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- Proto-Berber phonological reconstruction: An update
- Harmony and disharmony in Mbat (Jarawan Bantu) verbs
- Inheritance and contact in the genesis of Gisamba (Bantu, L12a, DRC): A diachronic phonological approach
- Comptes rendus / Book reviews

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Sommaire / Contents

Comptes rendus / Book reviews

2

Harmony and disharmony in Mbat (Jarawan Bantu) verbs

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Abstract

This paper is the first to describe aspects of the vocalic phonology of Mbat, a Jarawan Bantu language. Mbat exhibits a series of vowel-consonant interactions in its verbs that sometimes yield height harmony between a stem and suffixal vowel. Via this stem-controlled phenomenon, high vowels (i, u, ɪ, ʊ) harmonize across a stem-final non-dorsal sonorant while the low vowel (a) harmonizes across any stem-final dorsal. Under other conditions, these verbs appear disharmonic for height. A sixth contrastive vowel, schwa (ə), does not actively participate in harmony. I show that these otherwise straightforward generalizations on harmony vs. blocking are sometimes obscured by alternations triggered by a preceding glide that affect the stem vowel itself. I offer an analysis using a feature geometric model of vowel height. I show that an approach based on well-motivated binary vocalic features like [open], [closed], and [ATR] offers a transparent account of most Mbat outcomes. There is at least one instance, however, where these features seem unintuitive relative to the phenomena being modeled. For the sake of comparison, I discuss a possible reanalysis based on abstract features. Such an approach is unencumbered by expected phonetic correlates of vocalic features and focuses instead on featural interactions. This approach aligns itself with more recent "substance-free" approaches to phonology which assume a model of phonological computation based on features whose phonetic implementation is downstream and language-specific.

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Keywords

feature geometry, Jarawan Bantu, vowel features, vowel harmony

Résumé

Cet article est le premier à décrire certains aspects de la phonologie vocalique du mbat, une langue bantoue jarawan. Le mbat présente un ensemble d'interactions voyelle-consonne au sein des verbes qui génère parfois une harmonie de hauteur entre un radical et une voyelle suffixale. Via ce phénomène contrôlé par la racine, les voyelles hautes (i, u, ɪ, ʊ) s'harmonisent à travers une sonante non dorsale située en fin de radical, alors que la voyelle basse (a) harmonise à travers toute dorsale située dans cette même position ; dans toute autre condition, les verbes semblent disharmoniques pour la hauteur. Une sixième voyelle contrastive, le schwa (ə), ne participe pas activement à l'harmonie. Je montre que ces généralisations, de prime abord simples sur l'harmonie *vs* l'opacité, sont parfois obscurcies par des alternances déclenchées par une glissante antéposée affectant la voyelle du radical elle-même. Je propose une analyse élaborée à l'aide d'un modèle géométrique des traits de hauteur vocalique. Je montre qu'une approche fondée sur des traits vocaliques binaires bien motivés comme [ouvert], [fermé] et [ATR] rend compte de manière transparente de la plupart des formes de sortie du mbat, mais qu'il y a cependant au moins un cas pour lequel ces traits semblent peu intuitifs à l'égard des phénomènes modélisés. À titre de comparaison, je discute une nouvelle analyse potentielle construite à partir de traits abstraits. Une telle approche n'est pas bloquée par les corrélats phonétiques attendus des traits vocaliques et se concentre plutôt sur leurs interactions. Cette approche est en accord avec les approches « sans substance » de la phonologie les plus récentes, qui supposent un modèle de calcul phonologique fondé sur des traits dont l'implémentation phonétique se situe en aval et est spécifique à la langue.

Mots clés

géométrie des traits, harmonie vocalique, langue bantoue jarawan, traits vocaliques

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1. Introduction

Linguists know fairly little about the grammar of the approximately 20 Jarawan (or Jarawan Bantu) languages, a cluster of language spoken across portions of Nigeria and Cameroon. This excludes what has been reported about their lexicon in an array of historical and typological studies conducted over the last several decades (see, for example, Blench 2006; 2015; Gerhardt 1982; Grollemund 2012; Grollemund & Hombert 2012; Grollemund *et al.* 2015; Maddieson & Williamson 1975; Piron 1995; 1997; 1998; Shimizu 1983). These works illustrate that a sizable portion of the core Jarawan lexicon is comprised of Bantu cognates but that it is also influenced by contact with Chadic and Bantoid languages. Beyond these studies, there is only: (i) a Master's thesis (Yabilsu 1991) on one variety (Galamkya), (ii) one short descriptive paper (Gerhardt 1988) that deals with aspectual morphology in Jarawan verbs, and (iii) one additional paper (Green 2020) concerned with formalizing details of syllable structure in Mbat, the same Jarawan variety that is the focus of the current paper.

The description of Jarawan verbs in Gerhardt (1988) serves as an inspiration of sorts for the current paper. Gerhardt's paper discusses Perfective and Habitual "verbal extensions" in two Jarawan varieties, namely Jaar and Kantana. He illustrates patterns of phonologically-conditioned suffixal allomorphy where stem shape dictates the choice of one of three allomorphs of the Perfective and Habitual extensions. Though they are mentioned only in passing, Gerhardt's data show complex alternations that arise in both stem and suffixal vowels. Similar alternations are found in Mbat.

In this paper, I present data that I have collected on Mbat, a Jarawan language spoken by approximately 40,000 individuals (Eberhard *et al.* 2019), primarily in Bauchi State, Nigeria. Mbat verbs inflect for the same Perfective and Habitual extensions reported by Gerhardt and likewise exhibit phonologically-conditioned suffixal allomorphy based on stem shape. Mbat manifests similar, but not identical alternations to those seen in Gerhardt's Jaar in its stem and suffixal vowels. In Mbat, there are three realizations of the Perfective (*-m*, *-Vm*, *-ma*) and three corresponding realizations of the Habitual (*-n*, *-Vn*, *-na*). As I illustrate in Section 3, the first realization in each is limited to short CV stems while the third occurs with "heavy" CVVC and disyllabic stems. Of particular importance in this paper is the behavior of verbs with C(C)VC stems that select the -VC form of these extensions. My use of a placeholder V here is to represent the fact that the suffixal vowel has different surface realizations, the choice between which depends primarily on characteristics of the stem, namely the stem vowel and stem-final consonant.

Mbat's suffixal vowels are the target of stem-controlled alternations affecting vowel height. Under well-defined and predictable conditions, there is height harmony between a stem and suffixal vowel. The quality of stem vowels themselves is sometimes obscured by alternations triggered by a preceding glide. But, what I would argue is their basic form is apparent elsewhere. A stem vowel triggers harmonization of a suffixal vowel, with stem vowels of different heights (high vs. low) doing so only across particular consonants. The low stem vowel [a] harmonizes a suffixal vowel only across a dorsal consonant, be it a stop or sonorant. A high stem vowel [i, ɪ, u, ʊ], on the other hand, harmonizes a suffixal vowel only across a non-dorsal sonorant. In the presence of a blocker (i.e., an incompatible intervening consonant), harmony does not occur. In blocking contexts, a word's stem and suffixal vowels are disharmonic for height. Further complicating matters is that derived high stem vowels do not trigger harmonization of a suffixal vowel, thus resulting in an apparent underapplication of the process.

Given the essentially undocumented status of Jarawan languages, the primary goal of this paper is to describe the patterns of vowel alternations that arise in Mbat. In doing so, I also aim to add to the literature on vowel harmony systems by discussing interactions between vocalic triggers and transparent consonants vs. blocker consonants. To model these data, I adopt an autosegmental approach that employs geometrically-arranged features. My analysis proposes that harmony is strictly local such that a stem and suffixal vowel can harmonize only when the stem vowel and stem-final consonant also share the same feature. This entails that the stem-final non-dorsal sonorants and stem-final dorsal consonants that facilitate harmony are associated with certain vocalic features. When the stem vowel and stem-final consonant do not share the requisite feature, harmony is blocked.

