity (Heinz & Idsardi 2013:113). This is shown in Figure 1 (drawn from Lai 2015, Heinz 2018, and Avcu & Hestvik 2020).

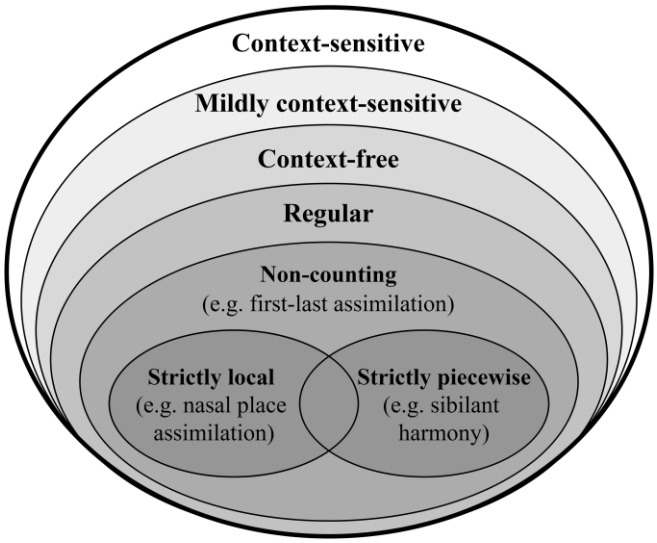


Figure 1: Chomsky hierarchy

The known range of phonological patterns (e.g. general phonotactics, epenthesis, metathesis, deletion, consonant/vowel harmony, assimilation, dissimilation, *etc*.) belong within what is called the 'regular class' in this hierarchy (Kaplan & Kay 1994), a restriction that has been called the 'Subregular Hypothesis' (Heinz 2018, *inter alia*). Heinz (2010) and Lai (2015) emphasize that even within this demarcated subregular region, not all patterns are attested.

One pattern which is specifically characterized by Lai (2015:426) as outside of the known range of subregular patterns is first-last harmony, a position which has emerged as a consensus within the computational phonology literature (Heinz & Rogers 2010, Heinz & Idsardi 2013, Lai 2015, Graf 2017, 2018, Heinz 2018:146). This is seen within Figure 1 where it falls outside of other subregular types, e.g. Strictly Local patterns like standard nasal place assimilation where a "string's well-formedness can be determined solely by examining … contiguous substrings of bounded length" (Chandlee 2014:25), or Strictly Piecewise patterns like sibilant harmony, which may operate at a distance. To quote Heinz & Idsardi (2013:119), "even if humans were exposed to words conforming to this [first-last harmony] pattern, they would fail to detect it, as it lies outside the hypothesis spaces of humans' phonological 'pattern detectors'".

To illustrate in more concrete terms how first-last tone harmony is different, consider the following discussion taken from Jardine (2020) looking at another Bantu language Karanga Shona [sna] (Odden 1984, 2014). Jardine summarizes that non-assertive verb stems are limited to a two-way H-toned vs. L-toned contrast. The surface patterns of this H vs. L contrast is predictable based on the number of TBUs. This is shown in (48).

[11] Other cases of morphologically restricted first-last tone harmony are found in Nyamwezi [nym] (Schadeberg 1989) and Ekegusii [guz] (Larry Hyman, p.c.). Cilungu is not particularly close to any of these other Bantu languages (Kikamba, Nyamwezi, and Ekegusii). Cilungu is a Zone M language of northern Zambia, while Ekegusii (Zone J/E transition) and Kikamba (Zone E) are in Southern Kenya; between them is Nyamwezi (Zone F) in central Tanzania. Genealogically, Cilungu is also in a separate East Bantu branch from all of them, as well (Nurse 1999).

(48)	Karanga Shona	1σ	2σ	3σ	4σ	5σ	6σ	7σ
a.	H-toned roots	H	HL	HLH	HHLH	HHHLH	HHHLLH	HHHLLLH
b.	L-toned roots	-	LH	LHL	LHHL	LHHLL	LHHLLL	LHHLLLL

In (a.), a H-toned root generally shows a HLH pattern if there are enough TBUs. The first TBU is always H and this spreads over a maximum of three TBUs. This is followed by a L (again, spreading maximally over three TBUs), and a H is final (except in 2σ cases). In (b.) with a L-toned root, the initial TBU is always L (which does not spread), followed by a H maximally over two TBUs, and then the remaining TBUs are L. Notice that the 3-7σ stems of both root types superficially show a first-last tone pattern, as both positions are tonally identical.

Examining these patterns computationally, Jardine shows that these Karanga Shona data can be analyzed in strictly local terms using contiguous forbidden substrings on the melody tier. For example, a forbidden melody set {#HL#, HLHL, LHLH} bans instances with not enough contours at the word-level but equally instances with too many contours, as well.[12] These melody constraints can be used in conjunction with another set of constraints at the TBU tier, and what emerges is that these surface patterns and only these patterns are permissible strings. Pattern like Karanga Shona do not involve any literal long-distance first-last tone harmony, and the list of banned strings always constitute a finite set.

Jardine explicitly contrasts this with a hypothetical first-last harmony constraint, i.e. forbidden melodies of the type {#H…L#, #L…H#}. Because those of this type do not constitute a contiguous string (the '…' expressing the variable structure in between), they are necessarily non-local. Why this is crucially different (e.g. as compared to other subregular patterns) is that the banned structures do not form a finite set of forbidden substring constraints, as the "melodies of these can strings can be arbitrarily long…: `mldy`(HLHL) = HLHL, `mldy`(HLHLHL) = HLHLHL, `mldy`(HLHLHLHL) = HLHLHLHL, ad infinitum" (Jardine 2020: 1170). If we were to capture phonologically non-local interactions (like first-last tone harmony) literally *via* non-local constraints, this would drastically increase the power of the phonological module and consequently lessen its restrictiveness significantly.

The third and final point regarding the phonological unnaturalness of first-last tone harmony comes from experimental evidence from artificial language designs (Lai 2012, 2015, Finley 2012, 2017, Avcu & Hestvik 2020). To discuss a few of these, Lai (2012, 2015) compares 'Sibilant Harmony' (an attested pattern) where all sibilants in a word must be identical ([s…s…s], [ʃ…ʃ…ʃ], *[s…s…ʃ]), to a 'First-Last Assimilation' where the first and last sibilants must be identical, but intervening sibilants can be of any type ([s…ʃ…s], [ʃ…s…ʃ], *[ʃ…s…s]). The results match the predictions given its unattestedness: "intensive First-Last participants definitely failed to internalize the First-Last Assimilation grammar that was intended in this study", showing that "First-Last Assimilation is harder to learn than Sibilant Harmony" (Lai 2015:445). A recent experiment in Avcu & Hestvik (2020) largely replicated Lai's findings, though they observe "a residual sensitivity to the [First-Last Assimilation] rule in the [First-Last] and [Intensive First-Last] groups, which contradicts Lai's previous conclusion" (p. 15). The authors interpret this as an artifact of the laboratory learning situation rather than reflecting linguistic-specific learnability, though further studies are required to have more confidence in its applicability to first-last tone harmony specifically. As an anonymous reviewer points out, however, all of the studies below show complications undermining a straightforward interpretation, and none of them directly probe first-last harmony with tone itself. Further studies are required.

