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A Phonetic Analysis of Manange Segmental and Suprasegmental Properties

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0 INTRODUCTION[1]

The aim of this paper is to provide a description of a number of phonetic aspects of Manange, a Tibeto-Burman language of Nepal. Specifically I describe acoustic properties of select units in the segmental and suprasegmental domains. In particular, the tone system of Manange is of special interest because the domain of the tone bearing unit is the phonological word, as opposed to the syllable (e.g. Lahu) or the morpheme (e.g. Lhasa and Dolpo Tibetan). Other features of interest include the allophonic variation of the tap consonant and the status of nasalized and long or lengthened vowels. This analysis represents a first focused account of the major phonetic properties of Manange, and as such is of interest to other scholars of Tibeto-Burman languages, especially those with asymmetrical inventories or typologically unique tone systems.

1. This paper has benefitted from feedback from a number of individuals: Matthew Gordon, T. Alan Hall, and Michael Noonan. My research on Manange phonetics and phonology hasbenefitted from continued input from Carol Genetti.

1 Classification, Location, Methods

Classification and Location of Manange

Manange, also known by its endonym **ŋjeshaŋ**, or **ŋjeshaŋte** 'our language', is a Bodish language within the Bodic subphylum of Tibeto-Burman. It is grouped with other Tamangic (also called Gurungic or TGTM) languages like the Nar and Phu dialects, Gurung, Thakali, Tamang, Seke, and Chantyal (van Driem 2001, Bradley 1997). Figure 1 provides a family tree for Bodish languages.

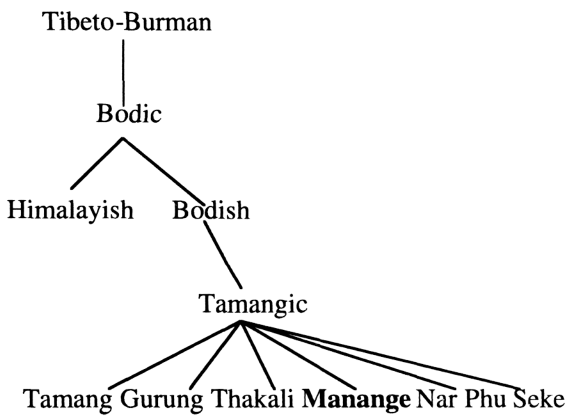

Figure 1.Classification of Manange

The Manange language has historically been spoken by members of a single ethnic group: the **ŋjeshaŋ** or Manange people.[2] The

2. The word ' Manange' is a compound: [ma˥naŋ˥] 'Manang people/place' and [kje˧] 'voice/language'. My orthographic transcription of the language name uses the letter g, which is also the IPA symbol for a voiced velar stop. The phoneme inventory of Manange does not include voiced stops; rather, voicing for obstruents is allophonic, the obstruent is weakly voiced when following another voiced segment. The transcription of Manange is neither phonemically nor phonetically accurate, but rather reflects a Roman alphabet version of the spelling of this language and the ethnic group that speaks it.

Mananges live in the Manang District, which is located in the northern district of the Western Development Region of Nepal.

Geographically, Manang is known as the Inner Himalayan Valley, as it is surrounded to the south, the east and the west by the Annapurna mountain range. The Tibetan border is about 10 kilometers to the north of Manang village. Manang is the second largest district in geographic area in the Gandaki zone, but it is also the least populated district in Nepal. Manang covers 2,246 square kilometers in area (Sharma 1994).

Both Gurungs and Mananges (or **Manangis**, also called **Manangpas**, **Manangbas** and **Manangbhots**) are the main ethnic groups of the Manang district, although there are Nar-Phu communities on the northern edge of the district and there have also been recent migrations of Tibetans and peoples from western Nepal to Manang. In the 1991 census report the Manang district reported a population of 5,363, underscoring the sparseness of the population (Gurung 1998). The 1991 census also reports that the population of the Manang district had decreased by 23% between 1981 and 1991, while the population of Nepal overall grew by the same amount (23%) during that time.