The approach I take to modeling Mbat's vocalic alternations and interactions between stem vowels and stem-final consonants assumes many, but not all of the hallmark characteristics of standard feature geometry (Clements 1985; 1991a; Halle 1995; Sagey 1986). I utilize a closed set of binary geometric features—[open], [closed], and [ATR]—organized under what I call the Vowel Manner (V-Manner) node. I motivate the arrangement of these features based on the ways that the segments that they comprise interact with and affect one another within an Mbat word. Odden (1991) has called a similar constituent the Vertical Movement node and instead employs the features [low], [high], and [ATR], respectively. I also appeal to a sub-constituent Aperture node composed of [closed] and [ATR] based on the fact that these often pattern together in operations involving feature spreading. I show that this standard approach to feature geometry offers a transparent means by which to represent most of the Mbat facts. However, the Mbat outcomes sometimes present an analytical challenge given standard assumptions concerning the cross-linguistic patterning of these features and their expected phonetic implementation.

As one potential means of overcoming this challenge, I briefly entertain an alternative analysis based on abstract features. Doing so allows one to focus on featural interactions that are unencumbered by expected or assumed phonetic correlates. Clements (1991b) employs such an approach in modeling vowel height alternations in several canonical Bantu languages. He does so based on a single feature, [open], arranged into several "registers". Such an analysis is reminiscent of more recent "substance-free" approaches to feature geometry like the Parallel Structures Model (PSM) (Morén 2003a; 2003b; 2006; 2007). The PSM posits that consonants and vowels are comprised of identical constellations of geometrically-organized phonological features whose relationship to one another and whose phonetic realization must be established language-specifically. I do not concern myself with broader conceptual issues related to the "substance-free" approaches to phonology, but see Blaho (2008) for an overview and critique of various proposals.

The remainder of this paper is organized as follows: Section 2 provides an introduction to various phonological and morphological properties of Mbat. These facts represent my understanding of Mbat grammar based on approximately 18 months of data collection, though the larger documentation project is still underway. Section 3 discusses suffixal patterns found in Mbat verbs inflected for the Perfective and Habitual, and illustrates the various vocalic alternations that arise depending on the particular combination of stem and suffixal vowels. Section 4 presents a feature geometric analysis of the Mbat alternations. Section 5 offers discussion, an alternative analysis of one particular complex matter that arises in the language, and concluding remarks.

2. Background on Mbat

Mbat (ISO 639-3: bau, Glottocode: bada1258) is also called Bada or Badanchi, though it is locally known as Jar. Mbat and the other approximately 20 Jarawan (or Jarawan Bantu) languages are not well-represented in the descriptive and theoretical linguistics literature. Historical linguists and typologists have been keenly interested in their lexicon and what it can reveal about the place of Jarawan languages alongside A-group Narrow Bantu vs. Southern Bantoid. From a grammatical perspective, even the most basic characteristics of these languages have yet to be reported, with just a few notable exceptions. Gerhardt (1988) discusses verbal extensions in "Jaar" and Kantana (ISO 639-3: mma, Glottocode: mama1272). It is unclear what variety is represented by Gerhardt's "Jaar", however, given that speakers of many varieties refer to their language as Jar or Jaar; see Maddieson & Williamson (1975). In addition, there is an unpublished

MA thesis on aspects of Galamkya (also assigned ISO 639-3: bau, Glottocode: bada1258) by Yabilsu (1991).[1] Based on lexical similarities alone, Mbat's closest sibling appears to be Duguri (ISO 639-3: dbm, Glottocode: dugu1249).[2]

The data in this paper were collected in person via direct elicitation at Syracuse University (Syracuse, NY) from a 31-year-old mother tongue speaker of Mbat who was raised in Tadnum village, Bogoro LGA, Bauchi State, Nigeria. She spent 29 years in Nigeria before leaving the country to pursue graduate education in the US. In addition to Mbat, she is a fluent L2 speaker of both Hausa and English. The data represent her speech, but we have confirmed them via phone with friends and members of her family back home in Nigeria. The findings that I present below are representative of approximately 18 months of collaboration with this speaker, though the larger documentation project is very much work in progress.

Mbat and its closest siblings are called Jarawan Bantu, but these languages share few immediately apparent grammatical similarities with "canonical" Bantu languages. Rather, in many ways, they seem to share more characteristics with Bantoid languages. For example, words other than borrowings are seldom more than two syllables in length, and their morphology has only a few instances of syntheticity. There is no functioning system of noun classes, and distinctions within the verbal system are aspectual, with little evidence of tense. For more discussion of grammatical comparisons between Bantu and Bantoid, see Hyman (2017; 2018).

Table 1 — Consonant phoneme inventory

	Labial	Alveolar	Post-Alv./ Palatal	Velar	Glottal
Plosive	p b	t d		k g	(ʔ)
Implosive	ɓ	ɗ			
Affricate			dʒ	kx gɣ	
Nasal	m	n	ɲ	ŋ	
Fricative	f (β)	s z	ʃ		
Approximant	w	l r	j		

1. I have been in contact with the author, and even she does not have an electronic copy of her thesis available to share, so I have been unable to evaluate its contributions.

2. I am grateful to Rebecca Grollemund for kindly computing cognate percentages from my Mbat data against other Jarawan, Bantu, and Southern Bantoid languages in her database. It is upon these percentages that I base this close connection between Mbat and Duguri.

This paper is concerned primarily with Mbat's vowels and their interaction with consonants. Based on the data that I have collected thus far, Mbat's inventory of consonant phonemes is as presented in Table 1. I have found that any of these consonants can appear in the onset of a CV or CVC syllable, though glottal stop /ʔ/ does so only in non-word-initial syllables. The bilabial fricative /β/ appears only in a few items in my database and may only be marginal.

The language has a three-way stem-initial contrast in labial and alveolar voiceless vs. voiced vs. implosive stops, but only voiceless stops are found word-finally. Stem-final consonants are particularly susceptible to alternation. For example, word-finally, coronals are either palatalized or retroflexed regardless of their manner (/n/ ~ [ɲ], /l/ ~ [ɭ], /r/ ~ [ɽ], /t/ ~ [ʈ]), and /k/ is realized [q]. When followed by a vowel-initial suffix, stem-final stops alternate with implosives: /p/ ~ [ɓ], /t/ ~ [ɗ], though /k/ alternates with the uvular stop [ɢ] or sometimes instead the uvular fricative [ʁ]. I assume that the affricates /kx/ and /gɣ/ listed above are phonemic based on their word-initial realization. Their intervocalic realization varies in ways that are yet unclear, sometimes with velar fricatives [x] and [ɣ], but other times with uvular fricatives [χ] and [ʁ]. Affricates, implosives, glides, and fricatives other than /s/ do not occur in syllable codas.

The only consonants that can occupy the second onset position of a CCVC syllable are approximants, specifically /j/, /w/, and /l/. Though the glides /j/ and /w/ often appear in a singleton onset, Green (2020) has shown that when they are the second member of a complex onset in a CCVC verb stem, they are involved in an unusual alternation (cf. further below). The data in this paper are presented phonetically unless otherwise indicated.

Most pertinent to the current paper are characteristics of the language's vowel system. Based on the Mbat data that I have collected thus far, the language appears to make a phonemic contrast between six vowels: /i, ɪ, u, ʊ, ə, a/.[3] These six contrastive vowels occur in what is arguably the language's basic word shape, namely in CVC stems (1).

(1) Words with CVC stems

a.	bíɭ	'follow'	b.	ɓɪ̄ɭ	'give birth'
c.	kúm	'find'	d.	gús	'wash'
e.	zʊ̀p	'cover'	f.	ɓʊ̄q	'throw'
g.	pʊ̄ɽ	'go out'	h.	ŋə̀m	'cry'
i.	ɓáɭ	'count'	j.	kə̀s	'cut'
k.	jáp	'climb'	l.	ʃāq	'chew'
m.	jáʈ	'fetch'	n.	kāŋ	'fry'

3. The vowel inventory presented here differs from that in Green (2020) in that it establishes contrastive /ə/. Green recognized the presence of [ə] in the Mbat inventory, but its phonemic status was unclear at the time. Based on data collected since that time, there is now ample evidence to distinguish between /ə/ and /a/.

A subset of these vowels, /i, u, a/, have a broader distribution in that they also occur in CV stems (2). *Cə* also occurs, but I have found it only in function words in my database. For example, the progressive auxiliary is *bə*, and the relativizers are *mə/ɓə*, though the latter are bimorphemic in that they inflect for singular vs. plural number, respectively.