5.4 Local summary

In this section, we provided evidence in favor of a morphological account for the Cilungu allomorphy patterns over a phonological account. The morphological account entails that the Cilungu patterns constitute suppletion, whereby one allomorph cannot be derived from the other and both need to be stored in the lexicon (Embick 2010:43, Paster 2016, Bermúdez-Otero 2018). The Cilungu patterns meet the threshold for suppletion assessed against three commonly used criteria for suppletion found in the literature. These are summarized in (49). Note that our use of 'suppletion' here applies to any allomorphic pairing and is explicitly not restricted to lexical roots.

[12] See Jardine (2020) for the details on how the 2σ HL pattern with H-toned roots escapes the {#HL#} ban.

(49) Criteria for assessing suppletion[13]

a. Phonological distance of forms: two forms F_1 and F_2 are suppletive if they exhibit phonological distance past a threshold T, measured with respect to phonological structure
b. Uniqueness of alternation: two forms F_1 and F_2 are suppletive if the alternation is not found in comparable morpho-phonological contexts
c. Phonological naturalness of alternation: two forms F_1 and F_2 are suppletive if the alternation cannot be derived via a phonologically natural rule

The first criterion involves the phonological distance of two allomorphic forms and is the weakest criterion. At first glance, Cilungu allomorphs like for [PERFECT] do not exhibit much phonological distance, i.e. /-il Ⓗ$^{2\text{-}F}$/ vs. /-il Ⓗ^{2}/ where the difference is solely located in how the GT associates. However, complicating a straightforward interpretation is that how different kinds of floating tones should be represented is not settled. For example, if one interpreted the different association patterns as due to an interaction of both floating Ⓗ and Ⓛ – e.g. /-il Ⓗ^{2}/ is rendered something like /Ⓛ Ⓗ Ⓛ il Ⓛ/ or something equivalent – this would impact the degree of distance between morphs, tipping the scales towards suppletion.[14]

The two more informative criteria from (49) involve the uniqueness of the alternation and the phonological naturalness of the alternation, and both criteria support the Cilungu patterns as suppletive. As this section has showed, these GT allomorphic patterns are severely restricted where they apply, displaying both a restricted set of triggers and a restricted set of targets. Furthermore, we considered a potential phonological rule – first-last tone harmony – which could derive the patterns without suppletion, and firmly concluded that it is both cross-linguistically rare if not non-existent and phonologically unnatural from the view of computational phonology (and likely laboratory phonology, as well). The result is that a morphological account with suppletion emerges as a superior analysis compared to a purely phonological account without it.

6 Implication: Outward-sensitive PCSA is possible

If the Cilungu allomorphic GT patterns are *bona fide* examples of suppletion, their inclusion in the wider typology of suppletion has significant implications for morphological theory. Specifically, they constitute a case of outward-sensitive phonologically-conditioned suppletive allomorphy (PCSA), which has been claimed to be unattested/impossible in several different strands of the morphological literature. To demonstrate this, in this section we take as our starting point the verbal syntactic structure of Cilungu, based on the extensive syntactic literature on Bantu. Based on this structure, we demonstrate the outward-sensitive nature of these suppletion patterns, and argue that this supports a view of exponence as simultaneous rather than strictly inside-out. Finally, we discuss a prediction made by simultaneous exponence, namely that reciprocal phonologically-conditioned allomorphy is possible, and show that this prediction is borne out by the Cilungu data.

[13] Different works within the morphology literature emphasize different parts of this definition. Literature emphasizing whether the forms are phonologically distant include Carstairs (1990:17), Mel'čuk (1994), Veselinova (2006), Corbett (2007), Bobaljik (2012), Bauer (2016:341), and Smith et al. (2019:1030). Other parts of the literature emphasize the generalizability of the alternation, e.g. Carstairs (1990:18), Mel'čuk (1994:390), Veselinova (2006:47ff), Embick (2010:43), Bonet & Harbour (2012), Inkelas (2014:153-154 fn5), and Paster (2016:96). A smaller number of works emphasize the phonological, phonetic, and typological plausibility of a potential rule which would derive the forms from one underlying representation, e.g. Kiparsky (1996) and Paster (2006, 2016).

[14] Further, a more general problem is that what the threshold T should be is quite subjective, or difficult to see how it could be applied consistently cross-linguistically. This ambiguity has spawned the strong vs. weak suppletion distinction (Dressler 1985), and a general approach to suppletion whereby allomorphs are gradiently suppletive with respect to one another. We fully recognize this history viewing suppletion as a cline with non-categorical canonical approaches to defining it (Corbett 2007); however, in order to test predictions of morphological theories which suppletion bears on, we need a way to include and exclude potential cases.

6.1 Directionality and allomorphy

Directionality with PCSA is a recurrent issue across the different schools of morphology (Carstairs 1987), and has played a particularly pronounced role in Distributed Morphology (Bobaljik 2000, 2012, Embick 2010, 2015). Directionality involves the relative position of the trigger of allomorphy and its target. One type is 'inward-sensitive' allomorphy, whereby the trigger of allomorphy is in a structurally inner position compared to the target of allomorphy, i.e. it is closer to the lexical head of the construction. This type is also referred to as 'outward-conditioning' in the literature. Its counterpart is 'outward-sensitive' allomorphy (a.k.a. 'inward-conditioning'), where it is the trigger which is in an outer position and the target in an inner position.

To illustrate inward-sensitivity with PCSA, consider English indefinite allomorphy where *a* is used before consonants but *an* is used before vowels, shown in (50). The trigger of allomorphy (bold, underlined) is a phonological property of the inner element (the head noun); in contrast, the target of allomorphy (boxed) is an outer element (the indefinite article). Allomorphy here is sensitive to an inner phonological property.

(50) Inward-sensitive PCSA:

Target	**Trigger**		Target	**Trigger**
a	***p**arty*	vs.	*an*	***e**vent*

Much more contentious is outward-sensitivity with PCSA. This is illustrated using the hypothetical toy example in (51), involving a prepositional construction.

(51) Hypothetical outward-sensitive PCSA:

Trigger	Target			**Trigger**	Target	
at	*a*	*party*	vs.	***to***	*na*	*party*

Here, there would be two hypothetical allomorphs *a* and *na*, conditioned by the preceding segment. The trigger would be a phonological property of the outer element (the preposition) and the target would be an inner element (the article). Prepositions which end in consonants (*at, with, in, during*) would condition one allomorph (*a*), while those which end in a vowel (*to, by, below, via*) would condition another (*na*). Allomorphy here would be sensitive to an outer phonological property.

