The linguistic phonetic properties of Mungbam vowels, and their areal-historical and theoretical significance

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Contents

1 Introduction[1]

This is a paper about the linguistic phonetic properties[2] of vowels in the five dialects of Mungbam [mij], a Bantoid language of Cameroon. Two of the dialects employ a type of phonetic contrast which is normally only found in West African languages possessing [ATR]-based vowel harmony, even though Mungbam does not have vowel harmony as a synchronic process.

The paper is organized as follows. Section §2 gives general background information about Mungbam, including some of its most prominent typological characteristics. Since Mungbam has been virtually unstudied until now, and there are no linguistics publications specifically dedicated to it, slightly more detail than is customary is included here. In §3, I outline the vowel inventories of each of the five dialects, and discuss some phonetic properties common to all five varieties. The focus is then narrowed to the phonetic details of the contrast between [e]-[ɩ] and between [o]-[ʊ] in the Abar and Biya dialects. The results of an acoustic analysis show that it is inconvenient to characterize the difference as one of height, and that a better characterization of the contrast might involve pharyngeal expansion, or tongue root advancement (ATR). What follows is an extended discussion on the theoretical import of the phonetic findings (§4), divided into two parts. The first part, §4.1, considers how the contrast between these vowels should be represented in a phonological description. Since Mungbam does not have any phonological process targeting [ATR], the choice is not straightforward. The second part, §4.2, considers some possible historical and typological explanations for the pattern of contrast found in Mungbam. In §5, I summarize the main findings of the paper and discuss directions for future work aiming to answer some of the questions that have been raised.

[1] This work has been made possible by the patience and expertise of the Mungbam speakers who assisted me in Cameroon: Ngong Belta, Esther Nungo, Kizita Simpe, Bong Christian, Mbelebo William, Pawbeh Kelvin, Kang Protus, Kang Egidius, Kang Gerald, Kang Nesla, Ma Pius, Njimbong Diboral, Nchang Adeline, Ladji Mispa, Asoa Julius, Sangbo Glory, Akanga Marcos, Abanga Christian, and Akwe Thomas. Special thanks is due to Ngong George Bwei Kum, who acted as my guide and protocol on several occasions, and to Attia Brigid and Duylinh Nguyen for their alimentary support. This work has benefited from insightful comments and advice from Jeff Good, Karin Michelson, David Fertig, Pierpaolo Dicarlo, Hiroto Uchihara, Kristin Kalinowski, Rebecca Voll, Larry Hyman, and the members of the UB Spring '11 Phonology Reading group. All errors are either my own or the result of an elaborate conspiracy of monumental proportions. This work has been funded by NSF grant BSC-0853981 and by a Summer Research Grant from the University at Buffalo College of Arts and Sciences Humanities Institute.

[2] That is, the phonetic properties which must be described to account for contrasting sounds within a language, but not necessarily the characteristic differences between similar sounds in different languages. See, for example, the discussion in Ladefoged (1989:8ff.)

2 Language overview

2.1 Geographic data and classification

Mungbam is a group of closely-related dialects spoken in the Lower Fungom region of Northwest Cameroon. It has approximately 2500 speakers divided between five dialects: Abar, Ngun, Biya, Missong and Munken (Good et al., submitted). Lower Fungom itself contains at least five different languages, including Mungbam, which have no known close relative outside of Lower Fungom. The five villages where varieties of Mungbam are spoken are quite close to each other, all five being confined to an area of perhaps 8 mi.^{2} (see map, figure 1). Despite the proximity of the villages where they are spoken, there are significant differences between the dialects. While speakers of Ngun, Biya, Abar and Munken claim to be able to understand each other without much trouble, the Missong dialect is divergent to the point of being unintelligible to speakers of the other four dialects who are not used to hearing it. While a systematic study of interintelligibility has not been undertaken, I will simply note that the structural diversity that I have observed in the course of documenting basic lexical items and sketching the grammar of each variety is in line with speakers' impressions about differences.

2.2 Previous work on Mungbam

There is very little previous published linguistic data on Mungbam. Hombert (1980) includes a sketch of the noun class system of Missong. A SIL survey described in Hamm, Diller, Jordan-Diller, and Tiati (2002) includes a wordlist of 126 items for Abar and Missong (though tone is not marked), and proposes Abar as the reference dialect. Data collected between 2005 and 2008 by Jeff Good and Scott Farrar, concerning mostly noun class systems and vowel ablaut in verb stems, has been the subject of several conference presentations (e.g. Farrar & Good, 2008; Good & Lovegren, 2009). Good et al. (submitted), who first proposed the label Mungbam (the group of dialects had previously been referred to as "Abar"), include a basic outline of the phonological and morphological sytems for each of the five Mungbam dialects. The present work is based on data collected as a result of a six-month field trip by the author during the first part of 2010.

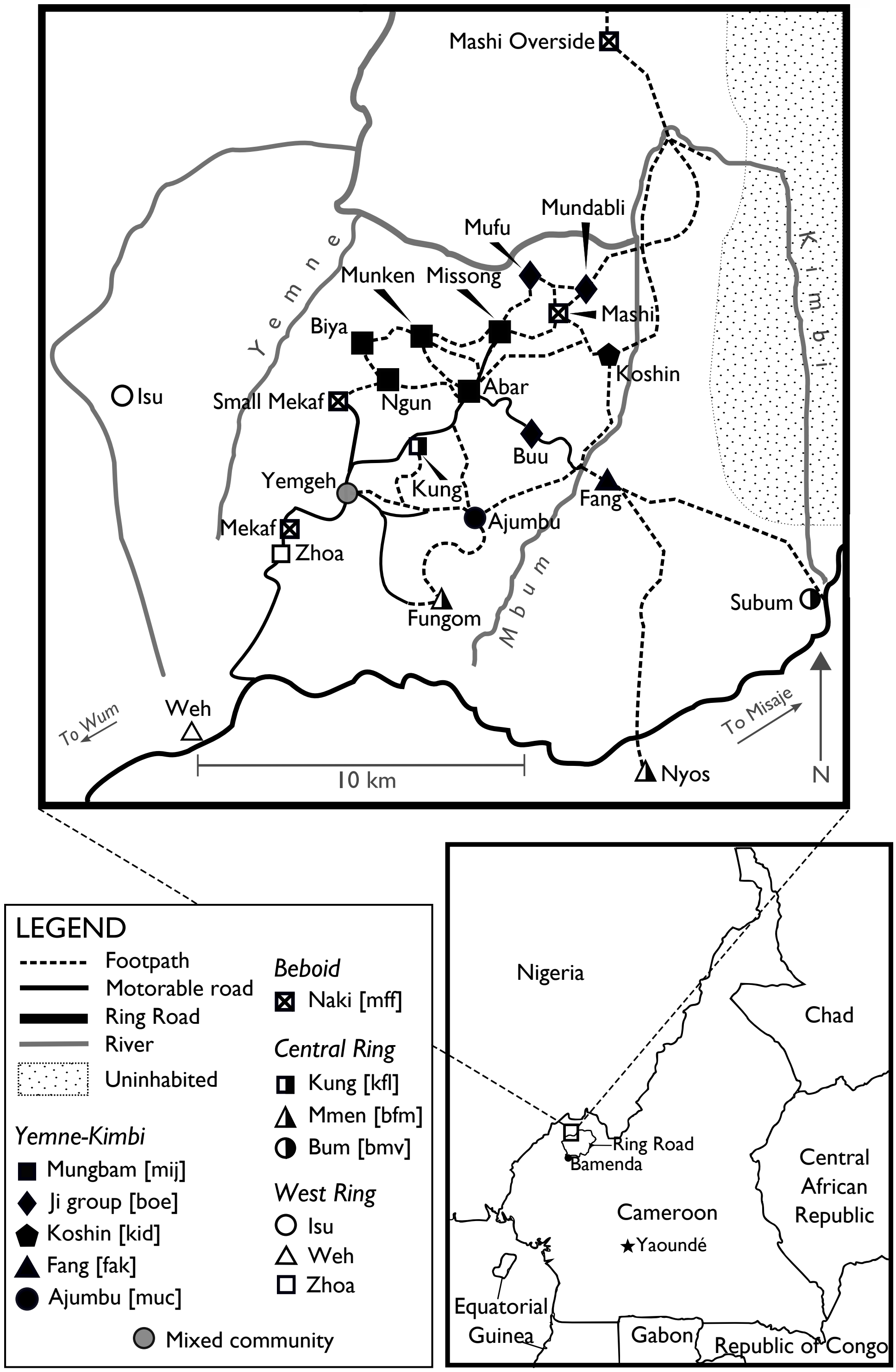

Figure 1: Lower Fungom and surrounding area (Good et al., submitted)

The genetic classification of Mungbam is uncertain at this point. Although it is uncontroversial to consider it a Bantoid language within the proposed Benue-Congo family, Good et al. (submitted) reject the notion that Mungbam and surrounding languages form a low-level genetic unit, leaving the nature of its relationship to neighboring languages uncertain until further comparative work is completed. Such a problem is not uncommon within Niger-Congo linguistics: Williamson & Blench (2000:12) admit that comparative studies are complicated by "the large number of languages, the inaccessibility of much of the data, and the paucity of able researchers committed to this field." The geographic label "Yemne-Kimbi," referring to the Lower Fungom languages Mungbam, Ji, Koshin, Fang and Ajumbu, has been proposed by Good et al. to replace the presently-unsupported genetic label "Western Beboid."

2.3 Basic typological properties

Mungbam resembles the Bantu-like languages of the Cameroonian Grassfields in that it has a large set of noun class prefixes and concordial particles. Unmarked clauses have basic constituent order SV/SVO,[3] and nominal heads usually precede all of their modifiers. Basic clause structure is dominated by serial verb constructions of the contiguous type, where all the verbs of a clause appear together without any intervening arguments. See, for example, example (1) below.

(1)	íyɔ̋ŋ	àlē	sàn	gbè	úkpə̋
	wind	P2	pass	fall	house

"The wind blew down the house." (Biya dialect)

There is a medium-sized class of locative postpositions, most of which are historically derived from body part terms. Postpositions strictly encode only location; all other spatial semantic encoding (i.e. path and manner function) is in the serial verb complex (cf. Pérez Báez & Bohnemeyer, 2008). The language has a somewhat complex formal system of information structure marking, with reduplication used to indicate verbal focus, as in Lower Cross languages (Faraclas & Williamson, 1984). It has mostly isolating morphology in the segmental domain, though tonal inflection and vowel ablaut processes are found in verbs. It has a large tone inventory. Although ultimately it will probably be preferable to assign tones to some prosodic level higher than the syllable (i.e. the word), we can

[3] Or, equivalently, SV/AVO, following Dixon (2010:73).

say here for the sake of comparison that there are four tone levels which combine for a total of 9-10 surface tones, including contour tones, depending on the dialect. Tonal contrasts are both lexical and grammatical. Noun and verb stems are generally mono- or disyllabic, though (almost) all additionally carry a noun class prefix. Nouns, verbs, and postpositions display a prominence asymmetry whereby their first stem syllable usually sounds louder (this has yet to be verified instrumentally) and permits a wider range of vowel and consonant oppositions than do other syllables. Following the terminology of van der Hulst (2006:655) and Downing (2010:382-3), we will call such syllables accented. Accent, given its culminative nature, may eventually prove to be very important for defining the phonological word in Mungbam. At the very least it will prove useful in providing a term referring to the position in which the greatest number of lexical vowel contrasts are present. The vowel systems of the Mungbam dialects are treated in detail in §3.

3 A linguistic phonetic description of Mungbam vowels

3.1 Section overview

The present section concerns the basic phonetic properties of the vowels in each of the five dialects. §3.2 presents the vowel inventories for each dialect, along with some observations on their phonetic realization. §3.3 is concerned with identifying the physical parameter which varies in the contrast involving the "lax" vowels, /ɩ/, and /ʊ/ of the Abar and Biya dialects, and contains the results of an acoustic analysis of these vowels. It is found that for one of the two Abar subjects, these vowels do not differ in acoustic height from /e/ and /o/, respectively.