Published descriptions of the Manange language are few in number. Michiyo Hoshi put out a glossary and a grammatical description of Manange (1984, 1986) with data from speakers who were born in Prakaa. Another glossary of the variety of Manange spoken in the Ngawal village has been published by Nagano (1984). Hildebrandt (in press) provides an updated grammatical sketch of Manange, with special attention to the phonetics of tone (and the phonemic inventory in general). That work also comprises a complete sketch of the primary morphological and grammatical systems in the language. Hildebrandt (2003) charts the process of tone merger as it is occurring among some speakers of a growing urban Manange community, looking to sociolinguistic and language contact variables as relevant factors in this case of rapid structural change. Additional contributions towards Manange phonology have been from a diachronic, tonogenetic, perspective (Mazaudon 1978, 1988).

Methodology

The data for this analysis come from four speakers, all born and raised in the Manang District. Speakers 1 through 3 are females, between the ages of 28-35 at the time of data collection. Speaker 4 is a male in his early 30's at time of data collection. Speaker 3 moved to Kathmandu when she was 18, and has maintained a close relationship with Manange friends and relatives in both Kathmandu and Manang. All speakers are bilingual in both Manange (Tibeto-Burman) and Nepali (Indo-Aryan), and all four speakers have claimed Manange as the primary language of use in day-to-day communication. In this sense, these four speakers represent more conservative users of Manange. See Hildebrandt (2003) for an investigation of phonological differences between conservative and non-conservative speakers of Manange.

The data were recorded during a single field trip in 2001, using a Sony Professional Walkman and an Audio-Technica headset microphone. The recording mode was analog, with a sampling rate of 22,050 Hz. (16 bit sample size and monophonic audio channel) used in the computer digitization process. Unless otherwise noted, the values drawn from spectral analyses are taken from words uttered in isolation (the first repetition of the word in a three-repetition frame). The frame-medial context is used for an analysis of fundamental frequency values corresponding to the tones. This is an 'I said X' structure, where the target word is the middle constituent in the verb-final clause.

The data for this study were analyzed using Praat and PcQuirer acoustic analysis software. The data were compiled in Microsoft Excel spreadsheets and statistics were performed using SPSS for Macintosh, version 11.

2 SEGMENTAL SYSTEM

Consonants

The consonant phoneme inventory is shown in Table 1.

	labial	dental	alveolar	retroflex	palatal	velar	glottal
stops							
+ asp	p^h	t^h		$ʈ^h$		k^h	
- asp	p	t		ʈ		k	ʔ
labialized							
+ asp	p^{hw}					k^{hw}	
- asp	p^w					k^w	
affricates							
+ asp			ts^h		$tʃ^h$		
- asp			ts		tʃ		
nasals							
plain	m		n		ɲ	ŋ	
labialized	m^w					$ŋ^w$	
tap			ɾ				
fricatives			s	ʂ	ʃ		h
lateral approximant			l				
glide					j		

Table 1. Manange consonant phonemes

As the inventory shows, there are no voiced obstruent phonemes in Manange. Even in low tone words (/1, 4/), obstruent onsets remain phonetically unvoiced, while the vowel has a modal phonation and carries a low or falling fundamental frequency value (tone is discussed in more detail in section 3). These properties are different from what is found with some other Bodish tone systems, such as Tamang, Seke, Nar-Phu and some dialects of Tibetan, where there may be predictable voicing of the onset consonants and an accompanying breathy or mur-

mured phonation on the vowel (Mazaudon 1973, 1978, 2003; Watters 1999; Honda 2002; Noonan 2003b; Watters 2003).

