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ASPECTS OF THE PHONETICS OF CAMBAP*

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Increasingly, the need to document endangered languages before they cease to be spoken and disappear is being recognized. Corresponding acknowledgement of the importance of detailed descriptions of the phonetics of such languages, however, is lagging behind. This study examines the phonetics of Cambap, a Bantoid language spoken in the Nigeria-Cameroon borderland by approximately 30 people. The focus is on describing how its phonological contrasts are realized, and as such this study represents only a stage in a more complete description of Cambap phonetics, their relation to the phonology of Cambap and to more general aspects of the language and culture of the Camba.

1. Introduction

The growing endangerment and disappearance of languages throughout the world has become a matter of concern not only to the speakers of these languages and linguists, but also to the many people who recognize the importance of linguistic and cultural diversity. Efforts to revitalize endangered languages, or at least to provide adequate documentation of them before they disappear, are increasing. Even among such efforts, however, too frequently insufficient importance is placed on the phonetics of the language in question, the result being that only a partial understanding can ever be attained, not only of the phonology of the language, but of the language as a whole, and its place as an integral part of the culture of its speakers. The aim of the present study is to describe details of the phonetic

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characteristics of Cambap, following the practice established by some of those scholars who have explicitly recognized the importance of documenting the phonetic structures of endangered languages (e.g., Shryock, Ladefoged & Williamson [1996/97]; Sands, Maddieson & Ladefoged [1993]; Maddieson, Smith & Bessell [2001]). Work presented here is by no means meant to be an exhaustive description of the phonetics of Cambap, but does aim to provide some insight first, into how its phonological contrasts are realized, and second how Cambap conforms to or deviates from expectations based on observations of other languages found in the literature. For some aspects of speech production, e.g., VOT of fricatives, very little information is available in the literature and data is reported here simply to address such lacunae. It is hoped, then, that the description presented here will allow this language to contribute to the set of facts on which crosslinguistic generalizations are based.

1.1. Background. The Camba inhabit the Bankim sub-division of Adamawa Province in Cameroon (approximately 6° 28' N, 11° 27' E), near the Nigerian frontier. They and their language first found mention in the literature [Risnes & Starr 1989, Blench 1993] under the name by which they are known to their neighbours, Twendi or Toenba. They refer to themselves as Camba and call their language Cambap. The Camba are no longer a cohesive and homogeneous group, their small population being dispersed among six villages: Sanga, Camba, Ndem Ndem, Mbondjanga, Nyamboya, and Yimbéré. All of these are now Kwanja villages, though the first two are formerly Camba. Kwanja is spoken by approximately 10,000 people. There are fewer than 300 Camba, and Cambap is spoken by only a small percentage of these—30 or so people, the youngest of whom was about 45 years old at the time the data contributing to this report was collected. For those who do speak it, it is generally used on a daily basis as they normally speak it among themselves when together, though it is no longer anyone's primary language. Living among the Kwanja, the Camba have come to see themselves as ethnically Kwanja; many, however, recognize their language as being closer to Mambila, and particularly the varieties of Mambila spoken somewhat to the north and northeast of their present location, such as Langa, but also Kabri and other lects on the Mambila Plateau in Nigeria (see Connell [2000]). The Camba recognize no particular relationship to the Chamba people (Daka or Leeko) who inhabit the region further north, and of whom the Leeko are believed to have invaded the present Mambila/Kwanja area some two centuries ago, reaching as far south as the Grassfields region [Fardon 1988]. It is unlikely, then, that the Camba are a remnant population of the invading Chamba, though at least one such group does exist further south. Regarding linguistic affiliation, Leeko belongs to the Adamawa family, while Cambap is a Bantoid language.

2. Methodology

Description and analysis presented here are based both on impressionistic phonetic work, listening to and observing speakers, and on acoustic analysis of recordings made in the field. Seven native speakers of Cambap ranging in age from midforties to mid-eighties contributed to the data used in this study. Five were men and two were women; of the men, four are brothers, while the two women are mother and daughter. The brothers are of mixed Camba-Kwanja parentage; the parents of the other male speaker were both Camba. The older woman is also of mixed Camba-Kwanja parentage, but married a Camba, so both of the younger woman's parents are Camba.

Comparable material consisting mainly of wordlists was collected from the seven speakers; slightly less material is available from the older woman, while for three of the men considerably more material was collected, including recorded texts. The wordlist used was based on a much larger list collected earlier from one these, Pastor Nyagandji Ndi Samuel, who is considered by others to be the best speaker of the language, despite being one of its youngest speakers. As it happens, he took a greater interest in the language—and in language generally—and hence spoke it more frequently.

Recordings were done using a Sony TCD-D7 DAT recorder and an Audio-technica headset microphone. These were uploaded to a Macintosh G3 Powerbook at sampling rate of 22.05 kHz. Subsequent processing and analysis of the recordings were done using Macquirer software. Statistical analyses were done using SPSS v 10 for Macintosh. Further methodological details are given in the relevant sections below. The test items used for the various acoustic analyses, all natural words, are included in the appendix.

It should be pointed out that there is a considerable amount of variation, especially at the phonetic level, both within and across speakers of Cambap, and the description that follows must be understood in that light. This variation is discussed in detail elsewhere [Connell 2002a], with a view to establishing, first, whether or to what extent it is attributable to influence from Kwanja and/or Mambila, and second, whether it is a characteristic process of language contrac-tion (e.g., Dressler [1988] among others). Consequently, I do not concentrate directly on the variation here, but bring it into the discussion only as necessary. Conclusions presented in Connell [2002a] are that most of the observed variation is not due to interference from neighbouring languages, nor can it convincingly be considered a process specifically associated with language endanger-ment; rather, it is argued to be a characteristic of small and relatively isolated language com-munities, within which the pressure for standardization, maintenance, or even development, of strict sociolinguistic norms may be negligible.

3. Syllable Structures

The segmental structure of the syllable in Cambap is uncomplicated. CV and CVC forms predominate, though CV:C and CVV are also found. Of these last two possibilities, V occurs only as an affix, i.e., some CVV structures are interpretable as CV-V, while others are best seen as CV:, or CVG or CGV sequences. With respect to word structure, more than 62% of all nouns (free morphemes) are disyllabic (CVCV and CVCVC). Approximately 35% are monosyllabic, with the remaining few being longer, polysyllabic, words.

Table 1. The Cambap phonetic consonant inventory.
(Entries in parentheses represent free variants or minimally occurring phones.)

	bilabial		*labio-dental*		*alveolar*		*post-alveolar*		*velar*		*labialized velar*		*labial-velar*		*glottal*
plosive	p	b			t	d			k	g	k^w	g^w	k͡p	g͡b	
nasal		m				n		ɲ		ŋ					
prenasal	(mp)	mb		mv	(nt)	nd		ndʒ	(ŋk)	ŋg		$ŋg^w$		ŋ͡mg͡b	
fricative			f	(v)	s		(ʃ)								h
lateral						(ɮ)									
affricate							tʃ	dʒ							
approx						(r)		j						w	
lateral						l									

4. Consonants

4.1. Inventory and contrasts. The phonemic inventory of Cambap varies somewhat across speakers, as indicated earlier. The consonant chart in Table 1 contains all contrastive consonants; those not found for all speakers, as well as major allophonic variants, are included in parentheses. Some occur only rarely, viz: /p, v, mv, ŋgʷ, k͡p, g͡b, ŋ͡mg͡b/.