3.2 Contrasting vowels in accented syllables

3.2.1 Comparison of vowel inventories by dialect

Mungbam is characterized by differences between its dialects in terms of vowel inventories. The systems differ not only in their number of vowels, but individual vowels also generally fail to correspond to each other in a one-to-one fashion in cognate words. It would thus be difficult to claim that differences between the dialects reflected minor variations on a single underlying set of vowel phonemes.

In table 1 are presented the vowels which may appear in accented syllables for each of the five dialects. The unusual place of the rows containing /ɩ/ and /ʊ/ is due to the ordering of the vowels with respect to their acoustic heights (see §3.2.2). In three of the dialects, /ə/ may appear in an accented verb- or noun-stem syllable only if that syllable is a closed syllable. The vowel /ɛ/ in Abar is starred to indicate its low type frequency, as it is attested in only two verb stems. Likewise, the starred vowel /a/ in Biya is only attested so far in one noun stem and in the imperfect forms of a small number of verb stems. The Missong diphthong /o͡a/ regularly corresponds to the sequence /-an/ in the other four dialects.[4] How such a correspondence might have come about is not known at this point. Biya /e͡a/ is pronounced as a diphthong by some informants, and as [ɛ] by others. Its pronunciation is [æ] in closed syllables, where the only licit coda consonants are nasals.

ABAR			NGUN			BIYA		
i		u	i		u	i		u
e		o	e		o	e		o
ɩ		ʊ			ʊ	ɩ		
ɛ*	(ə)		ɛ	(ə)	ɔ	e͡a	ə	ɔ
	a			a			a*	

MUNKEN			MISSONG		
i		u	i		u
		o			o
e			e		o͡a
ɛ	(ə)	ɔ	ɛ	ə	ɔ
	a			a	

Table 1: Mungbam vowels which may contrast in accented syllables

3.2.2 Some properties of phonetic realization

The vowels in table 1 are presented with respect to their relative phonetic heights, on the basis of an acoustic analysis. This presentation reflects, for instance, that Missong and Munken /e/ are generally realized lower than /o/, and are also low with respect to realizations of /e/ in the other

[4] Hypothesized correspondences between vowels in cognates mentioned here and in §3.3 have been determined from a comparative list of approximately 200 lexical items. These may be revised in the future as more data is included.

three dialects. Concerning the high vowels /i/ and /u/ in all five dialects, they are usually produced with friction, and are associated with spirantizing mutations in the preceding consonant (cf. Connell (2000); Kießling (2010)). In Abar, underlying sequences /nyi/ and /mu/ become syllabic nasals **ny̩** and **m̩**, respectively, though this rule is blocked if it would create two consecutive syllables with nasal nuclei. In examples (2)-(3), /mu-/ 'class 18 prefix' and /nyì/ 'four' are reduced to syllabic nasals when not preceded by a syllabic nasal.

(2) bə̀mbʊ̀ŋ bə̄ǹy̩
2.cow 2.four
"Four cows"

(3) m̩̄bûs m̩̄nyì
18.cat 18.four
"Four cats"

That high /i/ and /u/ are produced with friction makes them distinct from mid /e/ and /o/, which, with the exception of Munken and Missong /e/, are much higher than vowels in other languages usually transcribed with this symbol (cf. Disner (1983) for a study of cross-linguistic differences in the phonetic realizations of similar-sounding vowels).

Abar, Biya and Ngun have "lax" vowels, transcribed with the symbols **ɩ** and **ʊ**. One interesting property of these pairs of vowels is that they are quite close perceptually to /e/ and /o/, respectively. Ngun /ʊ/ is quite centralized and not easily confused with /o/. However, /ɩ/ in Biya and /ɩ/ and ʊ/ in Abar sound only slightly lower than second-degree /eo/, such that I originally transcribed them **ɛ̝** and **ɔ̝**, and often confused them with /e/ and /o/.

3.3 An acoustic analysis of the contrast between /ɩ/, /ʊ/ and /e/, /o/

3.3.1 Correspondences with vowels in other dialects

The general lack of correspondence between vowels in cognate words discussed in §3.2 extends to /ɩ/ and /ʊ/ as well. Consultants from the same village almost always are in agreement with the particular vowel for a given word, so the lack of clear correspondences may be considered a cross-dialectal phenomenon, and not a byproduct of inter-speaker variation. If data from Biya and Missong are excluded, however, a correspondence between Abar /ɩ/ and /ʊ/ with Munken and Ngun /ɛ/ and /ɔ/ can be identified.

3.3.2 Dispersion with respect to other vowels

The difficulty in distinguishing /ɩ/ from /e/ and /ʊ/ from /o/ mentioned in §3.2 is supported by a plot of the F1 and F2 values for the contrastive stem vowels. Figures 2 and 3 show steady-state F1 and F2 values for all of the Biya vowels (speaker BY1) and all of the Abar vowels (speaker AB1). What is noteworthy is that tokens of /ɩ/ do not form a cluster which obviously differs in F1 from the cluster formed by tokens of /e/. The same is true of /o/ and /ʊ/ as well.[5] appear to overlap in their F1 values. Peripheral vowel tokens were in the context of a preceding coronal consonant. In this context, F2 values are expected to be significantly increased for high back vowels vis-à-vis a neutral context (Stevens, 1998:572-3; Stevens & House, 1963), but F1 values should not be affected.

In order to gain a better understanding of the physical parameters which differentiate the pairs /e/—/ɩ/ and /o/—/ʊ/, an acoustic analysis was conducted. The purpose of the experiment was twofold: first, I would like to understand what property of these pairs of vowels makes them difficult for a non-native speaker to distinguish.[6] And second, I would like to be able to classify this contrast with respect to common cross-linguistic phonetic parameters. The results of this analysis are reported in the following paragraphs.

3.3.3 Experiment design

Recordings were made for two speakers of Abar, both female, and two speakers of Biya, both male. The /o/-/ʊ/ contrast was only recorded for one of the Abar speakers, because the recording was made before I had learned that these two vowels were contrastive. Target words consisted of those given in table 2, though *ìtɩ̄* 'to fell a tree' was used for Abar speaker AB1 as an examplar of /ɩ/. The target words show a minimal segmental contrast between the vowels of interest. Consultants were

[5] A similar situation obtains with /i/ and /e/ and /o/ and /u/, though, as discussed above, these vowels are distinct from each other by virtue of the friction with which high /i/ and /u/ are produced.
[6] While I am referring primarily to my own difficulty, I should note that some of my Munken consultants (Munken lacks /ɩ/ and /ʊ/) who are able to speak either Biya or Abar were unaware of this contrast.

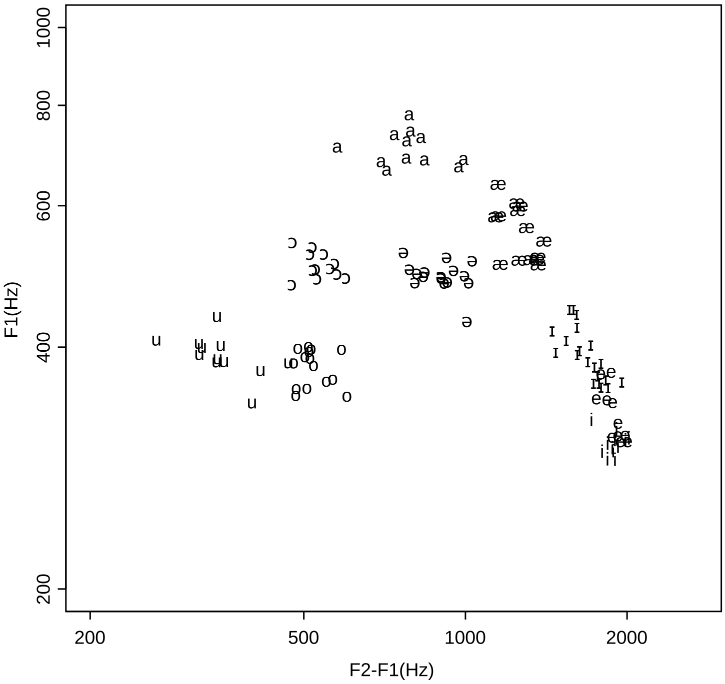

Figure 2: Dispersion of Biya vowels in F1 x F2 space, for tokens in the context of a preceding coronal consonant. (Speaker BY1) N.B. Biya lacks /ʊ/.

prompted with an English gloss, and they then produced the corresponding target word in isolation. Depending on the session, a set of between 6 and 12 target words were used, with only two of these representing the vowel contrast of interest. Each word was repeated in isolation 12 or 13 times, and tokens were presented in a randomized order.

ABAR				BIYA			
ídi̋	‘candle sap’	ìfū	‘to be rotten’	ìdī	‘to blow’	ìtū	‘to play’
íde̋	‘bean’	ìfō	‘to measure’	ìdē	‘to cry’	īdó	‘to carry water’
ídɪ̋	‘beard’	ītʊ̋	‘to point’	īdɪ́	‘to say’		

Table 2: High and mid vowels in Abar and Biya

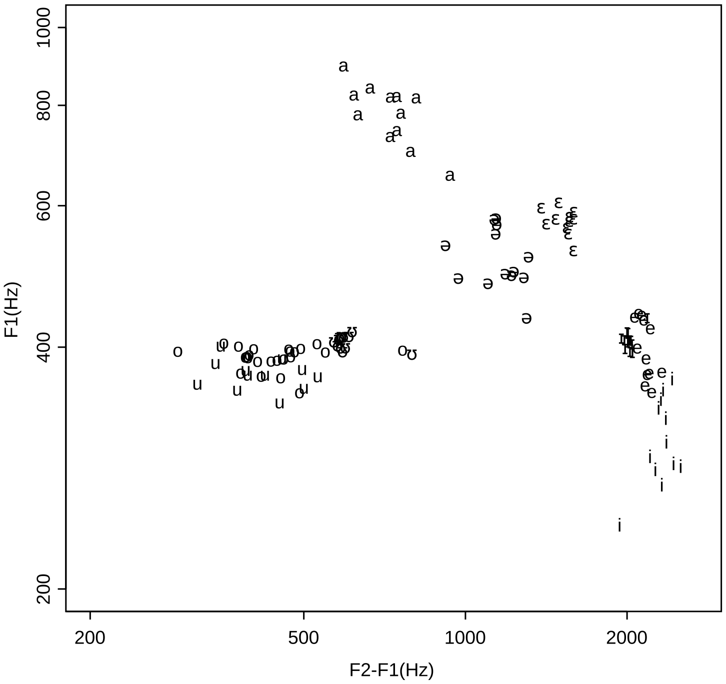

Figure 3: Dispersion of Abar vowels in F1 x F2 space, for tokens in the context of a preceding coronal consonant. (Speaker AB1)

3.3.4 Possible limitations

The present study is based on data collected in the field as part of a larger documentation project. Though documentation of phonetic detail for each of the five dialects is a priority, the use of a large sample size characteristic of projects with a narrower focus was not entirely feasible, especially since I had not committed to making a detailed study of any particular phonetic phenomenon until after leaving the field. The small sample size makes it impossible to give any convincing explanation for the differences between speakers within a single dialect. But by using data from two speakers for two different dialects, this case study does not overlook the possibility of diversity in the way that a study of an idiolect may have. Furthermore, by including all of the five dialects within the scope of the study, I have not risked choosing to describe only the dialects which lack the type of contrast found in Abar and Biya.