While inward-sensitive PCSA is very common cross-linguistically, outward-sensitive PCSA is considered rare at best and essentially unattested by many morphologists. Paster (2009) presents a typological survey of 137 instances of PCSA, and finds that "135 indisputably have 'inside-out' conditioning" (see also Paster 2006, 2015). Separately, work within DM uniformly adopts the position that outward-sensitive PCSA is impossible, e.g. Bobaljik (2000), Embick (2010, 2015), among others. The proposed empirical gap is insightfully linked to the procedure of exponence itself: terminal nodes in the syntax are spelled out cyclically from the most deeply embedded node, moving outward. Inner vocabulary items (i.e. exponents) are exponed earlier, and as such would have no access to the phonological features of outer vocabulary items. Few cases of outward-sensitive PCSA exist, and none has been universally accepted as a *bona fide* example. Potential examples are found in Fula (Carstairs 1987: 185-188, 205-206, citing Arnott 1970: 219, 224-225), Welsh (Hannahs & Tallerman 2006), Ndyuka (Bye 2007: 77, citing Huttar 1996), the Surmiran dialect of Swiss Rumantsch (Anderson 2008), Italian (Wolf 2008: 193ff) Icelandic (Svenonius 2012), Armenian (Wolf 2013), and Nez Perce (Deal & Wolf 2017; however, cf. Kiparsky 2021).

6.2 Determining directionality based on Cilungu verbal syntax

In order to determine the directionality exhibited by Cilungu grammatical tone allomorphy, we must articulate the underlying morphosyntactic structure which the individual allomorphs are mapped from. Relevant for our purposes are the positions of three types of morphemes: the subject marker (the trigger), tense before the root (e.g. /á-/ [RECENT]) and aspect after the root (e.g. /-il/ [PERFECT]), the latter two being the targets of allomorphy. We repeat the Cilungu verbal template in (52) (slightly modified from §2.1), where we mark in bold the relevant positions.

(52) [**SM T** [$_{MS}$ (OM) [$_{STEM}$ ROOT **ASP** FV]]] (SM = subject marker , T = tense , OM = object marker , MS= macro-stem , ASP = aspect , FV = final vowel)

As reflected in the bracketing in this template, the consensus within Bantu literature is that prefixes are treated as further away from the verbal root than suffixes (e.g. Downing 1999, Nurse 2008, and literature cited therein). This

inner complex is referred to as the stem across Bantu (and the macro-stem if including the prefixal object markers), a constituent which is morpho-phonologically demarcated across Bantu languages, e.g. being the domain of nasal harmony, reduplication, and vowel coalescence, among other phenomena (Nurse 2008:14). As we have seen in Cilungu, evidence for the stem comes from the alignment of grammatical tone.

In general, this verbal complex is formalized in the generative syntactic work on Bantu by positing a verb root and a series of higher functional heads which express verbal grammatical categories, e.g. subject agreement, polarity, tense, aspect, mood, etc. We analyze the syntactic positions of Cilungu verbal categories as in the tree in Figure 2, which synthesizes various accounts across Bantu while simultaneously being faithful to Cilungu-specific patterns.

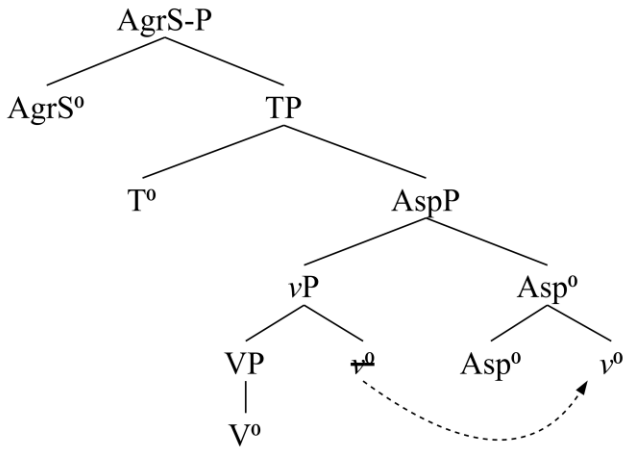


Figure 2: Cilungu verbal syntax

At the bottom of this tree is the lexical root, which we simply denote as V⁰. This is merged with a categorizing little-v head *v*⁰, which raises to form a complex head with an aspectual head Asp⁰ (if present). As we stated in §4.1 above, we follow Pietraszko (2018) in positing that the final vowel in Cilungu is the realization of this *v*⁰ head. The realizational rules are repeated in (53).

(53) Cilungu final vowel exponence: [*v*] ↔ -e / -il___
/ [SUBJUNCTIVE] & [AFFIRMATIVE]
/ [IMPERATIVE] & [OM]/[ANDATIVE]
↔ -a

Before the final vowel, the two aspectual suffixes /-il/ for [PERFECT] and /-ang/ for [IMPERFECTIVE] may appear. We assume that *v*⁰ raises to Asp⁰ in order to account for this linear order.[15]

Figure 2 diverges in a few ways from the general Bantu syntactic literature. One way is that only *v*⁰ raises, but V⁰ does not. Summarizing this literature, Pietraszko (2018:305) states that "it is typically assumed that the verb in Bantu languages does not move all the way to [Tense] T, but that it stops in a lower position—the head hosting the final suffix" (supporting literature include Myers 1990, Julien 2002, Carstens 2005, Buell 2005, Harford 2008, Van der Wal 2008, 2009, Cheng & Downing 2012, *inter alia*). However, if we follow this literature and assume V⁰ also raises, we would additionally have to account for why the linearized order is [V-Asp-*v*], rather than [V-*v*-Asp] which would be expected. While this perhaps could be attributed to a type of head-lowering, or morphotactics which rearrange heads post-syntactically (e.g. CARP templates *à la* Hyman 2003), we assume the simpler analysis whereby the linear order of suffixes simply reflects their syntactic position (Baker 1985). Regardless, nothing hinges on this decision with respect to the relevant directionality relations.

[15] Analyses differ as to whether the final vowel realizes some other, structurally low head, e.g. realizing Mood (Julien 2002) or even Aspect (Riedel 2009), either alone or together with the aspectual suffixal portion. Nothing hinges on this decision for our purposes.

Further, the order of subject markers and tense markers reflect their syntactic position, as well. Subject markers realize an AgrSº head, while tense realizes lower Tº heads. Subject agreement being outside of tense is well-supported in both the typological literature (Bybee 1985:35) and generative literature (Chomsky 1989:68ff.; Belletti 1990; Speas 1991:183ff; Harford 2008), and cross-linguistically tense predominantly scopes over aspect (Cinque 2014).[16]

With this established, we may now examine the directionality relations of the allomorphy patterns. We will diagram the syntactic structure and subsequent morphological realization of the examples in (54-55), taken from (16) and (13) above respectively. The trigger (bold and underlined) conditions the GT co-exponing either tense or aspect.

