Journal of West African Languages

Volume 45.1 (2018)

NOMINAL INFLECTION IN THE SAFANÉ DIALECT OF DAFING: TERNARY QUANTITY CONTRASTS AND MORPHOLOGICALLY CONDITIONED PHONOLOGY

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Abstract
The complex relationship between phonological processes and the morphological domains in which they apply has been of persistent interest to linguists (e.g. Kiparsky 1985 2010; McCarthy & Prince 1995; Inkelas & Zoll 2007; Inkelas 2014). The present study addresses one pertinent issue related to morphophonology by examining nominal inflection in the Safané Dialect of Dafing (an East Manding language of Burkina Faso). The existence of overlong vowels and a derived ternary vowel length distinction are central to the inflectional paradigm. They are described and quantified in an elicitation. The inflectional paradigm is also compared to that of other Manding languages, with attention paid to how related languages conform to putative constraints on syllable structure. Of theoretical interest is how morphological categories, even internal to a given inflectional paradigm, engender different phonological operations and restrictions on syllable content. Morphologically dependent phonological processes exist in a diverse set of languages and domains (e.g. Inkelas & Zoll 2007), but the role that markedness plays, and the representation of morphologically dependent phonology within the framework of Optimality Theory (Prince & Smolensky 1993) remain a topic of debate, with the two leading approaches being the indexed constraint approach (e.g. McCarthy & Prince 1995; Pater 2000) and the cophonological approach (e.g. Orgun 2000; Anttila 2000 2002). The current study addresses the Dafing data in terms of these two theories of representation.

Keywords: morphophonology; overlength; nominal inflection; Mande; Manding; Dafing.

1. Introduction

This paper is concerned with nominal inflection for definiteness and plurality in the Safané dialect of Dafing.[1] Dafing (also known as Marka or Marka-Kan) is classified as an East Manding language and spoken by about 200,000 speakers in the Northwest of Burkina Faso as well as adjacent territory in Mali (Diallo 2000: 379-380).

Nominal inflection in the Safané dialect is noteworthy for several reasons: it embodies a surface-level ternary vowel length/quantity distinction (i.e. overlength), and is derived by processes that demonstrate a non-uniform phonological component that varies across morphological domains. Such non-uniformity at the interface of morphology and phonology has long been of interest to linguists, for a variety of reasons (e.g. Kiparsky 1985 2010; McCarthy & Prince 1995; Inkelas & Zoll 2007; Inkelas 2014). One source of interest is how a language's phonology is conditioned by (or dependent on) morphological categories. Dafing nominal inflection presents one interesting case of this, both in the non-uniformity of phonological processes and in constraints on syllable content across morphological domains. The set of dependencies and relationships that fall out from the phonology and morphology involved in nominal inflection in Dafing offer insights into the language itself, as well as implicating several meaningful conclusions for morphophonological theory in OT more generally.

Dafing has been the subject of relatively little linguistic analysis. Diallo (1988) compiled a detailed grammar of the Yankasso and Zaba dialects of the language, however little additional research exists (though see Zie 1985). The Safané dialect in particular remains relatively unstudied, and differs from the dialects described by Diallo and Zie in significant ways which will be outlined below. The data reported here were collected during elicitations with a language consultant at the University of California, Berkeley.

The purposes of this article are as follows: to demonstrate how Safané Dafing inflectional morphology creates a surface-level ternary length contrast (Section 2), to discuss how the inflectional properties of other Mande languages compare to the

[1] Many thanks are due to Rassidatou Konate, the language consultant on this project. Further thanks to Peter Jenks for advice on earlier stages of the project, and to four anonymous reviewers for insightful commentary. I am also grateful to Marju Kaps for consulting on Estonian quantity contrasts.

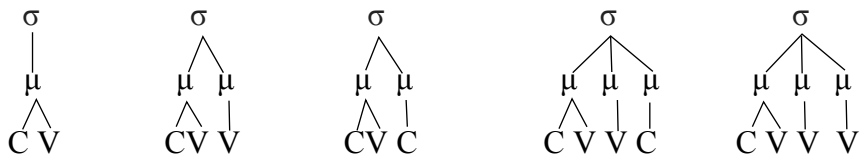
Safané Dafing paradigm (Section 3), to briefly quantify the durational differences argued for (Section 4), and finally to analyze the observed patterns and discuss what insights they entail for a theory of morphophonology (as implemented in OT) more generally (Section 5).

2. Dafing phonology and nominal inflection

In this section relevant phonological contrasts and their role in the nominal paradigm at hand will be laid out.[2] Dafing has contrastive lexical tone, vowel quantity, and vowel nasality. The role of these contrasts in the morphological paradigm will be explored, with special attention paid to how they conform to apparent constraints on moraic structure in the language. The tonal description herein assumes an autosegmental analysis of lexical tone (e.g. Goldsmith 1976a, 1976b). The phonological representation of vowel quantity in the analysis is moraic (e.g. Hyman 1984; Hayes 1989). In the transcriptions of Safané Dafing that follow, the IPA is used. Examples from other authors follow their own transcription conventions, except where noted.

Some of the basic tenants of these assumptions will be briefly summarized. Under a standard moraic theory of weight, syllable nuclei and codas project morae, but onsets do not (cf. Hajek & Goedemans 2006; Topintzi 2008 for analyses with onset weight). Vowel length distinctions are captured by moraic distinctions, where short vowels are monomoraic, long vowels are bimoraic, and overlong vowels are trimoraic (e.g. Hayes 1989). Syllables can vary in moraic content (though this is subject to restrictions within and across languages, e.g. Hyman 1984; McCarthy & Prince 1996). Several schematic examples are shown below for clarity. In what follows [V] is a short vowel, while [VV] is a long vowel, and [VVV] is an overlong vowel.

(1)



The tonal inventory of Safané Dafing, following Diallo (1988), is composed of L and H tonal targets, as well as a down-stepped H allotone (!H) which occurs after an underlying preceding H tone (discussed more below). Tautosyllabic HL contours were observed relatively rarely in the language, however tautosyllabic LH contours are not observed and seem to be prohibited, at least in the Safané dialect. When tautosyllabic LH contours are formed by the concatenation of morphemes with L and H tones, they are eliminated by phonological processes (described below).

Following previous descriptions of tone (e.g. Hyman 1984; Odden 1996) it is assumed that tones associate with morae. In Safané Dafing, contour tones are only observed on long (bimoraic) vowels, and so in this analysis it is assumed each mora may associate with one tone, and no more than one. This explains the restriction of contour tones to long vowels in that each mora in the bimoraic long vowel hosts one tone and creates a tautosyllabic contour, while short vowels cannot realize contours as they only have one mora. In this sense the mora is treated as the TBU in the following analysis (e.g. Odden 1996:449). Finally, in any subsequent discussion where syllabification is relevant, the Maximal Onset Principle is assumed (e.g. Selkirk 1982; Prince & Smolensky 1993).

Safané Dafing has an overwhelming preference for open syllables, with very few exceptions.[3] This generalization is confirmed for Dafing generally as well in looking

[2] For an in-depth review of Dafing phonology more generally see Diallo (1988).
[3] /zák.nʷéé.nì/ 'cat.INDEF.SG' is one of the very few examples of a closed syllable observed during data collection.

at other compiled data, where the vast majority of lexical items have open syllables (Diallo 1988; Traore 1978).

2.1 Contrasts in quantity, tone and nasality

The vowel inventory of the language consists of seven oral vowels: / i e ɛ a ɔ o u/, all which have phonemic long-vowel counterparts (see Diallo 1998, Vol. I:70-71). Several minimal pairs exemplifying quantity and tone contrasts are shown below in (2) and (3), respectively. Glosses are given below the forms.

(2)	**ʃì**	**àkɔ́ɔ́tʃè**
	hair.INDEF.SG	his/her older brother
	ʃìì	**ààkɔ́ɔ́tʃè**
	eight.INDEF.SG	your older brother

(3)	**sú**	**flá**
	corpse.INDEF.SG	two
	sù	**flà**
	night.INDEF.SG	Fulani (ethnic group)

Dafing also exhibits contrastive nasality in vowels. Diallo (1988) analyzes nasal vowels as underlying VN sequences (Vol. I:73-76).[4] However here they are treated simply as V̰. This is in line with their phonetic realization as coda-less nasalized vowels. This difference in transcription between this study and Diallo (1988) is for our purposes, largely peripheral. Several examples of contrastive nasalization on vowels are shown below in (4) (long and short vowels can both have contrastive nasality, also noted by Diallo (1988, Vol. I:75)).

(4)	**bɛ̰́ɛ̰́**	**bɛ́ɛ́**
	sesame.INDEF.SG	rock.INDEF.SG
	tɔ̰̀ɔ̰̀	**tòò**
	game.INDEF.SG	ear.INDEF.SG
	dɔ̰́	**dó**
	to cultivate	to wear

2.2 Plural and definite marking in nominal inflection

Given the basic phonological contrasts described above we can now explore their role in nominal inflection. One type of plural inflection is manifested in the affixation of the suffix /-ɾu/ to the nominal stem. The allomorph [-nu] appears after nasal vowels. Several examples are given in (5) below.[5]

[4] The treatment of nasal vowels as underlying VN sequences has been employed to explain their so-called unpacking in borrowings, or their behavior in the phonology internal to a given language (e.g. Barbosa 1962; Narang & Becker 1971; Paradis & Prunet 2000). No such evidence has been observed in Safané Dafing. Investigating gestural and acoustic differences between phonological VN sequences and V̰, in terms of aperture of the velopharyngeal port, nasal air flow, and acoustic correlates of nasality (Cagliari 1977; Medeiros 2011; Marques 2014) might help to decide what form of representation of nasal vowels is best suited to Dafing. Such data is currently not available, and so in the absence of compelling evidence to treat nasal vowels as underlying VN sequences, here they are simply represented as V̰.

[5] Another suffix nominal /-déké/ 'many' can be used to convey plurality in Safané Dafing as well; its distribution seems to be more limited than that of /-ɾu/.

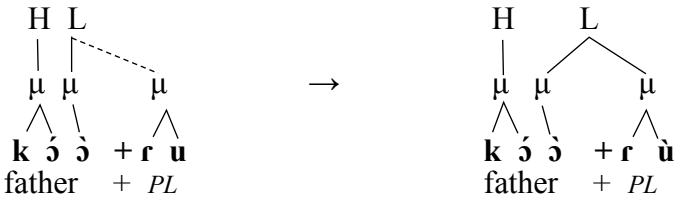
(5)

jɛ̀	**jɛ̀rù**
fish.INDEF.SG	fish.INDEF.PL
só	**sórú**
horse.INDEF.SG	horse.INDEF.PL
ʒwɔ̰̀nɩ̰̀	**ʒwɔ̰̀nɩ̰̀nù**
ant.INDEF.SG	ant.INDEF.PL
bɛ̰́ɛ̰́	**bɛ̰́ɛ̰́nú**
sesame.INDEF.SG	sesame.INDEF.PL

As is clear from the examples above, the tonal identity of the plural morpheme is entirely dependent on the tone of the preceding TBU, having the same tonal identity as it (note that this pattern is different than that in the other dialects documented by Diallo (cf. Diallo 1988, Vol. I:148)). The dependence of the suffix's tone on the preceding tone is treated here as a case of rightward tonal spreading, where the tone of the preceding TBU (= mora) spreads rightward onto the suffix. Accordingly, the suffix is toneless, receiving its tonal value from the preceding TBU. Toneless suffixes have been documented in other Manding languages (e.g. Dumestre 2003) and are well attested in African tone languages more generally (e.g. Archangeli & Pulleyblank 1994:300, for Margi (Chadic); Hyman 2013:34, for Aghem (Bantu); Paster 2003:148, for Leggbo (Volta-Congo)). Additionally, the observed pattern of spreading is one which would typically be expected: according to Hyman (2013:34), "toneless TBUs most commonly acquire their tone by local spreading from the preceding TBU".

In observing the rightward spreading from nominal stems to the plural suffix, we can note that the suffix takes only the last portion of the contour tone from the preceding syllable. Concretely, in a nominal stem with a final falling (HL) contour, the suffix will bear a low tone. This is another piece of evidence that contours on long vowels are decomposable into two TBUs (morae), and only the suffix-adjacent TBU is the one that spreads. For clarity, in (6) below, the process of tonal spreading is represented schematically. The noun **/kɔ́ɔ̀/** 'father', which becomes [**kɔ́ɔ̀rù**] when inflected, is used as an example. Spreading is represented by the dotted line.[6]

(6)



Diallo analyzed definite marking as a purely tonal morpheme, bearing a H tone, and co-occurring with lengthening of the nominal stem (Diallo1988, Vol. I:54-56). Two examples with phonemically short vowels in the uninflected stem are shown below.