Aside from the obvious factors of language, gender and age is the issue of multilingualism, which is probably the most important factor. AB2, for example, is a native speaker of Abar, and both of her parents are also natives of Abar, but she claims to be able to speak Abar, Metaʔ [mgo], Bafmen [bfm] and Pidgin English [wes], and has passive knowledge of Buu [boe]. Two demographic factors are relevant to this case: first, it is very common in Cameroon for children to spend extended periods of time living with extended family members outside of their hometown; and second, young adult populations from rural areas are quite mobile: frequent travel and relocation for employment reasons is common. A third general factor which promotes the development in rural populations of highly-multilingual individuals who do not necessarily share the same languages of competence is a high rate of exogamy, which is especially relevant for smaller communities (Good et al., submitted). This factor may be especially relevant for the Biya speakers. The number of Naki women who have married Biya men is such that all of the people in Biya are apparently able to understand some Naki [mff], and most speak it fluently, including both of the Biya speakers who have contributed data for this study. Although there are no categorial differences between vowels for speakers of a single Mungbam dialect, interference from other languages as a factor contributing to the low-level phonetic variation of the type shown here cannot be ruled out.

The decision to have consultants produce words in isolation rather than in a carrier phrase was motivated by the difficulty of training consultants to perform the task and the level of intermittent ambient noise, between whose lulls recordings of individual tokens were made. The use of carrier phrases is customary in recording phonetic data for several reasons, so the decision to not use them should be addressed at this point. The merits of carrier phrases are discussed in Ladefoged (2003:7-9) and Chelliah & de Reuse (2010:252-4). Carrier phrases mostly correct the problem of list intonation effects. When appropriately designed, they allow for standardized measurement of segment lengths. They can also sidestep the problem of utterance-final effects, which are generally manifested as changes in intonation and vowel length. Vowel length in Mungbam, though it has a rather low functional load as far as the number of lexical items which are distinguished only by vowel length, varies indepently of vowel quality (e.g. Abar **kẃí** ‘enter!’ vs. **kẃíː** ‘tie a bundle!’). List effects are irrelevant because consultants did not produce words from a list, and they were not given any indication of when the task would end until it actually ended. There are no automatic utterance-final effects on tone or vowel quality in the language, although sentence-final question and emphatic particles may be associated with a boundary tone. To summarize, the differences which arise from failure to use carrier phrases in our case either do not arise or are irrelevant to the contrast of interest.

Audio was recorded outdoors on a Marantz PMD661 solid state recorder with a Shure WH30XLR head-mounted condenser microphone. Recordings were made at a sampling rate of 44.1 kHz, at 24-bit resolution. Vowels were tagged and extracted. Sounds were then downsampled to twice the formant frequency ceiling (5 kHz for males, 5.5 kHz for females), and formants were determined via LPC analysis with 10 or 11 prediction coefficients, using Burg's method for generating prediction coefficients. Measurements for F1, F2 and F1 bandwidth (B1) were made for each vowel. B1 measurements were made from the LPC curve generated for the purpose of formant tracking. All procedures were performed automatically using Praat version 5.2.03 (Boersma, 2000). Measurements for /u/ (though these were relevant only for constructing figures 2-3) had to be made by hand, as the formant tracker often had difficulty in separating F1 and F2 values for this vowel. Figures 2 and 3 show steady-state F1 and F2 values for all of the Biya vowels (speaker BY1) and all of the Abar vowels (speaker AB1).

3.3.5 Results

Table 3 gives reported values for each parameter. These data may be contrasted with the vowel plots shown in Figures 2 and 3 (pages 11,12), which give a visual display of how the vowels are dispersed with respect to their F1 and F2 values. These plots confirm the impression that mid /e/ and /o/ are higher than their transcription suggests, and would not be fully distinct from high /i/ and /u/ if not for frication present in the latter, as mentioned in §3.2. We also see the reason for the difficulty in discerning the pairs /e/-/ɩ/ and /o/-/ʊ/. Althought Abar /ʊ/ is centralized with respect to /o/, the centralization of /ɩ/ appears to be very slight in both Biya and Abar. This raises the question of whether all of these pairs of vowels are distinct with respect to their F1 values. It will be also useful to see whether the pairs of vowels show a difference in B1, on the assumption that "lax" vowels (as they are transcribed) tend to exhibit acoustic losses at lower frequencies, signaled by an increase in B1, as has been predicted by Halle & Stevens (1969:212-3). Lax vowels are also predicted to be lower and more centralized than their tense counterparts (ibid). Table 4 shows the results of two-tailed,

ABAR				BIYA			
	F1(Hz)	F2(Hz)	B1(Hz)		F1(Hz)	F2(Hz)	B1(Hz)
NA-/ɩ/	410(11)	2460(62)	17(9)	BY1-/ɩ/	400(31)	2100(113)	150(94)
NA-/e/	390(34)	2580(65)	50(29)	BY1-/e/	340(32)	2210(74)	40(10)
NA-/ʊ/	409(8)	1030(59)	20(13)	BY2-/ɩ/	430(22)	1900(130)	40(17)
NA-/o/	390(10)	900(110)	70(27)	BY2-/e/	360(15)	2160(74)	50(20)
ML-/ɩ/	480(11)	2460(99)	80(61)				
ML-/e/	390(54)	2610(71)	140(37)				

Table 3: Mean values of F1, F2 and B1 for two Abar speakers (AB1 & AB2) and two Biya speakers (BY1 & BY2). Values in Hz, standard deviation in parentheses.

paired t-tests, to determine the level of significance in F1, F2 and B1 for each pair of vowels. A Rom sequentially-rejective procedure was employed to control for family-type error (Rom, 1990). Because of the large number of tests, the critical value for rejecting the null hypothesis, shown in table 4, for a given significance level is considerably lower than the actual value of α.

For three of the speakers, including both Biya speakers, F1 is the most significant parameter for distinguishing between the two pairs of vowels. For AB1, F1 is the least significant of the three parameters, and is not significant at $\alpha = 0.01$ for either vowel contrast. F2 is significant at $\alpha = 0.01$ only for the front vowel contrast for AB1. It is significant at $\alpha = 0.05$ in all of the cases except for BY1. In all cases, differences in F2 are such that vowels transcribed as lax are more centralized. B1 is the most significant parameter for both pairs of vowels for AB1, significant at $\alpha = 0.01$ in both cases. It is significant at $\alpha = 0.05$ for BY1. It is remarkably insignificant for BY2.

	F1	F2	B1
AB1-/e,ɩ/	$t(12) = 2.05, p = .075$	$t(12) = 4.67, p = .0005$	$t(12) = 4.68, p = .0005$
AB1-/o,ʊ/	$t(11) = 4.28, p = .001$	$t(11) = 3.90, p = .002$	$t(11) = 5.01, p = .0004$
AB2-/e,ɩ/	$t(12) = 6.58, p < .0001$	$t(12) = 3.95, p = .002$	$t(12) = 3.53, p = .004$
BY1-/e,ɩ/	$t(11) = 5.86, p = .0001$	$t(11) = 3.68, p = .004$	$t(11) = 4.03, p = .002$
BY2-/e,ɩ/	$t(11) = 8.00, p < .0001$	$t(11) = 4.70, p = .0007$	$t(11) = 0.39, p = .70$

Table 4: Significance levels for differences in F1, F2 and B1. Speakers AB1 & AB2 (Abar), BY1 & BY2 (Biya). Critical value for $\alpha = 0.05$ is $a_{1,15} = 0.0034$, for $\alpha = 0.01, a_{1,15} = 0.00067$.

3.3.6 The independence of B1 differences and F1 differences

We should at this point rule out the possibility that the differences in B1 measurements could be explained by differences in F1 and F2 values. To a certain degree of accuracy, B1 is expected to be affected by F1, and not by F2 (Fant, 1972:47). This issue specifically motivated the choice to compare the pair /e/-/ɩ/ rather than pairs supposedly differing only in tenseness, /i/-/ɩ/ or /e/-/ɛ/. If F1 differences between the vowels were very small, then the possibility that differences in B1 were only an artifact of differences in F1 could be disregarded. This has turned out to be the case for AB1: the B1 difference is obviously not explainable by F1 differences, since F1 differences are considerably less significant than differences in B1. That B1 and F1 are not correlated is also true in a trivial way for BY2, for whom B1 differences are not at all significant. While there are correlations between F1 and B1 for AB2 and BY1, these are in opposite directions: BY1's /ɩ/ has a higher B1 than /e/ does, as is expected (following Halle & Stevens, 1969:212-3), but the opposite is true for both Abar speakers: if B1 may be considered an indication of tenseness, then the vowels transcribed as "lax" in Abar are actually more tense than the vowels transcribed as "tense." F1 and B1 cannot therefore be related in a non-language-specific way for both dialects.

3.4 Summary

We are now in a position to propose, with some empirical support, a set of physical parameters which can distinguish the vowels of the Abar and the Biya dialects, abstracting away from inter-speaker differences as much as possible. The discussion will be framed in terms of selecting the most appropriate from the set of multi-valued linguistic phonetic features for representing vowel contrasts, as proposed by Lindau (1978).[7]

3.4.1 Rejecting [HEIGHT] in favor of [ATR]

The most likely features for representing the contrast between /e/-/ɩ/ and /o/-/ʊ/ in Abar and Biya are [HEIGHT] and [ATR] (the latter of which Lindau (1978) refers to as [EXPANDED]). These vowels do not involve a lip-rounding contrast. The main acoustic correlate of [HEIGHT] is F1, or a mathematical function of only F1 (Lindau, 1978:545), and the usual acoustic correlates of [ATR] are F1, F2,

[7] Lindau does propose a feature [PERIPHERAL] (a.k.a. [TENSE]), but she does not fully justify it on phonetic grounds.

and differences in spectral shape (these will be discussed in much greater detail in §4.1.2.3). One reason why it is not a simple matter to judge whether a contrast is supported by [ATR], or instead by [HEIGHT], is that [ATR] includes among its acoustic correlates an increase in F1. For this reason the choice between [HEIGHT] and [ATR] by linguists is often motivated by non-phonetic factors: e.g. a desire to reduce the number of height values, or a preference for a feature which coincides with a natural class in the language's phonology. To avoid this type of problem, I have chosen to examine pairs of vowels for which the height contrast is difficult to perceive. If it is not possible to show that two vowels have different steady-state F1 values, then [HEIGHT] is not a good choice for representing the contrast between them. B1, on the other hand, is expected to vary with F1 in a predictable way for vowels which contrast only for height; any variation which cannot be explained as being tied to F1 would be due to differences in the acoustic resistance of the vocal tract which are independent of F1. Thus, a preference for [ATR] can be grounded in the inappropriateness of [HEIGHT] for representing the physical differences.

For Abar speaker AB1, differences in B1 are much more significant than differences in F1. For the /e/-/ɩ/ contrast, F1 is not statistically significant at $\alpha = .05$. [ATR] is to be clearly preferred over [HEIGHT] in this case. For AB2 and BY1, the choice is not quite as clear; one could argue for an interpretation in terms of either [ATR] or [HEIGHT]. For BY2, the case for [ATR] is not as strong given that there appear to be no differences in B1 whatsoever between /e/ and /ɩ/. Even so, the differences in F1 and F2 are consistent with an [ATR] interpretation. If we are to avoid the problems for a [HEIGHT] analysis raised by data from AB1, it is necessary to include [ATR] among the features used to represent the lexical contrasts between vowels in the Abar dialect of Mungbam. For the Biya dialect, there is no phonetic argument for ruling out a [HEIGHT] analysis, but there is also no argument for preferring an [ATR] to a [HEIGHT] analysis. A classification of the Abar and Biya front and back stem vowels is presented in table 5. An alternative [HEIGHT]-based analysis for Biya is presented in table 6. Since the features employed are intended to represent concrete phonetic differences, the commonly employed binary height features are replaced with multi-valued features.[8]

[8] The simultaneous use of [HIGH] and [LOW] is not tenable for phonetic features when there are more than two contrastive vowel heights (Ladefoged, 1966). Multi-tiered [APERTURE] (Clements & Hume, 1995:282-3) sidesteps this issue, but its design is motivated more by a desire to make phonological rules easier to express, and less by a desire to represent phonetic structure. It can, for example, allow for the representation of many more vowel heights than are needed to describe any

ABAR					
FRONT	[+ATR]	[-ATR]	[-ATR]	[+ATR]	BACK
[HEIGHT 1]	i	ɩ	ʊ	u	
[HEIGHT 2]	e	ɛ		o	
BIYA					
FRONT	[+ATR]	[-ATR]	[-ATR]	[+ATR]	BACK
[HEIGHT 1]	i	ɩ		u	
[HEIGHT 2]	e	ea	ɔ	o	

Table 5: A possible phonetic featural decomposition of the Abar and Biya front and back stem vowels

	[FRONT]	[BACK]
[HEIGHT 1]	i	u
[HEIGHT 2]	e	o
[HEIGHT 3]	ɩ	
[HEIGHT 4]	ea	ɔ

Table 6: Alternative featural decomposition for Biya front and back stem vowels

4 Theoretical issues raised by Mungbam vowels

Though interesting in itself, the full significance of the phonetic details of the contrast between the vowels in Abar becomes apparent when viewed in its typological and historical context. In the remainder of the paper I will consider theoretical and methodological issues related to the interpretation of the facts presented up to this point. I will explore in some detail two broad questions: first, in what sense can the vowels of Mungbam be considered as being organized by a feature [ATR]? And second, is there a convincing explanation for how the Mungbam vowels got to be the way they are?