(54) Ⓗ$^{2\text{-}F}$/Ⓗ^{2} allomorphy in Perfect /-il-e/

a. / **<u>tú</u>**- |$_{STEM}$ ful-il-e Ⓗ$^{2\text{-}F}$ / → \ **<u>tú</u>**-ful-íl-é \ [túfúzˡílé] ‘we have washed’

b. / **<u>a</u>**- |$_{STEM}$ ful-il-e Ⓗ^{2} / → \ **<u>a</u>**-ful-íl-e \ [àfùzílè] ‘he/she has washed’

(55) Ⓗ^{F}/Ø allomorphy in Recent Perfect /á-...-a/

a. / **<u>yá</u>**-á-sukilil-a Ⓗ^{F} / → \ **<u>yá</u>**-á-sukilil-á \ [yáásúkìlìlá] ‘they have just accompanied’

b. / **<u>u</u>**-á-sukilil-a Ø / → \ **<u>u</u>**-á-sukilil-a \ [wààsúkílìlà] ‘he/she has just accompanied’

Figure 3 below illustrates the spell-out of these examples, going from the syntactic structure to the linearized sequence of exponents.

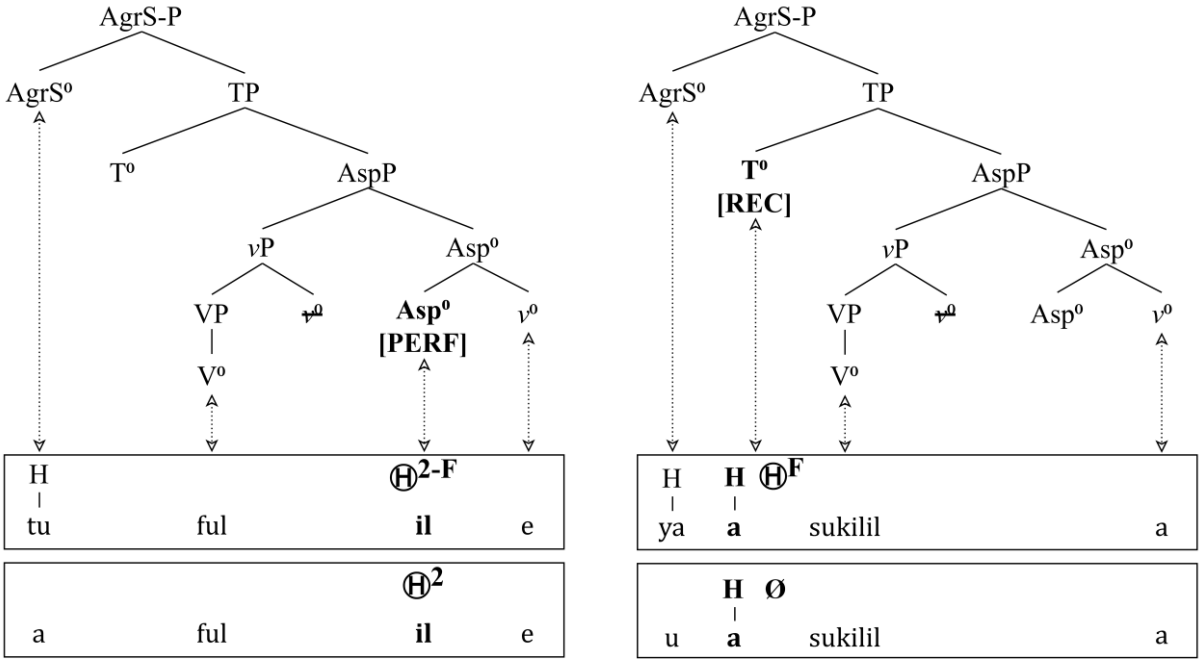


Figure 3: Cilungu illustration of Spell-out and allomorphy

[16] An important morphosyntactic issue which we gloss over is whether subject agreement constitutes a separate projection in verbal syntax (e.g. AgrS-P, as we posit), or not. One alternative is in Pietraszko (2018), where a phi-feature bundle [φ] (exponed as subject markers) falls on the highest head of the projection (e.g. a tense head T), and a fission rule splits off the φ-node from its head after which φ appears as an adjunct to the head T. This structure is also achieved via the insertion of 'ornamental' morphology, quite common within DM analyses (Embick 2015:65, *inter alia*). Under such an approach, it becomes non-trivial how to assess inward and outward relations, given that the two heads of the complex head do not originate at syntactic locations which are clearly asymmetrical (unlike with AgrS-P, which dominates TP).

The spell-out of AgrS^0 and V^0 as subject markers and lexical verb roots (respectively) happens straightforwardly, and the spell-out of *v*^{0} as the final vowel proceeds according to the realizational rules in (53) above. The relevant allomorphy involves the Asp feature [PERF] and the T feature [REC], whose realizational rules are repeated in (56).

(56)

a.	[ASP:PERFECT]	↔	-il	Ⓗ$^{2\text{-}F}$ /	H—τ—[SM]	___
		↔	-il	Ⓗ^{2}		
b.	[T:RECENT]	↔	á-	Ⓗ^{F} /	H—τ—[SM]	___
		↔	á-	Ø		

In this example, because the subject markers /tú-/ and /yá-/ have a pre-linked lexical high tone, this triggers the more specific suppletive allomorph to be inserted in these contexts.

The directionality relations in these diagrams are clear: the trigger (agreement) is structurally higher and in an outer position while the target (tense/aspect) is structurally lower and in an inner position. Because (*i*) the trigger is outward compared to the target, and (*ii*) a phonological property of the trigger is part of the conditioning environment, this thus constitutes the aforementioned rare type of allomorphy, namely outward-sensitive PCSA.

6.3 Simultaneous exponence

If Cilungu constitutes outward-sensitive PCSA and therefore shows that this type of allomorphy is rare but possible, what ramifications does this have for morphological theory? We contend here that the Cilungu facts support the notion of 'simultaneous exponence'.

To explain, recall that within the DM literature it is generally assumed that exponence proceeds cyclically moving inside-out. We can call this model 'serial exponence'. For example, for the leftmost tree in Figure 3, this would involve four steps of exponence, starting with the most deeply embedded (V^0) and ending with the least embedded (AgrS^0). One can identify several variations on serial exponence in the literature (e.g. exponence takes place one at a time but the steps may not necessarily reflect linear order – Myler 2017), but all generally share the idea that exponence is staggered. In contrast is a model of simultaneous exponence, whereby the realizational rules all apply simultaneously within the relevant spell-out domain. The Cilungu facts are compatible with simultaneous exponence but not with strict inside-out serial exponence. Under the latter model, inner [PERF] and [REC] should be already realized before phonological properties of the outer subject marker become available.

While simultaneous exponence is less prominent than serial exponence, there is some precedence for it outside of Cilungu. For example, under Nanosyntactic approaches involving 'spanning' (Starke 2009, Caha 2009, Svenonius 2016, *inter alia*), larger contiguous constituents can be realized as a single exponent (e.g. portmanteaux), which entails that inner heads cannot always be exponed before and to the exclusion of outer ones. Other works have even pointed out that two heads may not be structurally local but still condition portmanteaux or allomorphy, e.g. bracketing paradoxes like [*under*][*went*] from [[UNDER[GO]]PAST] (see Haugen & Siddiqi 2016). If many-to-one exponence is permitted, it is a short move to also allow many-to-many exponence as well. The latter is simultaneous exponence.