(7)

jɛ̀	**jɛ́ɛ́**
fish.INDEF.SG	fish.DEF.SG
kùrù	**kùrúú**
bone.INDEF.SG	bone.DEF.SG

[6] An alternative analysis might argue that there are no L tones in the language, however such an analysis would likely have to posit contour tones as primitive (which would involve ad hoc stipulations about their distributional restriction to phonemically long vowels), and would need alternative explanations for a variety of tonal phenomena in nominal and verbal derivational morphology (e.g. Diallo 1988, Vol. I:35-58) which show low tones are involved in tonal changes that cannot be readily explained as only H tone operations. See (Diallo 1988) for further arguments for L tones' existence in the language.

Nasal vowels exhibit non-uniformities in definite inflection; with some denasalizing when marked as definite and some retaining nasality (tonal changes are consistent). For example, consider the asymmetry between the forms in (8) below.

(8)

tɛ̰̀	**téé**
forehead.INDEF.SG	forehead.DEF.SG
kwɔ̰̀ɔ̰̀	**kwɔ́ɔ́**
belly.INDEF.SG	belly.DEF.SG

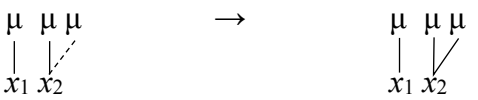
Note that in the definite forms, [**téé**] 'forehead.DEF.SG' has lost nasality on the final vowel, while [**kwɔ́ɔ́**] 'belly.DEF.SG' has not (the non-lengthening of [**kwɔ̰̀ɔ̰̀**] in the definite will be discussed shortly). Such a pattern is not dependent on vowel quality or any other discernable phonological determinant. Based on the data collected for Safané Dafing, retention of nasality seems to be the exception to the rule of denasalization in the definite with the majority of nasal forms denasalizing. Further, based on available data there does not seem to be a coherent distribution, with no particular factor determining whether or not a stem will de-nasalize when inflected. Diallo (1988) comes to a similar conclusion, noting a short list of lexical exceptions to the observed denasalization (Vol. I:75-76). Further work may benefit from searching for a pattern underlying the above asymmetry, but it is left aside here as it is largely peripheral to the question at hand.

Under the moraic framework adopted here, the definite morpheme is represented abstractly as a "segmentally unaffiliated mora" (e.g. Hayes 1989:262) linked to a high tone. This is represented schematically in (9) below.

(9)

This approach is slightly different from that of Diallo, as it unifies the two changes seen in definite marking. Diallo states that observed lengthening is "[…] a copy of the final vowel of the stem so that it may serve to support the H tone in definite nominal modality" (Vol. I:56, translated). A base-copying account is similar in spirit to the one used in this analysis, but conceives of tonal and length changes as separate, and co-occurring, where in the moraic account they are both driven by the addition of (9) to the stem. In a moraic theory of lengthening, morae which are not affiliated with a segment can cause lengthening by triggering a segmental linking to the unaffiliated mora. A schematic representation of such a process is shown in (10) below, where *x* is used to represent segments. A dotted line represents segmental association with the mora.

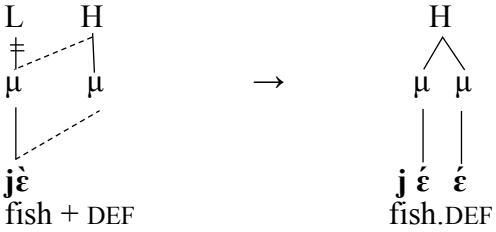
(10)



In (10) above, x_2 would lengthen by virtue of its association with the floating mora; a concrete example is shown in (11) below. Representing definite inflection with a moraic theory of length can thus account for the vowel lengthening seen in the definite form (see e.g. Hayes 1989 for analogous treatment of compensatory lengthening).

The concurrent tonal changes are analyzed here as a case of leftward tonal spreading and de-linking. An example with /**jɛ̀**/ from (7) above is shown in (11) below. The H tone spreads leftwards and the L tone delinks from the first mora in the sequence (represented by the two horizontal lines between mora and tone). This phonological process appears to be operating in conformity with the general prohibition on tautosyllabic LH sequences mentioned previously.

(11)



Further evidence for the H tone as a part of the definite morpheme comes from affixation to H-tone-final stems. When the stem-final mora in the uninflected noun bears a high tone, it does not de-link but instead triggers downstep on the second H tone of the definite marker (cf. 7 above). Downstep is represented in the segmental transcription with ↓ preceding the down-stepped TBU. The aforementioned vowel lengthening also co-occurs with downstep:

(12)

sɔ́sɔ́	**sɔ́sɔ́↓ɔ́**
bean.INDEF	bean.DEF
só	**só↓ó**
horse.INDEF	horse.DEF

Downstep is a general phonological process in Safané Dafing; anytime there are two adjacent H tones, the latter will downstep, being realized as phonetically lower in pitch.[7] This process can be conceptualized as originating from constraints on adjacent tonal entities with the same value; i.e. the Obligatory Contour Principle (e.g. Goldsmith 1976a; Odden 1996). Following previous approaches in Manding (e.g. Bird 1966) downstep is conceptualized as originating from a floating L tone, which causes downstep of the following H. The floating L tone thus serves as a repair for and adjacent /H H/ sequence. Schematically: /H H/ → [H L !H]. Downstep occurs whenever two H tones are adjacent, and can occur multiple times, where a series of H tones downsteps to lower pitch values successively, this would be represented as /H_1 H_2 H_3/ → [H_1 L !H_2 L !H_3], where !H_3 is further downstepped from !H_2. The generality of downstep is shown below in three examples which are unrelated to definite marking. The gloss and translation are shown below the transcriptions.

(13)

áá ↓vjɛ́ɛ́ ↓jáá sɔ̀
3.PL all be.thin PROG
'they are all getting thin'

kábá ↓ʃíì
sky owner
'lord of the sky'

jììbɔ́ɔ́ ↓zúkɔ̀
tree.DEF under
'under the tree'

An alternative analysis of downstep in Safané Dafing might postulate that downstep is an automatic process that does not involve the insertion of a floating L tone, and is the result of the phonetic interpretation of adjacent tonal entities (e.g. Bickmore 2000; Odden 2010; cf. Paster & Kim 2011). The floating L tone analysis is adopted here, as it has clear explanatory power in other Manding varieties (e.g. Bird 1966), and in

[7] Downstep also serves as a diagnostic for the tonal identity of multisyllabic words. For example, the absence of downstep in a multisyllabic H tone word, like /kúrú/ 'mountain.INDEF' indicates that there is only one H tone target spread across two syllables; compare with /kúrú↓ú/ 'mountain.DEF' with two H tonal targets, the latter being downstepped.

terms of formal representation it is more suitable for a constraint based analysis (Section 5).

Returning to Safané Dafing inflection, thus far only nominal stems with final short vowels have been discussed. These stems lengthen from monomoraic to bimoraic length (a short vowel to a long vowel) in the definite form, as schematized above. In stems with final long (bimoraic) vowels in the uninflected form, an asymmetry emerges. In the Safané dialect, bimoraic uninflected stems do not further lengthen in the definite form.[8] This is exemplified in (14) below. Note the tonal changes mentioned above (leftward H tone spreading and downstepping) distinguish the definite from indefinite forms. In the final example **/kɔ́ɔ̀**/ 'father', the definite morpheme de-links the stem-final L tone and also downsteps (because it is following a H tone).

(14)	**bòò**	**bóó**
	arm.INDEF.SG	arm.DEF.SG
	téé	**té↓é**
	day.INDEF.SG	day.DEF.SG
	kɔ́ɔ̀	**kɔ́↓ɔ́**
	father.INDEF.SG	father.DEF.SG

This lack of lengthening in long-vowel-final stems in the Safané dialect is emblematic of a general preference in the language for limiting a syllable to two morae, to be discussed further below.

One final property of definite inflection merits mentioning. Most vowels undergo purely tonal and/or quantity-based changes when inflected but [a] undergoes a change of quality as well, becoming [ɔ] when inflected. The aforementioned tonal and durational changes also occur. Two examples are given in (15) below.[9]

(15)	**bá**	**bɔ́↓ɔ́**
	goat.INDEF.SG	goat.DEF.SG
	bà	**bɔ́ɔ́**
	mother.INDEF.SG	mother.DEF.SG

Readers familiar with Manding plural inflection will note that this alternation is highly reminiscent of what is analyzed as a suffixal vowel in other Manding varieties (e.g. Creissels 1983, 2013). Definite marking across Manding varieties will be discussed in Section 3, but here some important notes are worth mentioning. The diachronic origin of the definite marker in Manding has been reconstructed as a postposed demonstrative pronoun [-o] (Derive 1990, Fascicule I:178-179), which persists segmentally in some Manding varieties, like Mandinka and Maninka. There are other cases, such as Dyula where it is lost entirely, and, like in Dafing, is manifested in length increases (Bracconier 1973). In Dafing, the non-uniform behavior of nouns with stem-final /a/ under inflection is well explained by a diachronic fusion of /a+o/ → [ɔɔ]. As this is the only place where any vowel quality changes occur with definite marking, the representation of the definite morpheme as

[8] Some interesting dialectal variation can be noted here. Diallo observes in the Zaba dialect, that long vowel stems readily lengthen when inflected (written as VV → VVV in Diallo 1988, Vol. I:145). However in the Yankasso dialect of the language Diallo observes that lengthening is "blocked" if the stem-final uninflected vowel is long, i.e. vowels that are long in the indefinite form do not further lengthen when inflected, while vowels that are short in the indefinite form readily become long when inflected (Diallo 1988, Vol. I:235). The Safané dialect matches the Yankasso dialect in this regard.

[9] Such vowel quality changes also vary across dialect. In the Zaba dialect, stem-final vowel quality is consistent across inflectional categories in the paradigm, where a stem-final indefinite /a/ remains such when inflected. Take for example **/bá/** 'goat.INDEF.SG', which becomes [**bá↓á**] in the definite (cf. 15 above) (Diallo 1988, Vol. I:72).

(9) seems preferable to positing the form of the suffix as an underlying /-o/. The alternative account of the suffix as /-o/ in Safané Dafing would have to argue why there is no segmental material from the suffix appearing when all other vowels are inflected. As such, with a historical explanation for the non-uniformity in (15), the suffix here is treated as a segmentally unaffiliated mora, with (15) as the exception to pure stem final lengthening. This will be discussed in more depth, with reference to other Manding varieties in Section 3.7.

By not lengthening in the definite and only undergoing tonal changes (as in (14) above), long vowel stems retain bimoraicity, as opposed to further lengthening. This contrasts with short vowel stems, which readily lengthen to bimoraicity (as in (7) and (15) above). This difference can be conceptualized as originating from a constraint on the preferred mora count in a given syllable, where a maximum of two morae per syllable is preferred. Here a comparison with the Zaba dialect documented by Diallo provides some insight. In the Zaba dialect, many long-vowel-final nominal stems readily lengthen to overlong when inflected for definiteness (Diallo1988, Vol. I:74, 145). As has been established for the Safané dialect, no such lengthening occurs. As an illustrative example, contrast the forms below (with dialect listed above); see Diallo (1988, Vol. I:145) for other examples.

(16)

SAFANÉ	ZABA
ʃʷɔ́ɔ́	**súó**
meat.INDEF.SG	meat.INDEF.SG
ʃʷɔ́↓ɔ́ (*ʃʷɔ́↓ɔ́ɔ́)	**súó↓ó**
meat.DEF.SG	meat.DEF.SG

(Zaba data from Diallo 1988, Vol. I:145)

This shows that overlength is certainly a possible manifestation of definite marking in the Zaba dialect, but one that is not an option in Safané Dafing inflection (which uniformly does not lengthen long vowels in the definite-singular, as exemplified in (14) above). Further evidence for such a general language preference can be obtained from looking at the frequency of moraic structures in the language. Monomoraic and bimoraic syllables are clearly the norm, both heavily attested in the collected data (with one systematic exception, described below). One other piece of evidence for a language-general preference for bimoraic syllables in Safané Dafing comes from the few forms observed with closed syllables. All of these forms have only short vowel syllable nuclei: meaning all the syllables are maximally bimoraic (Where CVC is bimoraic and CVVC would be trimoraic).

Given this observation, the restricted and systematic appearance of trimoraic structures in Safané Dafing might be seen as surprising. Trimoraic length was noted in only one morphologically restricted case, outlined below.

2.3 Definite-plural nouns and the trimoraic syllable

Given the apparent constraint on mora count argued for above, we now turn to a case where it appears to be inoperative: specifically, where the syllable becomes trimoraic. The trimoraic syllable has long been accepted as a possibility in moraic analyses of language (e.g. Hayes 1989) and has clear explanatory power for languages with ternary weight distinctions and weight-dependent stress assignment. It has been argued for in Hindi and Dutch on these grounds (van der Hulst 1984; Pandey 1989), as well as in languages with ternary vowel length distinctions such as Dinka (Andersen 1987, 1990, 1993; Remijsen & Gilley 2008; Remijsen & Manyang 2009). In Dafing, ternary length distinctions were documented in the Yankasso dialect of the language by Diallo, in sporadic alternation with CVV syllables (Vol. I:301), apparently realized in free variation without any coherent distribution in the language.