4.1 The feature [ATR] in Mungbam

We have shown in §3 that [HEIGHT] as a phonetic parameter is inappropriate for representing the contrast between /ɩ/-/e/ and /ʊ/-/o/ for one of the Abar speakers tested. As an alternative, [ATR] is

possible language when three or more [OPEN] tiers are employed (cf. Clements (1991:46-56)).

not only appropriate for representing the contrast found in the speech of Abar speaker AB1, but it is also just as appropriate as [HEIGHT] is for the other three speakers. But is [ATR] useful in describing phonological patterns in Mungbam? And is its use consistent with the way that this feature is used in describing other languages?

4.1.1 Section overview

The purpose of this section is to answer the question "To what extent is the feature [ATR] present in Mungbam?" In order to answer this question in a meaningful way, a series of related issues will have to be considered. In §4.1.2 I will review what is known about the feature [ATR] and how it functions in West African languages. In §4.1.3, I examine two types of assumptions about what features are and what they do. Finally, in §4.1.4, I weigh the relevant phonological and phonetic evidence for Mungbam, finding that the difficulty in unifying the phonological and phonetic descriptions reveals the question posed above as theory-dependent, in that the answer depends on one's assumptions about what sorts of information features should encode. I will conclude that [ATR] in Mungbam is a linguistic phonetic parameter, but not a phonological natural class, and suggest a way of illuminating this observation within an analysis.

4.1.2 [ATR] in West African languages

Here are presented the background facts about [ATR] which will inform the theoretical discussion in §4.1.3 and §4.1.4. These include a discussion of why [ATR] is needed to describe West African vowel systems (§4.1.2.1), a classification of the types of phonological patterns that can be accounted for by [ATR] (§4.1.2.2), and a presentation of previous findings on the physical correlates of [ATR], including how these correlates map onto phonological features (§4.1.2.3). One point to keep in mind throughout the discussion is that the use of [ATR] in a description of a West African language is almost always motivated by a vowel harmony process where [ATR] is thought to be the alternating feature. Treatment of [ATR] as a parameter characterizing lexical contrasts is generally secondary to its role in phonological processes.

4.1.2.1 Vowel systems in West African languages While African languages present a wide diversity of vowel systems, there are a few generalizations which hold for large parts of Africa. Languages of West Africa, or non-Bantu Niger-Congo languages, typically have large inventories consisting mostly of peripheral vowels, with nasal vowels not being uncommon. These languages also tend to exhibit vowel harmony where [ATR] is the alternating feature. Narrow Bantu languages typically have five- and seven-vowel triangular systems, though nine-vowel systems occur as well. Vowel harmony is also common in Bantu, though the alternating feature is usually [HEIGHT]. The vowel systems of the Cameroon grassfields, where Mungbam is found, have yet to be subjected to a proper typological analysis. The data that is available suggests that there is no consistent profile adequate for the majority of the languages, but a typical Grassfields language might have one or more of the following features: fricativized vowels, nasal vowels, front rounded vowels, more than one central vowel, and no regular process of vowel harmony. In this section I will discuss some typical properties of the vowel systems of West African languages which have the potential of suggesting an interpretation to the Mungbam vowels.

4.1.2.1.1 Tendency towards large vowel inventories Among the languages of the world, the triangular five-vowel system /ieaou/ is the most common (Maddieson, 1984:126). For languages of equatorial Africa, however, such a system is not the most common type. In a typological study of 100 Equatorial African languages (roughly those found in the proposed Macro-Sudan linguistic area (Güldemann, 2008)), Clements & Rialland (2008:51) found that triangular seven-vowel systems (with either two sets of mid vowels or two sets of high vowels) are approximately twice as common as five-vowel systems with one set each of mid and high vowels. Furthermore, five-vowel systems are not significantly more common than nine-vowel systems with two sets each of high and mid vowels. The nine-vowel triangular system was found to be 73 times more common in the Macro-Sudan area than in the surveyed languages outside of Africa. Ten-vowel systems (with an additional central vowel) are also not uncommon in West Africa.

4.1.2.1.2 Correlation between inventory size and presence of vowel harmony Nine-vowel triangular systems found in African have been described as having five contrasting vowel heights (see, e.g. Casali, 2003). But this does not mean that nine-vowel African languages routinely require the specification of five contrastive vowel heights in phonemic analysis. Instead, phonologists use the feature [ATR], thought to have the articulatory correlate of tongue root advancement/retraction, or pharyngeal volume, in combination with a smaller number of height feature values. Clements & Rialland (2008:51) note that "[i]t is usually the case, outside Bantu, that if an African language has two sets of high vowels it has ATR harmony as well." The tendency is so pervasive that Clements (2000:138) wonders whether "...all African vowel systems with four or five vowel heights should be described with the feature [ATR]." Williamson (2004:128) essentially affirms this: "Nine-vowel triangular systems in West African Niger-Congo languages, in my experience, always have [EXPANDED] vowel harmony; seven-vowel systems often have a reduced form of it; five-vowel systems do not." The tendency for African languages to have larger than average vowel inventories is may be explained by [ATR]-based vowel harmony. Vowel harmony of this type probably helps to stabilize large vowel systems by limiting the number of contrastive vowels which may appear in a given position (Stewart, 1976; Kaun, 1995; Maddieson, 2008).

4.1.2.1.3 Perceptual issues involving [±ATR] vowels African languages with ATR-harmony often have pairs of vowels which are very perceptually close. Typically, the F1 and F2 values of the high [-ATR] vowels /ɩ/ and /ʊ/ are very near or may even overlap with those of neighboring [+ATR] vowels, most commonly mid /e/ and /o/. This situation has presented difficulties for field linguists, to the extent that "...a considerable number of 5Ht West African languages were at one time or another incorrectly analyzed as 4Ht(M) languages due to a failure on the part of some researcher(s) to correctly distinguish [ɩ], [ʊ] from both [e], [o] and [i], [u] in phonetic transcriptions" Casali (2003:329).[9] Lindau (1978:552), noting the overlapping F1 and F2 values of Akan (Kwa; Akanic) /ɩ/ and /e/, went so far as to claim that the two vowels were acoustically merged. A similar overlap is seen for Nawuri (Kwa; Guang) /e/ and /ɩ/ (Casali, 2002), and likewise for Foodo (Kwa; Guang) (C. G. Anderson, 2007). The insufficiency of formant frequency for categorization extends to perception: Fulop, Kari, & Ladefoged (1998:95-7) had a group of Dẹgẹma speakers create synthesized vowels, using the method introduced by Johnson, Flemming, and Wright (1993), to determine the formant values of supposedly hyperarticulated phonetic targets. These vowels, which could only be

[9] Also see the discussion in Hyman (1999:247-8) about a related problem in the description of Bantu languages.

adjusted for F1-F3, were not fully distinct from each other. If two contrasting vowels have the same height and backness (as evidenced by their having the same mean F1 and F2 values), yet are still distinct, they are obviously distinguished by some parameter other than [HEIGHT] or [BACKNESS], and this parameter tends to be [ATR] for a large number of African languages. It is tempting to add to the generalizations of Clements & Rialland and Williamson another one: West African Niger-Congo languages having pairs of contrasting vowels which have overlapping F1 and F2 values almost always make use of [ATR].

4.1.2.1.4 Cross-height vowel harmony *Harmony* in phonology is defined by van der Hulst and van de Weijer (1996) as "a state in which segments agree with respect to their value for some feature within the relevant domain." Harmonic processes in African languages may involve vowels or consonants. Kalenjin (Southern Nilotic) [ATR]-harmony, for example, targets both vowels and consonants (Local & Lodge, 1996, 2004). But vowel harmony is by far the most widely reported and studied harmonic process. Of the types of vowel harmony attested in West African Niger-Congo languages [ATR]-harmony is by far the most common (Williamson, 2004). [ATR]-harmony in West African Niger-Congo and Nilo Saharan languages is surveyeyed in detail by Casali (2008). Although a rather wide range of vowel harmony processes in African languages are described as [ATR]-harmony, it is not certain that all harmony systems where [ATR] is deemed the active feature involve regular alternations in pharyngeal volume. Starwalt (2008:445-6) has suggested that in vowel harmony languages with seven-vowel inventories (/iɩeaoʊu/ or /ieɛaɔou/), the uncrowded nature of the vowel space may allow speakers some latitude in which articulatory strategies they employ to articulate the second-degree vowels (either /ɩʊ/ or /eo/), so that [ATR] would not necessarily be appropriate for describing *articulatory* properties of vowels in these languages. Przezdziecki (2000:386) expresses a similar skepticism about the appropriateness of [ATR] as an articulatory label for (seven-vowel) standard Yoruba. The type of [ATR]-harmony which may be considered canonical, for which regular articulatory alternations have been observed for several of the languages possessing it, is termed Cross-Height Vowel Harmony (CHVH), defined by Stewart (1971:198) as follows:

> Vowel harmony is of this type if, on the basis of the harmony, the vowels of the language

[+ATR]		[-ATR]	
i	u	ɩ	ʊ
e	o	ɛ	ɔ
ə		a	

Figure 4: Ḍẹgẹma vowels

> in question can be divided into two mutually exclusive sets such that (i) the tongue positions of the vowels of one of the sets are high in relation to the tongue positions of their counterparts in the other set, but (ii) the tongue position of at least one member of the relatively high set is lower than the tongue position of at least one member of the relatively low set.

We illustrate a typical CHVH system with data from the Edoid language Ḍẹgẹma. Ḍẹgẹma vowels may be divided into two harmonic sets as in figure 4. CHVH applies within words in Ḍẹgẹma, and may even apply across syntactic word boundaries. In examples (4)-(5) (Kari, 2007:93), the [ATR] value of the verb stem vowel can be described as spreading leftwards across a morpheme boundary to the subject proclitic, and rightwards across a word boundary to the object pronoun. The result is that all of the vowels in (4) belong to the [+ATR] set, and all the vowels in (5) belong to the [-ATR] set.

(4) ə́=kotu ɓə́əw
2PL.NEG=call them.FACT
"Y'all didn't call them."

(5) á=ɓɔm ɓáaw
2PL.NEG=beat them.FACT
"Y'all didn't beat them."

To this example I will add that of of the Ọ̀yọ́ dialect of Yoruba (Yoruboid). In Ọ̀yọ́, vowel harmony involves an alternation between [+ATR] /e/ and /o/ with [-ATR] /ɛ/ and /ɔ/, respectively, as in examples (6)-(7) (Bamgbose, 1967:269).

(6) mɔ lɔ
1SG go
"I went."

(7) mo jó
1SG dance
"I danced."