(2) Words with CV stems

a.	pà	'give'	b.	ɓì	'him/her'
c.	tù	'pluck'	d.	gú	'millet'
e.	sá	'will (n.)'	f.	zù	'judge'
g.	mí	'me'	h.	nù	'drink'
i.	lì	'eat'	j.	ra	negative particle
k.	jú	'come'	l.	wù	'die'

The vowels that occur in CCVC stems are restricted (3). I have found no high vowels (tense or lax) in this frame, but rather lax mid vowels [ɛ] and [ɔ] appear here, as does the low vowel [a].

(3) Words with CCVC stems

a.	zwɔ̄ɽ	'sew'	b.	kjɛ̄ʈ	'sweep'
c.	vwɔ̄ʈ	'take forcefully'	d.	swɔ́ɽ	'hide'
e.	fwɔ̄ʈ	'peel'	f.	swɔ́p	'pour'
g.	twɔ̄p	'wash'	h.	mjɛ̄ɽ	'kill'
i.	ŋ̄gláp	'woman'	j.	tjáq	'trek'
k.	kwáɽ	'bowl'	l.	kwáŋ	'spear'
m.	jwàq	'snake'	n.	ljáŋ	'iron'
o.	mjáp	'spatula'	p.	pwàɭ	'cold'

The behavior of verbs like those in (3) is discussed at length in Green (2020). According to the analysis therein, verbs of this shape with mid vowels undergo unusual alternations when a vowel-initial suffix like the Perfective or Habitual is added to them. Upon suffixation, the stem-final consonant is syllabified into an onset. As a result, the stem glide is deleted, and the stem vowel ɛ/ɔ alternates with its high counterpart ɪ/ʊ. For example, [zwɔ̄ɽ] 'sew' becomes [zʊ̄.ràm] 'sewn' when the Perfective extension is added to it. An analogous alternation can be seen for [kjɛ̄ʈ] 'sweep' and [kɪ̄ɗ-ám] 'swept'. Similarly shaped stems with [a] do not undergo either alternation: cf. [kwāq] 'drive' vs. [kwāɢ-ám] 'driven'. As Green discusses, both in these instances and elsewhere in Mbat, the mid vowels [ɛ] and [ɔ] appear only after glides. He argues that their alternation with [ɪ] and [ʊ], respectively, upon the loss of a preceding glide, suggests that [ɛ] and [ɔ] are allophones of /ɪ/ and /ʊ/. These "lax" mid vowels do not alternate with their "tense" counterparts (i.e., [e] and [o]). Indeed, the latter vowels are not found in Mbat's inventory. I will have more to say about this particular issue below.

The details of Mbat's tonal system are still a work in progress. At present, I have identified three main surface tone levels—High, Mid, and Low—and have marked tone on the data in this paper accordingly. In addition, the Habitual suffix appears lowered after a stem Low tone. I transcribe this as a Super-Low tone, but I have not yet found evidence for Super-Low more broadly in the language. That said, there is some (albeit preliminary) evidence that the language makes a four-way underlying tonal contrast, with the addition of toneless tone bearing units. One fact in support of this observation is that nouns surfacing with High tone in isolation can be divided into two classes based on how they interact with surrounding High tones. One group is susceptible to spreading from an adjacent H tone while the other does not participate in such spreading. For the current paper, the two extensions to be discussed (Habitual and Perfective) behave differently from a tonal perspective, but this varies and appears not to bear on the vocalic alternations under consideration.

3. Alternations in Perfective and Habitual verbs

Mbat behaves in a manner similar to its cousins discussed in Gerhardt (1988) in that it exhibits phonologically-conditioned patterns of suffixal allomorphy that depend on stem shape. Of particular interest are verb stems that select a vowel-initial suffix. These allow us to witness vocalic phenomena that I argue are, at least in part, attributable to vowel height harmony. I begin this section by establishing the patterns of suffixal allomorphy seen in Mbat.

3.1 Suffixes without vowel alternation

Examples of the simplest C(G)V verb stems (where G stands for a glide) are in (4). These stems select *-m* for the Perfective and *-n* for the Habitual. Mbat verbs do not inflect for person, number, or gender. Person and number are encoded, where relevant, via pronouns or through number marking on nouns.

(4) Perfective and Habitual verbs with C(G)V stems

	Stem	Perfective	Habitual	
a.	pà	pà-m	pà-n	‘give’
b.	tù	tù-m	tù-n	‘pluck’
c.	jú	jú-m	jú-n	‘come’
d.	lì	lì-m	lì-n	‘eat’
e.	tā	tā-m	tā-n	‘sow seed’
f.	kwā	kwā-m	kwā-n	‘enter’
g.	swá	swá-m	swá-n	‘pierce’
h.	ɓwà	ɓwà-m	ɓwà-n	‘carve’

Verbs with C(G)VVC stems in (5) instead select *-ma* for the Perfective and *-na* for the Habitual. The same allomorphs are selected by the disyllabic verb stems in (6).

(5) Perfective and Habitual verbs with C(C)VVC

	Stem	Perfective	Habitual	
a.	māās	māās-má	māās-nā	‘ask’
b.	míín̠	míín-má	míín-nā	‘blow nose’
c.	lààm	lààm-má	lààm-nā	‘cook’
d.	dììl̠	dììl-má	dììl-nā	‘know’
e.	gɣʊ̄ʊ̄m	gɣʊ̄ʊ̄m-má	gɣʊ̄ʊ̄m-nā	‘yawn’
f.	fwāāt̠	fwāāt-má	fwāāt-nā	‘vomit’
g.	ljāāt̠	ljāāt-má	ljāāt-nā	‘paste’
h.	tjááq	tjááq-má	tjááq-nā	‘trek’

(6) Perfective and Habitual verbs with disyllabic stems

	Stem	Perfective	Habitual	
a.	lāɣāt̠	lāɣāt-má	lāɣāt-nā	‘taste’
b.	kxə̄mə̄t̠	kxə̄mə̄t-má	kxə̄mə̄t-nā	‘squeeze’
c.	lāŋās	lāŋās-má	lāŋās-nā	‘lick’
d.	gɣāgɣāt̠	gɣāgɣāt-má	gɣāgɣāt-nā	‘open’
e.	ɲūŋwāl̠	ɲūŋwāl-má	ɲūŋwāl-lā	‘write’

In the next sections, I describe various outcomes in Mbat verbs whose stem shapes are CVC or CGVC. Both stem shapes select a vowel-initial allomorph of the Perfective (*-Vm*) and Habitual (*-Vn*). I show that the surface quality of the suffixal vowel depends on both the quality of the stem vowel and the nature of the intervening stem-final consonant. The data are organized based on the quality of the vowel in the uninflected stem. I take these forms as basic given that stem vowels are sometimes susceptible to alternation upon inflection, though in predictable ways.[4]

3.2 Alternations with high vowel stems

The examples in (7) and (8) show verbs whose uninflected stem contains a high vowel. These stem vowels represent Mbat's four contrastive high vowels, being either front or back, tense or lax. Beginning with (7), these verbs have stem and suffixal vowels of the same quality. They are unique in that their stem-final consonant is a non-dorsal sonorant, be it a nasal or liquid.

(7)

	Stem	Perfective	Habitual	
a.	nùm	nùm-ùm	nùm-ǜn	‘bite’
b.	kúm	kúm-úm	kúm-ūn	‘find’
c.	bíl̠	bíl-ím	bíl-īn	‘follow’
d.	pʊ̄ɽ	pʊ̄r-ʊ̀m	pʊ̄r-ʊ̀n	‘go out’
e.	sɪ̄ɲ	sɪ̄n -ɪ̀m	sɪ̄n-ɪ̀n	‘see’

4. There are no tonal alternations affecting the stem upon suffixation, though the tone associated with the suffixal vowel alternates depending on the tone of the stem vowel. These alternations differ in some instances between the two suffixes.

Verbs with a high stem vowel in (7) differ from those in (8) in that they select *-əm/-ən* suffixes. The factor corresponding to this difference is that their stem-final consonant is not a member of the aforementioned class of non-dorsal sonorants.