Table 2: Examples of consonant contrasts

p	*pà:ɾì*	'hut'	f	*fàɾā̀*	'to untie'
b	*bàɾì*	'wound (n.)'	v	*vəɾān*	'sky'
m	*màr*	'clay'	mv	*mvɯ́nēn*	'brain'
mb	*mbâr*	'witch'			
t	*táɾā̀*	'to shoot'	s	*sáɾā̀*	'to sew'
d	*dáɾè*	'near'	l	*làn*	'intestine'
n	*náɾā̀*	'to cook'			
nd	*ndǎr*	'argument'			
tʃ	*tʃàɾé*	'basket (type)'	j	*jáɾā̀*	'to eat'
dʒ	*dʒàɾé*	'work (n.)'			
ɲ	*ɲāɾâ*	'to defecate'			
ndʒ	*ndʒàɾà*	'claw, nail'			
k	*káɾā*	'man's hunting bag'			
g	*gàɾā̀*	'to divide, share'			
ŋg	*ŋgár*	'shin'			
kʷ	*kʷāɾāp*	'fish scales'			
gʷ	*gʷànɯ́*	'news'			
ŋʷ	*ŋʷáɾā̀*	'to drink'			
ŋgʷ	*ŋgʷáɾā̀*	'to hear, perceive'			
k͡p	*k͡pǎkpâ*	'grey parrot'	w	*wàɾā̀*	'to return'
g͡b	*g͡bá*	'calabash'			
ŋ͡mg͡b	*ŋ͡mg͡báɾīâ*	'to push'			
h	*hāɾēn*	'town'			

Ladefoged and Maddieson (1996) indicate that, with respect to place of articulation, there are ten target regions among which languages choose in forming phonological contrasts. Cambap utilizes six of these—labial, dental, alveolar, postalveolar, velar and glottal—together with combinations of four classes of active articulator (labial, coronal, dorsal, laryngeal) in creating contrasts at the eight places of articulation shown in Table 1. From available surveys [for example, Maddieson 1984], it would appear that this strategy is more commonly employed among languages of the world than the alternative of utilizing a greater number of target regions, and thereby potentially creating contrasts between, for example, postalveolar and palatal, which would be perceptually more difficult to maintain. Examples of consonant contrasts in Cambap are given in Table 2.

4.2. Distribution of consonants. In Cambap the greatest number of consonant contrasts is found in initial position, a fact which also accords with what is generally found in languages of the world [Ohala & Kawasaki 1984]. All con-sonants are found initially, as shown in Table 2, though /p, v, mv, k͡p, g͡b, ŋmg͡b/ are all relatively rare.

In medial position, consonant distribution is restricted; generally only /b, t, d, m, n, ŋ, mb, nd, ŋg/ are found, with /d/ being realized as [ɾ]. Occurrences of medial /b, t/ are rare and most, though apparently not all, may ultimately result from historical processes of reduplication or affixation. Other consonants appear in compounds, reduplications, and borrowings (e.g., /d/ = [d], /s, l/). Examples of consonants in medial position are given in Table 3.

Table 3. Examples of consonants occurring in medial position

b	*bàbā*	'elder sister'
m	*kàmà*	'chest'
mb	*kámbá*	'crab'
t	*tàtā*	'father'
d	*káɾā*	'men's bag'
n	*ŋgànà*	'kola'
nd	*fàndā*	'skin'
ŋg	*bāŋgā*	'agama lizard'

In final position, the distribution is still more restricted, with only the nasals /m, n, ŋ/, the voiceless plosives /p, t/ and /d/ permitted. Of these, /p/ occurs primarily as a plural marker; /t/ is very rare and it may be that all occurrences of it in final position are in borrowed words, or ideophones; /d/ is typically realized as a voiced apical trill, [r], though it may be voiceless, or a fricative, [ɹ̝], the variation being personal and sporadic (Connell 2002a). Final /k/ has been noted, but only in borrowings. Examples of consonants occurring in final position are found in Table 4.

Two notes may be added with regard to the above distributions. First [ŋʷ] and [ŋ] are in complementary distribution, with the former only occurring initially and the latter only finally. They may therefore be said to comprise one phoneme, /ŋ/. Second, although the occurrence of [ɾ] and [r] medially and finally are analyzed here as realizations of /d/, the evidence for this is ambiguous and they could equally be said to represent /l/ or a neutralization of these two phonemes.

Table 4: Examples of consonants occurring in final position.

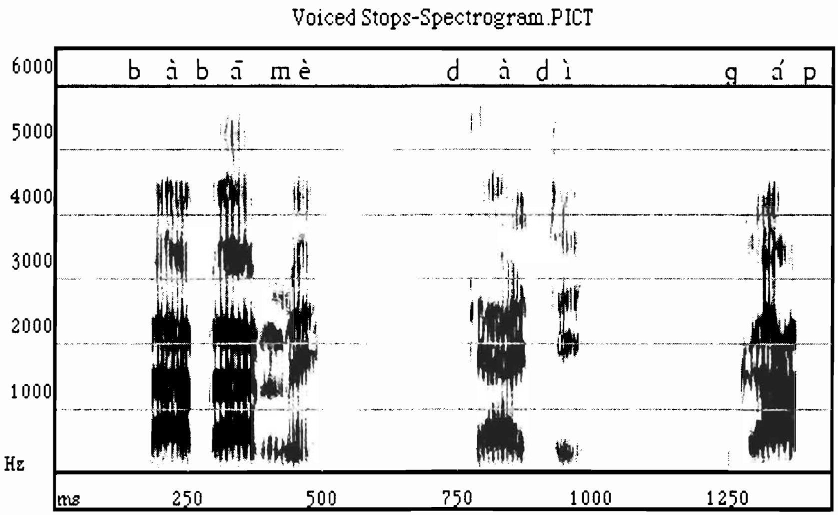
p	*táp*	'war'
t	*pát*	'all'
d	*tááŕ*	'three'
m	*tàm*	'hat'
n	*tán*	'stone'
ŋ	*tàŋ*	'hippopotamus'

Cambap has a vowel inventory of /i, e, a, ɯ, u, o, ɔ/ (see section 5). While most consonants combine freely with following vowels, certain of them are restricted in their distribution. Those noted above as being rare, viz, /p, v, mv, k͡p, g͡b, ŋ͡mg͡b/, are most affected in this regard, occurring only before /a, ɯ/, while initial /ŋgʷ/ is only slightly less uncommon and occurs only followed by /a/. This may be partially a result of their rarity, but it is unlikely to be accidental that these consonants all involve a labial element and do not occur followed by rounded vowels. To these can be added /kʷ, gʷ/, both of which occur relatively frequently, but similarly are not found followed by rounded vowels. Restrictions of this nature have been noted elsewhere; cf. Kelly [1974] on the restricted occurrence of labial-velars in Fang and Mutaka & Ebobissé [1996/97] on labial-velars in the Sawabantu group, where in both cases labial-velars are found only preceding front (i.e. unrounded) vowels. Ohala & Kawasaki [1984] give a general statement on this constraint against the co-occurrence of labial consonants and rounded vowels. Given this, it is worth noting that /b, m, mb/ all apparently combine freely with rounded vowels in Cambap.

4.3. Plosives. Plosives are found at five places of articulation, labial, alveolar, velar, labialized velar, and labial-velar. A voicing contrast exists at each of these (see Table 2 for examples). The nature of this contrast in Cambap is interesting, first for its symmetry, as there is a tendency to an asymmetry in voicing tied to place of articulation, whereby labials show a greater propensity to voicing (Maddieson 1984). This is usually attributed to the fact that the larger oral cavity present in the production of labials will permit a longer period before the transglottal pressure differential, required to maintain voicing, is neutralized. Maddieson's discussion, however, focuses on phonological contrast, rather than the actual phonetics of voicing contrasts. In Cambap, voiced plosives may be said to be fully voiced, whereas in many languages phonologically 'voiced' plosives are phonetically voiceless, In the following sections, the voicing characteristics of Cambap plosives are examined with respect to the presence or absence of closure voicing and voice onset time.

4.3.1. Voicing characteristics of plosives. The voiced plosives are typically fully voiced during closure, whether occurring initially or between vowels. Spectrograms in Figure 1 of *bàbā mè* 'my elder sister', *dàdì* 'vein, tendon', and *gáp* 'peelings', illustrate this for labials, alveolars and velars, respectively. Although these stops are characterized as being fully voiced, voicing frequently appears to cease, or at least weaken, slightly before or just at release, prior to the commencement of the vowel, for all voiced stops except /g͡b/. This break in voicing typically lasts for approximately 20 ms. The fact that it appears to be tied to or timed with the release, rather than with the onset of closure, suggests it results from an active gesture abducting the vocal folds and is not a passive result of aerodynamic factors. The voiced stops in Figures 1 and 2 illustrate this curtailment of voicing, most noticeably in /gʷ/, which may be compared with /g͡b/.