The status of /ɾ/

One particularly interesting case of consonantal allophonic variation in Manange is that regarding the tap consonant /ɾ/. The tap has two allophones: a tap [ɾ] and a fricative with a varying post-alveolar or retroflex place of articulation, which I will represent with the IPA symbol [ʐ].[3] The fricative occurs only in word-initial position, while the tap occurs in all other environments (i.e. in C2 onset, in word-medial onset and coda, and in word-final position). No other consonant in the inventory displays this type of allophonic alternation. Examples of the allophones for /ɾ/, in both phonemic and phonetic transcription, are given in Examples (1) and (2)

(1) Word-initial /ɾ/ = [ʐ]

/1ɾʌ/	[ʐʌ˨]	'goat'[4]
/3ɾo/	[ʐo˥˩]	'friend'
/4ɾo/	[ʐo˧˩]	'corpse'
/2ɾu/	[ʐu˥]	'(animal) horn'

3. There is no true rhotic approximant in Manange, either contrastive or allophonic. In Hildebrandt (2003) I suggested that the tap may have an approximant allophone [ɹ]. Upon further investigation, it appears that the phonetic representation is more accurately identified as a tap.

4. The numerals in these examples represent the four tone categories. Phonetically the four tones are represented with the following symbols: ˨ for low level tone /1/, ˥ for high level tone /2/, ˥˩ for high falling tone /3/, and ˧˩ for mid-low falling tone /4/. Tone is discussed in more detail in section 3.

(2) Elsewhere /ɾ/ = [ɾ]

C2 onset

/2mɾe/	[mɾe˧˥]	'door'
/3pɾi/	[pɾi˥˦]	'write'
/2nokɾe/	[no˥˦.kɾe˥˦]	'bone'

Word-medial, syllable initial

/3toɾe/	[to˥˦.ɾe˨˩]	'graveyard'
/1naɾaŋ/	[na˨˩.ɾaŋ˨˩]	'before'

Syllable or word final

/1tʌɾkja/	[tʌɾ˧.kja˧]	'white'
/1kʌɾtẽ/	[kʌɾ˧.tẽ˧]	'knife'
/4kʰjokoɾ/	[kʰjo˨˩.koɾ˨˩]	'old animates'
/2sʌɾ/	[sʌɾ˧˥]	'star'

In addition to illustrating the environments of allophonic variation, these examples also show that the variation occurs independent of tonal influence, as the two allophones may occur in words of all four tone categories.

Figures 2 through 4 illustrate spectrograms of /ɾ/ in three positions in three native words: word-initially in the noun /1ɾʌ/ 'goat', in C2 onset position in the verb root /1kɾa/ 'cry', and in word-final position in the noun /2sʌɾ/ 'star'. These words are recorded from Speaker 1. The spectrograms all have a broad bandwidth (172 Hz./128 pts.), and the formant search range was set at 5500 Hz. for the three female speakers, and at 5000 for the one male speaker.