(8)		Stem	Perfective	Habitual	
	a.	zùp	zùɓ-əm	zùɓ-ə̀n	'cover'
	b.	gʊ̄p	gʊ̄ɓ-əm	gʊ̄ɓ-ən	'close'
	c.	gús	gús-ə́m	gús-ə̄n	'wash'
	d.	lɪ̄p	lɪ̄ɓ-əm	lɪ̄ɓ-ən	'moisten'
	e.	nʊ̀q	nʊ̀ɢ-əm	nʊ̀ɢ-ə̀n	'sit'

The analysis that I present below proposes that the compatibility of stem-final sonorants to full height vowel harmony in (7) is due to them sharing the same height feature, [+closed], with high vowels. Consonants not specified [+closed] do not permit harmonization via this feature. There is no direct evidence that a feature like [ATR] is associated with stem-final consonants, as it does not intervene in the process. Both [+ATR] and [–ATR] vowels harmonize across a [+closed] stem-final consonant, as in (7). The propensity for high vowel stems to select *-əm/-ən* instead of *-am/-an* in (8) may also have a featural explanation.[5] I discuss this further in Section 4.2.

3.3 Alternations with [a]- and [ə]-stems

As was the case for verbs with high stem vowels, there are verbs with stem [a] that realize a harmonization of sorts with their suffixal vowel. The verbs in (9) show uninflected stems with [a] that select suffixal [a]. These contexts have in common that their stem-final consonant is a dorsal, be it either a nasal or oral stop.

(9)		Stem	Perfective	Habitual	
	a.	ɓāŋ	ɓāŋ-àm	ɓāŋ-àn	'blow (wind)'
	b.	ʃāq	ʃāɢ-àm	ʃāɢ-àn	'chew'
	c.	wàq	wàɢ-àm	wàɢ-ȁn	'hear'
	d.	kāŋ	kāŋ-àm	kāŋ-ȁn	'fry'

These can be directly compared to verbs in (10) whose uninflected stem contains [a] but where the stem vowel alternates to [ə] following suffixation. Unlike the verbs in (9), these have a stem-final consonant that is not a dorsal.

(10)		Stem	Perfective	Habitual	
	a.	dʒàm	dʒə̀m-àm	dʒə̀m-ȁn	'stop'
	b.	kām	kə̄m-àm	kə̄m-ȁn	'teach'
	c.	gɣāɭ	gɣə̄l-àm	gɣə̀l-ȁn	'find'
	d.	ɓáɭ	ɓə́l-ám	ɓə́l-ān	'count'

5. One verb in my database, *ɓīŋ* 'dance', behaves differently when an alternating coda nasal is involved. Here, the Perfective is *ɓīn-àm*, and the Habitual is *ɓīn-àn*. This likely arises because harmony is predicated on the featural specification of the dorsal nasal rather than on that of the alternant.

The analysis that I present below entertains the possibility that the underlying quality of the suffix vowel is /a/. Based on this, the analysis proposes that stem-final dorsals in (9) facilitate harmony between stem and suffix [a] because they share the same height feature, [+open], with [a]. Stems with non-dorsal final consonants in (10), on the other hand, are not compatible with the creation of a single harmonic span across the word. What is interesting in the latter case is that, rather than maintaining two separate [+open] vowels in the same word, Mbat resorts to dissimilation of the stem vowel to [ə]. The same surface outcome arises in verbs like those in (11) whose uninflected stem contains [ə]. These verbs select *-am/-an* and do not undergo alternation. This outcome suggests that [ə] differs minimally from [a], perhaps in that it is [–open].[6]

(11)		Stem	Perfective	Habitual	
	a.	ŋə̀m	ŋə̀m-àm	ŋə̀m-ȁn	'cry'
	b.	kə̀s	kə̀s-àm	kə̀s-ȁn	'cut'
	c.	ɗə̏p	ɗə̏ɓ-àm	ɗə̏ɓ-ȁn	'pick/carry'

There are other alternations that affect a subset of *CaC* stems whose stem-initial consonant is a glide (12). These verbs have stem [a] when uninflected, however, the stem vowel surfaces either as [i] or [u] upon inflection by the Perfective and Habitual suffixes. Stem [i] is found after [j], while stem [u] is found after [w].

(12)		Stem	Perfective	Habitual	
	a.	wáɭ	wúl-ám	wúl-ān	'laugh'
	b.	jàʈ	jìɗ-àm	jìɗ-ȁn	'love'
	c.	wàɭ	wùl-àm	wùl-ȁn	'quench'
	d.	jáʈ	jíɗ-ám	jíɗ-ān	'fetch'

Given that these alternations arise only in inflected forms suggests that /a/ > [ə] dissimilation of the stem vowel, as in (10), occurs before other features are contributed by spreading from the onset. Important to the matter of interest in this paper is that the result may yield opacity. In (12a) and (12c), for example, one might otherwise expect harmonization of a high stem vowel across a stem-final liquid.

3.4 Alternations with mid vowel stems

The verbs in (13) are unique in that their stem shape is CGVC. As introduced above, CGVC is the only stem shape in which the mid vowels [ɛ] and [ɔ] occur. When the stem-final consonant of such a verb is resyllabified into an onset before a vowel-initial suffix like the Per-

6. A reviewer asks about the status of [ə] stem vowels before a dorsal. As similarly noted in Green (2020) concerning mid vowels, there are no instances of [ə] before a stem-final dorsal in my data. Thus, in the case of stem /a/ and /ə/, the contrast between them appears to be neutralized in this environment.

fective and Habitual, their pre-vocalic glide is lost, and the stem vowel raises to its high counterpart. Stem [ɔ] alternates to [ʊ], and stem [ɛ] alternates to [ɪ].

(13)	Stem	Perfective	Habitual	
a.	zwɔ̄ɽ	zʊ̄r-àm	zʊ̄r-àn	‘sew’
b.	vwɔ̄ʈ	vʊ̄ɗ-àm	vʊ̄ɗ-àn	‘take forcefully’
c.	swɔ́ɽ	sʊ́r-ám	sʊ́r-ān	‘hide’
d.	twɔ̄p	tʊ̄ɓ-àm	tʊ̄ɓ-àn	‘wash’
e.	zwɔ̄ʈ	zʊ̄ɗ-àm	zʊ̄ɗ-àn	‘lose’
f.	kjɛ̄ʈ	kɪ̄ɗ-àm	kɪ̄ɗ-àn	‘sweep’
g.	mjɛ̄ɽ	mɪ̄r-àm	mɪ̄r-àn	‘kill’

These verbs reveal that, in a way similar to the verbs in (12), derived high vowels cannot trigger harmony. For example, we might expect, based on comparison to (7), that Perfective and Habitual forms like (13a), (13c), and (13g) would result in full harmonization across a stem-final non-dorsal sonorant. However, **zʊ̄r-ʊ̀m*/*zʊ̄r-ʊ̀n*, **sʊ́r-ʊ́m*/*sʊ́r-ʊ́n*, etc. do not occur. Likewise, even across a non-harmonizing stem-final consonant, we might expect a verb like (13b) to select suffixal *-əm/-ən*, as did the verbs in (8). Again, however, forms like **vʊ̄ɗ-əm/ʊ̄ɗ-ən* do not occur. These outcomes show that: (i) derived high vowels cannot act as harmony triggers, and (ii) mid vowel stems select *-am/-an*. Thus, mid vowel stems pattern with verbs whose stems contain [a] and [ə].

3.5 Perfective and Habitual verb summary

The alternations seen above raise an important question concerning the underlying quality of the *-Vm/-Vn* suffixal vowel. In order to begin to address this, the following list summarizes the basic realizations of these suffixes. They are:

- *-im/-in*, *-ɪm/-ɪn*, *-um/-un*, *-ʊm/-ʊn* in harmonizing contexts after a high stem vowel of the same quality;
- *-əm/-ən* in non-harmonizing contexts after a high stem vowel of any quality;
- *-am/-an* elsewhere (including after stem vowels *ə*, *ɛ*, and *ɔ*).