6.4 A prediction borne out: Reciprocal PCSA

Simultaneous exponence makes different predictions from serial exponence. As pointed out in Deal & Wolf (2017), under simultaneous exponence theories "we expect to find cases where allomorphic selection for two adjacent morphemes is resolved in a way that involves mutual phonological dependence" (p. 57). Thus, simultaneous exponence uniquely predicts that two exponents can trigger 'reciprocal PCSA', where both have a phonological property which triggers suppletive allomorphy of the other. Serial exponence predicts this to be impossible.

Importantly, this prediction is actually borne out by Cilungu when we consider other facts of the language. Specifically, tonal properties of subject markers can condition allomorphy of tense, while at the same time segmental properties of tense can condition allomorphy of subject markers. The relevant data involve the class 1 (CL1) subject marker (expressing third singular reference). In Table 2 from §2.3, we listed the CL1 subject marker with two allomorphs, /u-/ and /a-/ (both toneless). Bickmore (2007: 29) details how the /u-/ allomorph is only used next to exponents of the shape /a/, while the /a-/ allomorph is used in all other contexts. In (57), the /u-/ CL1 allomorph appears before the tense prefix /a-/ [REMOTE] (e.g. in Far Past /a-...-il-e Ⓗ$^{2\text{-}F}$/) as well as before the tense prefix /á-/ [RECENT]

(e.g. in the Yesterday Past /á-...-il-e Ⓗ^{F} ~ Ø/). All TAM designations which involve these prefixes /a-/ or /á-/ equally condition this CL1 allomorphy. In (57), the tense prefix (the trigger) is in bold and underlined while the subject marker (the target) is boxed.

(57) CL1 allomorph /u-/ if before exponent with segmental shape /a/ [B07:8]

a.	/ u-**a**-mu-fuk-il-il-e	Ⓗ$^{2\text{-}F}$ /	[wààmùfùkíílé]
	CL1-**REM**-CL1-harvest-APPL-PERF-FV	GT	'he/she harvested for him/her'
b.	/ u-**á**-mu-fuk-il-il-e	Ø /	[wààmúfúkìílè]
	CL1-**REC**-CL1-harvest-APPL-PERF-FV		'he/she harvested for him/her (yesterday)'

This can straightforwardly be understood as a dissimilation effect, whereby two exponents of the shape /a/ cannot be adjacent, a kind of 'repeated morph constraint' (Menn & MacWhinney 1984).

In all other contexts, the /a-/ CL1 allomorph is used instead. For example, if the tense prefix (the trigger) and the subject marker (the target) are interrupted by the negation prefix /tá-/, the default /a-/ form surfaces, shown in (58).

(58)

/ a-**tá**-a-ziik-il-e	Ⓗ$^{2\text{-}F}$ /	[àtáázíìsílé]
CL1-**NEG**-REM-bury-PERF-FV	GT	'he/she didn't bury' [B07:253]

Furthermore, the elsewhere /a-/ is also seen before both vowel-initial and consonant-initial roots when there is no TAM prefix (59), or before vowel-initial and consonant-initial prefixes other than of the shape /a/ (60).

(59) CL1 allomorph /a-/ used elsewhere – Before V- and C-initial roots

a.	/ a-**anz**-a	Ⓗ$^{2\text{-}F}$ /	[àáánzá]	(*[wàá…])
	CL1-**spread**-FV	GT	'and then he/she spread'	[Second author field notes]
b.	/ a-**elek**-il-e	Ⓗ^{2} /	[àéélé^{l}sílè]	(*[wèé…])
	CL1-**cook**-PERF-FV	GT	'he/she has cooked'	[B07:519]
c.	/ a-**léet**-il-e	Ⓗ^{2} /	[àléésílè]	(*[ùlé…])
	CL1-**bring**-PERF-FV	GT	'he/she has brought'	[B07:294]

(60) CL1 allomorph /a-/ used elsewhere – Before V- and C-initial prefixes

a.	/ a-Ⓗ**aa**-sukilil-a	Ø /	→	[áásúkílílà]	(*[wáá…])
	CL1-**INCEP**-accompany-FV			'and then he/she started to accompany'	[B07:196]
b.	/ a-Ⓗ**áa**-sukilil-a	Ø /	→	[áàsùkìlìlà]	(*[wáà…])
	CL1-**HORT**-accompany-FV			'let him/her start accompanying'	[B07:208]
c.	/ a-**la**-mu-ziik-il-a	Ⓗ$^{2\text{-}F}$ /	→	[àlàmùzììkílá]	(*[ùlà…])
	CL1-**FUT**-CL1-bury-APPL-FV	GT		'he/she will bury for him/her'	[B07:287]
d.	/ a-**ngá**-ful-a	Ⓗ^{F} /	→	[ààngáfú^{l}lá]	(*[ùùngá…])
	CL1-**POT**-wash-FV	GT		'he/she can wash'	[B07:114]
e.	/ a-**ku**-mu-ziik-a	Ø /	→	[àkúmúzííkà]	(*[ùkú…])
	CL1-**PROG**-CL1-bury-FV			'he/she is burying him/her'	[B07:153]

The data in a.-b. in (60) are especially important, as they show that the trigger of CL1 allomorphy must be an exponent which is exactly short /a/; it does not apply when the prefixes is long /aa/.

The /u-/~/a-/ CL1 allomorphy also holds outside of the TAM system. In associative constructions, the /u-/ allomorph is also chosen before another exponent of shape /a/. The associative construction expresses possession and general linkage between two noun phrases. Its structure is schematized in (61), consisting of a possessed NP, an inflected linker morpheme /-a/ glossed as LINK, and a possessor NP.[17] The linker /-a/ must agree with the possessed

[17] This slightly simplifies the associative structure for our purposes, specifically leaving out irrelvant details about the lack of the Bantu preprefix/augment on the possessor NP. See Bickmore (2007:438ff.) for these details.

noun to its left in noun class, e.g. in b. the linker agrees with the possessed NP *imiti* 'trees' (class 4) and not the possessor NP *mulimi* 'farmer' (class 1).

(61) The associative construction

a.	[Possessed NP	Linker	Possessor NP]	
b.	/ **í-mi**-ti	**i**-a	mu-limi /	[ímítì yàà mùlìmì]
	PP.4-CL4-tree	**CL4**-LINK	CL1-farmer	'the farmer's trees' [B07:440]

Bickmore (2007:438) details how the agreement markers on the linker are segmentally and tonally identical to the subject markers on verbs (Table 2). We therefore interpret them as the same series of exponents in two different morphological contexts: marking subject agreement on verbs, and agreement with possessed NPs on /-a/ LINK.[18] This correctly predicts that the CL1 allomorph chosen will be /u-/ since it appears before an exponent of the shape /a/. This is shown in (62).

(62)

a.	/ Ø-Ø-yemba	u-**a**	mu-limi /	[yèèmbà wàà mùlìmì]
	PP1a-CL1a-lake	CL1-**LINK**	CL1-farmer	'the farmer's lake' [B07:439]
b.	/ ú-mu-enyi	u-**a**-kúe /		[úmwéènyì wààkwé]
	PP1-CL1-guest	CL1-**LINK**-his/her		'his/her guest' [B07:439]

If we take the data in (62) with /-a/ LINK together with the data in (57) with tense prefixes /a-/ [REMOTE] and /á-/ [RECENT], we see that the triggers of CL1 allomorphy do not share a common grammatical feature (i.e. they are not a morphological or syntactic natural class), but they do share a common phonological property (i.e. they are all segmentally homophonous /a/). This therefore meets the definition of PCSA.