If the vowels of Ọ̀yọ́ are arranged according to their relative heights (figure 5), it will be seen that of the vowels which participate in the alternation, no member of the "lower" set is higher than any member of the "higher" set. Therefore Ọ̀yọ́ cannot be said to possess CHVH under Stewart's (1971) definition.

i		u
e		o
ɛ		ɔ
	a	

Figure 5: Ọ̀yọ́ vowels

4.1.2.1.5 Historical loss of CHVH As Stewart (1971:204-5) goes on to point out, a language may lose its CHVH by virtue of the loss of its high root-unadvanced vowels (i.e. /ɩ/ and /ʊ/), yet maintain [ATR]-harmony, provided that these vowels merged with other root-unadvanced vowels, *viz* /ɛ/ and /ɔ/. Such a historical change is not at all uncommon, attested, for example, in the Left-Bank Kwa languages Nyangbo and Tafi (Ford, 1973:50-3). Another way in which CHVH may be lost is by drift in phonetic height without any vowel mergers. If, for example, a language has vowel harmony and a total vowel inventory of /iɩeɛaɔoʊu/, then it will have CHVH only if at least one of /ɩ/ or /ʊ/ is higher than /e/ or /o/. Thus, when Elugbe's (1983:83) (basing himself only on data from Isoko (Southwest Edoid)) suggests that the vowels of Proto-Ẹdoid may have had the relative acoustic heights as in figure 6, he is referring to a system which would be lacking CHVH

i		u
e		o
	ə	
ɩ		ʊ
ɛ		ɔ
	a	

Figure 6: Elugbe's (1983) proposal for the vowels of Proto-Edoid and their relative heights

under Stewart's definition, since all of the [+ATR] vowels are treated as phonetically higher than all of the [-ATR] vowels. It could even be ambiguous whether a language had CHVH if /ɩ/ and /ʊ/ were actually at the same height as /e/ and /o/. Such a possibility for the loss of CHVH has not been acknowledged in previous studies, to my knowledge, but such a case would be more of a technicality than a fundamental change in the language's phonology.

4.1.2.2 Phonological properties of [ATR] Having gone over the major issues involving [ATR] in West African languages, I would now like to go into slightly more detail concerning how [ATR] operates in a phonological grammar.

It will be helpful to divide cases of [ATR]-harmony into three types, depending on the domain over which the harmony takes place: either within a morpheme, across morpheme boundaries, or at a V#V juncture. The first type of harmony involves co-occurrence restrictions on vowels in multisyllabic roots, and does not involve spreading of features. Although it can be argued that this type is not a phonological process, but merely a generalization over lexical entries, it is customary for scholars to refer to it as harmony nonetheless (Williamson, 2004:139). Languages possessing harmony of the co-occurrence restriction type differ in the extent to which exceptional disharmonic lexical stems are found. Table 7 gives some examples from Kòhúmónó (Cross River), which has a ten-vowel system similar to that of Dẹgẹma. The second type of [ATR]-harmony may be described as involving the

[+ATR]		[-ATR]	
vìnèǹè	"be awake"	ɛ̀tɔ̀tɔ́ɩ̀	"bee"
èpìnē	"charcoal"	rɛ̀hɔ̄r	"bush"

Table 7: [ATR] co-occurrence constraints on Kòhúmónó lexical items (Cook, 1969)

spread of [±ATR] values across morpheme boundaries. Typically, the allomorph of an affix or clitic is determined by the dominant [ATR] value of the root to which it attaches.[10] Examples (4) and (5) (p. 23) show harmony of this type involving the pronominal proclitic. The third type of [ATR]-harmony involves vowel coalescence processes at word boundaries. This type of harmony is unique in that it only involves two vowels, and only applies when these vowels are separated only by a

[10] It is occasionally possible for affixes or clitics to control alternations in root vowels, a phenomenon termed "strong assimilatory dominance" by Casali (2003:320). See, for example, Kalinowski (2010) for a case of prefix-controlled height harmony in Esimbi (Bantoid).

word boundary. Termed “coalescent harmony” by Casali (2003), this type of harmony has not been accorded as much attention in the literature as the other two types, but has been treated thoroughly by Casali (1996a, 1996b, 2003). In coalescent harmony two vowels merge to a single vowel having the [ATR] feature of one of the vowels. Table 8 gives an example of coalescent harmony in Igede (Idomoid), where the vowel resulting from the coalescence takes the [ATR] value of the first vowel, and the [height] and [backness] values of the second vowel. It seems that coalescent harmony by

/rì ʊ́wɛ̄/	→	rúwɛ̄	“eat fufu”
/yɛ́ īdɔ̄/	→	yīdɔ̄	“see oil”

Table 8: Coalescent harmony in Igede (Bergman, 1971:17)

itself is not enough to support a full CHVH system, as languages with CHVH generally are not restricted to coalescent harmony, but also employ one or both of the other two types of harmony.[11]

This three-way distinction (summarized in table 9) is made to suggest the somewhat obvious point that a language may have [ATR]-harmony only if it has either affixal morphology, roots with more than one contrastive vowel, or frequent occurrence of V-V junctures at word-boundaries. This point becomes relevant in §4.1.4, where Mungbam’s lack of vowel harmony is discussed.

PHONOTACTIC PROPERTIES	
	Agreement constraints on vowels within a stem
PHONOLOGICAL ALTERNATIONS	
	[ATR]-based affixal allomorphy
	Coalescent harmony

Table 9: Summary of three-way division of sound patterns typically referred to as [ATR]-harmony

4.1.2.3 Phonetic properties of [ATR] While scholars of West African languages had for some time been aware of the process which would eventually be termed [ATR]-harmony, it was not until the late 1960’s that a series of developments led to the discovery of its underlying articulatory mechanism. As will be seen, full understanding of the acoustic correlates of pharyngeal expansion has

[11] The CHVH (so-called 5Ht systems) languages in Casali’s (2003) sample which were only listed as having coalescent harmony, Kabiyé (Gur) and Gade (Nupoid), were found by the author, on the basis of sources not consulted by Casali, to also have vowel harmony of the co-occurrence type (Lébikaza, 1999; Sterk, 1977). But the languages in Casali’s sample which have some form of [ATR] harmony but not CHVH (i.e. seven-vowel languages) may have coalescent harmony as their only harmonic process.

yet to be achieved.

4.1.2.3.1 Articulatory correlates Based on observations about the articulations of Akan vowels as well as X-ray tracings for Igbo vowels published by Ladefoged (1964/1968), Stewart (1967) suggested that harmonic sets of vowels in Akan were characterized by either an advanced or a retracted tongue root. Lindau (1979), noting that advancement of the tongue root was generally accompanied by a lowering of the larynx, suggested that [EXPANDED], referring to the pharyngeal volume, would be a more accurate label for the feature. Stewart's original label, [ATR], however, is still the most commonly used in discussion of this phenomenon. More recently, MRI (Tiede, 1996), ultrasound (Gick et al., 2006) and laryngoscopic (Esling & Harris, 2005; Edmondson & Esling, 2006) studies, though usually limited to one or two languages, have helped to refine the understanding of the articulatory basis of [ATR].

A more precise description of the articulatory mechanism underlying [ATR] alternations is given by Edmondson & Esling (2006:159,178-82) and Esling (2005:19-21). On the basis of laryngoscopic data from Akan, Kabiyé, and Somali, they describe [-ATR] vowel articulations as involving two simultaneous gestures: contraction of the hyoglossus muscle, which retracts the tongue root and raises the larynx, and contraction of the aryepiglottic and oblique arytenoid muscles (cf. Hardcastle, 1976:75-8), which causes a buckling of the aryepiglottic folds towards the epiglottis. The closure formed by the latter process is referred to as the aryepiglottic sphincter. Languages which have voice quality differences associated with [±ATR] vowels may employ additional gestures. Somali [-ATR] vowels, for example, are additionally produced with lateral incursion of the false vocal folds, giving them their characteristic "harsh" quality (Edmondson & Esling, 2006:175-8).

Here it is important to remember that although we can make some useful generalizations about the type of articulation involved in tongue root contrasts, similar articulations will have small but perceptible differences across languages. Guion, Post, & Payne (2004:518), for example, mention the inability of one of the members of their research team, a native speaker of Akan, to perceive tongue root differences between Maa (Eastern Nilotic) vowels. Also it is important to remember that although there is usually a relationship between phonological sets of vowels and a particular physical parameter, the relationship is not necessary. Lodge (2009:77) notes, for example, that while van der Hulst and van de Weijer (1996) consider a prototypical [ATR]-harmony system to contain [+ATR] /a/ and [-ATR] /ɑ/, in the Tugen dialect of Kalenjin /a/ belongs to the [-ATR] set and /ɑ/ belongs to the [+ATR] set.[12] Bearing this in mind, it should not be surprising that vowels can shift diachronically from one phonological group to another. Andersen (2006) gives the example of how Proto-Western Nilotic [+ATR] /*i/ and /*u/ became [-ATR] /ɩ/ and /ʊ/ in Jumjum (Western Nilotic).

4.1.2.3.2 Acoustic correlates Research into the acoustic correlates of [ATR] articulations has suggested some possible measures which are useful for some vowels of some languages, but no clear correlate which applies to all cases. Part of the reason for this may be due to the variations in articulation described in the two preceding paragraphs. One pattern, predicted by simple acoustic modeling (Halle & Stevens, 1969:211) involves the lowering and centralization of root retracted vowels with respect to their root advanced homologues. The reported language facts generally support this prediction, though there are exceptions, as with Ikpɔsɔ (Kwa; Left Bank) /i/ and /ɩ/, which overlap with each other in F1 and F2 (C. G. Anderson, 2003:16). The tendency for overlap between adjacent [+ATR] and [-ATR] vowels, mentioned in §4.1.2, strongly suggests that there are acoustic correlates besides shifts in F1 and F2.

A handful of studies have sought to establish acoustic indicators of tongue root advancement or retraction beyond perturbations in F1 and F2. All of these have sought a way of measuring differences in the acoustic impedence of the pharyngeal walls due to changes in pharyngeal volume. Acoustic losses in the region of the first three formant have been modeled by Fant (1972:41-4), who also proposed an empirical equation for determining formant bandwidths on the basis of Swedish data reported by Fujimura and Lindqvist (1971).

Hess (1992), using data from one Akan speaker, found a reliable difference in B1 between [±ATR] vowels having similar F1 values, with root retraced vowels having higher B1 values. For pairs of

[12] See Esling (2005) for discussion on why the articulatory relationship between [±ATR] low vowels should be expected to be much less consistent than it is for high vowels.

vowels not having similar F1 values, she considered differences between measured B1 values and values predicted on the basis of F1 from Fant's equation. Root retracted vowels were found to show a greater divergence from Fant's equation than root advanced vowels. Hess additionally meausured spectral tilt, or the differential between the intensity of the first and second harmonics, which has been shown to be sensitive to phonation type (Gordon & Ladefoged, 2001:397-9). No correlation was found for this measure. This method was replicated by C. G. Anderson (2003), using Ikpɔsɔ data. No reliable differences were found in B1, but an effect for spectral tilt was observed.

A less specific measure, which has the advantage of being easy to compute accurately, is spectral center of gravity (COG). Edmondson (2009) proposed this measure, believing that it would correlate with the perceptual quality of "flatness," as described by Kingston, Macmillan, Dickey, Thorburn, and Bartels (1997), and, using Akan and Kabiyé data, found an effect for [ATR], with root retracted vowels having higher COG. C. G. Anderson (2007) found a similar effect with data from Foodo (Kwa; Guang). Since COG necessarily takes the full spectrum into account, it is susceptible to various factors, including the value of the first three formants, and the presence of noise at higher frequencies.

Fulop et al. (1998), used a somehwat sophisticated procedure, employing a model which calculated a vowel's spectrum on the basis of the contribution to the overall spectrum by each formant. They computed a measure, called normalized $A_1 - A_2$, which compares the difference between the measured intensity of the harmonics nearest F1 and F2 and the theoretically calculated intensities for the same F1 and F2 values, again using Fant's (1972) model. Acoustic losses in the F1 region would be reflected by a negative normalized $A_1 - A_2$ value. Although this measure showed an overall significant effect for [ATR], it was only significant for two of the five [$\pm$ATR] pairs.

With the caveat that previous studies have not been fully consistent in their findings, I will summarize by noting that [-ATR] vowels generally differ acoustically from [+ATR] vowels in one or more of the following ways: they are lower, more centralized, and/or have greater acoustic losses at low frequencies.