It was also observed in the lengthening of bimoraic long vowels in definite inflection in the Zaba dialect as mentioned above (Diallo 1988, Vol. I:72,145).

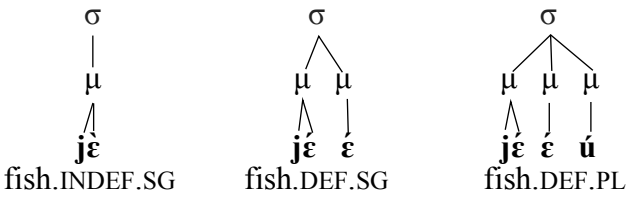
In the Safané dialect, trimoraic length is observed in a different and systematic domain: when definite and plural marking co-occur. As an illustration, consider the uninflected nominal stem /**jɛ̀**/ 'fish.INDEF.SG'. When inflected for definite-ness the stem vowel lengthens, and the L tone is delinked, resulting in [**jɛ́ɛ́**] 'fish.DEF.SG', as described above. When inflected both for definite and plural the output is the trimoraic [**jɛ́ɛ́ú**]; the paradigm is shown in (17) below.

(17)

jɛ̀	**jɛ̀ɾù**
fish.INDEF.SG	fish.INDEF.PL
jɛ́ɛ́	**jɛ́ɛ́ú**
fish.DEF.SG	fish.DEF.PL

The assumed underlying form of the definite-plural is one in which the definite form is inflected for plurality, e.g. /**jɛ́ɛ́+ɾu**/. We next assume that /ɾ/ in the plural morpheme is deleted, meaning /**jɛ́ɛ́+ɾu**/ → [**jɛ́ɛ́ú**]. The third mora is syllabified as one unitary, trimoraic syllable; for clarity the moraic/syllabic representations of the monosyllabic surface forms in (18) are shown below.

(18)



Here an important digression on syllabification is warranted. One pertinent question is: how do we really know that resyllabification has occurred? That is, how do we know that the definite-plural example above is [**jɛ́ɛ́ú**] and not [**jɛ́ɛ́.ú**]? Evidence for syllabification as one unitary syllable comes from the phonological structure in the language and phonotactic restrictions therein.

Syllables without onsets are rare in Dafing, in terms of frequency in the lexicon; according to Diallo (1988, Vol. I:302) they are only found in the pronominal forms (e.g. (2) above) and borrowings from Arabic. Other compiled data for Dafing confirms this (see Traore 1978). Back vowels /o/ and /ɔ/ in syllables without onsets are even more limited in terms of frequency in the lexicon than non-back vowels (as all pronominal forms begin with non-back vowels). These forms often alternate with variants with an onset [w]; take for example [**òpèrè**]~[**wòpèrè**] (Traore 1978:178). Of further note is the fact that [w] has a strong tendency to precede back vowels in the language (e.g. Diallo, Vol. I:83). All of this represents a phonotactic dispreference for vowels, and especially back vowels in syllables that lack onsets in the language.

However, in the case of /u/, it seems a categorical generalization can be made. During fieldwork with the Safané dialect an /u/ in an onset-less syllable was never observed. Further, Traore (1978) and Diallo (Vol. II:35) document not a single word where /u/ is not preceded by an onset. This can be taken as a phonological/phonotactic restriction on /u/ in a syllable lacking an onset, a more restrictive embodiment of the general dispreference for syllables without onsets in general and back vowels in syllables without onsets in particular. If the lack of syllables with /u/ nuclei and no onset in the language is interpreted as general phonotactic restriction, a variant of the forms in (18) above, where /u/ is argued to be a distinct syllable (e.g. [**jɛ́ɛ́.ú**]), would stand in clear violation of this phonotactic constraint.

Accordingly, an argument that the form in (18) above is [**jɛ́ɛ́.ú**] is in need of an explanation for why these forms exhibit an otherwise unattested phonotactic configuration in the language. In fact, such a phonotactic restriction could be seen as a constraint, which triggers syllabification as one single syllable (see Section 5). This

phonotactic evidence indicates that the forms in (17) above are syllabified as one unitary (trimoraic) syllable, as in (18).[10] It is thus argued here (and supported with quantitative evidence in Section 4) that the ternary length distinction is robust, and that the trimoraic syllable is an appropriate syllabic representation for Dafing phonology. This pattern is the same across all stem-final vowels in the definite-plural paradigm that is /oo+ɾu/ → [oou], /ii+ɾu/→ [iiu], and so on.

Another piece of evidence for a ternary length distinction is a ternary inflectional distinction manifested by vowel length only. These are indeed seen in Dafing, when the nominal forms with stem-final /u/ are inflected. That is, when a stem-final definite-singular /uu/ form becomes inflected for the plural, it becomes /… uu+ɾu/, which following the deletion of /ɾ/ and syllabification, surfaces as [uuu]. Because of the aforementioned tonal changes that take place in the paradigm, a perfect minimal triplet cannot be observed within a single nominal stem; however across stems a minimal triplet can be realized. Take the two inflected nouns shown in (19) below:

(19)

sú	**sú↓ú**	**sú↓úú**
corpse.INDEF.SG	corpse.DEF.SG	corpse.DEF.PL
sù	**súú**	**súúú**
night.INDEF.SG	night.DEF.SG	night.DEF.PL

Across nominal stems we can observe a three-way distinction in vowel length, corresponding to three different meanings: [**sú**] *corpse.INDEF.SG*, [**súú**] *night.DEF.SG*, and [**súúú**] *night.DEF.PL.* These are all monosyllabic (as in (18) above).

It should be emphasized here that Safané Dafing presents a strong case for having a ternary length contrast at the *surface* level. The distinction is derived via a phonological process and it is not present underlyingly. In specific terms, because we assume that the underlying form of [**súúú**] (from (19) above) is /**súú**+**ɾu**/, there is not an argument to be made for ternary length as a primitive (underlying) property of vowels in Dafing.

Another important issue is the status of the deletion of [ɾ] as morphologically conditioned, as the deletion of [ɾ] has *only* been observed in definite-plural nouns. A reasonable assumption might be that phonological factors cause the deletion in the paradigm; however this is not the case. In what follows comparisons will be made with analogous phonological environments (to that of the definite-plural forms), with the goal of showing that potential phonological triggers for [ɾ] deletion do not cause it, and that is it restricted to definite-plural forms only.

One possibility would be the deletion of [ɾ] occurs after a long vowel and preceding a short vowel (this is always the environment in the definite-plural). That is, schematically /VVɾV/ → [VVV]. However there are abundant counter-examples to this; take for example [**lùùɾù**] 'five', and [**ʃúùɾù**] 'cabbage.INDEF.PL' (compare this to the definite-plural forms in (19) above which also contain /uu+ɾu/).

More precise comparisons can be made in looking at the indefinite-plural and definite-plural forms of long-vowel-final stems. Because these long vowel stems do not change in length when inflected for definiteness, they are segmentally the same, meaning that the following comparisons in (20) can be made. Below, three phonemic long-vowel stems are shown in the indefinite and definite-plural. Note that [ɾ] is only deleted in the definite-plural.

[10] Phonetic definitions of a syllable have focused on the acoustic properties that define it. Roach for example says that syllables are usually described as consisting of a "centre which has little or no obstruction to airflow and which sounds comparatively loud; before and after that centre […] there will be greater obstruction to airflow and/or less loud sound" (Roach 2000:70). This is in line with the conception of the syllable in sonority theory; where syllable nuclei correspond to "peaks in sonority" (Giegerich 1992:132). From this phonetic point of view the words in (18) above all certainly qualify as mono-syllabic; that is, they are all realized with only one prominence locus and are not decomposable into discrete sonority peaks.

(20)			
	/kɔ́ɔ̀ + ɾu/	→	**[kɔ́ɔ̀ɾù]**
	father.INDEF + PL		father.INDEF.PL
	/kɔ́↓ɔ́ + ɾu/	→	**[kɔ́↓ɔ́ú]**
	father.DEF + PL		father.DEF.PL
	/téé + ɾu/	→	**[téérú]**
	day.INDEF + PL		day.INDEF. PL
	/té↓é + ɾu/	→	**[té↓éú]**
	day.DEF + PL		day.DEF. PL
	/bòò + ɾu/	→	**[bòòrù]**
	arm.INDEF + PL		arm.INDEF.PL
	/bóó + ɾu/	→	**[bóóú]**
	arm.DEF + PL		arm.DEF.PL

Ignoring tonal differences, the nominal stems present identical segmental environments of /CVVɾV/, and as is clear above, [ɾ] only deletes when the forms are definite-plural. This precludes the explanation [ɾ]-deletion as phonologically conditioned by *segmental* (non-tonal) material.

The question still remains: could the tonal changes that occur in definite inflection be triggering [ɾ] deletion? Such a relationship between lexical tone and segments has not been observed in any other domains in the language, and would be contrary to general expectations about tonal behavior in autosegmental phonology (see for example Hyman (2007) for arguments that tones are largely autonomous). Given this, such a proposal would seem dubious at the outset. We can find direct evidence against it in the language as well. Consider for example the difference between **/bòò + ɾu/** 'arm.INDEF + PL' /**bóó + ɾu/ '**arm.DEF + PL' from above. Assuming spread of the stem tone onto the suffix, a tonal account of deletion would have to propose that [ɾ] deletion occurs between two high-tone-bearing vowels or perhaps more specifically [VVɾV], where all TBUs are linked to a high tone (e.g. /**bóó + ɾú/ → [bóóú**]). However, positing such a tonal environment as a phonological trigger for deletion is blatantly contradicted by surface forms like [**téérú**] 'day.INDEF.PL' (or any long-vowel H tone stem that is indefinite-plural for that matter), where [ɾ] persists in exactly that environment. In this sense tonal changes cannot explain deletion for underlying L tone stems, such as /**bòò**/ 'arm.INDEF.SG'.

For H-tone-final stems, a tonal explanation for [ɾ] deletion would have to rely on the fact that the H tone associated with the TBUs surrounding [ɾ] is downstepped, as this is the only tonal difference between forms like [**téérú**] day.INDEF.PL and [**té↓éú**], day.DEF.PL. In other words, this explanation would have to claim that [ɾ] deletes whenever surrounded by TBU's that are linked to !H. This is obviously not the case where [ɾ] is not deleted when H tones are downstepped anywhere else in the language. To give just a few examples, take the possessive construction with the 3PL pronoun: [**áárá↓wúrú**] 'their dog' and [**áárá↓kúrú**] 'their knot'. In this case the second [ɾ] in these constructions is between two TBUs that are linked to a !H high tone, and deletion does not occur.

Given that general phonological processes cannot be shown to induce [ɾ] deletion, as demonstrated in the examples above, it is argued that such deletion is based on morphological category, where [ɾ] deletes only when the affix /-ɾu/ is suffixed to definite-plural nominal stems. As mentioned above, this is the only domain in which [ɾ] deletion has been observed. This is an example of non-uniform phonological processes across morphological domains and will be analyzed under a formal framework in Section 5.

2.4 Ternary quantity contrasts and morphological domains

Independent of its morphologically restricted status, a ternary length distinction is notable. Cross-linguistically, ternary vowel (or consonant) length distinctions are a relative rarity. They have however, been observed in a diverse set of languages: North Low Saxon (Chapman 1993; Prehn 2012), Estonian (Prince 1980), Wichita (Rood 1975) and Mixte (Hoogshagen 1959), as well as other African languages such as Dinka (Nilo-Saharan) (Andersen 1987, 1990, 1993; Remijsen & Gilley 2008; Remijsen & Manyang 2009) and Shilluk (Nilo Saharan) (Remijsen et al. 2016). Importantly, an observed ternary contrast may not necessarily entail an underlying distinction. Certain documented cases of surface-level ternary distinctions are well-explained by the interaction of some other linguistic feature (such as metrical feet) with binary length distinctions, and ternary length as a primitive feature is not well supported in such cases (e.g. Chapman 1993; Prince 1980; Odden 2011:486). However, as noted by Odden (2011:486-487) there are other more compelling cases for ternary length distinctions as independent and primitive phonological features (i.e. not the interaction of binary length with orthogonal linguistic elements), such as Dinka.

As proposed by Remijsen & Gilley (2008), ternary contrasts may be relatively rare because of their susceptibility to diachronic reanalysis. As found in Dinka, the restrictions on vowel length necessitated in ternary contrasting systems were shown to centralize the shortest vowels in the series (in terms of F1 and F2). The authors posit these sub-phonemic quantity-dependent changes in vowel quality and "greater crowding in the vowel duration space" (Remijsen & Gilley 2008:340) could potentially lead to a diachronic reanalysis of the system, as a form of hypo-correction (as described by Ohala 1989, 1993) effectively eliminating the length contrast.