Based on distribution alone, it might be reasonable to posit *-am/-an* as the basic realization of the Perfective and Habitual suffixes. This is supported by at least two other factors. First, *-am/-an* would be transparent variants of the *-ma/-na* suffixes selected by “heavy” stems in (5) and (6). The vowels of these -CV suffixes do not alternate. Second, *-am/-an* would similarly be aligned with what Gerhardt (1988) proposes for the Jarawan varieties in his study. He states that *-aC* suffixes are basic and have a wider distribution than other suffixal variants. He describes *-əC* as an "unexpected" or "reduced" variant. While it is true that the *-əC* variants are less widely distributed in Mbat, the appearance of *-əC* is entirely predictable, rather than being unexpected.[7]

What should be clear is that non-*am*/*-an* suffixal variants are selected only by high vowel stems. One way to view this might be to assume that *-am*/*-an* is basic and that the suffixal vowel raises after high vowels: raising to *-əm*/*-ən* is partial in a non-harmonizing context and complete in a harmonizing context across a non-dorsal sonorant. One matter to be explored is how to account for such a possibility from a featural perspective. Another possibility would be to propose that the suffixal vowel is underspecified for height. Under such a view, high vowel stems would select either the "partial" or "full" variant depending on the nature of the intervening stem-final consonant. The *-am*/*-an* variants would represent the elsewhere condition.

Either of these approaches seem tenable and entail a certain set of reasonable assumptions. Based on the facts taken together, however, I will assume *-am*/*-an*. A third possibility suggested by an anonymous reviewer is to treat *-əm*/*-ən* as basic, as a means to highlight or to reinforce the harmonizing nature of the alternations. This might be possible but would entail height alternations in two directions. The approach that I suggest based on *-am*/*-an* would instead implicate a singular harmonic raising imperative after high vowel stems whose degree differs according to context. This third alternative might also struggle to explain why *-am*/*-an* is selected after stem *ə* rather than non-alternating *-əm*/*-ən*.

4. Applying feature geometry to Mbat's vowels

Feature geometry, like other autosegmental approaches to phonology, provides an elegant means by which to model interactions and dependencies that features associated with adjacent and even sometimes non-adjacent segments have on one another. One advantage particular to feature geometry is that features that function or move together can be analyzed as forming a constituent or node within the feature tree. As discussed above, Mbat's stem high vowels have the ability to harmonize a suffixal vowel only when they are followed by a stem-final non-dorsal sonorant. Such a consonant acts as transparent to feature spreading from the stem vowel onto the suffix. In an analogous way, the low stem vowel [a] and dorsal consonants have a bearing on one another such that in the presence of a stem-final

7. Another possible factor pertains specifically to the Perfective. The Perfective almost certainly derives from Proto-Bantu **mad* 'finish', whose cognate synchronically in Mbat is *mal* 'finish'. Both contain [a].

dorsal, stem [a] and suffixal [a] do not alternate. To model these and other effects, I assume that consonants of some types have height features akin to those uncontroversially ascribed to vowels. This is not a significant departure from other feature-based approaches which often propose that dorsal consonants, for example, are [high] vs. [low] or [front] vs. [back]. In other works, sonorants have also been described as associated with typical vocalic features like [ATR] (see, for example, Carnie 2002; Uchihara & Báez 2016). Geometric models like the Parallel Structures Model (PSM) of feature geometry (Morén 2003a; 2003b) assume that vowels and certain consonants make use of the same constellation of geometrically-organized vowel manner (i.e., height) features.

The analysis that I present below proposes that vocalic manner features associated with some consonants are key to understanding the alternations in Mbat's Perfective and Habitual verbs. The behavior of stem-final dorsal consonants suggests that their ability to permit low vowel harmony relates to a shared featural specification between them and low vowels. Likewise, the behavior of stem-final non-dorsal sonorants and their ability to permit high vowel harmony suggests that they share some featural specification with high vowels. In this section, I model Mbat's vowel system with three fairly uncontroversial binary features—[open], [closed], and [ATR]—that pertain to vowel manner, i.e., height. The features [open] and [closed] could easily be restated as [low] and [high], respectively. To differentiate vowel place, i.e., backness, I use the feature [dorsal]. Based on these features, and upon the patterning of vowels in the data above, I propose the feature specifications in Table 2 for Mbat's six contrastive vowels.

Table 2 — Featural specification of Mbat vowels

	V-Place	V-Manner		
	[dorsal]	[open]	[closed]	[ATR]
i	–	–	+	+
ɪ	–	–	+	–
u	+	–	+	+
ʊ	+	–	+	–
ə	–	–	–	
a	–	+	–	

Some preliminary observations can be made based on these proposed featural specifications for Mbat's six contrastive vowels that are predictive of other outcomes. First, based on how these vowels behave, [ATR] appears to be a subsidiary feature that patterns together with [closed]. Only a [+closed] vowel can be specified [+ATR]. Geometrically-speaking, this implies that [closed] and [ATR] are resident within the same node or constituent. Such a finding is not unique cross-linguistically. I refer to the node containing [closed] and [ATR] as Aperture, though other terms like Height (Odden 1991) or Vertical Movement (Green & Hantgan 2019) have been proposed for such a constituent that might also be appropriate. Second, and more important, is that a vowel can be specified either as [+open] or [+closed], but there are no vowels that are positively specified for both features. The features [open] and [closed] are precisely those that I propose are involved in word level vowel harmony. There is evidence that I entertain below that the incompatibility of [+open] alongside [+closed] extends beyond individual segments. Such a combination of features appears to be avoided at the level of the word. While these feature specifications pertain to Mbat's contrastive vowels, there is more to consider about the properties of the language's mid vowels, [ɛ] and [ɔ], before offering more detail concerning their associated features. Recall that these vowels pattern as if they are allophones of /ɪ/ and /ʊ/, respectively.

The analysis below attributes low vowel/dorsal consonant interactions to Mbat's preference for a single [+open] span within a word. In instances where such a span is not possible, and two instances of the feature might instead appear within the same word, the result is disharmony. In the case of /a...a/ across a non-dorsal stem-final consonant, there would be two vowels specified [+open]. The language responds by dissimilating the first vowel to [–open], yielding [ə]. Analogously, I attribute the behavior of non-dorsal sonorants and their ability to permit high vowel harmony to their shared specification for V-Manner [+closed] with high vowels. Mbat prefers a single [+closed] span within a word, which is possible only across a non-dorsal sonorant.

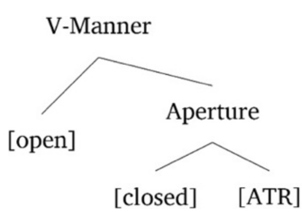

Figure 1 — Geometry of V-Manner features

Based on the behavior of Mbat's vowel and the proposed architectural relationships discussed thus far, I offer the basic geometric organization of Mbat's V-Manner features in Figure 1. For the sake of space and simplicity, I present only V-Manner trees below, as my analysis treats V-Manner features as responsible for the harmony and dissimilation phenomena introduced above. Vowel roundedness/ backness, as dictated by a place feature like [dorsal], does not play a major role in Mbat.

Also important to this geometric analysis is the featural specification of the Perfective/Habitual suffix. As suggested above, several pieces of evidence point toward underlying *-am/-an* and accordingly [+open, -closed] for the suffixal vowel. This is represented in Figure 2.

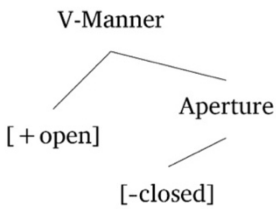

Figure 2 — Underlying form of the Perfective/Habitual suffixal vowel

With Mbat's basic vowel geometry proposed, I turn in the subsections below to modeling each of the alternations earlier discussed in Section 3.

4.1 Alternations involving [open]

Full harmony involving stem and suffixal [a] is possible within a word only across an intervening stem-final dorsal (e.g., *kāŋ* 'fry', *kāŋàm* 'fried'). Under an analysis where the suffixal vowel is underlyingly /a/, this state of affairs involves no overt alternation. I have shown, however, that the vowel of a *CaC* stem elsewhere dissimilates to schwa when such featural harmony cannot be achieved (e.g., *dʒàm* 'stop', *dʒəmàm* 'stopped'). I analyze low harmony between stem /a/ and suffixal /a/ as being possible because both are specified [+open], as is the intervening stem-final consonant.