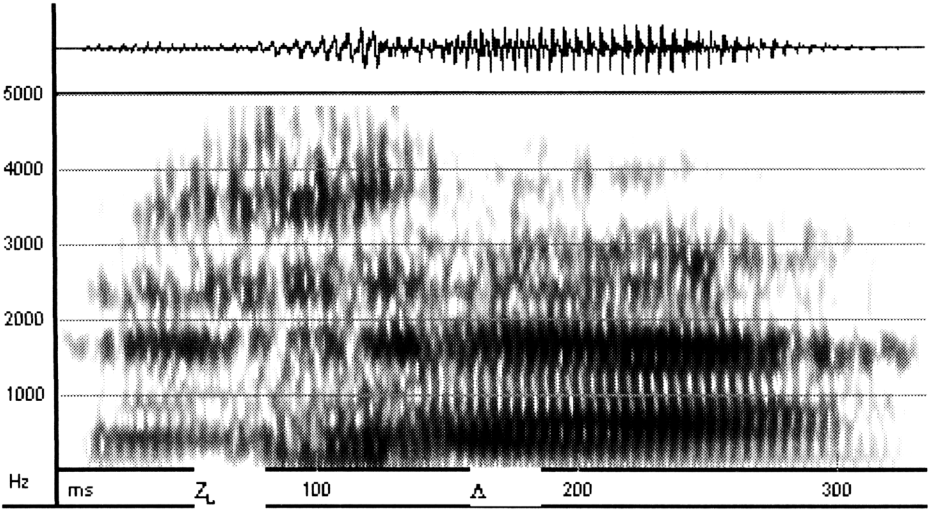

Figure 2.Spectrogram of /1ɾʌ/ [z̢ʌ˧] ‘goat’, speaker 1

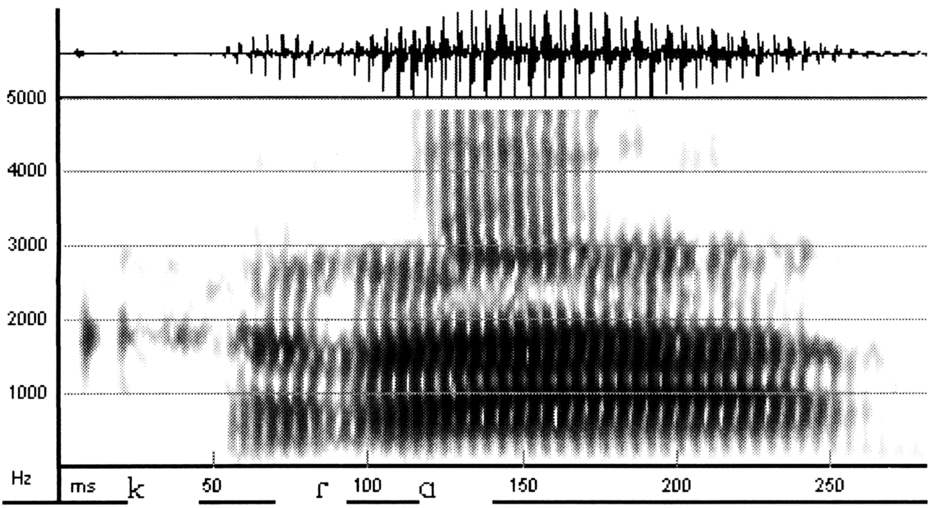

Figure 3. Spectrogram of /1kɾʌ/ [kə̥ɾɑ˧] ‘cry’, speaker 1[5]

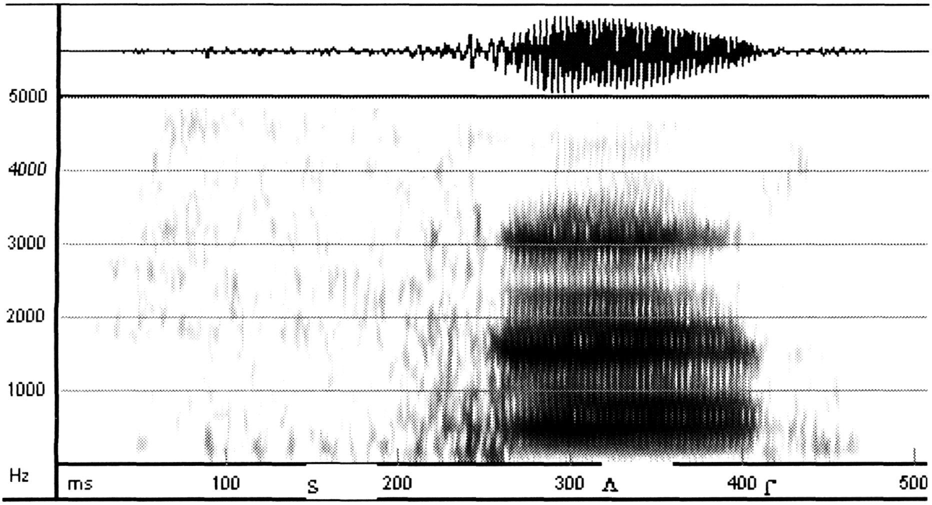

Figure 4. Spectrogram of /2sʌɾ/ [sʌɾ˧] 'star', speaker 1

In Figure 1 the weak formant bands illustrate the structure of an initial, voiced, fricative, not a tap. In Figures 2 and 3 the formant bands lower before the single point of contact between the tongue and the roof of the mouth, indicating a tap. In Figure 3, the tap in /2sʌɾ/ 'star' is word-final and so it tends to be realized as simply a devoiced segment.