Vowel length contrasts have been argued to persist diachronically where their neutralization would produce homophony and where they serve a pertinent morphological function (e.g. Blevins 2004; Blevins & Wedel 2009). Consider a case from Estonian, here dealing with a three way consonant duration contrast: (Q(uantity)1, Q2, and Q3). In (21) below, the case is shown above the words, with the gloss to the right.[11]

(21)	GENITIVE (Q2)	PARTITIVE (Q3)	GLOSS	
	kappi	**kapppi**	cupboard	
	kammi	**kammmi**	comb	
	külma	**küllma**	cold	(Mürk 1997:6)

As in (21), the contrast between Q2 and Q3, is the only distinguishing factor between the morphological categories in the paradigm for many nominal forms, thus serving an important morphological function (Blevins 2004:207). Another pertinent example of morphological functionality and ternary contrast maintenance is that of vowel length in Dinka. As an example of the contrast, consider the minimal triplet from Remijsen (2014), from the Ageer dialect of the language, where length conveys both lexical and morphological information.

(22)	**kól**	**kóol**	**kóool**
	take.out.INF.NEG	abduct.INF.NEG	abduct.INF.PAST

(Remijsen 2014:248)

[11] Though not shown (21) above, Estonian quantity contrasts are also exemplified by minimal triplets. Two examples (obtained from an Estonian language consultant) are shown below.

kala	**kalla**	**kallla**
fish.NOM.SG	Calla.lily.NOM.SG	pour.IMPERATIVE
kapi	**kappi**	**kapppi**
hoof.NOM.SG	cupboard. GEN.SG	cupboard. PART.SG

Contrasts between long and overlong vowels also distinguish morphological categories for certain classes of verb stems. Take for example (23) below. The two relevant morphosyntactic categories are for 3rd person singular verb stems (3S) and for verb stems with a preposed subject which have a distinct phonological shape (PRE). Here ̰ represents creaky voice modality (not nasalization) following Andersen's use of the diacritic. This is the only case in this article where it is used in this way.

(23)	PRE	3S	GLOSS	
	cɛ̰ɔl	**cɛ̰ɔɔl**	to call	
	lɛ̀er	**lɛ̀eer**	to roll	
	t̪̀iŋ	**t̪̀iiŋ**	to hit	(Andersen 1990:22)

Blevins argues that in cases like those in (21) – (23) above "it is this basic paradigmatic function which has allowed this contrast to be maintained […] inhibiting the otherwise expected neutralization of long and extra-long […]" (Blevins 2004:207).

In Dinka the contrast between long and overlong vowels also conveys morphological information about number (analogous to the Dafing paradigm).

(24)	**rn̰̪ɔt̪**	**rn̰̪ɔɔt̪**	
	wizard.SG	wizard.PL	(Andersen 1987:11)

Blevins notes that for cases like those in (24) above, "[…] the uncommon phonological contrast is the sole exponent of a morphological feature, in this case number" (Blevins 2004:208), and it is this function in the paradigm which allows persistence of the contrast diachronically (Blevins 2004:204-209). The examples given in this section have obvious parallels to the Dafing data outlined above: In Safané Dafing, for nominal stems with final [u], the contrast between long and overlong vowels is the sole phonological manifestation of the morphological feature of plurality (in definite forms). The non-neutralization of the Dafing contrast and its crucial interface with morphological categories is well explained by the view of morphologically-functional contrast maintenance, where neutralization would create homophony.

In line with the view of morphological functionality influencing contrast maintenance, morphological restrictions on the distribution of surface-level ternary contrasts are far from unheard of. For example, Estonian quantity contrast is largely restricted by morphophonological gradation, among other things (Prince 1980:512, 537), The concept of paradigmatic functionality forwarded above would in fact predict such dependencies between morphological category and quantity contrasts (Blevins 2004:204-209; Blevins & Wedel 2009) and in this sense it is not surprising that the contrast between long and overlong vowels in Safané Dafing has only been observed in a specific inflectional context. Further work on the language may well find other environments in which overlength is tolerated, though the conclusion that it is highly restricted is likely to remain.

Returning to the case at hand, we are confronted with an apparent paradox: how can phonological restrictions limit mora count in general in the language, while they facilitate trimoraic structure, via deletion of the initial consonant in the plural morpheme, and syllabification as a unitary syllable, in the definite-plural? This represents one case of a well attested phenomenon: the non-uniformity of phonological operations and restrictions across morphological domains (e.g. Inkelas & Zoll 2007; Inkelas 2014). The non-uniformity of Dafing phonology, in terms of mora count and processes that determine it will be subject to formal analysis in Section 5, with attention paid to what the evidence from Dafing suggests for a theory of phonological and morphological representation. We now turn to an overview of

how the patterns outlined above fit in with the inflectional properties of other Manding varieties.

3 Nominal inflection in other Manding languages

The inflectional paradigms outlined for Safané Dafing above no doubt look familiar to readers familiar with Manding phonology and morphology. In this section the Safané Dafing inflectional paradigm above is compared to its analogs in several other East and West Manding varieties. The goal of the following section is simply to highlight some pertinent similarities and differences between Safané Dafing and other Manding languages. In the comparisons that follow, special attention is paid to how inflectional properties conform to apparent moraic constraints on syllable content (as conceived of in Section 2), and how trimoraic weight is *not* observed in the other Manding varieties sketched here, due to crucial differences in how nominal stems are marked for definiteness and plurality.

3.1 Plural marking

In a variety of other Manding languages the suffix /-ru/ or /lu/ marks the plural. However, in the languages where this is the case, this suffix does not alternate with an onset-less allomorph (like it does in definite-plural forms in Dafing).

Consider for example the definite-plural forms of Dyula (East Manding). There are three different suffixes that convey plural marking in Dyula, subject to different restrictions in their distribution (Braconnier 1983, Vol. II:176, pp-182-183). Braconnier provides several examples showing that the /-ru/ suffix is not subject to the same [-u] alternation in the definite-plural observed as its analog in Safané Dafing. In (25) below the words are followed by a verbal frame (note Braconnier only glosses the inflected verb as the infinitive + "suffix" (SUF)). The following predicate affects the tonal realization of the plural suffix but not any segmental material.[12]

(25) **mósòórú yènì**
woman.DEF.PL see.SUF
'the women were seen'

jèérù sa̱nì
squash.DEF.PL buy.SUF
'the squash were bought' (Braconnier 1983, Vol. II:177)

In Maninka, Mandinka, Kagoro and Xankosa (all West Manding) the case it the same, where the suffix /-lu/ is invariably realized with an onset /l/ (Creissels 1983, 2009, 2013; Tviet 1983; Vydrine 2001). As an example consider the following words in Mandinka; (26) below exemplifies the retention of the consonant in the definite-plural. In these cases the retention of the suffix-initial consonant in the definite-plural precludes the possibility of a trimoraic syllable.

(26) **mùsulu** **mùsoolu**
woman.INDEF.PL woman.DEF.PL (Creissels 1983:58, 212)

One other interesting point of comparison is Bambara (East Manding), where the suffix is invariably realized as /-ù/ on the nominal stem (Bazin 1965; Bird 1966, p7). This suffix might be expected to give rise to a ternary length distinction (as does the analogous Dafing allomorph), but this is not the case as definiteness is not marked

[12] The forms in (25) and (26) can be compared directly with the same lexical items in Safané Dafing (where the deletion of the suffix initial consonant in the definite-plural creates a trimoraic syllable). The indefinite and definite-plural are shown below

músɔ́rú **músɔ́↓ɔ́ú**
woman.INDEF.PL woman. DEF.PL

by lengthening in Bambara, but instead by tone (Bird 1966), discussed below. In the handful of examples given we can see that the lack of an alternation in the suffix (or the lack of length as an exponent of definiteness) do not give rise to the possibility of a trimoraic syllable.

3.2 Definite Marking

Three general types of definite marking that are observed in the Manding varieties dealt with here can be identified: Exclusively tonal marking (Bambara, Kagoro), suffixation of /-o/ (Maninka, Mandinka, Xankosa) and lengthening (Dyula). These will be discussed in turn.

In Bambara definite marking is implemented by purely tonal means. In this language, a floating low tone following the nominal element serves as the definite marker (Bird 1966). Bird (1966) showed how the definite marker can trigger downstep on the following tone. This is shown in example (27) below, taken from Green (2010) and following his transcription conventions; note that the LH/LL alternation in **mùso** is the result of tonal *affaissement*, and is not directly related to definite inflection (cf. Courtenay 1974; Creissels 1978).

(27) **mùsò bɛ́ yàn**
woman.INDEF AUX here
'a woman is here'
mùsó ↓bɛ́ yàn
woman.DEF AUX here
'the woman is here' (Green 2010:33)

As made clear by Green (2010:33) definite marking does not induce any changes in vowel length, and in this sense it is fundamentally different in Bambara than in Safané Dafing.[13] Kagoro also employs a purely tonal inflection for definiteness, as outlined by Vydrine (2001:99), there is substantial influence from Bambara on Kagoro.

Another means of definite inflection in Manding is the addition of an overt suffixal /-o/. In the Niokolo dialect of Maninka the definite morpheme is analyzed by Creissels (2013:29-30) as a suffixal /-o/ which overrides the quality of stem-final short vowels. An example for the word for 'woman', following Creissels' transcription conventions for tone, is shown below. Note that inflection introduces tonal changes as well.

(28) **músu** **músŏo**
woman.INDEF.SG Woman.DEF.SG (Creissels 2013:29)

In nominal stems with final long vowels, quality/and or tonal changes occur under inflection, but importantly, long vowels do not become longer when inflected. Take for example two long-vowel stems with final [aa], where only tonal marking cues inflection. Here again Creissels' tonal transcription is used.

(29) **baa** **bằa**
river. INDEF.SG river. DEF.SG
báa **bã̀a**
goat.INDEF.SG goat.DEF.SG (Creissels 2013:29-30)

[13] Also of note is the more restricted status of phonological length distinctions in Bambara: Green (2010:23) states that the phonological contrast is restricted to monosyllables and the first syllable of disyllabic words and the contrast in disyllabic words is lost in the speech of some speakers (e.g. Creissels & Grégoire 1993).

We can compare this non-lengthening to that in the Dafing forms in example (14) above, where plural marking does not alter vowel length, for long vowels in the definite-singular. In the Kita dialect of Maninka, the realization of definite marking is often purely tonal as well (Creissels 2009:90-91), though it does sporadically appear as the segmental /-o/ suffix. In purely tonal implementations of inflection, the definite marker in this dialect is analyzed as a floating low tone, which induces tonal alternations in subsequent words, and importantly, does not introduce changes in quantity (Creissels 2009:31-32) in similar fashion to Bambara (Bird 1966).

Similarly, in Mandinka the definite morpheme is an underlying suffixal /-o/ (Creissels 1983:52). When the final vowel of the inflected stem is short, the output of that vowel plus the definite suffix is always a long [oo], regardless of the quality of the stem-final vowel. Definite marking also engenders tonal alternations; one example is given below.

(30) **músòó màn sôn**
woman.DEF NEG agree
'the woman does not agree'

músù màn sôn
woman.INDEF NEG agree
'no woman agrees' (Creissels 1983:57)

Analogous to Dafing and Maninka, long-vowel-final stems do not further lengthen when inflected. Below, a summary of the suffix's combination with the five phonemic long vowels of Mandinka is shown (note Mandinka has five long and five short oral vowels), adopted directly from Creissels (1983) (*x~y* indicates that both *x* and *y* are observed).

(31) ii + o → io
uu + o → uo
ee + o → eo ~ ee
aa + o → aa
oo + o → oo (Creissels 1983:56)

Mandinka and Maninka thus provide evidence for similar constraints on syllable content under inflection as observed in general in Safané Dafing, where long vowels do not lengthen when inflected for definite-ness, but short vowels do (as well as undergoing changes in quality in some cases).

The case of Xankosa offers further evidence of such a constraint, with an alternative repair. Plural marking follows the Mandinka pattern quite closely, with a suffixal /-o/ that replaces the stem-final vowel in short vowel stems (Tveit 1997:18). Long vowels exhibits similar alternations under inflection, with one difference being glide formation in the case of several long vowel stems (note Tviet's [y] is IPA [j]).

(32) ii + o → iyo
uu + o → uwo
ee + o → ee
aa + o → aa
oo + o → oo (Tviet 1997:19)

Here overlength does not occur, either by non-lengthening, or by glide formation, where /ii+o/ → [iyo], and /uu+o/ → [uwo]. This presents another strategy for avoiding trimoraicity.