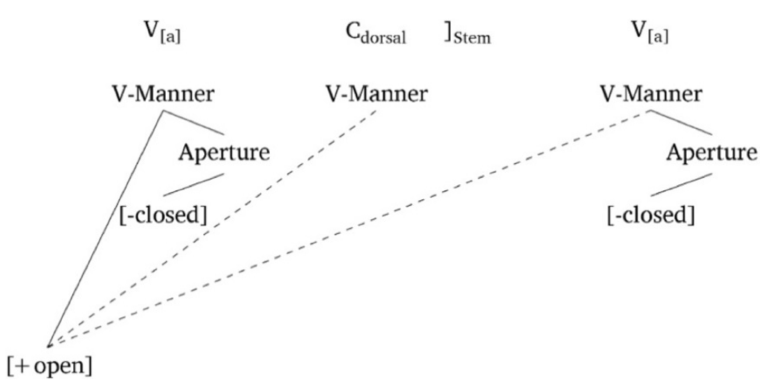

Figure 3 — [+open] conflation – e.g., kāŋ *'fry'* + am → kāŋ-àm *'fried'*

As illustrated in Fig. 3, I propose that Mbat avoids multiple instances of [+open] within a word via feature conflation. Such an outcome is reminiscent of what Cole & Trigo (1988) discuss for [tense] spreading in Menomini Height Harmony. That is, in Mbat, one condition on harmony is that adjacent features (in this case, [+open]) associated with the stem vowel and a stem-final consonant conflate. In the case of harmony with [a], this thereafter extends to the suffixal vowel, creating a single [+open] span across the word.

In related instances, as in (10), where a stem-final consonant is not specified [+open], conflation of the stem vowel's and suffixal vowel's [+open] features is not possible. As a result, Mbat avoids two independent instances of [+open] within the word by dissimilating the first to [–open]. Stem /a/ surfaces as [ə], being [–open, –closed]. This outcome is represented in Figure 4. It is unclear why Mbat opts for alternation in the stem vowel instead of the suffixal vowel under these conditions.[8]

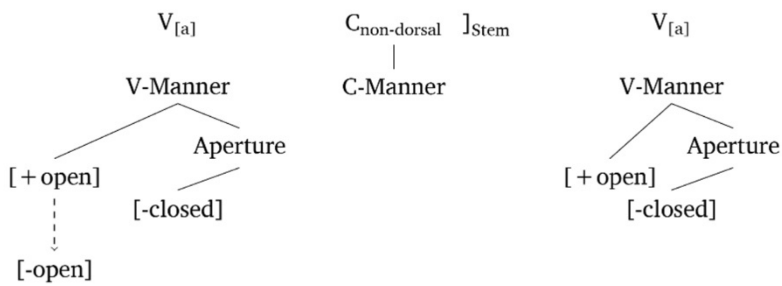

Figure 4 — [+open] dissimilation
– *e.g.*, ɓáɭ *'count'* + am → ɓəl-àm *'counted'*

In those instances where the vowel in an uninflected stem is [ə], as in (11), there is no alternation when *-am*/*-an* is added to the stem. Compare, for example, verbs like *ɗə̂p* 'pick/carry' and *ɗə̂ɓ-àm* 'picked/carried'. Here, there is no issue of adjacent [+open] vowels, and thus no repair is necessary. Adjacent instances of [–closed] appear unproblematic.

In addition, there is the special case of "dissimilating" contexts, like those in (12), that involve an onset glide (e.g., *wáɭ* 'laugh', *wúlám* 'laughed'). In Figure 5, rather than a simple dissimilation of the stem vowel [a] from [+open] → [–open] before the Perfective or Habitual suffix, the presence of an onset glide entails an additional alternation of the stem vowel to a high "tense" vowel. Such a vowel is specified

8. A reviewer suggests that there may be rhythmic preferences underlying this choice. It would be difficult to independently justify such a claim, however, given that the language elsewhere opts for alternations in the vowel of the same suffixes.

[+closed, +ATR], and also takes on the specification for backness from the preceding glide. The status of Mbat's onset glides as [+high] (here, [+closed]) is discussed in Green (2020). Notice that the two Aperture features could be said to spread together.

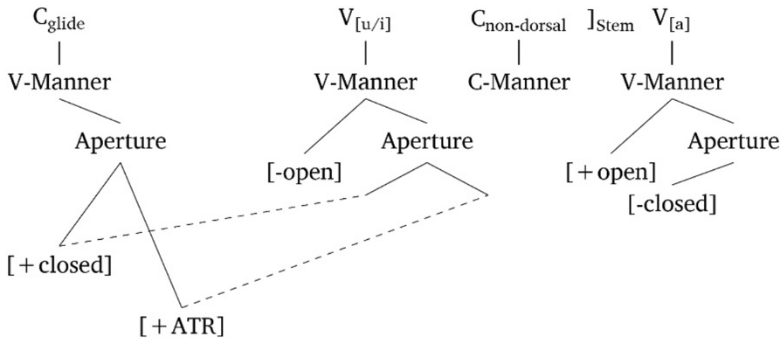

Figure 5 — Dissimilation with onset glide
– e.g., wáɭ *'laugh'* + am → wúl-ám *'laughed'*

I have shown in this section that Mbat adopts two strategies to avoid multiple instances of [+open] within a word, whether through feature conflation across a stem-final dorsal or via dissimilation of the stem vowel. I have also shown that stem vowels that are underlying [–open, –closed] do not undergo alternation under the same conditions. In doing so, I have suggested that positive-valued features are marked relative to their negative-valued counterparts. Last in this section I showed a special case of alternations involving onset glides. These alternations bring to light that there are some, albeit few, instances where two marked feature values, [+closed] and [+open], co-occur within the same Mbat word. In the next section, I illustrate that this is elsewhere avoided and that there are clear instances in which [+closed] dominates [+open] when a choice between retaining one or the other must be made.

4.2 Alternations involving [closed]

In this section, I turn to harmony involving high vowels, whether they are "tense" [i, u] or "lax" [ɪ, ʊ]. Such harmony was illustrated in (7) and is possible only across a stem-final non-dorsal sonorant (e.g., *kúm* 'find', *kúmúm* 'found'). I attribute this outcome to these stem-final consonants sharing the feature [+closed] with high vowels. For the sake of simplicity, I again set aside the issue of backness as it does not play a key role in the harmony process.

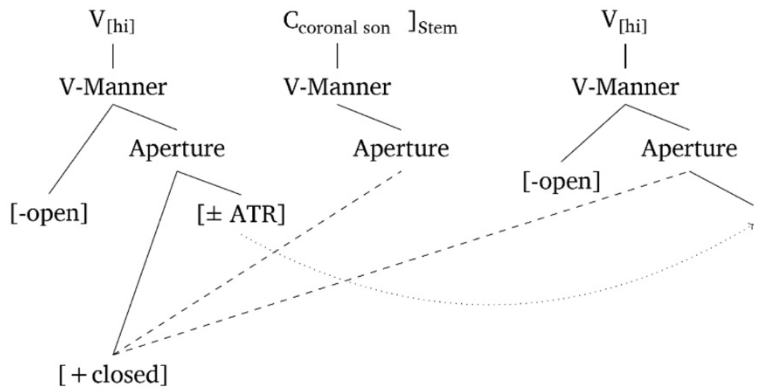

Figure 6 — High vowel harmony
– *e.g.*, bíl̪ *'follow'* + am → bíl-ím *'followed'*

Similar to what I propose in Section 4.1 for the role of [+open] in low harmony, a key factor in harmony involving high stem vowels is the ability for [+closed] to conflate with the same feature associated with the stem-final consonant. Doing so avoids two independent instances of [+closed] within the same word. What is different here, however, is that [+closed] thereafter spreads onto the suffix. In doing so, it replaces the suffix vowel's specification for [–closed] and also leads to a change in the value the suffix's [+open] to [–open]. I have suggested previously that a specification for *[+open, +closed] is avoided in Mbat. This might not be surprising given that the two gestures are contradictory. A general illustration of this outcome is in shown in Figure 6.

Though the [ATR] specification of the stem vowel also arises on the suffixal vowel, it is not clear if [ATR] spreads alongside [closed] (first to the stem-final consonant and then on to the suffixal vowel) or otherwise spreads independently, directly to the suffixal vowel. In this particular figure, I represent [+closed] as operating in a semi-independent way relative to [ATR]. I do this because there is no evidence that stem-final sonorants in Mbat are associated with the latter feature. As stated, it may be possible that both features spread together, or even that the Aperture node itself spreads, even though there is no overt effect on the intervening stem-final consonant. There is evidence elsewhere in Mbat, however, that although the two features often function together, they do not do so in all instances.