Figure 1. Spectrograms of voiced consonants /b, d/ in both initial and medial positions and /g/ in initial position. (Speaker 5)



Voiceless plosives are unaspirated. For most speakers only a slight VOT delay occurs, though some variation has been observed, especially with /p/. Two speakers varied between a realization of /p/ as unaspirated or with noticeable aspiration.

To examine voice onset time, voicing in voiced plosives was measured from the onset of consonant closure to consonant release. In those cases where voicing clearly ceased before release, as described above, this was taken as the end point of the measurement. That is, the measurement given for voiced plosives is essentially a measurement of closure voicing. For the voiceless plosives, measurements represent the period from the consonant release to the onset of voicing. At least two repetitions of two words containing each of the plosives in initial position and followed by a low vowel were recorded by each of the seven speakers. A small number of tokens were discarded, leaving an average of 26 tokens of each consonant. Examples of /gʷ/ were not available from all speakers; the measurement for /gʷ/ provided here is based on tokens of word initial /gʷ/ from six different words from a single speaker (/gʷ/ was therefore not included in the subsequent analysis of variance). Mean values of VOT for the five different places of articulation are shown in Table 5. Comparison between voiced and voiceless at each place of articulation shows clearly the difference between the two series of consonants, with a mean difference across places of articulation of 125.2 ms.

These reflect the expected hierarchy as reported in the literature on voicing for comparable languages (i.e., languages with a two-way contrast involving one series of stops which features closure voicing; e.g., Lisker & Abramson [1964]): velars are the shortest, labials longest, and alveolars are closer to labials than velars. An analysis of variance followed by post hoc tests (Tukey's), however, showed only /g͡b/ to be significantly different ($p < 0.000$ for all three comparisons).

Voice onset times for voiceless unaspirated /p, t, k, kʷ, k͡p/ also reflect universal trends in that the labial and alveolar values are relatively similar, with the velars being longer than these two [Lisker & Abramson 1964, Cho & Ladefoged 1999]. The labial-velars are discussed in detail below. The high standard deviation observed for /p/ reflects variation across speakers, as noted. The differences in means between labials and alveolars on one hand, and velars and labialized velars on the other were significant (for /p/ vs /k/, $p = 0.02$; for all other comparisons, $p < 0.000$. The labial-velar is significantly different from each of the other four stops ($p < 0.000$ for all four comparisons).

In summary, the values given in Table 5 correspond generally to those found elsewhere for comparable stops in other languages, both in absolute terms and with respect to relations between places of articulation.

4.3.2 Labial-velars. Given the relative paucity of phonetic data available on labial-velars, it is worthwhile examining these in greater detail, to assess how they differ from other stops. The preceding section has drawn attention to one aspect of this difference: labial-velars each differ from other stops of the same series, voiced or voiceless, in an obvious important respect. Unlike other voiced stops, /g͡b/ is fully voiced throughout, with no weakening or curtailment of voicing during closure. And, unlike other voiceless stops, /k͡p/ does not exhibit any delay in VOT; indeed, as seen for other West African languages with labial-velars [Ladefoged 1964,

Table 5. Voice onset times in ms for initial plosives by place of articulation, with standard deviations in parentheses.

	Bilabial	*Alveolar*	*Velar*	*Labialized-Velar*	*Labial-velar*	*Mean*
+Vce	– 110.7 (24.2)	– 101.9 (22.4)	– 97.4 (27.1)	– 85.4 (19.5)	– 146.5 (38.6)	– 108.4
–Vce	18.2 (18.9)	15.7 (4.8)	30.1 (11.5)	33.4 (10.8)	– 13.3 (9.1)	16.8

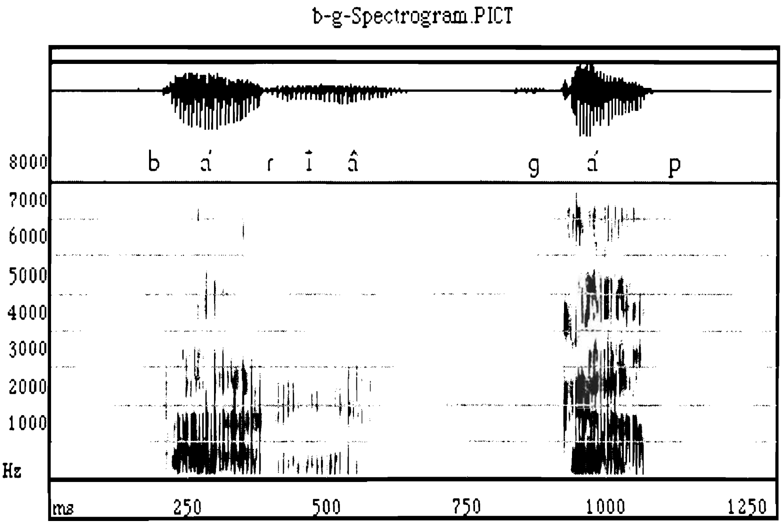
Connell 1994], there is a degree of pre-voicing associated with its release. The voice bar in these cases typically consists of two or three pitch periods only and ranges in duration from 0 to 32 ms.

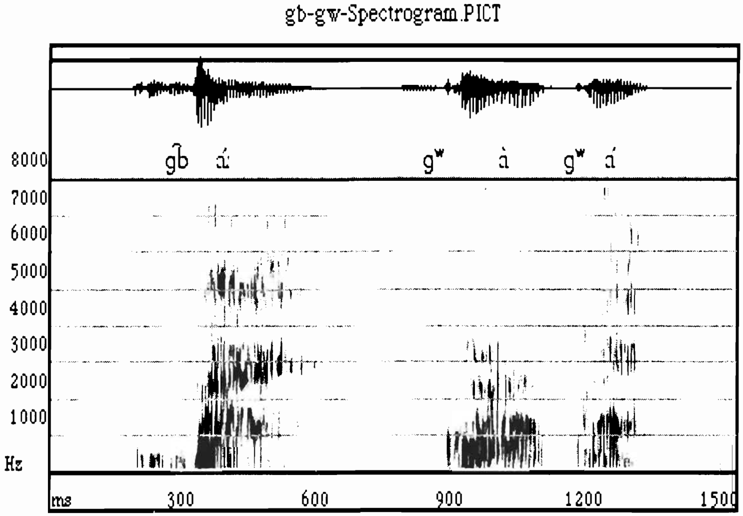
Similar to descriptions of labial-velars reported elsewhere, there is an asynchronicity in the timing of the release of the two closures such that the labial release is subsequent to that of the velar. This may be responsible for the voicing characteristics of the labial-velars, since an early lowering of the tongue associated with the velar release would have the effect of expanding the oral cavity allowing voicing to be maintained, in the case of [g͡b], or to begin, in the case of [k͡p].

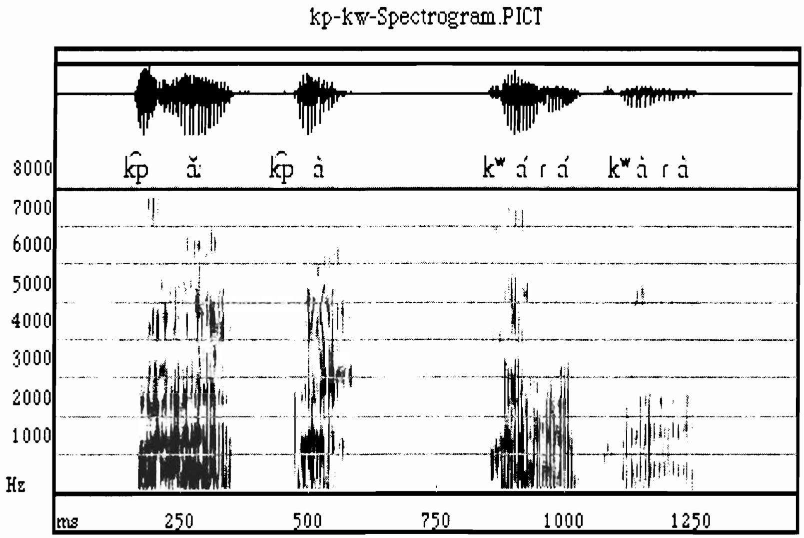
The asynchrony between the velar and labial elements is reflected in the formant transitions associated with the release of the consonant, which for labials are rising for the second formant while for velars F2 falls. Spectrograms of [b] and [g] in Figure 2 show this difference between labials and velars and may be compared to those of the labial-velars which differ from velars, and resemble labials, showing a rising transition for F2.