The tap also surfaces when in initial position at a morpheme boundary, as long as it is still within the phonological word. Figure 5 illustrates a spectrogram of the locational noun plus locative enclitic /2p^{h}i=ɾi/ 'upwards'.

5. There is an epenthetic schwa /ə/ between the first and second onset in 'cry'. It is variably present.

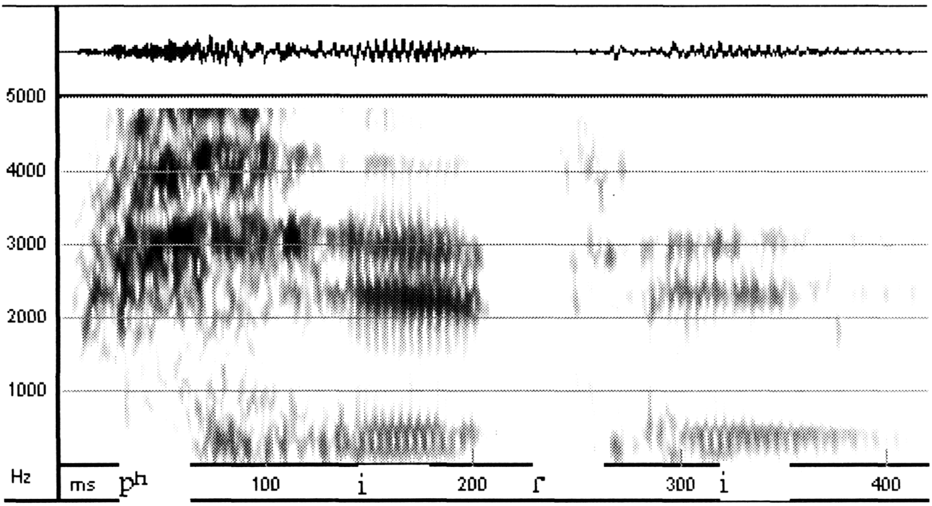

Figure 5. Spectrogram of /2pʰi=ɾi/ 'upwards', speaker 1[6]

Case enclitics like locative =ɾi in Manange display some selectional freedom in the hosts to which they can attach; however, they are always phonologically bound, as evidenced by optional vowel harmony with the stem vowel. In Figure 4 there is a slight drop in the frequency of the F2 just before the tap, and then a dramatic loss of energy with the single point of contact. Thus, the surface realization of the /ɾ/ as a tap in this morphologically complex form suggests that the relevant environment for the appearance of the other allophone is the start of the phonological word, and not the syllable.[7] (Possibly another allophone of the tap is a slightly devoiced variant, at word-final edge). Therefore, I treat the fricative [ʐ̥] as an allophone of the tap /ɾ/, which only occurs in word-initial position. The tap occurs "elsewhere."

6. A reviewer has noted that the tap in Figure 5 appears as a voiceless segment and looks long enough to be considered a full-fledged stop with a burst.

Vowels

Vowel quality

Manange has six plain vowel phonemes, represented in Chart 1.

Front	Central	Back
i		u
e		o
	ʌ	
	ɑ[8]	

Chart 1. Manange vowels

In order to examine the phonetic properties of the different vowel qualities, a set of monosyllabic roots (nouns, verbs, and verbal adjectives) were analyzed for their F1, F2 and F3 values across the same four speakers.[9]

The intervening effects of preceding consonants on the formant frequencies of vowels is discussed in Kent and Read (1992) and in

7. I do not have acoustic data for a consonant series of morpheme-final tap before another tap, as in a noun plus indefinite or locative clitic **2sʌɾ=ɾi** 'a star' or 'to a star', but there is no gemination detected in pronunciations of words like this, suggesting that one of the consonants is not realized. Such a dispreference for geminates is expected, as the only geminate occurs in a quantifier borrowed from Nepali: **2kʌtti** 'very, many, too many' (listed as an emphatic in Turner 1931). Incidentally, this word in Nepali does **not** have a geminate alveolar plosive. Gemination here may have an emphatic function.

8. In Hildebrandt (in press) /ɑ/ is analyzed as a low central vowel /a/, but in light of the formant results shown in this study, it is better analyzed as an open back vowel.