This u~a alternation is a quirk of this class 1 exponent, and is not generalizable as a phonological rule. For other instances of two exponents /a-a-/ in a row which do not involve a class 1 exponent, there is no dissimilation. For example, consider the copulative construction in (63) with a prefix /a$^{Ⓗ}$-/ COP, meaning 'it is (a) ___'. The underlying shape of the vowel is seen before consonant initial NPs (a.). For those which begin with a vowel, the vowel of the prefix assimilates and can only be detected via tone changes. If the stem is short enough, the initial syllable is rising (b.), otherwise it is low (c.).

(63) Copulative construction with prefix /a$^{Ⓗ}$-/ COP

a.	/ musáto /	[mùsátò]	'python'
	/ **a**$^{Ⓗ}$-musáto /	[**à**músátò]	'it is a python'
b.	/ í-sote /	[ísótè]	'grass'
	/ **a**$^{Ⓗ}$-í-sote /	[**ì**ísótè]	'it is grass'
c.	/ ú-mu-limi /	[úmúlímì]	'farmer'
	/ **a**$^{Ⓗ}$-ú-mu-limi /	[**ù**múlímì]	'it is a farmer'

Class 6 nouns can be marked with a preprefix (augment) /á-/ (followed by the regular class marker /ma-/), e.g. /á-ma-ue/ [á-má-wé] 'stones'. When the copulative /a-/ appears before the preprefix of the noun /á-/, no alternation with [u] is found. This is shown in (64). The result is either a single low-toned vowel or a rising tone, depending on the total number of mora in the word.

[18] That the same series of exponents are used in both LINK and inflected verb environments is not trivial. In other contexts, a different series of class agreement is used. For example, in (i.) below the CL1 agreement marker on adjectives is /mu-/ (identical to the CL1 marker on nouns), rather than /u-/~/a-/.

(i.)

/ ú-**mu**-limi	**mu**-táli /	[úmúlìmì mùtálì]	
PP1-**CL1**-farmer	**CL1**-tall	'tall farmer' [B07:26]	

(64) No dissimilation of /a-/ COP before the class 6 preprefix /á-/

a.	/ á-ma-ue /	[á-má-wé]	‘stones’
	/ **a**-á-ma-ue /	[**à**-má-wé]~[**à**á-má-wé]	‘they are stones’
b.	/ á-ma-papiko /	[á-má-pápíkò]	‘wings’
	/ **a**-á-ma-papiko /	[**à**-má-pápíkò]	‘they are wings’

Having established that CL1 allomorphy is truly PCSA, we can now show how it specifically constitutes one part of a reciprocal PCSA pattern. The following realizational rules can be written for CL1 allomorphy, in (65). These state that if the following exponent is exactly /a/, then [CL1] agreement features are exponed as /u-/, and otherwise /a-/

(65) [AgrS:CL1] ↔ u- / ___ /a/
↔ a-

At the same time, recall the realization rules we wrote for the tense prefix [REC], repeated in (66). These state that if the preceding subject marker has a lexical high tone, [REC] is realized as /á- Ⓗ^{F}/, and otherwise /á- Ø/.

(66) [T:RECENT] ↔ á- Ⓗ^{F} / H—τ—[SM] ___
↔ á- Ø

In examples which involve both class 1 agreement and recent tense, as in (67), these realizational rules must apply simultaneously.

(67) / **u**-**á**-sukilil-a **Ø** / \ **u**-**á**-sukilil-a \ [wààsúkílìlà] ‘he/she has just accompanied’

If tense were realized first, then the relevant phonological features triggering allomorphy (the tone of the subject marker) would not be available to condition its allomorphy. Equally, if agreement were realized first, then the relevant phonological features triggering allomorphy (the segments of tense) would not be available. This mutual dependency is naturally captured if exponence is simultaneous and exponents have access to the phonological shapes of their neighbors in both directions. It is not naturally captured under purely serial models of exponence (whether inside-out or outside-in).

7 Conclusion

This paper has sought to incorporate a case of grammatical tone suppletive allomorphy into ongoing debates on allomorphy within the morphological literature. We showed that in the Bantu language Cilungu, the grammatical tone (GT) which is co-exponed with the tense/aspect/mood (TAM) morphs /á-/ RECENT and /-il/ PERFECT shows allomorphy depending on the tone of prefixed subject agreement markers (SMs). We posited the following realizational rules to account for these allomorphic patterns:

(68) Realizational rules involving GT allomorphy

a.	[RECENT]	↔	á- Ⓗ^{F}	/	H—τ—[SM] ___
		↔	á- Ø		
b.	[PERFECT]	↔	-il Ⓗ$^{2\text{-}F}$	/	H—τ—[SM] ___
		↔	-il Ⓗ^{2}		

If the SM is high-toned, then one type of GT is selected, but if it is toneless then an elsewhere GT is selected. We presented several aspects of the data which support an interpretation as suppletive allomorphy: the patterns are not subject to phonological locality, other TAMs involving similar tone patterns are not subject to this alternation, and other high-toned prefixes do not trigger it. We contrasted our account to an alternative phonological account which would involve no suppletive allomorphy and instead a morphologically-restricted phonological operation of first-last tone harmony, where the first and last positions of a word must agree in tone value. We dismissed this as a highly

phonologically unnatural rule: it has little to no cross-linguistic support and it exceeds the computational properties of all well-known and established phonological operations (e.g. with respect to the Chomsky Hierarchy and the 'Subregular Hypothesis').

The Cilungu suppletive GT patterns have important implications for morphological theory. Specifically, they constitute a rare type of outward-sensitive phonologically-conditioned suppletive allomorphy (PCSA), which has been claimed to be unattested/impossible in several places in the morphological literature. We showed that across the Bantu literature, it is generally accepted that subject agreement (the trigger of allomorphy) is in an outer position compared to tense and aspect (the target of allomorphy). This therefore entails that this pattern is outward-sensitive, i.e. more inwardly located exponents are sensitive to features of more outwardly located exponents. If we accept that Cilungu shows outward-sensitive PCSA, this supports a view of exponence as simultaneous rather than strictly inside-out. A prediction of simultaneous exponence is that that reciprocal PCSA should be possible, and prediction which is borne out by PCSA exhibited by class 1 subject agreement conditioned by the phonological shape of an inner exponent.

We conclude with a few general comments for future work. First, if we accept outward-looking PCSA as possible and empirically attested, we must address why it is so vanishingly rare. If we cannot localize its rarity to factors of grammatical architecture (i.e. within a Universal Grammar), then what are the potential usage-based, diachronic, or cognitive pressures which counteract its development? Second, a hope of this research is to encourage closer examination of grammatical tone systems through the lens of morphological theory, systems which proliferate across sub-Saharan Africa (amongst other places). Many of these languages demonstrate complex, nuanced, and consistent patterns, collected by careful fieldwork and textual analysis. We have no doubt that many of these are well-described enough at the present moment to be valuable for testing morphological hypotheses.