It is of interest to compare the labial-velars with the labialized velars to assess which of their characteristics may be salient to their contrastiveness. As mentioned, the spectrograms of /g͡b/ and /k͡p/ in Figure 2 show clearly the labial release transitions associated with labial-velars, though the transitions for /gʷ/ and /kʷ/ are less well defined. One may note a number of other features, in addition to this, which may also serve as distinguishing acoustic cues: first, the C-to-V transitions are considerably steeper for the labial-velars; second, the spike associated with the

Figure 2: Spectrograms of [b] and [g]; [g͡b] and [gʷ], top of next page; and [k͡p] and [kʷ], bottom. (Speaker 5)







release burst of the labial-velar is sharper than that of the labialized-velar; and finally, their voicing characteristics are different, as noted above.

4.4. Nasals and prenasalized consonants. Cambap has contrastive nasals occurring initially at four places of articulation, labial, alveolar, postalveolar, and velar. Two aspects of the nasals bear mention at this point; first, what is called here postalveolar is, in terms of its actual place of articulation, best described as pre-palatal; it is represented with [ɲ]. Second, in initial position the velar nasal is realized with accompanying labialization, [ŋʷ]. Prenasalized consonants (NCs) are found at seven places of articulation initially, /mb, mv, nd, ndʒ, ŋg, ŋgʷ, ŋ͡mg͡b/, and at four places of articulation medially, /mb, nd, ndʒ, ŋg/. Of initial NCs, /mv/ and /ŋ͡mg͡b/ occur only very rarely, and the labiodental not with all speakers. Approximately 90% of all initial NCs occur with nouns, suggesting that they may have developed from an earlier nasal noun class prefix that fused to the root as this system of noun classification degenerated. Medial NCs occur with about equal frequency in both nouns and verbs. One speaker consistently produced the initial prenasalized consonants (though not medial ones) devoiced, i.e. with the oral portion of the consonant voiceless, though the nasal remained fully voiced. For other speakers, voicing carried on throughout the oral portion of the consonant, but as with the voiced plosives, it often terminated at about release.

A number of interesting issues arise with respect to NCs in Cambap. First is whether there is any phonetic evidence for analyzing these consonants as unitary phonemes as opposed to sequences of nasal and oral consonants. This is of interest from both a general perspective, and one specific to Cambap. Generally, given that relatively little phonetic analysis has been conducted on NCs, it is important to discover whether any such evidence exists for Cambap. And, given the presumed origin of initial NCs in Cambap suggested above, it is of interest to compare these with medial NCs, whose origin, although uncertain, is clearly different. In both cases the overall duration of NCs and the relative durations of their component parts are potentially relevant. With respect to their phonological status, unit or cluster, one might expect clusters to demonstrate longer durations than single phonemes [cf. Herbert 1975, 1986]. This apart, if it is the case that Cambap initial NCs evolved in the manner described in the previous paragraph, they might be expected to have different duration characteristics than their medial counterparts.

4.4.1 Nasals. Duration measurements are given in Table 6 for nasals at the three anterior places of articulation Measurements are based on up to four tokens of /m, n/ from each of the seven speakers and two tokens of /ɲ/ from five speakers. Comparison with nasal portions of the prenasalized consonants is given below. It may be noted in passing that there are no significant differences across place of articulation, and the relation between labial and alveolar nasals is of the same order

Table 6. Duration measurements for initial /m, n, ɲ/ in ms.

	Mean	*SD*	*N*
m	118	31.7	24
n	107.58	21.8	26
ɲ	124.61	30.4	10
Mean	116.56		

as that seen in Table 5 for the voiced stops (other comparisons are not possible on the data available).

4.4.2 Initial NCs. Table 7 compares the durations of nasal and oral portions and the total duration of prenasalized consonants in initial position at four places of articulation, for four of the seven speakers. Of the other three, comparable material was not available for two and the third didn't produce the prenasalized consonants consistently; i.e., for her they were frequently simply plain oral consonants. The total number of tokens of each consonant is given in the table. These are based on up to five repetitions of at least two words for each consonant. The usual environment was a following low front vowel, e.g., *mbâr* 'witch'. Where this was not possible, or when productions of words with this vowel were substandard, another word was substituted. Measurements were made on the basis of spectrograms; the end of the oral portion of the consonant was marked at the moment of closure release, rather than at vowel onset.

Table 7. Mean durations in ms of nasal and oral portions of prenasalized consonants in initial position, with standard deviations in parentheses; 4 speakers, 3 M, 1 F.

	Nasal	*Oral*	*Total Duration*	*N*
mb-	96.85 (26.42)	39.01 (10.73)	135.86 (31.62)	37
nd-	93.83 (37.88)	33.17 (13.21)	127.02 (42.24)	35
ndʒ-	92.97 (23.96)	50.53 (13.34)	143.49 (32.95)	29
ŋg-	97.35 (24.15)	34.74 (9.95)	132.09 (26.84)	26
Mean	95.25	39.37	134.62	

Analysis of variance and post hoc tests (Tukey) showed no significant difference among durations for nasal portions as a group and oral portions as a group. The exception to this is the postalveolar /ndʒ/, where the oral portion was significantly longer than that of the other consonants ($p < 0.000$ for all comparisons). This is not unexpected, given the slower release associated with the affricate. These findings carried over when considering the relative length of nasal as compared to oral components, the mean of Nasal = 71% and Oral = 29% was matched fairly closely at three of the four places of articulation, the exception again being the postalveolar.

4.4.3 Medial NCs. In looking for duration differences between initial and medial NCs, the important comparison, given the expectation that medial consonants generally are shorter than initial ones, is not their overall durations, but rather the ratio of nasal to oral components. Table 8 compares medially occurring prenasalized consonants. Again, analysis of variance and Tukey's post hoc tests revealed no significant differences among durations for nasal portions as a group and oral portions as a group. However, with respect to total duration, -mb- was significantly longer than -nd- (p = 0.045). In comparing medially occurring NCs with those in initial position, it will be seen that the medial are noticeably shorter in each case than initial. This fits with the general expectation that medial consonants are shorter than initial consonants of the same type, but interestingly the relative length of nasal to oral components as a portion of the overall duration of the consonant was identical to that found for initial NCs, with the nasal component 71% and the oral component 29% of the total duration when averaged across places of articulation. This suggests that if any reflection at all can be gained of the history of NCs in Cambap from their current structure, the indication is that once having lost their functionality as noun class markers, the nasal element fused to the following oral C, following a template that determines the relative durations of component gestures.

Table 8. Mean durations of prenasal, nasal and oral consonants in medial position; with standard deviations in parentheses.

	Nasal	*Oral*	*Total Duration*	*N*
-mb-	81.57 (22.56)	32.60 (12.57)	113.79 (28.82)	32
-nd-	65.33 (11.67)	26.87 (5.72)	92.2 (12.83)	33
-ŋg-	70.26 (16.30)	28.46 (7.81)	98.96 (18.04)	36
Mean	72.39	29.31	101.65	

4.4.4. Discussion. As mentioned, evidence of duration has previously been presented as evidence in favour of a cluster or unitary analysis of NCs (e.g., Herbert 1975, 1986). In Cambap, however, the evidence from duration would appear to be ambiguous in this regard: initial nasals (Table 6) have a mean duration of 116.6 ms and oral stops of approximately 108.4 ms (Table 5), while prenasalized Cs are somewhat longer, averaging 134.6 ms across place of articulation (Table 7). It could be argued that this is sufficiently short as to warrant considering them unitary, and it may be noted that this duration is less than that reported above for /g͡b/, which is uncontroversially unitary. Browman & Goldstein [1986], endorsed by Burton, Blumstein & Stevens [1992] and Ladefoged & Maddieson [1996], argue that duration is an inappropriate criterion since, in languages such as English, where independent evidence favours a sequential N+C analysis, durations of these sequences are often comparable to durations reported for languages where an NC analysis is preferable. As durations of NCs in Cambap do not approach those of combined simple nasal and oral stops, they could be argued to be consonants in sequence, having substantial overlap as Browman & Goldstein suggest. So this fact does not rule out the possibility that they are clusters. At present in Cambap, the most convincing evidence that these consonants are unitary is phonological and is found on two fronts; first, no other consonant sequences or clusters are permissible in the language, in either initial or medial position. Second, and particularly with regard to initial position, if they were to be analyzed as sequences, the nasal would need to be considered either as syllabic or as part of a syllable onset. In the former case, they would be expected to be tone bearing (they aren't), while in the latter case they would contradict expectations based on the sonority hierarchy.