9. In the elicitation setting for this study, the verb and verbal adjective roots are always immediately followed by the nominalizing suffix **–pʌ**. Unlike the presence of a root-internal coda consonant or the presence of an onset of a second root syllable, the presence of this suffix appears to have no measurable effect on the formant values of the preceding verb or adjective root morphemes.

Stevens (2000). Specifically, the constraints placed on the tongue body and lips in the production of certain consonants may carry over to the following vowel. For example, syllables with bilabial and velar onsets may have a slight raising of F1 effect on the high front vowels. Conversely, alveolar onsets have a raising of F2 effect on following high back vowels. To better control for these types of intervening effects, the words chosen for this study that begin with front and central vowels (/i, e, ʌ, ɑ/) follow coronal consonants, and words with back vowels (/u, o/) follow bilabial or velar consonants. All words have open syllables.

A total of 30 monosyllabic words were examined for their representative formant values.[10] The vowel quality with the most lexical representatives is /e/, with seven tokens, and the vowel quality with the fewest representatives is /ʌ/, with three tokens.[11]

Tables 2 through 5 show the mean F1, F2 and F3 values (in Hz.) for all speakers, arranged by vowel quality.

Speaker #1	Tokens	F1	F2	F3
i	6	336	2372	3144
u	4	263	1151	2826
e	7	556	2054	3105
o	4	559	1322	2704
ʌ	3	603	1763	3080
ɑ	5	961	1630	2812

Table 2. Mean F1 through F3 values, speaker 1

10. The charts do not include data for closed-syllable monosyllabic stems or for disyllabic stems. It may be noted that the standard deviation values rise dramatically for all speakers across all vowel qualities when the formant values for disyllabic stems are considered in averages. Therefore, it appears that the phonetic characteristics of vowel quality in Manange are somewhat sensitive to phonotactic patterns and word size.

11. Due to unintended gaps in the data sets, the word for ‘book’ is not included for Speaker 4, and the word for ‘lard’ is not included for Speaker 3.

Speaker #2	Tokens	F1	F2	F3
i	6	297	2536	3337
u	4	365	1079	2744
e	7	543	2557	3164
o	4	582	1183	2776
ʌ	3	627	1571	2956
ɑ	5	976	1609	2780

Table 3. Mean F1 through F3 values, speaker 2

Speaker #3	Tokens	F1	F2	F3
i	5	369	2420	3052
u	4	337	864	2777
e	7	540	2313	3225
o	4	530	1400	2930
ʌ	3	627	1527	3186
ɑ	5	906	1843	2870

Table 4. Mean F1 through F3 values, speaker 3

Speaker #4	Tokens	F1	F2	F3
i	6	346	2037	2647
u	4	338	928	2313
e	6	448	1798	2239
o	4	540	1006	2407
ʌ	3	517	1441	2884
ɑ	5	693	1374	2336

Table 5. Mean F1 through F3 values, speaker 4

In order to present a visual perspective on the relative locations of the six vowels in the oral cavity, the mean values for the first formant (F1) and the mean values for the difference between the first and second formants (F2-F1) have been plotted on a chart where the vertical (y) axis represents F1 (height/openness) and the horizontal axis (x) represents the F2-F1 difference (backness). This chart is shown in Figure 6. The averages for Speaker 1 are represented by a diamond symbol. The averages for Speaker 2 are represented by a circle symbol. The averages for Speakers 3 and 4 are represented by a triangle and a square, respectively.