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9 Appendices

9.1 Appendix 1: Special GT allomorphy in negative clauses

As alluded to in §3.1, one morphological context systematically disrupts normal GT allomorphy, namely negative clauses. Let us first establish the basic facts about verbal negation in Cilungu. In most TAM designations, negative morphology is marked by a prefix /tá-/~/táa-/ NEG (see Bickmore 2007:240 for details on the distribution of short vs. long variants). The prefix appears after the SM but before TAM prefixes. Before this negative prefix, SMs become toneless, which we notate as /$^{\emptyset}$tá-/ with a superscript Ø. An example of the negative is in (69), in the Future Progressive TAM designation. The first plural SM /tú-/ which has lexically-high tone surfaces as low in this negative context. This tonal effect is found across the full range of TAMs and SMs whenever they are in a negative context.

(69) / tú-**$^{\emptyset}$tá**-la-áa-ziik-a / \ tu-tá-la-áa-ziik-a \ [tùtálàázíìkà]
SM-**NEG**-TAM-TAM-bury-FV ‘we will be burying’ [B07:518]

In TAM designations which appear with grammatical tone but show no allomorphy, the negative does not affect the grammatical tone. This is shown in (70) with the Potential /ngá-...-a/, which has a non-allomorphic GT Ⓗ^{F}. This GT is found in both affirmative (a.) and negative clauses (b.).

(70) Grammatical tone of non-allomorphic GT of Potential is unaffected by the negative

a.	/ tú-^{Ø}ngá-ziik-a Ⓗ^{F} /	\ tu-ngá-ziik-**á** \	[tùùngázîká]	'we can bury' [B07:229]
b.	/ tú-^{Ø}**tá**-ngá-ziik-a Ⓗ^{F} /	\ tu-tá-ngá-ziik-**á** \	[tùtáángázîká]	'we cannot bury' [B07:239]

In contrast, the negative systematically affects those TAM designations which display GT allomorphy. We summarize the differences between GT in affirmative vs. negative clauses with four TAMs which show allomorphic GT, in Table 14. Note that three other TAM designations which show allomorphic GT – the Recent Perfect, Recent Perfect 2, and Recent Past Progressive (see Table 4) – cannot be used in the negative and therefore their tone patterns cannot be compared.

TAM designation	Segments				Affirmative clause			Negative clause		
					SM=H		SM=Ø	Root=H		Root=Ø
Yesterday Past	á-		-il	-e	Ⓗ^{F}	/	Ø	Ⓗ^{F}	=	Ⓗ^{F}
Yesterday Past Prog.	á-		-ang	-a	Ⓗ^{F}	/	Ø	Ⓗ^{F}	=	Ⓗ^{F}
Recent Past	á-	cí-	-il	-e	Ⓗ^{F}	/	Ⓗ^{2}	Ⓗ^{F}	/	Ⓗ^{2}
Perfect			-il	-e	Ⓗ$^{2\text{-}F}$	/	Ⓗ^{2}	Ⓗ^{F}	/	Ⓗ^{2}

Table 14: GT allomorphy in affirmative vs. negative clauses

First, in the affirmative form of the Yesterday Past and Yesterday Past Progressive, as we have seen these are exponed with Ⓗ^{F} if the SM is high-toned and Ø if the SM is toneless. In contrast, in the negative only the Ⓗ^{F} is found, regardless of any tonal properties of its environment. This is shown in (71), where both high-toned SMs (a.) and toneless SMs (b.) condition the GT Ⓗ^{F} in negative contexts only.

(71) Negative of Yesterday Past– Allomorphy neutralized to Ⓗ^{F}

a.	/ tú-^{Ø}tá-á-ziik-il-e	Ⓗ^{F} /	\ tu-tá-á-ziik-il-é \	[tùtáázîsìlé]
	SM-NEG-TAM-bury-TAM-FV	GT	'we didn't bury'	[B07:253]
b.	/ a-^{Ø}tá-á-ziik-il-e	Ⓗ^{F} /	\ a-tá-á-ziik-il-é \	[àtáázîsìlé]
	SM-NEG-TAM-bury-TAM-FV	GT	'he/she didn't bury'	[B07:253]

One thing of note is that the negative prefix /tá-/ neutralizes all SMs to Ø, and normally toneless SMs trigger the Ø allomorph of this TAM. It is therefore surprisingly that in negative contexts the Ⓗ^{F} form is chosen. This shows that it is not the default allomorph which is chosen when the negative disrupts allomorphy. To accommodate these data, we posit another realizational rule for the tense prefix [RECENT] which applies in the negative. This is shown in (72), which updates (27) from §4.1.

(72) [T:RECENT] ↔ á- Ⓗ^{F} / [NEG] ___
↔ á- Ⓗ^{F} / H—τ—[SM] ___
↔ á- Ø

Next, let us examine the effect of negation on the other two allomorphic TAM designations from Table 14, the Recent Past and the Perfect. In the Recent Past, in affirmative clauses the grammatical tone is Ⓗ^{F} with high-toned SMs but with toneless SMs it becomes Ⓗ^{2}. In the negative, however, the allomorphy pairing remains but the trigger shifts to the tone value of the *root*. To exemplify, consider the data in (73). These show that in the negative, a high-toned root (e.g. /léet/ 'bring' in a.-b.) triggers the Ⓗ^{F} GT, while a toneless root (e.g. /ziik/ 'bury' in c.-d.) triggers the Ⓗ^{2} GT. In the negative, the tone of the subject marker – lexically high-toned in (a. and c.) or toneless (b. and d.) – does not play a role in conditioning GT allomorphy.

(73) GT allomorphy with Recent Past in the negative

a.	/ tú-ø**tá**-á-cí-mu-**léet**-il-e	Ⓗ^{F} /	\ tu-tá-á-cí-mu-léet-il-é \	[tùtáácímúˡléésìlé]	
	SM-NEG-TAM-just-OM-**bring**-TAM-FV	GT	‘we didn’t recently bring him/her’	[B07:265]	
b.	/ a-ø**tá**-á-cí-mu-**léet**-il-il-e	Ⓗ^{F} /	\ a-tá-á-cí-mu-léet-il-il-é \	[àtáácímúˡléétílé]	
	SM-NEG-TAM-just-OM-**bring**-APPL-TAM-FV	GT	‘he/she didn’t recently bring for him/her’	[B07:266]	
c.	/ tú-ø**tá**-á-cí-mu-**ziik**-il-e	Ⓗ^{2} /	\ tu-tá-á-cí-mu-ziík-il-e \	[tùtáácímúzìsílè]	
	SM-NEG-TAM-just-OM-**bury**-TAM-FV	GT	‘we didn’t recently bury him/her’	[B07:265]	
d.	/ a-ø**tá**-á-cí-mu-**ziik**-il-e	Ⓗ^{2} /	\ a-tá-á-cí-mu-ziík-il-e \	[àtáácímúzìsílè]	
	SM-NEG-TAM-just-OM-**bury**-TAM-FV	GT	‘he/she didn’t recently bury him/her’	[B07:265]	

Informally, we can characterize the tone of the root acting as a ‘secondary trigger’. Under normal conditions, it is the tone of the SM that triggers allomorphy (the primary trigger), but under negation it is the tone of the root that triggers allomorphy (the secondary trigger).