Finally the fact that NCs maintain a consistent ratio between nasal and oral components in both initial and medial position, despite differences in overall durations in the two contexts, suggests the possibility of a template governing the timing relations of the two components in production of these stops.

4.5. Fricatives. Cambap has only two fricatives that occur with any degree of frequency, non-sibilant /f/ and sibilant /s/; /v/ also exists, but only with some speakers, and even for these speakers apparently only in a very small number of lexical items. I report here characteristics of the two that occur with all speakers, looking first at their spectral characteristics, then their durational and voicing characteristics.

4.5.1. Spectral characteristics of fricatives. The main acoustic cue for place of articulation of fricatives is said to lie in the location and distribution of energy in the spectrum. Labiodental fricatives are typically found to have weak energy distributed relatively evenly throughout the spectrum, while for alveolar fricatives a concentration of energy in the region of 4 kHz and above is characteristic, and for the more retracted palato-alveolar fricatives there is a concentration beginning as low as 2 kHz to 2.5 kHz. Spectrograms for /f/ and /s/ may be compared in Figures 3 and 4.

The alveolar fricative in Cambap is noteworthy for its variation. It is sometimes somewhat palatalized, giving an articulation close to [ʃ]; one speaker exhibits this realization consistently, though other speakers do so only occasionally. Figure 4 illustrates representative tokens of initial /s/ from each of four male speakers produced in the word *sàn* 'grave'. A lower concentration of energy, beginning at around 2.2 kHz, may be noticed in particular for S2, reflecting his more retracted articulation, whereas for the other three speakers the more prominent energy is located above 4kHz. The acoustic effect found for S2 is possibly a result of irregular dentition creating a larger cavity anterior to the constriction which could have the effect of lowering the concentration of energy in the spectrum; however evidence from the formant transitions are indicative of a more palatal articulation, in that the locus of the F2 transition is higher, and the transitions longer, than for the [s] articulations. In addition, as Connell [2002a] notes, the [s] ~ [ʃ] variation is not uncommon in the Mambiloid region generally, though in languages such as Ba-Mambila it appears to be environmentally conditioned. Nevertheless, despite the variation in /s/, its acoustic structure is clearly different from that of /f/.

4.5.2. Durations of fricatives. With the focus generally being on the spectral characteristics of different fricatives as the main cue to place of articulation, their durations are rarely reported. (Maddieson, Smith & Bessell's [2001] investigation

Figure 3: Spectrogram of initial /f/ in *fàɾà*.

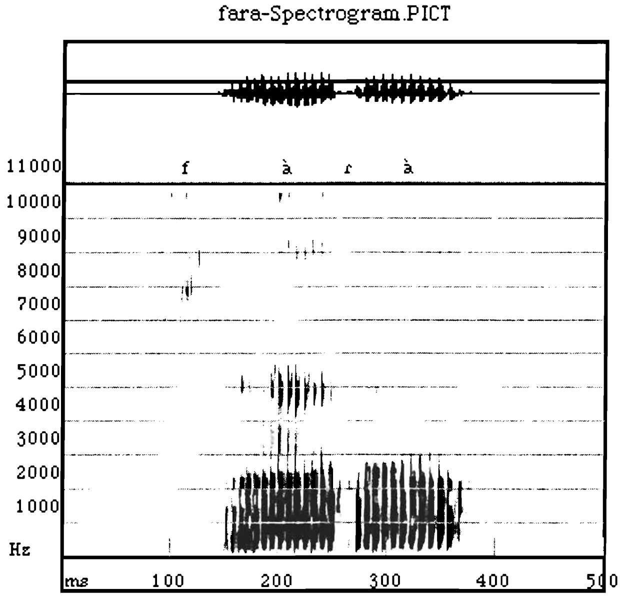
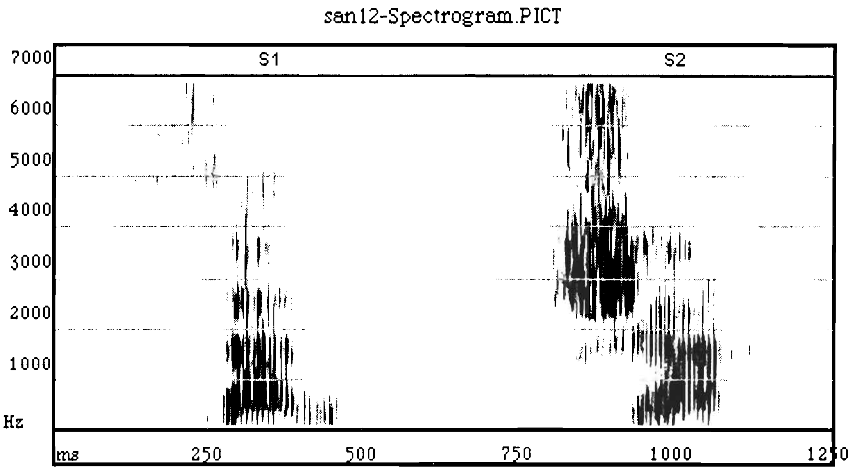
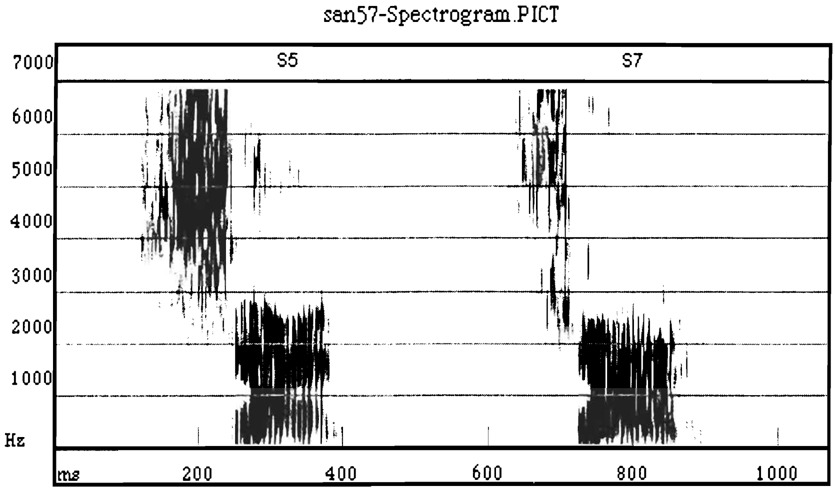


Figure 4: Spectrograms of *sàn* 'grave' from 4 speakers, illustrating variation in production of initial /s/.





of plain and ejective fricatives in Tlingit is one notable exception.) It is not inconceivable, however, that duration may also serve as a cue to place of articulation, and it is, in any case, of interest to ascertain whether or to what extent fricatives follow the same durational patterns with respect to place of articulation as plosives. Duration measurements given here are for the period of frication associated with the two fricatives and are based on two repetitions of two words by each of the seven speakers. For one speaker there were no tokens of /f/, whereas for another there were no tokens of /s/, so data from six speakers is available for each of the consonants. The test words contained the fricatives in initial position followed by /a/. Results are presented in Table 9. Contrary to what was observed for the plosives, it is notable that /s/ is longer than /f/, and this difference is significant (F (1, 45) = 16.183; $p < 0.000$).

Table 9. Durations of voiceless fricatives.

	Duration	*SD*	*N*
f	86.35	24.9	23
s	115.16	24.2	24

4.5.3. Voicing characteristics of fricatives. Except for those few items for certain speakers that contain, /v/, it can fairly be said that Cambap does not have a contrast in voicing with fricatives, to parallel that seen for plosives. For both /f/ and /s/, for all but one speaker however, there is frequently a short delay in the onset of voicing following the end of frication, similar to that seen with the voiceless plosives. This occurs more consistently with /s/. As a VOT lag has rarely been reported as being associated with voiceless fricatives, we report values for this here; Table 10 gives VOT measures for tokens in which this lag occurred. As can be seen, it very closely matches VOTs reported above in Table 5 for voiceless stops of related places of articulation.