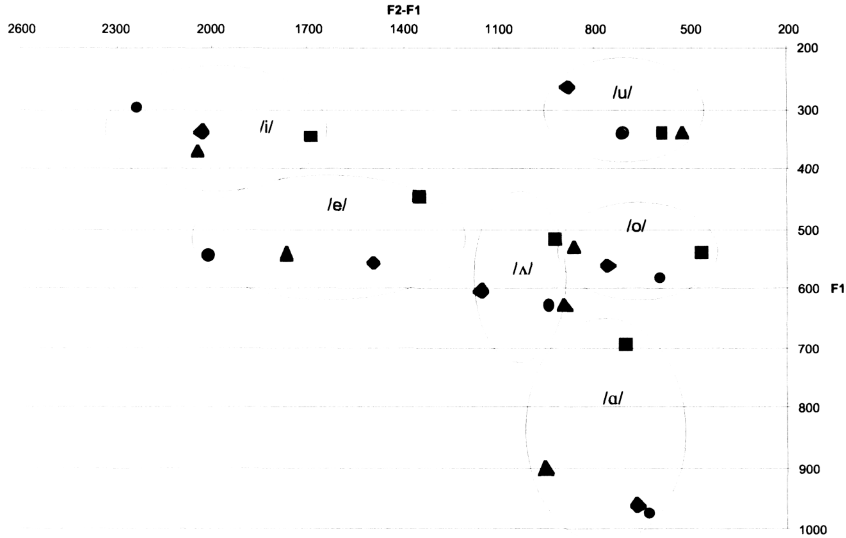

Figure 6. Average F1 vs. F2-F1 values (for six vowels, all speakers)[12]

Most vowels for Speaker 4 (the male speaker with a square symbol) are located in a more centralized space. This is especially evident with the front vowels /i, e/ and the open back vowel /ɑ/. Speakers 1 and 3 (diamond and triangle) also have the mid-front vowel /e/ located in a more central location, suggesting that a more accurate (narrow) IPA transcription of this vowel may be /ʌ/. The average values for /o/ and /ʌ/ show a good deal of overlap, and this overlap is often apparent in rapid speech, or when /o/ is in an unstressed (second) syllable, where it may be realized as [ʌ] (The same may be said for /a/ and /ʌ/ however).

12. The ellipses in Figure 5 serve to roughly demarcate the space in which the mean vowel quality values for each speaker are located, and do not represent any specific pattern of deviation from the means.

Nasalized Vowels

Five of the six vowels in Manange have (phonetically) nasalized counterparts, listed in example 3:

(3)	Plain	Nazalized
	i	ĩ
	u	ũ
	e	ẽ
	o	õ
	ɑ	ɑ̃

The phonemic status of nasalized vowels in Manange (and in other TGTM languages) is a somewhat tricky matter. Taking a cross-linguistic perspective, Noonan describes nasalized vowels in Nar-Phu as contrastive, but generally derivable as a former vowel and nasal consonant series (2003b, 337). Nasalized vowels in Tamang are "very marginally distinctive" (Mazaudon 2003, 292). On the other hand, Chantyal is said to have fully phonemic nasalized vowels (Noonan 2003a:315-16). In Manange, establishing the phonemic status of nasalized vowels presents an interesting analytical challenge. In previous analyses of Manange, Hoshi (1984, 1986) posits a full set of both phonemic plain and nasalized vowels (six of each, for a total of twelve vowels). However there are no minimal sets included in this analysis to illustrate their contrastive status.

Hildebrandt (in press) reports that nasalization in Manange is actually quite idiosyncratic in distribution and in phonetic realization. For one thing, there are no bound inflectional or derivational forms with nasalized vowels, nor are there any such morphemes with a nasal consonant in coda position (i.e. no bound or free grammatical morphemes ending in /-n, -m, -ŋ/). In addition, the surface realization of nasalized vowels in verb and verbal adjective roots may be predicted by the place feature of the initial consonant of any inflectional or derivational morpheme, and is therefore allophonic. Specifically, roots with suffixes realize a nasal coda consonant that shares place of articulation features with the onset consonant of the suffix. Roots that are followed by an evidential particle (that is phonologically unbound) have a lengthened and nasalized vowel. With nouns, monosyllabic words with nasalized vowels represent a very small percentage of the overall lexicon (fewer than 20 words), and are almost entirely restricted to words with front vowels (/i, e/). Added to this, there are no disyllabic roots with nasalized vowels.