The most complicated case under negation is the Perfect TAM designation, the last row of Table 14 above. In the affirmative, this has Ⓗ$^{2\text{-}F}$ ~ Ⓗ^{2} allomorphy conditioned by the SM tone, but in the negative this shifts to the root tone, plus an additional change: high-toned roots trigger a Ⓗ^{F} GT (rather than Ⓗ$^{2\text{-}F}$). This is shown in (74) with high-toned /páapaatik/ ‘flatten’ (a.-b.) and toneless /sukilil/ ‘accompany’ (c.-d.).

(74) GT allomorphy with Perfect in the negative

a.	/ tú-ø**tá**-**páapaatik**-il-e	Ⓗ^{F} /	\ tu-tá-páapaatik-il-é \	[tùtápáápáàtììké]
	SM-NEG-**flatten**-TAM-FV	GT	‘we haven’t flattened’	[B14:50]
b.	/ a-ø**tá**-**páapaatik**-il-e	Ⓗ^{F} /	\ a-tá-páapaatik-il-é \	[àtápáápáàtììké]
	SM-NEG-**flatten**-TAM-FV	GT	‘he/she hasn’t flattened’	[B14:50]
c.	/ yá-ø**tá**-mu-**sukilil**-il-e	Ⓗ^{2} /	\ ya-tá-mu-sukíl-il-il-e \	[yàtámúsùkílíílè]
	SM-NEG-OM-**accompany**-TAM-FV	GT	‘they haven’t accompanied him/her’	[B14:50]
d.	/ a-ø**tá**-mu-**sukilil**-il-e	Ⓗ^{2} /	\ a-tá-mu-sukíl-il-il-e \	[àtámúsùkílíílè]
	SM-NEG-OM-**accompany**-TAM-FV	GT	‘he/she hasn’t accompanied him/her’	[B14:50]

To account for these data, we adjust the realizational rules involving /-il/ [PERFECT], adding an allomorph conditioned by the joint presence of negation and high tone on the root. This is provided in (75), updating (35) above.

(75)

[ASP:PERFECT]	↔	-il	Ⓗ^{F} /	[NEG]	&	H—τ—[ROOT]	___
	↔	-il	Ⓗ$^{2\text{-}F}$ /	[POS]	&	H—τ—[SM]	___
	↔	-il	Ⓗ^{2} /	['just'] ___			
	↔	-il	Ⓗ^{2}				

We must also adjust the Ⓗ$^{2\text{-}F}$ allomorph to applying only in affirmative clauses (marked [POS]). This accounts for something we alluded to in §4.1, namely a principled reason why the second allomorph (with Ⓗ$^{2\text{-}F}$) triggered by a high-toned SM should win over the third allomorph (with Ⓗ^{2}) triggered by the presence of /cí-/ 'just', if both conditions exist in the environment at the same time. The former actually has two conditions and is therefore more specific, while the latter has only one condition and is less specific. The most specific allomorph takes priority during insertion.

9.2 Appendix 2: Unexpected tone patterns of TAMs with Ⓗ^{F}/Ø allomorphy

This final appendix presents a small set of recalcitrant data, included for full transparency. All of these involve those TAMs with Ⓗ^{F}/Ø allomorphy, where it appears that the wrong allomorph is selected. While these present additional complications for our analysis (and likely any analysis), we stress that they constitute a small portion of the overall paradigm. The overwhelming majority of data support the generalizations laid out in this paper.

To exemplify, consider the Yesterday Past TAM designation /á-...-il-e/, which we showed is co-exponed with Ⓗ^{F} GT if the SM is high-toned, but with Ø GT if the SM is toneless. In a limited number of contexts, however, it appears

as if the Ⓗ^{F} is chosen with a toneless SM. An example is in (76). Here, the verb forms end in a high tone in the intermediate and surface forms, rather than the expected form with a final toneless TBU in the intermediate form (low on the surface).

(76) / **u**-á-lás-il-e Ⓗ^{F} / → \ **u**-á-lás-il-é \ → [wààlásíˡlé]
SM-TAM-hit-TAM-FV GT 'he/she hit' [B07:249]
(Cf. expected: */ **u**-á-lás-il-e Ø / *\ **u**-á-lás-il-e \ *[wààlásílè])

The exact conditions on when and where the 'wrong' GT is selected appear to be complex, and it is not clear what the generalizations are. For example, if the same verbal construction as in (76) is not at the end of an intonational phrase (ιP), the expected allomorph Ø is found instead. Compare (77) where the verb is followed by /sáaná/ 'a lot'.

(77) / **u**-á-lás-il-e Ø sáaná / → \ **u**-á-lás-il-e sáaná \ → [wààlásílè sáàná]
SM-TAM-hit-TAM-FV GT a.lot 'he/she hit a lot' [B07:249]
(Cf. */ **u**-á-lás-il-e Ⓗ^{F} sáaná / *\ **u**-á-lás-il-é sáaná \ *[wààlásíˡlé sáàná])

Other TAM designations with Ⓗ^{F}/Ø allomorphy show similar complicating data. For example, in the Recent Perfect /á-...-a/ certain short vowel-initial roots appear to select for the wrong allomorph. In (78), the toneless SM /u-/ CL1 root with the root /el/ '(to) fish' occurs with the unexpected Ⓗ^{F} GT, rather than the expected Ø.

(78) / **u**-á-el-a Ⓗ^{F} / \ **u**-á-el-á \ [wèélá]
SM-TAM-fish-FV GT 'he/she has just fished' [B07:271]
(Cf. expected: */ **u**-á-el-a Ø / *\ **u**-á-el-a \ *[wèélà])

The unexpected form is also found with short roots extended with the derivational suffix /-il/ APPLICATIVE, where the unexpected Ⓗ^{F} GT is also selected, shown in (79). This happens both with toneless roots (a.) and high-toned roots (b.), demonstrating that the irregularity cannot be attributed to some kind of interface from the root tone.

(79)

a. / **u**-á-lem-il-a Ⓗ^{F} / \ **u**-á-lem-il-á \ [wààlémeˡlá]
SM-TAM-grab-APPL-FV TAM 'he/she has just grabbed for [someone]' [B07:269]
(Cf. expected: */ **u**-á-lem-il-a Ø / *\ **u**-á-lem-il-a \ *[wààlémélà])

b. / **u**-á-lém-il-a Ⓗ^{F} / \ **u**-á-lém-il-á \ [wààlémeˡlá]
SM-TAM-plant-APPL-FV TAM 'he/she has just planted for [someone]' [B07:269]
(Cf. expected: */ **u**-á-lém-il-a Ø / *\ **u**-á-lém-il-a \ *[wààlémélà])

As seen here and the other data points, many of the exceptional surface patterns end in a downstepped high, but it is not known at this point whether this is a coincidence. Further study of these exceptional patterns is required.