Table 10. Voice onset times for voiceless fricatives.

	VOT	*SD*	*N*
f	17.12	5.98	10
s	15.54	6.72	18

5. Vowels

5.1. Inventory and contrasts in vowels. The phonemic inventory of Cambap consists maximally of seven vowels: /i, e, a, ɯ, u, o, ɔ/. (The status of the /o/ - /ɔ/ contrast is questionable, as discussed below.) All occur in both open and closed syllables, with closed syllable realizations of /i, e, u/ typically being more open and slightly centralized in closed syllables, and /a/ somewhat raised and centralized ([ɐ̝]) when followed by /ŋ/. The presence of /ɯ/ in a seven-vowel system is unexpected. The usual inventory for such systems, particularly in Africa and for Bantoid languages, is /i, e, ɛ, a, u, o, ɔ/. The realization of /ɯ/ is variable, falling in the range described by [ə, ɨ, ɯ]. A vowel length contrast also exists, but it is not clear on the available data how extensive it is. This is discussed below.

Table 11. Examples of vowel contrasts.

/i/	*bǐ*	'you' (pl)	*tʃínī*	'one'
/e/	*bē*	'hand'	*tʃébâ̄*	'to look at'
/a/	*bàbā*	'elder sister'	*tʃàŋ*	'spirit, god, soul'
/ɯ/	*bɯ̀*	'hill, slope'	*tʃɯ̄*	'death'
/u/	*bù*	'knife'	*tʃúŋgò*	'walking stick'
/o/	*bó*	'they'	*tʃòwò*	'slowly'
/ɔ/	*wɔ̀râ*	'open, uncover'	*tʃɔ́ŋgâ̄*	'steal' (v.)

There are both systemic and realizational differences across speakers which bear mention. First, it should be acknowledged that the variation in the phonetic realization of these vowels makes phonemicization difficult. This is particularly true of the mid back vowels and the central vowel, where there appear to be differences in the number of contrasts found across speakers; in particular, the /o/ – /ɔ/

distinction doesn't exist for all seven speakers, leaving some with a six vowel system. For those who do have it, its functional load is apparently low. At least one speaker seems to have lost the /u/ – /o/ contrast, in at least some environments where it is present for the others. Both types of variation, systemic and realizational, are discussed in depth from a sociophonetic perspective elsewhere [Connell 2002a].

5.2. Vowel length. In the material collected from all speakers, only one vowel quality, [a], exhibits a length contrast. It seems unlikely that these are to be analysed as vowel sequences comprising two syllables, as would result in an otherwise unattested syllable structure of VC in words such as *kà:n* 'anger' (i.e., *kà.àn*), or a syllable consisting of V only word internally, in words such as *pà:ɾì* (i.e., *pà.à.ɾì*). Syllables consisting of a lone V otherwise only occur as affixes. Duration measurements were done to compare the vowels of *pàm* 'mat' and *pààɾì* 'hut', based on three repetitions of each word from each of five speakers. The average duration of [a] was 118.1 ms, and of [a:] 200.8 ms. Maddieson's [1984] survey indicates that a low central vowel is among the least likely vowels to participate in a length contrast, so it is worth noting that, at least for the one speaker for whom the most material is available, other vowel qualities also appear to contrast length. These include: [i], *mí:n* house; [e] *gē:n* egg; [ɯ] *ndɯ́:dɯ́* garden egg (*Solanum melongena*); [o] *kò:ɾō* cock. However, such examples are few, while there are many to illustrate [a:].

5.3. Acoustic characteristics of vowels. Acoustic analysis of the vowels was based on recordings of all seven speakers. Words were elicited containing each of the vowels preceded by an initial bilabial consonant, i.e., essentially the list in the first column of Table 11 was used. One of these words, *wɔ̀ɾâ*, was not included, having an initial labial-velar. Instances of /o/ – /ɔ/ in this environment were not found in the data available. Four tokens of each word were recorded by each speaker. In a small number of cases it was necessary to reject tokens; in these cases it was possible to substitute another word containing the desired bV sequence. Recordings were made in the field as described above, and were later re-digitized for the spectral analysis at a sampling rate of 11.025 kHz. Spectrograms were produced and formant measurements taken at or near the midpoint of the vowel. Formant values were estimated automatically from LPC power spectra, and compared visually with measurements taken from wideband spectrograms. Measurements from a small number of tokens were rejected because the values produced by LPC analysis could not be reconciled with those taken visually from the spectrogram. Mean F1 (first formant) and F2 (second formant) values are presented in Table 12 for the two female speakers and in Table 13 for the five male speakers. Figure 5 (p. 200) gives formant plots for the vowel space of the two female speakers (left) and the five male speakers (right). F1 is plotted on the y–axis and F2 on the x–axis; means are represented by the vowel symbol and the radius of the ellipses represents two standard deviations of the mean.

Table 12. Mean formant values and standard deviations for 2 female speakers.

Vowel	*F1*	*SD*	*F2*	*SD*
i	341	41	2438	111
e	428	50	2221	123
a	698	52	1502	62
o	478	60	1040	114
u	336	57	858	35
ɯ	374	39	1312	139

Table 13. Mean formant values and standard deviations for 5 male speakers.

Vowel	*F1*	*SD*	*F2*	*SD*
i	306	17	1942	84
e	390	33	1881	60
a	664	43	1302	87
o	425	40	914	114
u	302	41	728	35
ɯ	399	52	1312	132

For the female speakers, a degree of overlap between vowels can be seen, especially for /u/ – /o/, and to a lesser extent also for /i/ – /e/ and /o/ – /ɯ/. Analysis of variance and Tukey's post hoc tests showed means for these vowels for the relevant parameter (i.e. F1, for each of the three pairs) to be significantly different (/i/ – /e/, $p = 0.039$; /u/ – /o/, $p < 0.000$; /o/ – /ɯ/, $p = 0.017$). Overall, there is greater variation in F1 than F2. Inspection of the raw data suggests that the variation in F1 may be due to the fact that one speaker has a generally higher F1 than the other. However a t-test comparing F1 means for the two speakers showed this difference is not significant ($t = -1.906$; df, 42; $p = 0.063$), so it is pos-sible that within speaker variation contributes substantially to the variation in F1.

Again, for the five male speakers, overlap between high and mid-high vowels, both front and back, exists, though means for F1 are, as expected, significantly different (/i/ – /e/, $p < 0.000$; /u/ – /o/, $p < 0.000$).

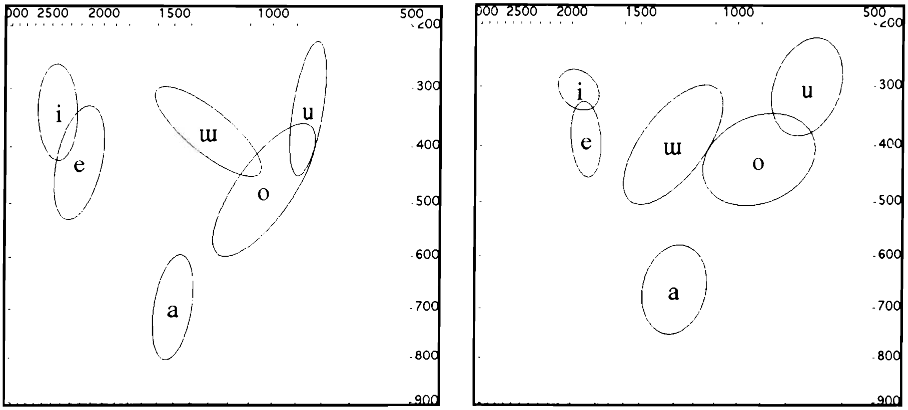


Figure 5. F1 x F2 plot for 2 female speakers, left, and 5 male speakers, right.