Definite marking in Dyula is perhaps most analogous to Dafing: vowel lengthening co-occurs with tonal alternations in inflection. However, this lengthening

is non-uniform, where some stems undergo purely tonal marking, and do not lengthen. Braconnier (1983 Vol. I:20-26) analyzes this differential behavior as originating from the membership of nouns to different "tonal classes", and the complexities of these classes and their behavior is left aside here. The examples in (33) below show that lengthening and tonal alternations that manifest definite marking are fairly comparable to those of Safané Dafing. The transcription follows Braconnier's conventions. Note also the words are in the frame '*x* **tɛ̀**' which translates roughly to 'it is not a/an/the *x*'. The two examples below contrast in that one lengthens when marked as definite and one undergoes only tonal marking.

(33)

gbɔ́mbɛ̀rɛ̀ tɛ̀	**gbɔ́mbɛ̀rɛ́ tɛ̀**
readhead.INDEF NEG	readhead.DEF NEG
mɛ̀lɛ́kɛ̀ tɛ̀	**mɛ̀lɛ́kɛ̀ɛ́ tɛ̀**
angel.INDEF NEG	angel.DEF NEG

(Braconnier 1983, Vol. I:21)

In a crucial difference from Dafing, Dyula does not have phonemic vowel length distinctions (e.g. Charnell & Hartell 2014), so derived overlength is a non-issue in definite inflection.

3.3 Comparing inflectional strategies

As shown above, different Manding varieties employ distinct strategies for marking definiteness. A diachronic perspective offers some unifying insights. A mentioned in Section 2, the origin of the definite marker has been argued to be what was historically the demonstrative pronoun, realized as [o], [wo] or [ou]. Derive (1990, Fascicule I:178-179) argues that the pronoun became reinterpreted semantically as definite marking, and as such became a suffix on the noun stem which preceded it. For some languages, Derive argues, only the tonal (and as we have seen in Dafing and Dyula, quantity) distinctions remain, while in others the suffixal /-o/ is still manifested segmentally, depending on the preceding stem vowel.

The trimoraic syllable (and surface-level ternary vowel length contrast) observed in Safané Dafing do not arise in the languages outlined above. Importantly, the examples above show that in languages where quantity changes occur with definite marking, long vowels do not further lengthen when inflected, as in Safané Dafing. Alternatively in the case of Xasonka, glide formation occurs for some stem-final long vowels. Languages like Bambara that inflects for definiteness by purely tonal means, avert these sorts of constraints on mora count entirely. Dyula seems to be the most comparable to Safané Dafing in terms of definite inflection (in that vowels lengthen and undergo tonal changes when inflected) but it lacks a phonemic vowel length contrast, averting the possibility of overlength in another way.

What makes Safané Dafing exceptional in comparison with the other Manding varieties sketched above is the (morphologically restricted) [-u] allomorph of the plural morpheme. The Bambara plural is uniformly /-u/, but due to the aforementioned tonal nature of definite marking, trimoraic length does not occur in definite-plural nouns. In all of the other languages sketched above, the retention of the suffix-initial consonant ([l] or [ɾ]) prevents any sort of ternary moraic contrast in definite-plural nouns. Safané Dafing is thus in the rather unique position of employing quantity changes in definite inflection, and also possessing an onset-less allomorph of the plural /-ɾu/, that, only in definite-plural forms, engenders ternary weight distinctions. The above sketch of Manding inflection is not exhaustive, but serves well to show both the variation and commonalities in the language group. The Dafing paradigm of interest in this study also differentiates itself from the examples above in being the only observed case of overlength. A further survey of Manding morphophonology is left aside here, though the search for more commonalties and differences is sure to be valuable.

We now turn to a quantification of the durational contrasts proposed for the Safané Dafing inflectional paradigm. Section 4 reports on an elicitation carried out with the intent of providing an instrumental assessment of durational categories in the paradigm.

4 Quantifying vowel length

Given the crucial role that quantity distinctions play in the phonology of the language, vowel durations in the paradigm were quantified to observe inflection-driven quantity changes, including the ternary distinction. The following subsections report on an elicitation carried out in the UC Berkeley Phon Lab. Data analysis was carried out in Praat (Boersma & Weenik 2017) and visualized with ggplot2 (Wickham 2009) in RStudio (RStudio Team 2015).

4.1 The ternary moraic contrast

In order to confirm the qualitative assessment that the ternary vowel length contrast observed is robust, the language consultant was recorded producing definite and plural paradigms for nouns with stem-final /u/ that demonstrate the contrast. The language consultant (age: 21, gender: female) was seated in a sound-attenuated recording booth and presented with sequential randomized and self-paced prompts for each word in English. The consultant then spoke these words in Dafing (i.e. the consultant would see "a dog" on the screen and then say **'wúɾú'**). In the presentation of words in the elicitation, the target words (from Table 1 below) were interspersed with fillers: other nouns in singular, definite and definite-plural forms. All words were completely randomized to avoid effects of habituation or fatigue. The consultant's speech was recorded at 44100 Hz into Praat. Vowel duration was measured with the onset of the vowel as the beginning of periodicity following the release of the preceding consonant ([t], [d] or [ɾ]). The end of the vowel was calculated as the end of periodicity, triggered by a following consonant in the carrier phrase __ **kɔ̀bɛ̀**. This is a postposition that translates to 'behind' in English. For example, **dù kɔ̀bɛ̀** translates to 'behind a village', **dúú kɔ̀bɛ̀** to 'behind the village' etc. The target vowel is thus between the release of the preceding stop and the closure of the following one, making duration straightforward to calculate. The first set of words was chosen to quantify durational differences for the ternary length distinction in nouns with final /u/, shown in Table 1 below.

	'cluster of trees/brush'	'covering'	'fist'
INDEF SG	**tù**	**dàtù**	**bòkùtù**
DEF SG	**túú**	**dàtúú**	**bòkùtúú**
DEF PL	**túúú**	**dàtúúú**	**bòkùtúúú**
	'village'	'dog'	'chicken coop'
INDEF SG	**dù**	**wúɾú**	**kùkùɾù**
DEF SG	**dúú**	**wúɾú↓ú**	**kùkùɾúú**
DEF PL	**dúúú**	**wúɾú↓úú**	**kùkùɾúúú**

Table 1: table of words used to quantify ternary length distinctions in [u]. the gloss is shown in the columns while the inflectional category is shown in the rows on the left.

Here a brief excursus on the morphological constituency of the words in Table 1 is warranted. Some of the words used are not monomorphemic, and their compounding induces tonal modulations (often referred to as Compacité Tonal (CT) in Manding e.g. Green 2013); The tonal changes observed in compounding do not have any effect on the duration of the stem-final vowel, which is the sole object of interest in the elicitation, however they are still worth noting. Definite marking in Dafing (and in Manding generally) is manifested on the rightmost edge of the NP

(including post-posed modifiers and compounded nominal roots), and so in any compounded word with bases /*x + y*/ definite marking will influence the stem vowel on the rightmost edge of [*xy*]. Importantly, compounding related tonal changes have already occurred when the form is inflected for definiteness (outlined below).

The bimorphemic words used in the elicitation are discussed briefly in turn. **[bòkùtù]** is a compound of the Safané Dafing words /**bò**/ 'hand' and /**kúrú**/ 'knot'. Note the alternation between [ɾ] and [t] is not generally conditioned phonologically, but seems to be restricted to this lexical form. Diallo lays out a variety of tonal rules regulating tonal melodies in compounds and we can see here that the /**bò**+**kúrú**/ → **[bòkùtù]** follows the expected Dafing pattern of a /L+H/ nominal compound becoming [LL] (Diallo 1988, Vol. I:40). We can note that it must be this [LL] form that is inflected (as seen in Table 1, above) otherwise downstep would occur. [**kùkùrù**] is a compound of Dafing /**kùrù + kùrù**/ 'group/herd' (cf. Diallo 1988, Vol. IV:122; Vydrine 2015:251 for cognates) and follows the expected tonal pattern laid out by Diallo, whereby a reduplicated nominal L-tone base (/L+L/) is of the form [LL] (see Diallo 1988, Vol. I:43). The truncation of the nominal (or verbal) reduplicant to being mono-syllabic is also observed in many forms Dafing as shown in the examples below; both are comparable to [**kùkùrù**] in terms of truncation of the reduplicant.

(34)

STEM	REDUPLICATION	OUTPUT	
báràn 'stick'	/**báràn** + **báràn**/ →	**bánbáràn** 'stick'	
tɔ̀nì 'ooze'	/**tɔ̀nì** + **tɔ̀nì** / →	**tɔ̀tɔ̀nì** 'drip'	(Diallo 1988, Vol. I :44, 50)

Finally, [**dàtù**], is a compound of a nominal and verbal base, /**dà**/ (which has a variety of meanings, see e.g. Diallo 1988 Vol. I:175) and /**tù**/ 'to cover/ to close' (cf. Bambara **dátugu/dátugulan** (Dumestre 2011:223)). Interestingly, for this type of compound, the tonal output would be expected to be [HL] (*[**dátù**]) according to Diallo (Vol. I:47), not the observed [LL] (Vol. I:40). This difference is perhaps attributable to a dialectal distinction (as compared to the Zaba Dialect described by Diallo). Importantly, in all the compounded forms the compound-final vowel is [ù]. It should also be emphasized that the definite and plural inflections are evidently occurring on the form that has already undergone compounding-driven tonal changes; we would expect to see downstepping if H tone forms are being inflected for definiteness. Because there is no downstep, it is clear that the form that is being inflected has a stem final L tone (e.g. the change from /**bò**+**kúrú**/ → **[bòkùtù]** has already occurred when the noun is inflected); this fits with proposals for lexical/stratal phonology, where compounding is said to precede inflectional morphology (e.g. Kiparsky 1982, 1985; Mohanan 1986).

As all bimorphemic forms have a stem-final short vowel [ù], and as the duration of this final syllable is the only aspect under investigation, the status of a word as mono- or bimorphemic should not interfere with its behavior (in terms of lengthening) under inflection.

The words were also chosen to have one, two and three syllables. It has been well documented that vocalic duration varies robustly as a function of the number of syllables in a given word, decreasing as syllable count increases (e.g. Ham 2013:136; Lehiste 1972; Peterson & Lehiste 1960; Port 1981). By including mono, bi, and trisyllabic components in the elicitation, the robustness of the ternary contrast in the face of syllable-count-driven variation can also be observed.

The language consultant saw each morphological category of each target word in Table 1 eight times, meaning that a total of 144 durations were collected for the words in Table 1 (6 words x 3 morphological categories x 8 repetitions). Some productions were excluded because of disfluencies, leaving 135 observations. The data thus

provides a reasonably robust assessment of the durational differences for the ternary quantity distinction. As the goal of this paper is primarily to analyze the phonology and morphology of the nominal paradigm, this is deemed a sufficient amount of data to confirm the *phonological* quantity distinction. Work concerned with phonetic realization is tasked with looking across more speakers, with more data. Because the data comes from a single speaker, inferential statistics are of limited use. Accordingly only the means and standard deviations of relevant measurements are given.

Table 2 below shows mean values and standard deviations in parentheses for each of the words in Table 1 above. The words are divided by their morphological category, that is whether they are indefinite-singular, definite-singular or definite-plural. Means across all words is also represented visually below in Figure 1. The overall mean is the average across the aggregate word means.

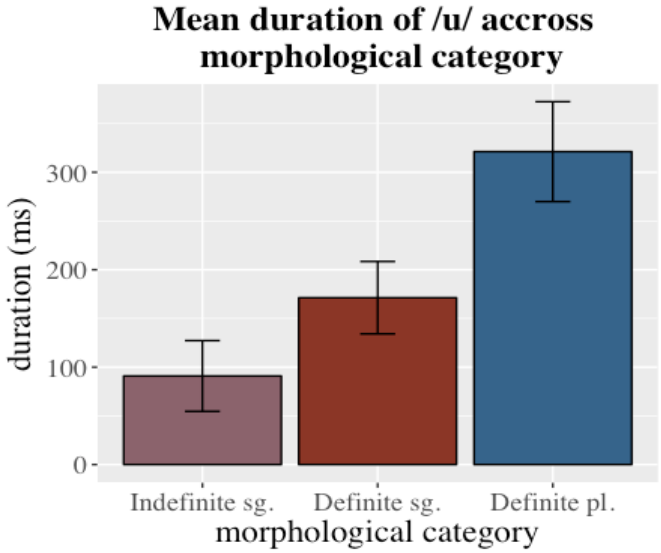


Figure 1: Mean duration, in milliseconds, of /u/ across morphological categories. Data is pooled by word and syllable count. Duration is on the y axis, categories are on the x axis. Error bars represent one standard deviation.