One of the more puzzling outcomes witnessed in Mbat Perfective/Habitual inflection concerns the alternation that occurs when a high stem vowel cannot harmonize a suffixal vowel across a non-dorsal sonorant, as in (8). In these instances, the surface quality of the suffixal vowel is *-əm*/*-ən*. This is seen in verbs like *līp* ‘moisten’, whose Perfective counterpart is *līɓ-əm* ‘moistened’. Under the view stated above that the suffixal vowel is underlyingly /a/, such an outcome involves the suffixal vowel undergoing an alternation from [+open] → [–open]. This occurs after a stem vowel also specified [–open]. Such an outcome is unusual in that there is no immediately apparent motivation for the alternation of the suffixal vowel to [–open] after a [–open] stem vowel. Considering the featural specification of these vowels more broadly, however, offers more insight to this outcome. Had alternation of the suffixal vowel not taken place, the result would be a form like **līɓ-àm*, where adjacent, “positive” specifications of [+closed] and [+open] would result on the stem and suffixal vowel, respectively, within the same word. We have not seen such an outcome, except in verbs like those in Figure 5 (cf. *wál̪* ‘laugh’ and *wúlám* ‘laughed’) where [+closed] spreads from an onset glide onto the stem vowel. We know that such spreading from the onset is late because even across a stem-final non-dorsal consonant, high harmonization of the suffixal vowel does not occur.

If I am correct that the spreading of [+closed] from an onset is exceptional, one possibility to explain the suffixal /a/ > [ə] alternation in *līp/līɓəm*-type verbs is that Mbat avoids positive values for opposing manner features within a word wherever possible. As such, and with [+closed] being dominant as elsewhere, the stem vowel [+closed] is maintained while the suffixal vowel alternates from [+open] → [–open].[9]

Compared to other alternations, another way to view this would be that it yields partial satisfaction of an imperative for vowel raising, achieved formally via the dominance of [+closed]. Under this view, total harmonization of the suffixal vowel is possible only with high stem vowels across a transparent consonant: this yields a single [+closed] span. Partial harmonization, leading to *-əm*/*-ən*, would instead be the result with a high stem vowel and a blocker consonant: there is no [+closed] span, but also no opposing [+open]. Elsewhere, when the stem vowel is not [+closed], the result is non-alternating *-am*/*-an*.

4.3 Opacity in stems with derived high vowels

I briefly discussed above that Mbat manifests opacity in some instances in that derived high vowels do not trigger vowel harmony. I illustrated this in (12) for verb stems with /a/ like *wál̪* ‘laugh’ whose

9. Starting with the assumption that the suffixal vowel is underlyingly /ə/ fares no better in that one would have to explain two alternations, one affecting the stem vowel and the other affecting the suffixal vowel, in *ɓál̪*/*ɓə́lám*-type verbs.

stem vowel alternates to a high tense vowel under the influence of a preceding singleton onset glide. For example, the Perfective form of this verb is *wúl-ám* 'laughed'. One might otherwise expect vowels like [u] and [i] to trigger full harmonization of the suffixal vowel across a non-dorsal sonorant (e.g., * *wúl-úm*), but this does not occur. The result is an apparent underapplication of height harmony.

A similar outcome obtains for CG[ɛ/ɔ]C verb stems like those in (13). Green (2020) has shown that Mbat manifests an unusual alternation in verb stems of this type such that they lose their glide upon the addition of a vowel-initial suffix like the Perfective *-am* or Habitual *-an* (e.g., *swɔ́ɽ* 'hide', *sʊ́rám* 'hidden'). Such inflection unsurprisingly results in the stem-final consonant being resyllabified into an onset due to a near-universal typological tendency for languages to avoid onsetless syllables wherever possible. That this resyllabification leads to the loss of the pre-vocalic glide is far more unusual. Green has argued that this outcome is due to an inherent connection between the second member of a complex onset and a singleton coda, as famously discussed by Kaye & Lowenstamm (1981) and formalized by Baertsch (2002). Important to the matters under consideration in the current paper, however, is that the loss of this pre-vocalic glide entails an alternation in quality of the stem vowel.

Following resyllabification, mid vowels raise to high but do not alternate in their "tenseness", i.e., [ɛ] → [ɪ] and [ɔ] → [ʊ]. Whereas stems with [ɪ] and [ʊ] otherwise have the ability to trigger harmony, these vowels cannot do so when they are derived. An example of such an outcome is seen in a verb like *swɔ́ɽ* 'hide' and its Perfective counterpart *sʊ́r-ám* 'hidden'. Here, stem [ɔ] alternates to [ʊ] upon the loss of the pre-vocalic glide, and the suffixal vowel surfaces [a]. There are other pairs in (13), like *pʊ̄ɽ* 'go out' and *pʊ̄rʊ̀m* 'gone out', in which stem [ʊ] harmonizes the suffixal vowel across the same stem-final consonant. In this latter case, however, the triggering high vowel is not derived. Thus, in the case of 'hide' and verbs like it, a derived high vowel does not act as a harmony trigger. Harmony in these instances is opaquely blocked.

One matter pertaining to these alternations that I have not yet entertained in detail is the formal connection between [ɪ/ʊ] and [ɛ/ɔ] from a featural perspective alongside other vowels. As I have suggested, following Green (2020), [ɛ] and [ɔ] behave as if they are allophones of /ɪ/ and /ʊ/, respectively, that occur only after a glide. Their featural properties alongside those of Mbat's other vowels are discussed in the Section 5.

5. Discussion and concluding thoughts

The primary goal of this paper has been to begin to establish certain details of the Mbat vowel system through the lens of alternations that I analyze as being connected to vowel harmony. One challenge inherent in doing so has been that so little is known about the grammar of Jarawan languages more broadly. This means, therefore, that few comparisons can be made to related languages in order to determine whether vowel harmony of a similar or perhaps even of a more transparent type is a pervasive characteristic of this group. Absent the ability to make such comparisons, Mbat still presents an opportunity to consider factors that appear to motivate and govern interactions between stem vowels and adjacent consonants of different types and the downstream effect(s) that these interactions have on suffixal vowels. Another challenge, of course, is that the larger documentation project from which these data are taken is still in progress, meaning that it is yet unclear where else in the language that other instances of harmony, on vowel height or otherwise, may ultimately arise.

While it is clear that Mbat favors harmony in the quality of its stem and suffixal vowels wherever possible, I have suggested that even some instances of disharmony may still implicate an imperative towards raising after high stem vowels. Of course, I have also shown that this trend is sometimes masked by the outcome of other alternations. Overall, vowel harmony in Mbat is triggered by a stem vowel but is blocked across certain intervening stem-final consonants. I have argued that the fact that low harmony occurs only across dorsal consonants and high harmony occurs only across non-dorsal sonorants implicates features that are generally associated with vowel height being intimately involved in the process. There are also two instances in which harmony underapplies in morphologically-derived contexts.

I have attributed the imperative towards raising to the behavior and dominance of [+closed]. This feature is associated with high vowels, but also glides. Mbat prefers a single span of [+closed] across a word, but when this is not possible, other outcomes still suggest that [+closed] is dominant relative to [+open]. The analysis that I present contends that Mbat actively avoids the co-occurrence of *[+closed, +open]. This appears absolute within the same segment, but it is also apparent in vowel alternations from [+open] → [–open]. This avoidance is seen on adjacent vowels in *līp/līɓə̄m*-type verbs, though it is relaxed somewhat when [+closed] propagates from a syllable onset. This is seen in *wál̩/wúlám*-type verbs. Of course, although [+closed] appears dominant relative to [+open], it is clear that the language also acts to create a single [+open] span wherever possible, or otherwise dissimilation occurs.

The generalizations stated above serve as a baseline for analyzing other phenomena in Mbat whose motivations are in some ways less clear cut. One such matter concerns the behavior of the CG[ɛ/ɔ]C stems discussed in Section 4.3, and particularly their alternation with [ɪ/ʊ]. The status of mid vowels is arguably marginal to the extent that they appear only after a glide. When a glide is lost, a mid vowel alternates to its high counterpart. Based partially on this behavior, Green (2020) analyzes mid vowels as being allophones of /ɪ/ and /ʊ/. He proposes that /ɪ, ʊ/ lower to [ɛ, ɔ] due to an OCP constraint against adjacent [+high] segments. Translated to the feature set employed in the current paper, where [+high] equates with [+closed], this resembles other cases where multiple instances of [+closed] are avoided. In a C_1C_2VC syllable, if C_2 and the nuclear vowel are both underlyingly [+closed], the vowel alternates to [–closed]: /zwʊr/ → [zwɔ̄ɽ] 'sew'. When inflection for the Perfective/Habitual entails loss of the onset glide, there is no antagonistic [+closed]/[+closed] sequence to compel lowering: [zʊ̄ràm] 'sewn'.