Two other characteristics revealed by the acoustic analysis bear mention. First, there is an interesting difference between males and females with respect to /ɯ/; for the female speakers, /ɯ/ is a high central vowel; this is confirmed by the statistical analysis (Tukey's) which reveals /i, ɯ, u/ as a homogeneous subset with respect to height; F1 means for these three vowels were not significantly different (p = 0.763). For the male speakers, however, F1 means show /ɯ/ groups with /e, o/, as a mid or mid-close vowel (p = 0.319). This difference may be due to differences in words used for the two groups. For both, *bɯ̀* 'hill, slope' was the primary word used, but for each a number of tokens of *bɯ̀ŋgá* were also included, and the proportion of the latter was greater for the female speakers. It is possible that the following velar has the effect of raising the tongue position, thereby lowering F1.

Finally, it is interesting to comment on spacing within the vowel system. For both males and females, the mid-high back vowel /o/ shows a greater range of variation than its front counterpart, /e/. It is not clear why this should be the case, though it could be related to the loss of contrast between /o/ and /ɔ/ in some speakers as observed above. I note that at least one neighbouring language (Ba-Mambila) has undergone a shift whereby /ɛ/ has centralized, i.e., /ɛ/ > /ə/, in specifiable conditions. Joan Weber (personal communication) suggests the opposite appears to be the case in Ndung-Kwanja, i.e. /ə/ > /ɛ/.

5.4. Intrinsic F0 of vowels. It is widely recognized that vowels of different heights have correlated differences in intrinsic fundamental frequency, often referred to as intrinsic vowel pitch, or simply IF0. This is generally agreed to be a universal phonetic phenomenon [Whalen & Levitt 1995]. The general claim is that high vowels [i, u] have a higher F0 than low vowels [a], and Whalen & Levitt's survey results, converted to semitones to permit grouping male and female speakers together, showed an average difference between high and low vowels of 1.65 semitones. It is, however, reasonable to assume that IF0 may be controllable and is constrained in tone languages, where variations in F0 might threaten the robustness of tonal contrasts. Connell [2002b] argues that this is the case with tone languages examined in his study, all of which showed a substantially lower IF0 than the mean reported by Whalen & Levitt. In particular Mambila, a four toned language closely related to Cambap, showed no evidence at all of IF0, so it is of interest to look at this phenomenon in Cambap. As the materials collected for Cambap were not specifically selected to examine this question, a preliminary view only can be offered. F0 values from natural words containing the high vowel [i] (*tʃínī* 'one', *jámí* 'cockroach') were compared to words containing the low vowel [a] (*tʃámíâ* 'to bud', *jámí* 'cockroach'). Since IF0 in tone languages has previously been found to be strongest with High tones and frequently neutralized with Low tones, only the vowels with High tone were examined. Four speakers, three male and one female, contributed to this aspect of the research, each giving at least two repetitions of the words used. As the F0 range used by all speakers, male and female, was similar, results are grouped together. Results given in Table 14 show that in Cambap, F0 values of High tone vowels do indeed follow expectations, with the mean difference between [i] and [a] being 10.9 Hz, equivalent to 1.1 semitones. A t-test comparing these means shows the difference to be marginally significant ($t = 1.999$; $df = 31.88$; $p = 0.054$).

Table 14. F0 values for [i] and [a], with standard deviations in parentheses; means for 4 speakers, 3 male and 1 female.

Vowel	*Mean*	*N*
i	177.41 (15.4)	17
a	166.53 (16.4)	17

6. Tone

6.1. Inventory, contrasts and functions. Cambap has three level tones, High (H), Mid (M) and Low (L). In citation forms one normally finds one tone per syllable; contours are also attested, though on monosyllables they are rare. Contours are readily analyzable as sequences of level tones. That all possible combinations of H, M, and L are attested on both monosyllabic and disyllabic words provides strong evidence for this analysis. In addition to this, the endpoints of rises and falls approximate the endpoints of the steady state pitch levels of the level tones (some evidence for this is found in Table 16, below). In addition to these arguments, Figure 7, below, provides phonetic evidence for this analysis. Contours on individual syllables of disyllabic words are, with one known exception, found only on the second syllable, e.g., *kʉ̀rê* 'riddle', (the single exception is *kâjā* 'charcoal'). All of these end with L, suggesting this contour (specifically, the final L) may reflect a former suffix. Tone functions both lexically and grammatically, and contours may also come about through the application of grammatical tone (discussed below). Examples of tone melodies and tonal contrasts in Table 15.

Table 15. Examples of tonal contrasts.

	CV(C)		CVCV(C)	
H, HH	*bú*	'dream'	*búrún*	'bundle'
	bóŋ	'latrine'	*kúŋgú*	'cooking pot'
	mbán	'breast'	*kámbá*	'crab'
M, MM	*wū*	'fire'	*būndū*	'dog'
	ŋʷē	'sugarcane'	*kūmā*	'hoe'
	gē:n	'egg'	*bāŋgā*	'lizard'
L, LL	*bù*	'knife'	*bùndù*	'well'
	bòŋ	'community, ethnic group'	*bàbà*	'area'
	pàm	'mat'	*kàmà*	'chest'
HM	*kɯ́¯n*	'fireplace (stone)'	*kɯ́mbɯ̄n*	'navel'
	ɲé¯	'tooth'	*káɾā*	'men's bag'
HL	*mbâr*	'witch'	*mánd ì*	'boil' (n.)
	kâ	'compound'	*wáɾì*	'comb'
MH	*wḗn*	'rope'	*lɯ̄ló*	'throat'
			mātú	'stomach'
ML	*ɲɔ̄̀n*	'nose'	*kōmbò*	'penis'
	mbā̀ŋ	'water pot'	*kwā:gò*	'fence'
LH	*bǐ*	'you' (pl.)	*bɯ̀ŋgá*	'pigeon'
	ndʒǎŋ	'sorrel (*Hibiscus sabdariffa*)'	*gʷànɯ́*	'news'
LM	*ɲò¯ŋ*	'guinea fowl'	*kàmā*	'back'
			bàbā	'elder sister'

H and M in citation form are generally level. L, however, is typically falling in citation, as has frequently been observed for L in other African languages. This roughly parallels the behaviour of phrase final Lows, suggesting an analysis that citation forms are equivalent to one word phrases, and the fall may be a result of a Low boundary tone. L, M, and H tones on disyllabic words are illustrated in Figure 6.

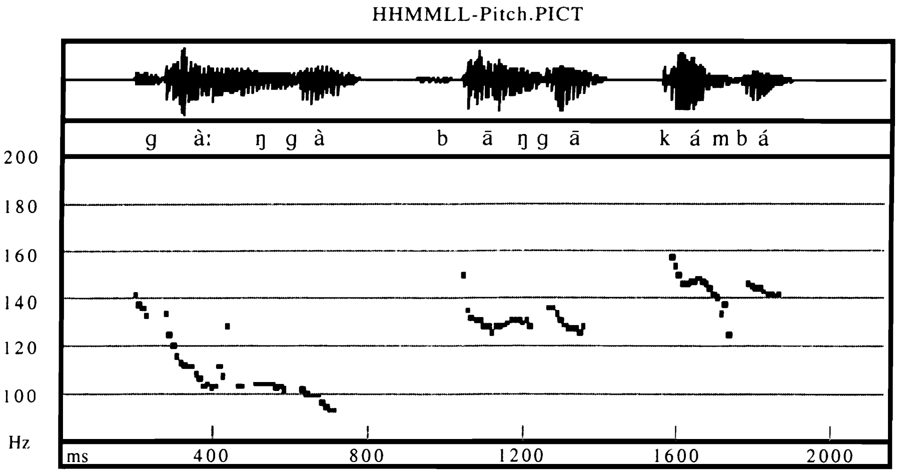


Figure 6: Low, Mid and High tones on the disyllabic words *gà:ŋgà* 'okra'; *bāŋgā* 'agama lizard'; and *kámbá* 'crab'. (Speaker 6)

Sequences of LH and HL, whether on single syllables or two syllable sequences are not obligatorily realized as Low-Rising and High-Falling tones in Cambap, as is found in other three-tone languages, for example Yoruba [Welmers 1973] or Kunama [Connell, Hayward & Abraha 2000], but rather, may show substantial plateaus of each of H and L (see Figure 7).