	INDEF SG.	DEF SG.	DEF PL.
tù	117*(20)*	187*(18)*	342*(74)*
dù	102*(20)*	192(*39)*	341 (*39)*
dàtù	52 *(15)*	153*(24)*	275 (*38)*
wúrú	125*(34)*	181*(25)*	347*(37)*
bòkùtù	56*(11)*	139*(18)*	288*(29)*
kùkùrù	98(*34)*	172*(54)*	328*(25)*
Overall mean	92*(22)*	171*(30)*	320*(42)*

Table 2: Means and standard deviations, in milliseconds, for the vowel in each word listed in Table 1 above, across morphological category. Morphological categories are the columns, while words are rows. The overall means are means for each morphological category pooled across the aggregated word data.

In line with previous research, an increased number of syllables were seen to decrease the mean duration of the target vowel, though not to an extent that it obscured the quantity distinctions shown in Table 2 and Figure 1 above. Mean durations across syllable count are shown in Table 3 below.

One syllable	Two syllables	Three syllables
213(*36*)	189*(29)*	180*(29)*

Table 3: Means and standard deviations, in milliseconds, for the vowel in each word listed in Table 1 above, split by syllable count.

4.2 Constraints on bi-moraicity: phonemic long versus short vowels

Given that we can observe a clear ternary distinction for duration of [u] in the inflectional paradigm, we now turn to a quantification of the behavior of phonemically long vowels under definite and plural marking. Recall that it was observed that stem-final bimoraic (long) vowels did not lengthen when marked as definite-singular, but did when marked as definite-plural. This clear difference was taken to be evidence of the non-uniformity of mora-count constraints across different morphological categories in the language. The relevant comparison to observe here is how the syllable does *not* substantially lengthen when long-vowel-final stems are inflected for definiteness, but does when they become definite-plural.

A short vowel and long vowel form will be contrasted for comparison. These words were also elicited in the same session as that for the ternary vowel length distinction above, subject to the same procedures, data collection and data parsing. Two words are chosen, the first serving as further evidence of the ternary moraic distinction for phonologically short vowels, the other as instrumental confirmation of the non-lengthening of phonologically long vowels when marked as definite. These are shown in (35) below.

(35)

só	**só↓ó**	**só↓óú**
horse.INDEF.SG	horse.DEF.SG	horse.DEF.PL
bɛ́ɛ́	**bɛ́↓ɛ́**	**bɛ́↓ɛ́ú**
rock.INDEF.SG	rock.DEF.SG	rock.DEF.PL

As before, the mean durations of these two words across the three morphological categories in the paradigm are shown in Table 4 and plotted in Figure 2 and Figure 3 below.

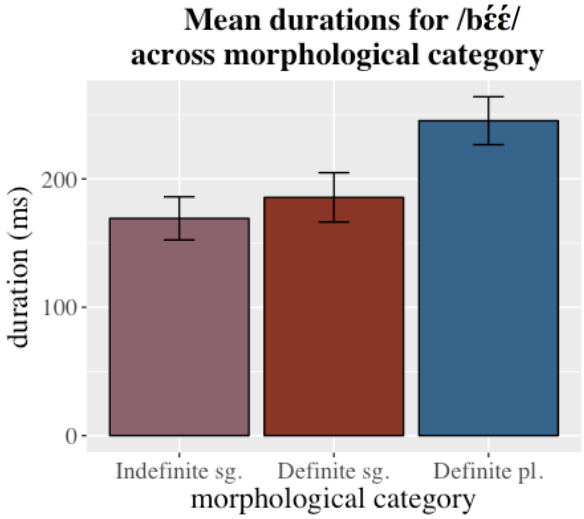


Figure 2

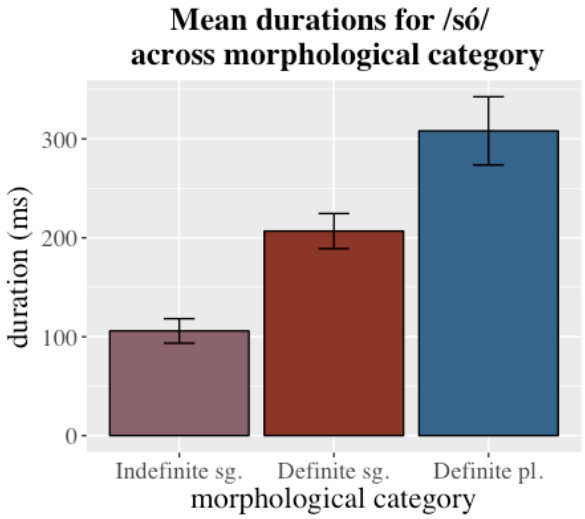


Figure 3

Figures 2 and 3: Mean durations, in milliseconds, for the vowels in the words shown in (34) above, across morphological categories. Error bars represent one standard deviation.

	INDEF SG.	DEF SG.	DEF PL.
só	105*(13)*	207 *(18)*	308*(35)*
bɛ́ɛ́	169*(17)*	186*(19)*	245*(19)*

Table 4: Means and standard deviations, in milliseconds, for the vowel in each word listed in (19) above, across morphological categories.

The trend towards longer vowel duration in definite-singular [**bɛ́↓ɛ́**] as compared to indefinite-singular [**bɛ́ɛ́**] (with approximate means of 186 versus 169 milliseconds) can be explained by the fact that there are two tonal targets in [**bɛ́↓ɛ́**] due to the addition of definite marking (H followed by !H). Multiple tonal targets in a given tonal contour have been shown to increase duration in vowels, and generally the vowel duration of TBUs with contour tones is claimed to be longer than those with monotonal tones (e.g. Gordon 2001; Köhnlein 2015; Kong 1987; Yu 2003). Importantly, such a difference is clearly of a different magnitude than the difference in durations between definite-plural and definite-singular forms. As predicted, there is only a large increase in vowel durations for definite-plural forms ([**bɛ́ɛ́**]/[**bɛ́↓ɛ́**] versus [**bɛ́↓ɛ́ú**]). The fact that duration robustly increases in the long-vowel stem only for the definite-plural category offers some confirmation of the claim that moraic constraints are operating differently as a function of morphological category. In contrast the paradigm for /**só/** patterns with Table 2 and Figure 1 above, in having a robust ternary distinction because the uninflected noun has a phonemically short vowel.

These results above are taken as a rough confirmation of the durational contrasts argued for in Section 2 above. It has been shown that the ternary quantity distinction in words with stem-final [u] is manifested in robustly different duration distributions across categories, and that such distinctions remain even in the presence of vowel quality changes (as in the inflected forms of /**só**/ in Figure 3 above) and syllable count changes. Second, this section presents quantitative evidence that phonologically long stem-final vowels do not substantially lengthen when inflected for definite-ness unlike stem-final short vowels (Figure 2 versus Figure 3 above).

These results do not represent a thorough phonetic study of the relevant properties investigated here, but they do provide at least a preliminary instrumental confirmation of the phonological representations used.

Having described and quantified the Dafing nominal paradigm, it will now be analyzed in a more formal phonological framework, asking what contributions it can make to a broader theory of morphophonology.

5 Dafing nominal morphology: a cophonological approach

The arguments for a ternary moraic distinction laid out above raise an interesting question about the non-uniformity in limits on moraic structure across morphological categories in the language. Safané Dafing presents evidence for a language-general preference for bimoraic rhymes, as discussed above. In a clear contradiction to such apparent constraints, there is a trimoraic length distinction in definite-plural nominal forms of the language. In this section we turn to a more formal phonological analysis, as well as some general implications that fallout from the Dafing paradigm.

5.1 Theories of phonology and morphology

The observation that phonological processes and restrictions are non-uniform across morphological domains has been well documented for a variety of morphological constructions across languages. To give several examples: in Fox the identity of epenthetic segments varies across stem-affix and base-reduplicant domains (Dahlstrom 1997); hiatus resolution varies based on suffix identity in Turkish (Kornfilt 1997); tonal alternations vary based on suffix category in Tokyo Japanese (Poser 1984); and other processes in Japanese vary based on the origin of words in the lexicon (Itô & Mester 1993, 1999). This small set of examples suggests not only that

morphologically conditioned phonology is a well-attested phenomenon cross-linguistically, but also that the processes and categories involved are diverse.

Given such varied and pervasive examples of morphological influences on the phonological grammar of a given language, the formal representation of phonology has sought to account for such non-uniformity in a variety of ways. Here two leading approaches to capturing morphological influences on phonology are briefly discussed, both of which are couched in the constraint-based framework of Optimality Theory (OT) (Prince & Smolensky 1993). It can be noted that such questions about morphophonology predate, and are not restricted to, OT. Rule-based accounts, with different morphological strata (e.g. Kiparsky 1982, 1985; Mohanan 1986), classes of affixes that trigger different templatic operations (e.g. Archangeli 1986), or cyclic application of rules to morphologically bracketed forms (e.g. Chomsky 1967) all have sought to address morphophonological irregularities.

The two OT approaches compared in this analysis are the cophonological approach (e.g. Orgun 2000; Anttila 2000, 2002) and the indexed constraint approach (e.g. McCarthy & Prince 1995; Pater 2000). Both theories have the formal apparatus to account for the phonology-morphology interactions outlined above. However, it will be argued that the cophonological approach is preferable, considering the role of markedness and faithfulness exhibited in the Dafing paradigm. Each theory is reviewed briefly below, with basic knowledge of OT assumed.

An indexed constraint theory posits one language-general ranking for a set of constraints, but restricts the morphological domains in which they apply by indexing a constraint for a given domain. The constraint only assesses violations within the relevant indexed domain. Restricting the applicability of constraints in this way ensures the mapping from input to output to vary across the indexed morphological categories. Non-domain-specific constraints are also used in this approach.

To illustrate, consider a partial example from the Dafing data. As we have noted, [ɾ] deletion occurs only in the definite-plural forms of the paradigm, and clearly does not occur in other non-definite-plural inflected forms or other morphologically unrelated forms. The /n/ allomorph that appears after nasal vowels also deletes in the definite-plural form. Take for example [**bɛ́ɛ̨́nú**] sesame.INDEF.PL versus [**bɛ́ɛ̨́↓ú**] sesame.DEF.PL. To capture the fact that both morpheme-initial consonants and their respective plural allomorphs are deleted a constraint against a Cu# sequence *indexed with a restricted morphological domain*, is used in this example.[14] Also for the purpose of this example we assume a highly ranked MAX V constraint which would prohibit vowel deletion as a repair to the markedness constraint; it is not shown in the tableau below for simplicity. Constraints are defined in (36) below.

(36) MAX C: Assess one violation for the deletion of a consonant.
*Cu#: Assess one violation for any instance of Cu#.
*Cu#$_{DP}$: Assess one violation for any instance of Cu# iff that Cu# sequence is internal to a definite-plural form. This is an indexed constraint.

Such a set of constraints if ranked as *Cu#$_{DP}$ >> MAX C >>*Cu# can correctly account for the morphologically restricted deletion of [ɾ] in the definite-plural forms. This is exemplified in Tableau 1 below, using one of the examples from (20) above. In the tableau the input forms are shown within straight brackets, with possible outputs listed below them. The ranked constraints appear to the right of the input

[14] *Cu# is used in this example, as well as the subsequent analysis. The non-specific C is used as both allomorphs of the plural morpheme's initial consonant ([ɾ] and [n]) delete in the definite-plural forms, while [u] is made specific as it is consistent across both plural allomorphs. For the purposes of this analysis, a more general constraint such as *CV# would suffice to generate the correct winners in the tableaux, but considering the fact that the relevant consonant deletion occurs only before [u], and that *CV# unnecessarily penalizes structure that is the norm in the language, the more specific *Cu# is used.

forms. For the sake of simplicity, and because the example is only meant to illustrate how an indexed constraint approach works, all other changes in the forms besides [ɾ] deletion are ignored here.

/kɔ́ɔ̀-ɾù/ father.INDEF.PL	*Cu#$_{DP}$	MAX C	*Cu#
☞kɔ́ɔ̀ɾù			*
kɔ́ɔ̀ù		* !	
/kɔ́↓ɔ́-ɾú/ father.DEF.PL	*Cu#$_{DP}$	MAX C	*Cu#
kɔ́↓ɔ́ɾú	* !		
☞kɔ́↓ɔ́ú		*	

Tableau 1

Above, because *Cu#$_{DP}$ only assess violations to definite-plural forms, and because MAX C >> *Cu#, no deletion occurs in [**kɔ́ɔ̀ɾù**] because it is not definite-plural. For the very same reason, it does occur for the definite-plural form in the paradigm. Thus, the indefinite-plural form that is [**kɔ́ɔ̀ɾù**], and the definite-plural form that surfaces is [**kɔ́↓ɔ́ú**]. In this sense, indexed constraints can capture variation in phonological processes across morphological domains. There is one single language-general ranking with domain-specific constraints.