4.1.2.4 Summary Vowel systems in languages of West Africa are characterized by their large inventory size, and their tendency to employ vowel harmony processes, especially CHVH. Languages with CHVH often have pairs of vowels which are very close perceptually, and may actually overlap in mean F1 and F2 values. This fact may explain the fact that historical mergers involving high [-ATR] are well-attested in languages having lost CHVH. When [ATR] as a phonological feature is referred to in a language desscription, it is usually the case that the feature is posited on the basis of its alternation in a vowel harmony process, rather than on the basis of a strict necessity of using it to characterize a lexical contrast. It is most likely that this is why the phonetic correlates of [ATR] have only recently been described in a satisfying way. While it is possible to make a generally accurate characterization of the articulatory correlates of [ATR], there seems to be considerable language-particular variation in the acoustic manifestation of [ATR], with the result that no necessary and sufficient set of acoustic properties can be referred to as being diagnostic of [±ATR].

4.1.3 What is a feature? Two approaches

The formal description of phonological phenomena requires a set of phonological primitives, usually understood to be distinctive features. Before proceeding to a phonological analysis of the Mungbam vowels, it is important to briefly survey the major approaches to defining features. Up until this point, I have been referring to the features that characterize lexical contrasts, and those that characterize phonological alternations, as if they were the same thing. But this is not assumed to be true in every theoretical framework. In this section I will examine such an assumption, and distinguish two basic approaches to phonological theory that arise from either accepting or rejecting it. In answering the question of whether Mungbam makes use of a feature [ATR] in its phonology (§4.1.4), I will adopt the more conservative approach for expository reasons, since it allows for a wider variety of observations to be expressed in a perspicuous manner, and also permits us to explore the consequences of the opposite aproach once the analysis is complete.

Kiparsky (1968/1973:5-6), whose terminology we will employ here, terms two of the main theoretical approaches to phonological analysis (and thus to defining features) “process morphophonemics” and "abstract morphophonemics."[13] The two approaches involve clear differences in assumptions about what features are, and how they should be defined, along the lines suggested above. The distinction between the appraoches is roughly as follows: in process morphophonemics, there is assumed to be a set of unviersal phonetic features which characterize *both* lexical contrasts and phonological patterns; in abstract morphophonemics, the features used to characterize phonological patterns do not have to have a universal phonetic base, although it is frequently possible to interpret them phonetically.

4.1.3.1 Features with a universal phonetic base All versions of process morphophonemics involve the assumption that phonetic representations are made of some more- or less-organized combination of universal phonetic features. Chomsky & Halle (1965:119) claim, dramatically, that "...all phonology breaks down if we do not assume analysis on the phonetic level in terms of universal phonetic features." (see also Chomsky 1964:66-7; Chomsky, 1965:160) Representation at the phonological level is in terms of the same kinds of features. What is not clear is what the features are made of. One approach is to consider that features are the minimal units which are capable of bearing phonetic contrast in any language, and that they are associated with invariant physical correlates. The feature sets proposed by Williamson (1977); Lindau (1978); Ladefoged (1989); Ladefoged and Maddieson (1996) generally adhere to this principle. One problem with this is the well-documented lack of invariance in feature specifications (see Ladefoged, 1980; Lindau & Ladefoged, 1986) cross-linguistically. One proposed solution involves increasing the number of features (perhaps considerably) by requiring features to encode characteristic phonetic differences between similar sounds in different languages, provided that these cannnot be explained by dispersions effects (cf. Liljencrants & Lindblom, 1972; Flemming, 2005), phonetic underspecification (cf. Keating, 1988; Hale, 2000) or context. Proposals for increasing the representation of phonetic detail in universal features have been endorsed mainly by Peter Ladefoged (1967, 1971, 1977), but also more recently by Hale, Kissock, & Reiss (2007:659-60). Another proposal for dealing with lack of invariance, endorsed by some Soviet phonologists, has been to allow for the enlargement of the domain over which features operate, from segments to rhymes or whole syllables (Fischer-Jørgensen,

[13] It would also be possible to interpret these types of approach roughly in terms of Haspelmath's (2010) distinction between "categorial particularism" and "categorial universalism."

1975:329-30; Liberman, 1981:726 Bondarko & Zinder, 1968). Such an approach has generally not received much attention.

The issue of lack of invariance has not been an impediment to most scholars in generative phonology because they prefer an "abstract" feature, only loosely based on measurable physical output. The approach is described by Postal (1968:xii) as follows: "[The] choice of representation of forms is based on considerations of morphophonemic alternations, word and morpheme boundaries, morpheme identity, and Surface Syntactic Structure, as well as on considerations of phonetics and contrast." While this approach has yielded a large number of elegant and revealing analyses for individual phenomena (see, for example, Halle (1975:533-4); S. R. Anderson (1981); Goldsmith (1987)), it tends to encourage "tampering" with the phonetic features, as they are to be chosen more with an eye towards making phonological rules more simple and general than towards reflecting the phonetic facts (see also Hale & Reiss, 2000). In these cases, it is not possible to verify that a particular feature has the phonetic base that it is claimed to have.

4.1.3.2 Features with no intrinsic phonetic interpretation The approach termed abstract morphophonemics is reminiscent of present-day research in typology (e.g. Dryer, 1997; Haspelmath, 2010) in that it avoids the use of universal categories in language descriptions. In abstract morphophonemics, phonological primitives are defined in terms of the phonological patterns actually present in a language, without referring to the phonetic form. Phonetic interpretation of features is language-specific, so universal phonetic features are dispensed with, except perhaps when their names are employed as comparative labels. Perhaps the earliest example of this approach is the glossematic theory of Hjelmslev and Uldall (see Fischer-Jørgensen (1975:114-43); S. R. Anderson (1985:140-68); Fudge (2006:88-94)). Since Fudge's (1967) influential paper (see Kiparsky, 1968/1973 for a critical discussion), the approach has not received significant attention until relatively recently. Work by British phonologists, namely Ken Lodge (2007, 2009), has been devoted to this approach, and the approach has gained some exposure in the mainstream community since Hyman's (2002) "abstract" analysis of vowel harmony in Kàlɔ̀ŋ (Bantu A.50). Since an abstract morphophonemic analysis involves identifying features on a language-specific basis, it is not obviously compatible with a theory of universal phonetic features. Kiparsky (1968/1973:8) criticizes it on these grounds, noting that "no general, universal statements about the structure of underlying forms are possible." It is probably correct to claim that for practitioners of abstract morphophonemics, the quest for phonological universals is secondary to a principle of avoiding procrustean analyses. Hyman (2002), for example, employs the term "bottom-up," in the sense of Gil (2000:174-5); Gil (2001:126-8); Nichols (2007:231); Epps (2011:644), to characterize his approach. He shows that the vowel features defined for Kàlɔ̀ŋ on language-specific grounds all happen to be interpretable as variants of the familiar universal features. Hyman interprets this as a virtue of the abstract approach, though the same result may be interpreted as a weakness, since, as S. R. Anderson (1985:153) notes, "...the categories of linguistic form show too close a relationship to those of substance to allow linguistis to treat this relationship as some sort of extrasystemic consideration, or even as a colossal accident."

4.1.4 Is Mungbam an ATR language?

I will now attempted to answer the question posed at the beginning of §4.1. It has been shown (§3.3) that [ATR] is preferable to [HIGH] for expressing lexical contrasts in Abar and Biya, but up to this point I have not given any evidence for whether [ATR] is needed to characterize any of the langauge's phonological patterns. In this section I will consider the phonological patterns relevant to vowels which are found in Mungbam in order to determine which features can be said to be phonologically active in the language.

4.1.4.1 Which kinds of data to consider The types of phonological patterns considered in this section are generalizations about distributional (i.e. phonotactic) properties, and about meaning-preserving alternations. Features needed to make generalizations about lexical contrasts are considered to be relevant to phonetic features, and are not considered to be of the same kind as those needed to express generalizations about alternations and distributional characteristics. This assumption is at odds with the foundational assumptions of process morphophonemics (§4.1.3), so I would like to briefly justify it.

The best consensus about the amount of phonetic detail that should be encoded in phonetic representations comes from data involving lexical contrasts. A principle that is generally tacitly acknowledged is that if a particular phonetic detail is contrastive in some language of the world, then it should be represented at the phonetic level in a phonological grammar. This step, though clearly an idealization, is necessary if the same set of phonetic features are supposed to be available for describing all languages.

The features which create lexical contrasts are not discovered by the linguist in the same way that phonological features are. Phonological features represent natural classes of segments which pattern in similar ways, and identifying natural classes does not require careful attention to phonetic detail. The features which produce lexical contrast, on the other hand, are determined solely on the basis of phonetic evidence.

To make this point clear, I will give a simple example concerning the sound system of Shupamem (Bantoid, Mbam-Nkam).[14] In order to make clear the role of of phonetic detail, I will hide nearly all of the phonetic facts until the end of the presentation. In Shupamem, some of the consonants which contrast when followed a word-initial nasal are $\{a_1, a_2, a_3, a_4, a_5\}$. Furthermore, the following alternation obtains for the initial consonants of verb stems when a nasal nominalizing prefix is added:

(8) $$\left\{\begin{matrix} b_1 \\ b_2 \\ b_3 \end{matrix}\right\} \longrightarrow \left\{\begin{matrix} c_1 \\ c_2 \\ c_3 \end{matrix}\right\}$$

From (8), we can establish a paired correspondences between each b_i and c_i. We can simplify the presentation of (8) by stipulating that there is some feature [F] such that each b_i is [+F] and each c_i is [-F]. For the consonants of the a set, we can stipulate that each a_i has a certain value for a feature [F′], such that consonants having this feature value may follow a nasal. It is obviously impossible to establish paired correspondences between any two members of the a set without further data.

[14] Thanks is due to Laziz Abdoulaye Ncharé for making me aware of this data in his native language.

Once the veil is lifted from the phonetic substance of the segments in question, everything changes. The a set becomes immediately familiar and is readily decomposed as in (9).

(9)

	[LABIAL]	[CORONAL]	[DORSAL]
[-VOICE]		t	k
[+VOICE]	b	d	g

The alternation in (8), on the other hand, is not clarified by a consideration of the phonetic detail revealed in (10). Because lexical contrast can only be characterized with reference to phonetic detail, I am here considering it to be a purely phonetic phenomenon. Conversely, distributional patterns and alternations are considered to be a different type of phenomenon because they can be characterized when the phonetic details are almost completely obscured.

(10)
$$\begin{Bmatrix} p \\ l \\ \text{ɣ} \end{Bmatrix} \longrightarrow \begin{Bmatrix} b \\ d \\ g \end{Bmatrix}$$

A sort of compromise is presented by Clements (2001), who proposes that features in a phonological grammar be employed on a three-tiered basis. On the top tier are those features needed for lexical contrasts in a language. The second tier contains all the features of the first tier, plus any additional features needed to describe phonotactic and phonological patterns. The third tier, finally, includes all of the feature from the second tier, plus any additional features needed to describe language-specific phonetic details. The problem with this system is that the nature of a particular lexical contrast can only be determined by examining the phonetic details of the contrasting segments, so it is not immediately clear how to decide which features belong in the first tier, and which belong in the third tier. Instead of using a two-tiered system where lexical contrasts and phonetic detail make use of the same type of features, Clements' model requires some kind of winnowing procedure (a proposed universal "accessibility hierarchy" (2001:78ff.)), which assigns some part of the phonetic detail to the highest tier and sends the rest to the least-important tier. A practical issue with this approach for assigning features is that the features available for the lexical contrast tier, and their relative ordering on the accessibility hierarchy, have been determined on the basis of the most common types of segmental contrasts (mostly between consonants) in the world's languages. It will then of course be difficult to apply in a consistent way to languages with rare types of contrasts. The phonetic parameters proposed by Ladefoged (1971); Williamson (1977); Lindau (1978); Ladefoged and Maddieson (1996), on the other hand, have been especially chosen to accomodate unusual cases, so they can be applied in a more consistent manner.