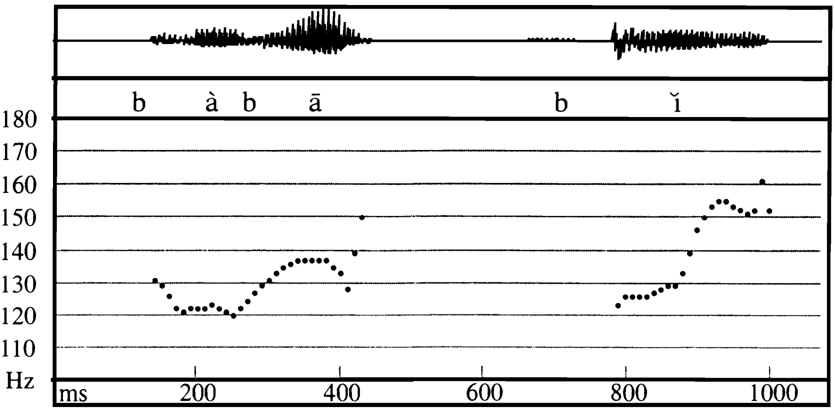


Figure 7: Low-Mid combination on *bàbā* 'elder sister'; Low-High on *bǐ*, 'you' (pl). (Speaker 7).

6.2. Measurements of tones. Measurements have been done on several of the tonal melodies listed in Table 15. Data from five of the seven speakers, three male and two female, contribute to this part of the study. An analysis of variance showed differences between speakers to be non-significant, so results have been grouped, male and female together. (The female speakers' F0 range was in fact encompassed by that of the male speakers.) Average values in Hz for these four speakers are presented in Table 16.

As with Cambap segmentals, there is variation in tone realization across speakers, and possibly systemic differences. One of the main sources of variance appears to be the effect of L on a following H or M, such that not all speakers maintain a clear difference between H and M in this context. This is reflected in the higher standard deviations reported in these cases. The pitch traces in Figure 7 are from one speaker who does maintain a difference between LM and LH.

Table 16. Average F0 values of Cambap tones in Hz for 5 speakers, 3 male and 2 female. Standard deviations are given in parentheses. Lf indicates the final value for L in citation.

Melody	*Mean*	*N*
H	180.7 (13.3)	20
M	162.2 (15.3)	16
L – Lf	139.4 (9.1) – 120.7 (8.6)	36–36
L – H	139.1 (13.4) – 176.5 (21.1)	22–23
L – M	133.9 (9.8) – 158.1 (21.2)	18–19
H – M	189.2 (15.8) – 158.1 (17.5)	12–12

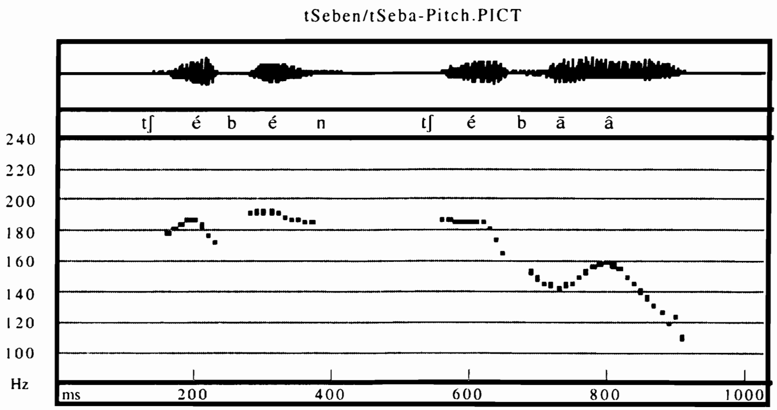
Differences between tones, i.e. their spacing within the register, can be expressed in semitones, giving some indication as to the nature of the tonal register in Cambap, and the space (tonal space) accorded each tone. These values are given in Table 17. The average overall normal range for Cambap, excluding the fall associated with L in citation form, is 4.4. semitones.

Table 17. Range and spacing of Cambap tones expressed in semitones.

Tonal Step	*H–L*	*H–M*	*M–L*
Distance	4.4 ST	1.6 ST	2.8 ST

6.3. Grammatical use of tone. The grammatical functions of tone in Cambap are as yet not well researched, but the most significant feature with respect to the phonetics of Cambap is that the use of tone for certain grammatical functions results in the creation of tonal contours, sometimes consisting of not just two, but three tones on one syllable. Such tone modifications seem only to affect the final syllable of the word in question. Infinitive forms are distinguished from imperatives through a tonal change of this nature, whereby a H or M on the final syllable of a disyllabic verb in the infinitive carries a MHL tone in the imperative form. Segmental modifications may also be involved. This is illustrated in Figure 8, where it is also apparent that the vowel increases substantially in duration—at least in citation form—to accommodate the complex tone.

Figure 8: Pitch traces of *tʃébén* 'look at!' and tʃébā̂ 'to look at' illustrating tone changes between imperative and infinitive verb forms. (Speaker 5.)



Finally, tone is used as a locative marker. In the following examples, location is indicated by means of a tonal alternation, with the High tone of the non-locative form being replaced by Mid in the locative in each case. Data is not available on possible alternations involving M or L tones.

Table 18: Locative use of tone.

tánú	'market'	*tānū*	'in the market'
wūmɔ́n	'forest'	*wūmū*	'in the forest'

7. Summary

This paper represents only a first step towards adequately describing the phonetics, and consequently the phonology, of Cambap. Most conspicuous in its absence is any discussion of phenomena associated with longer stretches of speech, whether at the segmental or suprasegmental level, and the prosodic organization of the language, but other of aspects the phonetics of Cambap, for example sound symbolism and the use of ideophones also remain to be examined. It is hoped that it will be possible to carry out work on these facets of the language while it is still spoken. Nevertheless, the data provided here on the segmental and tonal structure of Cambap do provide some record of the phonetics of this language and how its phonological contrasts are realized, and allow this language to contribute to the set of facts on which crosslinguistic generalizations are based. Perhaps more important, they will ultimately allow, in the words of one Cambap speaker, "our grandchildren to know we once had our own language".

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Appendix: Cambap wordlist and test items

A. 1. Consonants

pàm	'mat'	*kpáɾá*	'stool'
pàːɾì	'hut'	*kpăːkpà*	'parrot'
tàm	'hat'	*màr*	'clay'
táɾā̂	'to shoot'	*màɾā̂*	'to build'
káɾá	'bag'	*nàmà*	'mask'
kàmà	'chest'	*náɾā̂*	'to cook'
bàɾì	'wound' (n.)	*ɲàŋgā̂*	'to wash'
bátì	'gourd rattle'	*ɲàɾā̂*	'to defecate'
dáɾè	'near'	*mbátʃì*	'friend'
dámīâ	'to complain'	*mbâr*	'witch'
gàɾā̂	'to divide'	*mbù*	'beehive'
gáp	'peelings'	*ndăr*	'argument'
sàn	'grave'	*ndā̃ːmbà*	'slingshot'
sáɾā̂	'sew'	*ndùkò*	'rat'
fàp	'sheath'	*ndʒàm*	'laughter'
fàɾā̂	'untie'	*ndʒàɾà*	'nail, claw'
kwáɾáp	'scales (fish)'	*ŋgàm*	'because'
kwàndī	'slave'	*ŋgár*	'shin'
gʷàgʷá	'duck'	*làmbā̂*	'to cover'
gʷē	'cow-itch'	*kɯ́mbɯ́n*	'navel'
gwɯ̀nà	'in-law'	*būndū*	'dog'
gwījā	'leg, foot'	*fàndā*	'skin'
gwījāp	'legs, feet'	*nūŋgū*	'pepper'
gbá	'calabash'	*bāŋgā*	'agama lizard'
gbén	'tail'		

A. 2. Vowels

bǐ	'you' (pl)
bē	'hand'
bàbā	'elder sister'
bɯ̄	'hill, slope'
bɯ̀ŋgá	'pigeon'
bó	'they'
bòŋ	'group'
bù	'dream'
bɯ̀ŋ	'cloud'

A. 3. Tone

bɯ́	H
bē	M
bù	L
bɯ̀ŋ	L
bòŋ	L
bǐ	LH
bàbā	LM
bɯ̀ŋgā	LM
tʃínī	HM