In contrast, a cophonological analysis posits that a given language has only general (and un-indexed) constraints, which can be ranked differently in sets of co-phonologies. Cophonologies are different sets of rankings that are specific to a given morphological domain. The rankings in cophonologies are also captured in a so-called "master ranking" (e.g. Inkelas & Zoll 2007), a partial ranking of constraints in the grammar, which respects the rankings in all co-phonologies. A cophonological grammar is represented schematically as a lattice, with the master ranking as the superordinate node. Figure 4 below is an example of such a lattice for the simple example of [ɾ] deletion discussed above. Each cophonology is given an ad hoc numerical index. The partial ranking of constraints in the master ranking is represented with {}, where in {*x*, y}, there is no crucial ranking between *x* and *y*.

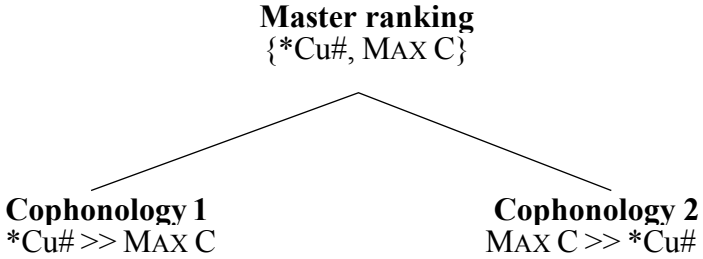


Figure 4

Different cophonologies are functional within different morphological domains. The mapping from morphological domain (e.g. definite-plural) to cophonology is assumed to be specified in the grammar, where "every morphological construction is affiliated with a cophonology which governs the input-output mapping" (Inkelas & Zoll 2007:136). In the case at hand Cophonology 1 would be the operative cophonology for definite-plural forms, and the fact that *Cu# >> MAX C would trigger the observed [ɾ] deletion. Cophonology 2 would operate on all other forms, where the higher ranked faithfulness constraint would preclude deletion. In this simple example the master ranking is entirely unranked, because each cophonology has the opposite

ranking. The separate cophonologies and their outputs for each of the forms above are shown below in Tableaux 2 and 3.

Cophonology 1- definite-plural forms

/kɔ́↓ɔ́-ɾú/ father.DEF.PL	*Cu#	MAX C
kɔ́↓ɔ́ɾú	* !	
☞kɔ́↓ɔ́ú		*

Tableau 2

Cophonology 2 – all other forms

/kɔ́ɔ̀-ɾù/ father.INDEF.PL	MAX C	*Cu#
☞kɔ́ɔ̀ɾù		*
kɔ́ɔ̀ù	* !	

Tableau 3

The cophonological and indexed constraint approach may, at first, seem to differ only in their aesthetics. They can certainly both capture the simple data in the example above. It will be argued however, that in the context of each theory distinct predictions are made. This will be discussed in more depth in Section 5.4. We turn now to a more thorough OT analysis to account for nominal inflection in the paradigm.

5.2 Analyzing Dafing nominal inflection with co-phonologies

As mentioned above, the definite-plural morphological category is exceptional in two ways. Firstly, it permits trimoraic syllables, dispreferred and actively restricted in other morphological domains. And secondly, the process by which these ternary moraic distinctions arise is the morphologically restricted deletion of [ɾ] and [n].

One striking aspect of these non-uniformities is the differential limit on mora-counts in syllables. Given that syllable composition is such a fundamental aspect of the phonological grammar of a language, one might predict that it should remain uniform throughout. However, variation in permissible structure across morphological categories is not uncommon, perhaps most well evidenced in reduplicative templates as described in prosodic morphology. The form of a reduplicant can be restricted in terms of syllable weight or foot structure, where restrictions are different in other domains (e.g. Hayes & Abad 1989; McCarthy & Prince 1990). Other structural restrictions imposed by morphological domains include different phonotactic restrictions in morphologically truncated words in English (Benua 1995) and the aforementioned interactions between vowel quantity and morphophonological grade in Estonian (Prince 1980). The Dafing patterns are another example of this type of morphologically conditioned restriction, with the more permissive (and exceptional) morphological domain being definite-plural forms (and potentially others). In what follows two cophonological grammars that account for the non-uniform morphophonology of Dafing nominal inflection will be laid out.

5.2.1 Tonal changes

As a preliminary, an brief OT analysis of the tonal changes in the language will be carried out. These tonal changes are entirely consistent across morphological categories, and in that sense are peripheral to the main question at hand. Given this, tonal changes and the set of constraints used to describe them will be assumed in subsequent sections. A general set of unviolated constraints, common to OT analyses of tone (e.g. Zoll 2003) is defined in (37) below. They are derived from earlier well-formedness conditions proposed for tones (e.g. Goldsmith 1976a, 1976b). The ones listed here are adapted directly from Zoll (2003).

(37) SPEC(TONE): Every TBU dominates a tone.
LINEARITY: Linear precedence relations from the input are preserved in the output.
NO LINE CROSSING: Association lines between tone and TBU do not cross.

Because these constraints are never violated they will be assumed in the following analysis and left out of the tableaux below. A set of constraints to account for the Dafing tonal alternations is also needed.

(38) *[LH]$_\sigma$: Assess one violation for a tautosyllabic instance of a L tone followed by a H tone, if both linked to segmental material (a floating L tone does not violate this constraint).
*HH: Assess one violation for any adjacent sequence of H tones (regardless of syllable association).[15]
DEP L: Assess one violation for the insertion of a L tone.
MAX L: Assess one violation for the deletion of a L tone.
MAX H: Asses one violation for the deletion of a H tone.

The existence of *[LH]$_\sigma$ accounts for the regressive tonal spreading of H tones and de-linking of L tones described above in (11), where the subordinate ranking of MAX L allows for the deletion of the L tone. Under the analysis that downstep is caused by a floating low tone, downstep occurs as a permissible repair to *HH due to the following ranking {MAX H, *HH } >> DEP L (shown in Tableau 5).

In the following tableaux, outputs are indexed with letters for reference. For simplicity, the definite marking and vowel lengthening sketched in (11) above is assumed to already be in place for the inputs into the tableau. Dashed lines between constraints in the tableau represent that the relevant constraints are not crucially ranked with respect to one another.

Tableau 4 below captures the regressive H tone spreading that occurs in the definite marking of words with stem-final low tones. The markedness constraint *[LH]$_\sigma$ penalizes the tautosyllabic LH sequence which is created by definite marking; the fully faithful output (a) above is ruled out by this undominated markedness constraint. The lowest ranking of MAX L allows for the observed repair of L tone deletion and tonal spreading (tonal spreading must occur due to the constraints outlined in (37) above). This observed output is candidate (b). Finally, the possibility of the L tone spreading as a repair is ruled out here by the undominated MAX H. Note that *HH and DEP L are not relevant in Tableau 4, but are used below in Tableau 5.

	L H /jɛ̀ ɛ́/ fish.DEF.SG	*[LH]$_\sigma$	*HH	MAX H	DEP L	MAX L
a	L H jɛ̀ ɛ́	* !				
b	H ☞ jɛ́ ɛ́					*
c	L jɛ̀ ɛ̀			* !		

Tableau 4

[15] This constraint is simply a more specific embodiment of the Obligatory Contour Principle (e.g. Goldsmith 1976a; Odden 1996). A general constraint (OCP) would serve the same purpose here.

Tableau 5 below exemplifies downstep. The faithful candidate (a) is penalized by the undominated *HH, while potential repairs are restricted by the subordinate ranking of DEP L to MAX H. This ranking means that deleting one of the two high tones is not an option, with the permissible repair being downstep (via insertion of a floating low tone). Though not included in the tableau it should be noted that any constraint penalizing a floating tone (e.g. Zoll's (2003) PARSE(TONE)), would necessarily be low ranked, to allow for the candidate with the floating tone (and downstep) to be selected. A further analysis of this is left aside here.

	H H / só ó/ horse.DEF.SG	*[LH]$_\sigma$	*HH	MAX H	DEP L	MAX L
a	H H só ó		* !			
b	H L!H ☞ só ↓ó				*	
c	H só ó			* !		

Tableau 5

The proposed ranking also captures the occurrence of both L tone de-linking and downstep noted in words like [**kɔ́ɔ̀**] **'**father.INDEF.SG', which becomes [**kɔ́↓ɔ́**] 'father.DEF.SG'. Here an added H tone in the definite inflection violates *[LH]$_\sigma$, and repair of that violation also necessitates repair of *HH, selecting for the downstepped output. This is shown in Tableau 6 below (note changes in vowel quantity in this form are not dealt with here; they will be treated in section 5.2.2, Tableau 7). It is also assumed that the inserted floating L tone is distinct from the L tone in the input in Tableau 6, meaning the winner violates both DEP L and MAX L.

	H L H / kɔ ɔ̀ ɔ́ / father.DEF.SG	*[LH]$_\sigma$	*HH	MAX H	DEP L	MAX L
a	H L H kɔ ɔ̀ ɔ́	* !				
b	H H kɔ ɔ́ ɔ́		* !			*
c	H L kɔ ɔ̀ ɔ̀			* !		
d	H L!H ☞ kɔ ↓ɔ́ ɔ́				*	*

Tableau 6

5.2.2 Capturing morphophonological irregularities

Having sketched a basic analysis of tonal changes, we now turn to the central question: how can the non-uniformities in Dafing inflection be accounted for with a cophonological analysis? This entails consideration of two relevant language-general properties: the prohibition of trimoraic syllables, and the preservation of penultimate [ɾ] and [n] (deleted in the definite-plural paradigm). The language-general cophonology is given the ad-hoc name CP_G to indicate it captures the language-general grammar. Because this grammar is posited to be inoperative for definite-plural forms (which are regulated by a grammar specific to the morphological construction), no definite-plural forms are subject to the constraints and their ranking in CP_G. This is emblematic of the cophonological approach: general constraints with a specified mapping to a morphological domain. CP_G is outlined first.

The language-general preference for no more than bi-moraic syllables, discussed at length above, is embodied by the constraint *μμμ. Given the fact that trimoraic forms are not observed in the language outside of the definite-plural forms, *μμμ, will remain undominated in CP_G.[16] The necessary constraints, some of which are redundancies from the example given above, are listed below.

(39) *Cu#: Assess one violation for an instance of Cu#.
*μμμ: Assess one violation for a trimoraic syllable.
MAX C: Assess one violation for the deletion of a consonant.
MAX μ: Assess one violation for the deletion of a mora.

The crucial ranking for these constraints is shown in Tableau 7 below, with the previously outlined constraints that account for tonal changes assumed and left out for simplicity, as they are irrelevant in determining a winner. Here it is also assumed that the input to the cophonology is morphologically inflected (following Inkelas & Zoll 2007; Alderete 2001). Input candidates are numbered for reference with possible outputs for a given input indexed with letters. Note too that each vowel on the segmental tier projects a mora, though the moraic tier is not shown for simplicity. Accordingly, deletion of a mora (violating MAX μ) entails deletion of the segment that it corresponds to.

In Tableau 7 below, we can first contrast inputs (1) and (2), which indicate how *μμμ is operative when long vowels are made trimoraic with definite inflection, as in input (2). Candidate (2a) is ruled out by *μμμ, while the permissible repair is allowed by the subordinate ranking of MAX μ. In (1), no deletion is required because the uninflected input is only bimoraic. Input (3) simply shows that penultimate consonants do not generally undergo deletion, captured by the ranking of *Cu# below MAX C. This analysis can thus account for the general processes outlined in Section 2. We can remark that *μμμ must outrank MAX μ, and MAX C must outrank *Cu# in CP_G to generate to observed forms.

[16] Capturing the free variation of bimoraic and trimoraic rhymes observed in the Yankasso dialect (see Diallo 1998, Vol. I:234-235) would re quire using a model of grammar that can account for variation in outputs (e.g. Anttila 1997).

1	/kɔ́ɔ̀/ father.INDEF.SG	*μμμ	MAX C	MAX μ	*Cu#
a	☞ kɔ́ɔ̀				
b	kɔ́			* !	
2	/kɔ́↓ɔ́ɔ́/ father.INDEF.PL	*μμμ	MAX C	MAX μ	*Cu#
a	kɔ́↓ɔ́ɔ́	* !			
b	☞ kɔ́↓ɔ́			*	
3	/wúrú/ dog.INDEF.SG	*μμμ	MAX C	MAX μ	* Cu #
a	☞ wúɾú				*
b	wúú		* !		

Tableau 7: CP_G

Next, consider the cophonology that is operating in definite-plural forms, given the ad hoc name CP_{DP} (where DP indicates definite-plural). As outlined above, this cophonology differs in two key ways from CP_G, in that trimoraic syllables are permitted and that the [ɾ] in the plural morpheme is deleted.

The issue of syllabification first needs to be addressed, as it was not relevant in the Tableau above but is here. As outlined above, the analysis posits that when [ɾ] deletion occurs in definite-plural forms, the three morae are syllabified to be tautosyllabic. The constraint used to penalize a lack of syllabification is defined below.