Because features for lexical contrasts and for phonological patterns are determined by considering different kinds of evidence, and because integrating the two (as in the three-tier model discussed above) introduces stipulations which can lead to arbitrariness in analyses, I have chosen to keep the features chosen on the basis of lexical contrasts in §3.2 separate from those chosen on the basis of phonological patterns. When each set of features has been constructed in its own way, we can then compare them to see how well they mix, rather than mixing them from the very beginning. This I consider to be the main virtue of the abstract approach.

I will now turn to an examination of the phonological patterns present in Mungbam, and show how they are divided into natural classes.

4.1.4.2 Features referring to either or both of the highest series of vowels As mentioned in §3.2, the highest series of vowels have spirantising effects on preceding consonants. To take an example, let us consider a pair of words (This example is valid for Biya, Abar and Ngun dialects), /ídí̋/ 'candle sap' and /ídé̋/ 'bean'. In the first word, the consonant is apico-alveolar, prevoiced and aspirated. In the second word, and in all other contexts, it is lamino-dental and fully voiced. We might transcribe these phonetically as [íd̥ʰí̋] and [íd̻é̋], respectively. While this phonotactic pattern is relevant to both /i/ and /u/, others must refer to one or the other, but not both. The labiovelar consonants /k͡p/ and /ɡ͡b/, for example, may not precede /u/ in any dialect. And in Abar, Biya and Ngun roots, the velar stop consonants /k/ and /g/ may not appear before /i/.[15] The sibilant sounds /s/ and /z/ additionally do not appear before /i/ in any dialect. To state these distributional generalizations, we need a feature to refer to the highest set of vowels, which have spirantising

[15] In Munken, where this restriction is not present, the cognate word meaning 'candle sap' is /íɡí̋/.

effects on neighboring consonants, and also a feature to distinguish /i/ from /u/.

4.1.4.3 Features needed to capture distributional asymmetries As noted in §2, accent is partly manifested by asymmetries in the number of contrastive vowels. Vowels in unaccented syllables, including noun class prefixes, grammatical particles, and the final vowels of nouns and verbs with disyllabic stems (i.e. unaccented stem vowels). Non-stem vowels are limited to /iuəa/. Unaccented stem vowels are even more restricted: if they appear in the context V́h__ , where V́ is the accented stem vowel, then they must be identical to V́. In all other cases they must be a "neutral" vowel. The neutral vowel is /ɔ/ in Abar (filling the gap in table 5) and /ə/ in the other dialects. To state the generalizations involving paradigmatic asymmetries, we would need a feature which can refer to a neutral vowel[16], and also a feature which can refer to the vowels permitted in unaccented positions, /iuəa/.

4.1.4.4 On the lack of vowel harmony As there can only be one contrastive vowel in each root, Mungbam cannot have vowel harmony of the cooccurrence type. The only productive affixation process, noun class prefixation, involves invariant prefixes having a restricted set of vowels, so there is no vowel harmony of the allomorphic type. There appear to be no system-wide rules of vowel coalescence, although there is some vowel merger in casual or fast speech. On the basis of the forms shown in table 10 for Biya, the coalescence seems to involve neutralization to /ə/ or complete assimilation, and not spreading of a single feature. Although I have not thoroughly investigated this phenomena, it seems to not be very pervasive even when it is licensed; given that most words start with consonants, opportunities for vowel coalescence are not as numerous as in languages like Igede (see p.26, above), where most nouns have the shape VCV. Bergman (1971:16) found for his text sample that coalescence applied at 20% of all morpheme and word junctions. The figure would be much lower for any Mungbam dialect. Accounting for vowel coalescence in fast speech does not appear to require any additional features.

[16] Another option would be to underspecify the representation of the neutral vowel.

CAREFUL	RAPID	GLOSS
ńyshì w**ù** **ā**lə̄ nyà dīn	ńyshì w**ə̀** **ə̄**lə̄ nyà dīn	"Wasn't she living there?"
y**ɛ̄** **à** gɔ̀ŋ wè	y**ā** **à** gɔ̀ŋ wè	"That it's only him..."
ìs**à**l**ə̄**	ìs**àā**	"to decide"

Table 10: Vowel sandhi in Biya rapid speech

4.1.4.5 Vowel alternations in verb stems A final phonological process[17] that can be considered is ablaut, to which perhaps 25% of all verbs are subject. Verbal lexemes participating in ablaut will have different stem vowels depending on whether the verb is in the perfective or imperfective aspect. Only monosyllabic verb stems which end in a vowel are subject to ablaut, and not all such verbs participate.

PERFECTIVE	IMPERFECTIVE	GLOSS
jî	jû	'eat'
wî	wû	'slap'
dzē	dzō	'plant'
féɛ̋	fɔ́ɔ̋	'do housework'
kɪ̄	kēa	'fell'
fɪ̂	fâ	'give'
sēa	sēa	'tear'
kêa	kêa	'demand repayment'
ŋə̂	ŋɔ̂	'plant a tree'
kə̄	kɔ̄	'pluck'

Table 11: Biya verb stem ablaut. All verbs carry a tone corresponding to the jussive form.

Table 11 gives examples of some PFV—IPFV verb stem alternations in Biya. The Biya central vowel /ə/ patterns with the front vowels in this process. To the extent that the process is regular and productive, it involves an alternation between a front vowel and a back vowel of the same height. That is to say that the active feature would be backness. But there is so little regularity in the process that it may be best to consider it suppletive in the synchronic grammar. To account for the productive examples of this alternation would not require an additional feature.

[17] There is additionally reduplication of verb stems. While the details of this process have not fully been worked out, the vowel of the reduplicant is always /ə/, /i/, or /u/, with the choice of vowel apparently determined by the initial consonant of the verb stem as well as by the stem vowel. Crucially, reduplicant syllables do not differ from unstressed syllables with respect to the vowels which they may contain.

4.1.4.6 A possible analysis in terms of natural classes The problem with analyzing the segmental phonology of Mungbam is a problem common to languages with mostly isolating morphologies: the phonological patterns underspecify the representation. The phonotactic evidence presented suggests five natural classes: {i,u,ə,a}, {i,u}, {i}, {u}, and {ə/ɔ}. The only type of phonological alternation which targets a feature rather than a segment, vowel ablaut, is highly irregular, and is probably best treated as suppletive. The features used to represent these natural classes do not have intrinsic phonetic content, so they do not have to be represented in a way that is suggestive of their acoustic properties. For the same reason the choice of labels is arbitrary, and they are chosen here for their transparence in suggesting the sound patterns that are relevant to them. The label [STRONG], for example, refers to all of the vowels which may not appear in an unaccented position. If some of the natural classes involved segments that had some salient phonetic property in common, an appropriate label could have been chosen to reflect that fact. The phonological patterning of the Abar vowels is represented in figure 7 as an inheritence hierarchy.

This method of representation has the advantage of being applicable to all of the five dialects, since the phonotactic patterns described above are applicable to all of them. The fact that the phonology of the language underspecifies the classification of the vowels is reflected in the fact that some of the terminal nodes contain more than one vowel. That the phonology does not *overspecify* the classification of the vowels is reflected in the fact that the diagram has no multiple-inheritance relationships. These are observations that are readily apparent from the type of representation shown in figure 7, but are not at all apparent from a presentation like that of table 5.

4.1.5 Conclusion

Figure 7 does not contain any natural class which refers only to [+ATR] or to [-ATR] vowels, so under an abstract analysis we can say that a feature recognizable as [ATR] is not part of the language's phonology. However, from a process morphophonemics standpoint, since [ATR] is needed to represent a type of lexical contrast, then it must be part of the language's phonology, because phonetic and phonological features are considered to be of the same type. Under a process morphophonemics interpretation, the labels in figure 7 would be cover terms for combinations of features

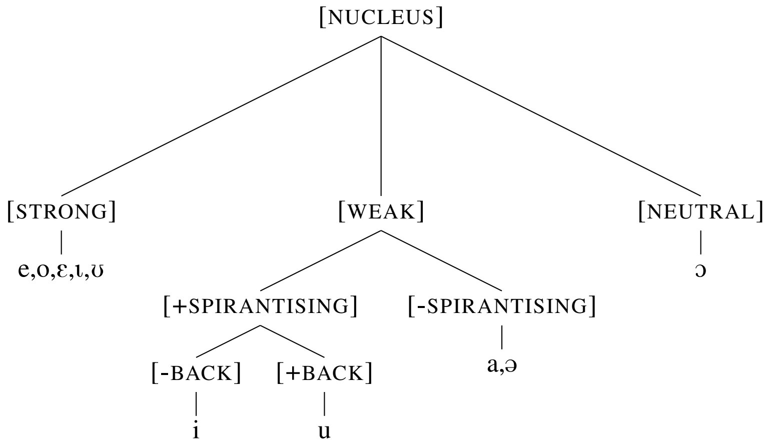

Figure 7: Phonological classification of Abar vowels represented with an inheritance hierarchy

(cf. Vennemann and Ladefoged (1973)). For example,

(11)
$$\begin{bmatrix}\text{STRONG}\end{bmatrix} = \begin{bmatrix}\text{HEIGHT } 1 \\ \text{-ATR}\end{bmatrix} \cup \begin{bmatrix}\text{HEIGHT } 2 \\ \text{+ATR}\end{bmatrix} \cup \begin{bmatrix}\text{HEIGHT } 2 \\ \text{+FRONT} \\ \text{-ATR}\end{bmatrix}$$

The abstract phonological analysis, which represents lexical contrasts separately from other sound patterns, can not only be clear and insightful, but can also be translated without difficulty into a process morphophonemics analysis. In the case of Mungbam, the dual nature of the representation allows us to make clear the observation that the language probably uses [ATR] for lexical contrasts, but that that feature is not phonologically active.

4.2 Towards an explanation for Mungbam vowel systems

In this section I would like to discuss some possible diachronic motivations for the development of vowel systems like those found in Mungbam. Historical change in some structure of a language may be random and spontaneous, with no non-universal motivation, it may be motivated by interactions with other structures also present in the language, or it may be motivated by influences from other languages, as in a language contact situation. The purpose of this section is to explore the latter two types of explanation. In §4.2.1 I will discuss a possible historical scenario where a former vowel-harmony system in Mungbam was lost as a result of the development of word-accent. In §4.2.2 I draw attention to the possibility of interpreting structural phenomena in Mungbam and neighboring languages as the result of areal typological processes, highlighting some reasons for identifying the area where Mungbam is spoken as a typological buffer zone.

4.2.1 Diachronic mechanisms for the loss of CHVH

4.2.1.1 Loss via system-wide vowel mergers The possibility for languages possessing CHVH to lose that harmony is well-documented in the literature. Generally, mergers involving the vowels /ə/, /ɩ/ and /ʊ/ cause a ten-vowel system, similar to that of Dẹgẹma (table 4, p. 23) to be reduced to a nine-vowel and finally to a seven-vowel triangular system. CHVH is lost, but a reduced form of harmony may still survive (Williamson, 1973; Ford, 1973). Dialects of Yoruba (Bamgbose, 1967; Przezdziecki, 2005) and of Ẹdoid (Elugbe, 1983) show a range of vowel harmony systems at varying degrees of reduction, with the most reduced type being a seven-vowel system where harmony is no longer productive and is only evident as co-occurrence restrictions for vowels in disyllabic roots, as in Standard Yoruba. In these cases, vowel mergers may be said to be distributed more or less equally throughout all of the subsystems of the language's phonology, so that the vestiges of the former harmony system remain observable.