If this featural analysis is correct, it raises a question about the featural specification of [ɛ/ɔ] relative to other vowels, and particularly to [ə]. Recall from Table 2, repeated here in Table 3 for convenience, that [ɪ, ʊ] are the [–ATR] counterparts to [i, u], all four of which are [+closed]. If in order to avoid an OCP violation on [+closed], mid vowels alternate to [–closed], one would need a means by which to disambiguate these vowels from [ə], which is also [–closed]. One reasonable possibility is that these vowels differ in their specification for [ATR]. Until now, of course, there has been no direct evidence to assume an [ATR] specification for [ə].

Table 3 — Featural specification of vowels

	V-Place	V-Manner		
	[dorsal]	[open]	[closed]	[ATR]
i	–	–	+	+
ɪ	–	–	+	–
u	+	–	+	+
ʊ	+	–	+	–
ə	–	–	–	?
a	–	+	–	

Based on the distribution and participation of mid vowels and [ə] in alternations within Mbat's verb system, I would propose that their behavior could be modeled using [ATR], provided that one step away from the usual assumption that [ɛ, ɔ] are "lax" and thereby [–ATR] vowels. That is, the phonological behavior of mid vowels in Mbat suggests that, despite their phonetic quality being [ɛ, ɔ], they pattern and are best analyzed featurally as [+ATR] relative to [ə]. This proposed featural distinction is shown in Table 4, and I will have more to say about it below. The low vowel [a] may be [–ATR], but there is no clear evidence to substantiate whether or not this feature has any role to play relative to this vowel.

Table 4 — Featural specification of vowels

	V-Place	V-Manner		
	[dorsal]	[open]	[closed]	[ATR]
i	–	–	+	+
ɪ	–	–	+	–
u	+	–	+	+
ʊ	+	–	+	–
ɛ	–	–	–	+
ɔ	+	–	–	+
ə	–	–	–	–
a	–	+	–	(–)

The status of mid vowels as [–closed] seems straightforward based on their alternation with [ɪ, ʊ] and their selection of *-am/-an* suffixes, but their [ATR] status in light of what I proposed just above is in need of further justification. If [ɛ, ɔ] are indeed allophones of /ɪ, ʊ/ but specified [+ATR], how do they receive this specification and what conditions their alternation? I would like to propose that one possibility might be that [+ATR] is contributed by spreading from the glide that precedes them.

There is an undeniable featural connection between glides and high vowels, in particular, with the substantive difference between them perhaps being that glides contain some consonantal manner feature. In traditional featural accounts, this would be attributed to glides being [–syllabic] relative to [+syllabic] vowels. This connection is discussed in Green (2020) and entailed in his analysis of stem /ɪ, ʊ/ alternation to [ɛ, ɔ] after a pre-nuclear glide. As introduced above, Green's earlier analysis refers to [+high], which correlates with [+closed] in the current paper. As such, a prenuclear glide triggers a [+closed] → [–closed] alternation on the nuclear vowel in CG[ɛ/ɔ]C stems. I augment this perspective here in proposing that Mbat's pre-nuclear glides are [+ATR] and that this feature is shared with a following vowel. This would apply both in CG[ɛ/ɔ]C stems, but it also has an analog in *wál/wúlám*-type verbs.

If this is correct, the ability for [+ATR] to be associated with [ɛ] and [ɔ] (though marginally) would entail a slight modification to the proposition stated previously that only [+closed] segments in Mbat can be specified [+ATR]. That is, [+ATR] can be licensed on a [–closed] segment, but only if it has spread from a preceding segment. Such a result would also illustrate that [ATR] and [closed] do not always act or spread in concert with one another. To be clear, assigning [–ATR] to [ə] as a counterpart to mid vowels being [+ATR] (as opposed to being underspecified for the feature) makes no incorrect predictions.

The apparent patterning of Mbat's [ɛ] and [ɔ] as [+ATR] vowels highlights a conceptual issue inherent in standard assumptions about features and their phonetic implementation. Based on their phonetic quality alone, one might presume that these vowels are "lax". Mbat indeed makes an [± ATR] contrast, at least in its high vowels. As such, one might expect these mid vowels to be paired with "tense" [e] and [o] based on what occurs in other languages where such a contrast is found. But, of course, these vowels do not appear in Mbat's inventory. It is only upon a more detailed comparison of their behavior that their featural relationship to [ə] can be appreciated. One might equally be tempted to assume instead that [ə] could be the [+ATR] counterpart of [a]. Of course, this is not the only instance in Mbat where assumptions about phonetic implementation might present an analytical challenge. Let us consider, for example, the selection of Perfective/Habitual *-am/-an* vs. *-əm/-ən* in context of the featural representation of Mbat's vowel in Figure 7.

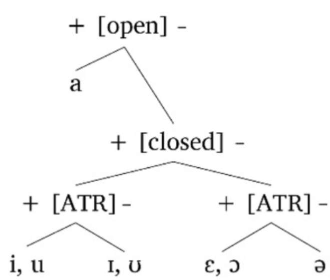

Figure 7 — Mbat vowels – standard features

Recall from earlier in this paper that *-əm/-ən* is selected by high vowels in non-harmonizing contexts. In harmonizing contexts, the suffixal vowel is identical in quality to that of the stem. Elsewhere, *-am/-an* is selected. The generalization based on the features in Figure 7 is that stems with a [+closed] vowel select a suffix with a [–open] vowel, *-əm/-ən*. Elsewhere, a suffix with a [+open] vowel chooses *-am/-an*. All things being equal, the phonological connection between [+closed] and [–open] is not apparent given phonetic assumptions about these features. Why would a [+closed] vowel choose a suffix with a [–open] vowel? As an alternative, however, consider the representation in Figure 8 where features are instead assigned as abstract categories, with the focus being on how they function phonologically, rather than how they are phonetically implemented.

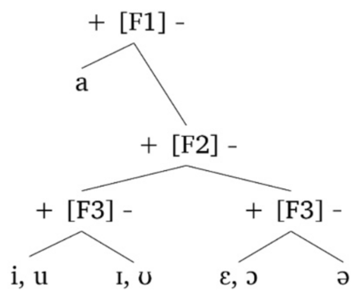

Figure 8 — Mbat vowels – abstract features

An analysis based on such abstract features is unencumbered by phonetic assumptions and is instead concerned only with phonological relationships and, more broadly, the computation entailed in the featural alternations. Surface outcomes are subsidiary. In light of this abstract approach, the choice of suffix that Mbat makes is more straightforward. Stems with a [+F2] vowel select a [–F1] suffix. The [+F1] suffix is selected elsewhere. Here, there is a simple dichotomy in the choice of suffix associated with one value or the other of a particular feature. The phonetic implementation of these featural specifications would be downstream and language-specific. A similar approach is taken by Clements (1991b) in modeling vowel height alternations in narrow Bantu languages and is reminiscent in some ways of substance-free approaches to phonology where phonology is responsible for computation and separate from phonetics. The suitability of such an approach to modeling Mbat's phonology overall must be left to future research.

In closing, this paper has accomplished the goal of bringing to light for the first time characteristics of the vocalic system of a nearly undescribed group of languages that have thus far been unavailable to the theoretical and descriptive linguistics community. This research sets the stage for further exploration not only of Mbat and its vowel system, but also the degree to which vowel harmony represents an areal feature of these languages. In addition, the analysis that I have presented explores the merits of a feature geometric approach to modeling both local and longer-distance vowel-consonant interactions. I have shown that there are both transparent and opaque outcomes in Mbat that are nicely captured by such an approach. I also showed that while standard vowel features offer a means by which to analyze many of Mbat's alternations and interactions, there are some interactions whose transparency is improved by employing an analysis based instead on abstract features.

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