(40) ONSET: Assess a violation for any syllable that lacks an onset consonant (e.g. Prince & Smolensky 1993:93).

ONSET seems reasonable to posit given the dispreference for syllables without onsets (and prohibition on a [u] that is not proceeded by an onset consonant) argued for in Section 2.[17]

The constraints in (39) and (40), ranked as they are in Tableau 8 below, capture the fact that the deletion of the initial consonant in the plural morpheme occurs exclusively in the definite-plural, and that trimoraic structures are not marked as they are in other domains of the language. There are two example forms in Tableau 8. Note that because this portion of the grammar is only operative for definite-plural forms, both inputs are definite-plural, with inflectional morphological operations already performed. Tonal changes are again ignored, assuming they are generated by the set of constraints laid out in Section 5.2.1. Moraic structure is not explicitly shown, using the previous notation of a single vocalic element for each mora (i.e. V equals one mora, VV equals two morae). Because syllabification is relevant, syllable representations are also included above the segmental tier, where lines connect a syllable to its component segments.

Candidates (1) and (2) in Tableau 8 below indicate how potential outputs for bi- and tri-syllabic forms are evaluated by the proposed constraints. In all definite-plural forms evaluated by CP_{DP}, the tap incurs a violation of *Cu# which must dominate

[17] This constraint could be argued to be dominated by faithfulness constraints that would offer potential repairs (e.g. DEP C, MAX V). The variation seen in forms such as [**ɔ̀pèrè**] ~ [**wɔ̀pèrè**] (Traore 1978:178) could be modeled with the method referenced in footnote 16 above.

In the case of word-medial onset-less syllable. the constraint mediates syllabification in the outputs (shown in Tableau 8). An alternative constraint with the same function might be ONSET[u]; specific to syllables with [u] nuclei which would capture the language's tighter restrictions for [u].

MAX C to allow for deletion and the possibility of a trimoraic output. This constraint ranking rules out inputs (1a) and (2a).

Syllabification of the affix-contained [u] with the preceding syllable is driven by ONSET, which must dominate *μμμ, effectively ruling out candidates (1b) and (2b). Finally (1d) and (2d) are ruled out by MAX μ; though they present a potential repair to *μμμ by deleting a mora, such a repair is not tolerated (otherwise trimoraic outputs would never win). The subordinate ranking of *μμμ to MAX μ thus allows for the trimoraic outputs in (1c) and (2c) to win, generating trimoraic syllables in the definite-plural paradigm. Any other possible repairs to ONSET (e.g. DEP C) would necessarily outrank it, though they are excluded from the tableau for simplicity.

1	/jéé-ɾú/ fish.DEF.PL	*Cu#	MAX μ	ONSET	MAX C	*μμμ
a	σ σ jéérú	* !				
b	σ σ jéé́ú			* !	*	
c	σ ☞ jéé́ú				*	*
d	σ jéú		* !		*	
2	/wúɾúú-ɾú/ dog.DEF.PL	*Cu#	MAX μ	ONSET	MAX C	*μμμ
a	σ σ σ wúɾúúɾú	* !				
b	σ σ σ wúɾúúú			* !	*	
c	σ σ ☞wúɾúúú				*	*
d	σ σ wúɾúú		* !		*	

Tableau 8: CP_{DP}

We can now address how the two cophonologies sketched above capture the difference in phonological processing across morphological domains emphasized in previous sections. Ignoring other differences that are less crucial, we can note two clear disparities between cophonologies CP_{DP} and CP_G. The first is that the plural morpheme loses its initial consonant only in the definite-plural forms. For reasons laid out in Section 2 above, such a loss cannot be explained by general phonological processes, but is instead emblematic of the influences of morphological category. This has been captured in the cophonological framework by a general constraint (*Cu#) implemented in a *morphologically restricted domain*. This markedness constraint triggers deletion of the initial consonant in the plural morpheme in CP_{DP}. For the observed deletion to occur, such a constraint must necessarily outrank the relevant faithfulness constraint MAX C. However, as noted above, such a constraint ranking cannot be a language-general property, as shown in abundant evidence of such forms

in other nominal stems and many other words. This indicates that in the language's general grammar CP_G MAX C outranks *Cu#. Regarding trimoraic rhymes, such structure is prohibited in general (in CP_G) meaning that *μμμ must outrank MAX μ, which would preclude the repair of trimoraic syllables. In definite-plural paradigms this is not the case: trimoraic syllables are not repaired. This is represented by the fact that MAX μ outranks *μμμ (see Tableau 8). These key differences are schematized in (41) below.

(41)

CP_{DP}	CP_G
MAX μ >> *μμμ	*μμμ >> MAX μ
*Cu# >> MAX C	MAX C >> *Cu#

These reversals in markedness will now be discussed in terms of more general concerns of phonological grammar and representation.

5.3 Markedness reversals and faith-based variation in grammar

The concept of markedness plays a central role in phonological theories of grammar; whereby the abstract notion of markedness refers to a linguistic element or structure that is dispreferred, less common, or actively mitigated in the phonology relative to other unmarked forms or structures (e.g. Moravcsik & Wirth 1986; Rice 1999, 2007). Correspondingly, the term "markedness reversal" has been used to refer to what have been described as non-uniform markedness preferences across linguistic categories (e.g. morphological categories) resulting in "wildly various surface patterns" (Benua 1997:6) internal to a given language. The apparent existence of such phenomena has been argued for and against by various proponents of indexed constraint and cophonological approaches to phonology, tied in closely with the concept of faith-based variation.

Faith-based variation claims that non-uniform phonology should be described in such as way that it reflects varying degrees of faithfulness to invariant markedness (e.g. Alderete 2001). In a formal constraint-based system, this principle is captured by indexing only faithfulness constraints for morphological category (see Inkelas & Zoll 2007:149-151 for an overview). This stipulation is intended to rule out markedness reversals, which are argued to not exist in phonological grammar under such a framework. Because of its relationship to faith-based variation (which can effectively only be captured with indexed constraints), the indexed constraint approach is typically seen as predicting that markedness should be static across domains, and that principles of faith-based variation should be respected (Alderete 2001; Inkelas & Zoll 2007).

Turning now to the Dafing data, we might ask to what extent it supports or repudiates the notion of faith-based variation and markedness reversals in grammar. Inkelas & Zoll (2007:152-157) give examples indicating that markedness reversals do indeed exist in natural language, and further that the notion of faith-based variation is vacuous in the sense that indexed faithfulness constraints can emulate markedness reversals, contrary to their putative purpose. Below, it is argued that the Dafing inflectional paradigm supports these conclusions.

As has been described above, the patterns in Dafing nominal inflection indicate a clear difference in what phonological structures are marked and unmarked. Trimoraic structures are permitted in definite-plural forms, while they are highly marked in the rest of the language. Similarly, deletion of the consonant which leads to trimoraic rhymes in the definite-plural is evidence of a differential markedness preference across morphological categories. These two marked structures observed in the Dafing data are embodied by the constraints *μμμ, and *Cu#; that latter of which is highly specific (i.e. not typically considered a marked structure). The specific circumstances of Dafing inflection exemplify how the structures' status as marked, or unmarked is reversed in the definite-plural, suggesting that markedness reversals can

target highly specific structures in highly restricted morphological domains (see Inkelas & Zoll 2007 for further examples), putting constraints in competition that would typically target different structures. Conceptually, the phenomenon detailed here thus seems to be a clear case of markedness reversal, both in terms of moraic structure and in the markedness of structures that derive increased mora count (shown schematically in (41) above). The differential markedness preferences are what drive the deletion of the suffix-initial consonant which allow for the trimoraic syllable to be formed. They are also what allow it to persist, where repair is necessitated in most cases, but not in the definite-plural.

Capturing the markedness reversal sketched above in an indexed constraint theory would perhaps most intuitively be accomplished by indexing markedness constraints for definite-plural category. However, as mentioned above, such an operation is in defiance of the notion of faith-based variation, which would argue that markedness constraints should not be specified morphologically, and that only faithfulness constraints should be indexed (note that this was also defied in the illustrative example in Tableau 1 above). With indexed markedness, the correct ranking of relevant constraints would necessarily be: {*Cu#$_{DP}$,*μμμ} >> {MAX C, MAX μ} >>{*Cu#,*μμμ$_{DP}$}. Here the DP-specific *Cu#$_{DP}$ eliminates the antepenultimate consonant in definite-plural forms (allowed by the subordinate ranking of MAX C), and the low ranking of *μμμ $_{DP}$ allows for trimoraic syllables to exist in the definite-plural. The opposite rankings for the language-general constraints produces the intended patterns, with mitigation of trimoraic syllables outside of the definite-plural (because of the subordinate ranking of MAX C and MAX μ), and also the general preservation of antepenultimate consonants. Thus the indexed constraints capture the observed markedness reversal, but in a way that disregards the notion of faith-based variation.

However, as demonstrated by Inkelas & Zoll (2007) faith-based variation can still be respected while producing the same output. This will be outlined with the same Dafing constraints. Consider the following ranking, this time with only indexed faithfulness (i.e. faith-based variation is respected in the formal sense): {MAX C, MAX μ$_{DP}$} >>{*Cu#, *μμμ} >> {MAX C$_{DP}$, MAX μ}. This ranking guarantees the same output for the relevant forms as that with indexed markedness above. The subordinate ranking of MAX C$_{DP}$ to *Cu# ensures that trimoraic forms will be created via consonant deletion in the definite-plural, while the subordinate ranking of *μμμ to MAX μ$_{DP}$ ensures that trimoraic rhymes will not be repaired in the definite-plural. This would successfully produce the observed patterns in the definite-plural by triggering deletion of the penultimate consonant and also retaining a trimoraic syllable (after resyllabification) in the definite-plural. The opposite rankings of the general constraints (which are not indexed) account for the dispreferred status of trimoraic stems and preservation of penultimate consonants in all other domains of the language. In this sense the indexed faithfulness constraints are adequate to capture the data. However, the pattern they are capturing seems to be a clear case of markedness reversal; a pattern which they were intended to preclude (see Inkelas & Zoll 2007:155-157 for a similar example). It is in this sense that the concept of faith-based variation seems to be of limited usefulness in respect to Dafing nominal inflection.

The markedness reversal in the Dafing data thus provides some insight more globally into phonological grammar. Firstly, and most obviously, its existence further indicates that markedness reversals are a real-world phenomenon which merit attention in a formal framework. Secondly, the fact that indexed faithfulness constraints are capable of producing such a pattern would suggest that they are not always compatible with their intended function, and as such do not carry much formal power in capturing the Dafing phonological grammar. For these reasons the cophonological approach is seen as being a more adequate tool in describing the Dafing data, as it is intended to include markedness reversals as elements of phonological grammar, and as it is not tied to predictions about faithfulness and markedness reversals which are not compatible with the Dafing paradigm.

6. Conclusions

Above, the phonology of Dafing nominal inflection has been described, quantified, and analyzed with cophonologies. Even in such a limited domain in the language the phonological contrasts and dependencies are informative, both about the language itself and for morphophonological theory more generally.

As always, insights are accompanied by a variety of further questions. One fundamental question is where other interesting morphophonological interactions might be seen in Dafing. The cross-linguistic examples cited above indicate that a huge swath of distinct morphological categories can influence phonology: morphophonological grade (Prince 1980), lexical category (Itô & Mester 1993 1999), status as base or reduplicant (Dahlstrom 1997), and so on. The vast range of possibilities for morphophonological conditioning points to the complexity in such processes that needs to be considered. The current Dafing data presents a further indication that even internal to a given paradigm of nominal inflection, morphological influences can be seen. From a general point of view, looking for other instances of such a relationship between category and phonology within the language and its dialects would surely enrich our understanding of Dafing phonology and morphology.

Another further question is where else, if anywhere, ternary length distinctions can be found in the dialect. Based on the examples of overlength seen in both of the dialects documented by Diallo, we now have a more complete picture about possible syllable structures across dialects of Dafing. Given that the Zaba dialect allows systematic lengthening of phonemically long vowels outside of the definite-plural category (Diallo 1988, Vol. I:64) it is clear the morphological restrictions do not apply uniformly across dialects. Both the Yankasso dialect as documented by Diallo (Diallo 1988, Vol. I:235) and the Safané dialect described here are clearly more restrictive, and this enriched picture of language-internal variation points to the need for a comprehensive consideration of dialects of Dafing in its study, as well as the existence of meaningful differences across dialects. Relatedly, further work on the language may find other domains where trimoraic syllables are realized, and relating those findings to the current description of the definite-plural is another step towards better understanding the complex and variable moraic structure of the language.

All told, the phonology of the language and the insights gleaned from such a narrow domain indicate that further work on Dafing is sure to be valuable.

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