4.2.1.2 Loss via position-specific vowel mergers Another logical possibility is for vowel mergers to proceed *unevenly*. In this scenario, different subsystems of the language's phonology undergo vowel mergers to different extents, such that distributional asymmetries develop. In the extreme case where only one syllable in each phonological word could exhibit the full set of vowel contrasts, with the other syllables having a sharply reduced set of available contrasts, any former vowel harmony that applied within roots would be lost. What is interesting in this scenario is that the modified system would be less likely to retain traces of the former harmony system than if mergers had been evenly distributed. The two types of scenarios for the loss of CHVH are presented in table 12. There

SCOPE OF VOWEL MERGERS	EFFECT ON VOWEL HARMONY
Symmetric across positions	Reduction
Asymmetric across positions	Complete or near-complete loss

Table 12: Two ways to lose CHVH via vowel mergers

are two reasons for being mindful of this distinction. Firstly, attested cases of phonological change usually involve a specific conditioning environment. Williamson (1983-4:67-9) notes, for example, two cases of system-specific vowel mergers: in one case, a merger of /ə/ to either /e/ or /o/ in the Central Delta languages Abua and Ogbia was found to have taken place in the first syllable of verbs, with final syllables still retaining /ə/. Likewise, the loss of /ə/ in certain Ịjọ dialects was found to have affected initial syllables of verbs earlier than final syllables. What would be crucial in these cases, should subsequent vowel mergers take place, is whether these mergers have the effect of reducing, or of amplifying, asymmetries between the different positions within the word.

Second, viewing vowel mergers in terms of their contribution to symmetry between phonological subsystems offers a clue about the endpoint of a historical process involving position-asymmetric vowel mergers. This endpoint would be a system with a different type of prominence asymmetry than that of a CHVH system: one position in the word would have prominence not as a trigger for vowel harmony, but as a position where a significantly larger number of contrastive vowels could appear. As remarked in §1, such a prominence asymmetry has been analyzed by scholars as a word-accent phenomenon. A hypothesis about the relationship between word-accent systems and vowel harmony systems in West Africa becomes apparent: namely, that the two may be in some sense incompatible within the same language. I will now explore this hypothesis in some depth, focusing on word-accent phenomena in languages of Cameroon and Nigeria.

4.2.1.3 The development of word-accent in languages of Nigeria and Cameroon Word-accent, where one constituent of each phonological word has phonological and/or phonetic properties which give it prominence above others, has been identified in a number of languages in Eastern Nigeria and Western Cameroon, as well as in Northwest Bantu languages (Downing, 2004:120; Larry Hyman, p.c.). Since these languages are all tonal, one of the most common phonetic correlates of stress-accent, increased pitch, is generally not available for the purpose of word-accent. But, as tends to be the case in stress-accent languages, the position of prominence within a phonological word is marked by distributional asymmetries, such that the number of possible vowel and consonant contrasts is significantly greater in the position of accent than it is elsewhere. This type of accent has been termed "etymological accent" by Meinhof & Struck (1915:72-6) because of its tendency to fall on the first syllable of a stem. Saker (1855:5) was perhaps the first to document this type of accent, in Duala (Bantu A.20): "Many words receive accessions both as affixes and suffixes, but the accent is not thereby disturbed..." A useful way of illustrating the content of hypotheses is to

NUMBER OF CONTRASTS	LANGUAGE	SOURCE
V_1: 9, V_2: 1 (predictable from C_2)	Mankon (Mbam-Nkam)	(Leroy, 2007:13-4)
V_1: 7, V_2: 1 (predictable from V_1)	Ejagham (Ekoid)	(Watters, 1981:42-3,76)
V_1: 7, V_2 is non-back in verbs[18]	Gokana (Kegboid)	(Hyman, 2011+)
V_1: 6, V_2: 4	Ibibio (Lower Cross)	(Akinlabi & Urua, 2002:148)
V_1: 7, V_2: 3	Koyo (Bantu C.24)	(Hyman, 2004)

Table 13: Number of different vowels permitted in V_1 and V_2 position in $C_1V_1C_2V_2$ stems in some languages of Cameroon and Nigeria

imagine a realistic scenario under which they might be falsified. I would like to clarify my hypothesis, then, by way of presenting data for an imaginary language which would contradict it. In this case, the hypothesis is that word-accentual systems of the type found in Cameroon and Nigeria are incompatible with CHVH systems of the type found in West Africa. I would like to imagine what it would look like for a language to have a full CHVH system like that of Akan or Degema, as well as a word-accent system similar to that of Mankon, Ejagham or Mungbam, where all vowels may appear in stem-initial position, and only one or two different vowels could appear in prefixes or in non-initial stem syllables. For the sake of concreteness, let us imagine that the language may have one of ten different vowels (/iɪeɛaɔoʊu/) in stem-initial position, only one vowel in non-initial stem syllables (/a/), and one of two vowels in affixes (/uʊ/). Let us further imagine that the vowels divide into two sets: [+ATR] /ieou/ and [-ATR] /ɪɛɔʊ/, with /a/ being neutral with respect to the harmony process. I can think of two possible conditions under which such a language could be described as possessing [ATR]-harmony, which I illustrate in table 14 with some imaginary examples. For both languages we can identify the same underlying verb forms (/sema/, /sʊma/, /sama/) and the same underlying affixes (/u/, /bʊ/).

Imaginary Language 1 has vowel harmony which is stem-controlled, so prefixes alternate depending

[18] For nouns, the distribution of vowels is mostly restricted to the following combinations: $V_1 = V_2$, a-i, i-a, a-a. This data also appears in an earlier version of the same paper, available as Hyman (2010:105-6).

IMAGINARY LANGUAGE 1		IMAGINARY LANGUAGE 2	
sema	'preen!'	sema	'preen!'
sʊma	'peck!'	sʊma	'peck!'
sama	'scratch!'	sama	'scratch!'
u-sema	'it preened'	u-sema	'it preened'
ʊ-sʊma	'it pecked'	u-suma	'it pecked'
u-sama	'it scratched'	u-sama	'it scratched'
bu-sema	'they preened'	bʊ-sɛma	'they preened'
bʊ-sʊma	'they pecked'	bʊ-sʊma	'they pecked'
bʊ-sama	'they scratched'	bʊ-sama	'they scratched'

Table 14: Examples from two imaginary languages having both word-accent and [ATR]-harmony

on the [ATR] value of the stem vowel. Such a vowel harmony process would be considered as defective, since although there is evidence for dividing the vowels into two sets on the basis of [ATR], no correspondences between pairs of vowels other than /u/ and /ʊ/ could be established. On the other hand, Imaginary Language 2 has *prefix-controlled* vowel harmony, so the stem vowel alternates depending on the [ATR] value of the prefix. In this case, all vowels save /a/ participate in the harmony process, and such a system would have to be described as exhibiting CHVH. The discovery of such a language would show that CHVH and word-accent are not completely incompatible. But telling from what is known about vowel-harmony systems cross-linguistically (e.g. that vowel harmony is usually stem-controlled), languages like Language 2 are expected to be very rare. Furthermore, only one sound change (i.e. merger of prefix /u/ and /ʊ/) would separate hypothetical Language 1 from a language like the Abar dialect of Mungbam, with a phonetic [ATR] distinction but no vowel harmony.

The discovery of two closely related languages, where one has CHVH but no word-accent, and the other has word-accent and no CHVH, would also be relevant to my hypothesis. Such a discovery would show that the historical pathway proposed here is actually attested. This would obviously lend support to the hypothesis.

Since the development from a CHVH system to a stem-initial accent system would involve a sharp reduction in the number of vowels which could appear both in non-accented stem syllables and in affixes, the obvious question is whether Mungbam developed a word-accent system at the expense of a former vowel harmony system.

4.2.2 Consideration of areal effects

In typological studies involving Niger-Congo languages it is customary to consider Narrow Bantu languages separately from the other languages, dividing Niger-Congo languages into two basic types: "Kwa"-type languages in West Africa and "Bantu"-type languages of Southern and Equatorial Africa (see Good, in press, submitted; Hyman, 2004). Bantu languages tend to have long words, agglutinating morphology, agreement marking on nouns and verbs, and relatively small vowel and tone inventories. They often exhibit stress-accent, most typically on penultimate syllables, but also on stem-initial syllables Downing (2004:121). Kwa languages tend to have short words, mostly monosyllabic verbs, isolating morphology, large tone and vowel inventories, and, as discussed above, [ATR]-based vowel harmony. Languages found between these two areas would be exposed to conflicting areal pressures.

The major effect of linguistic areas is to create and preserve structural homogeneity between languages (Dryer, 1989:267-8). An interesting case is those languages lying within so-called "buffer" zones, or regions on and around the borders of different linguistic areas. Stilo (2004:38-40) claims that languages in buffer zones tend to have hybrid profiles combining features common to either of the areas, even if this means acquiring a set of properties that violate implicational universals (see, for example, Stilo (1987, 1994, 2004); Koptjevskaja-Tamm (2011) and references therein). The prediction with respect to the Cameroonian Grassfields and Eastern Nigeria is that the languages spoken in these areas will, as a response to conflicting areal pressures, develop typologically unusual properties.

Regardless of what the eventual historical explanation will be, some facts about the Mungbam vowel system can be explained as buffer-zone effects. Mungbam dialects have a large number of peripheral vowels, and phonetic properties which would normally be indicative of a vowel-harmony system within the Kwa area, yet [ATR]-based vowel harmony is completely absent, as in Bantu languages. The unusual manifestation of word-accent in Mungbam and neighboring languages may also be interpreted as a hybrid system where both word-accent (as in Bantu) and vowel length and tone contrasts (as in Kwa) play an important role.

5 Conclusion

In this paper I have described the inventories of contrastive vowels for each of the five dialects of Mungbam. I have shown that the Abar and Biya dialects have a type of phonetic contrast which is typically found only in African languages possessing Cross Height Vowel Harmony (CHVH). Vowel harmony, however, is absent in Mungbam. The result is that the language makes use of a phonetic parameter [ATR], but that this parameter is not needed to identify any natural class in the language's phonology. I have discussed the issue both from a synchronic and a diachronic perspective. Concerning the synchronic phonology, it was shown that the choice of representational units depends on whether one wishes to mix phonetic categories (as determined from lexical contrasts) and phonological categories (as determined from morphophonemic alternations and phonotactic distributions) in constructing these representations. Though this is clearly not the first time that such a conflict has been exposed,[19] this study has been the first that I know of to seriously consider the phonetics of [ATR] in a language lacking vowel harmony. I have suggested some approaches for explaining the facts of Mungbam vowel systems from a diachronic perspective. I have explored some general scenarios involving the historical loss of CHVH, and have suggested that if Mungbam did have CHVH at some earlier stage, then its loss may have coincided with the development of a word-level accent system which involves an asymmetry in the number of vowel oppositions available at different positions within a word. Competing areal pressures between Bantu-type and Kwa-type languages are cited as a likely driving force in Mungbam's historical development.

5.1 Directions for future work

I have identified one possible historical scenario which could plausibly lead to the type of system presently attested in Mungbam, and I have also shown how insights from areal typology might be employed to explain the facts attested in Mungbam. What is needed now is for new descriptive data

[19] See, for example, Lass's (1976:44-9) discussion of correspondences between pairs of "tense:lax" vowels in Swedish and in Standard German.

to be incorporated which can either support the explanations put forth in this paper or modify them. One immediate goal which does not rely on the future availability of data from other languages is to develop an analysis of the prosodic structure of Mungbam, and to describe how phonological units map onto syntactic constituents. I can say that the present study has succeeded to the extent that it has led from one curious observation about phonetic structure in Mungbam to a series of wide-ranging and theoretically pertinent questions about the overall phonological structure of the language.

5.2 The importance of phonetic detail

One thing which should not be overlooked is that this study has taken as its starting point the close examination of phonetic detail in several closely related speech varieties. I would like to encourage the view that phonetic detail can hold easily overlooked evidence about a language's sound patterns, and about the areal and historical processes that have shaped the language, and that the typological approach to the study of language should incorporate phonetics, as it has already done for syntax, morphology, phonology and semantics.

Finally, I hope I have shown that basic phonetic analysis of the type presented here is something which can be done with data collected in the field. Access to a phonetics laboratory is preferred, but lack of access should not be a major deterrent in basic phonetic studies. A documentation project for an endangered language may not be followed by a specialized project for study of phonetics, so fieldworkers should not feel deterred from collecting phonetic data for lack of state-of-the-art facilities.

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