It is therefore not surprising that the phonetic realization of vowel nasalization in nouns is subject to a good deal of cross-speaker variation, with some speakers producing a nasalized vowel (e.g. [cṽ]), and others producing a slightly nasalized (or plain) vowel and a nasal segment in coda position (e.g. [cṽn or cṽŋ]) for the same words. The spectrograms in Figures 7 through 9 below show these differences for two words with high front vowels (/i/) and alveolar obstruent onsets, for three of the four speakers surveyed for this study.[13] In the following three figures, the word for 'heart', which has a nasalized vowel or nasal coda is contrasted with the word for 'skin', which always has a plain vowel and no coda for all speakers with whom I have worked:

13. A gap in the data set for Speaker 2 prevents the illustration of her data.

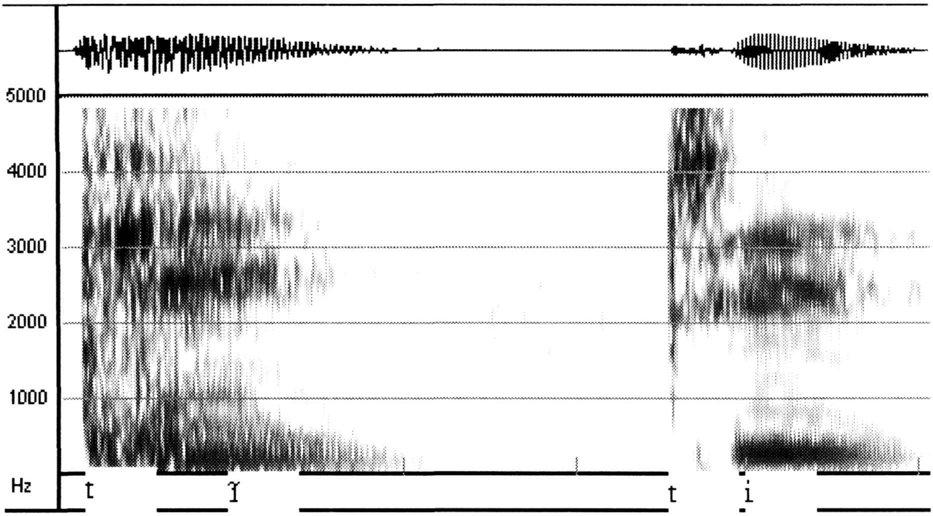

Figure 7. Speaker 1 [tĩ˧] 'heart' vs. [t̪i˥] 'skin'

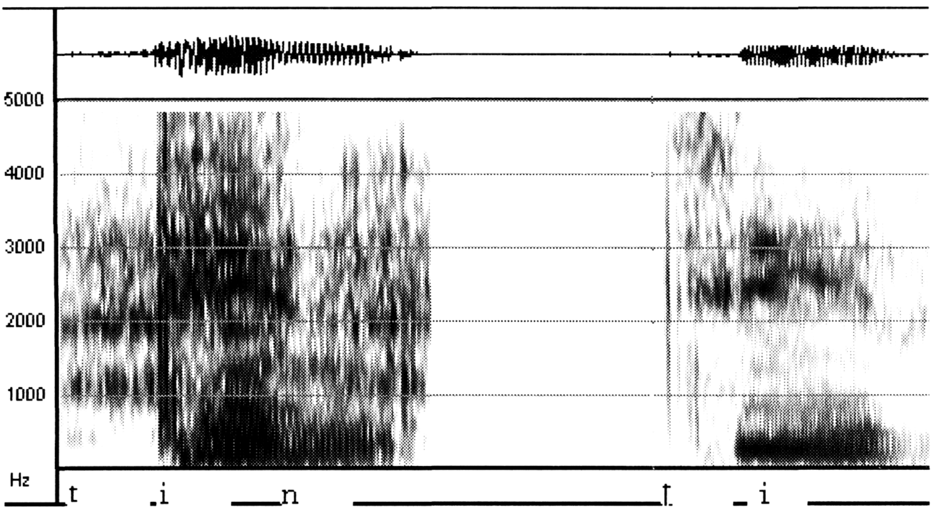

Figure 8. Speaker 3 [tin˧] 'heart' vs. [t̪i˥] 'skin'

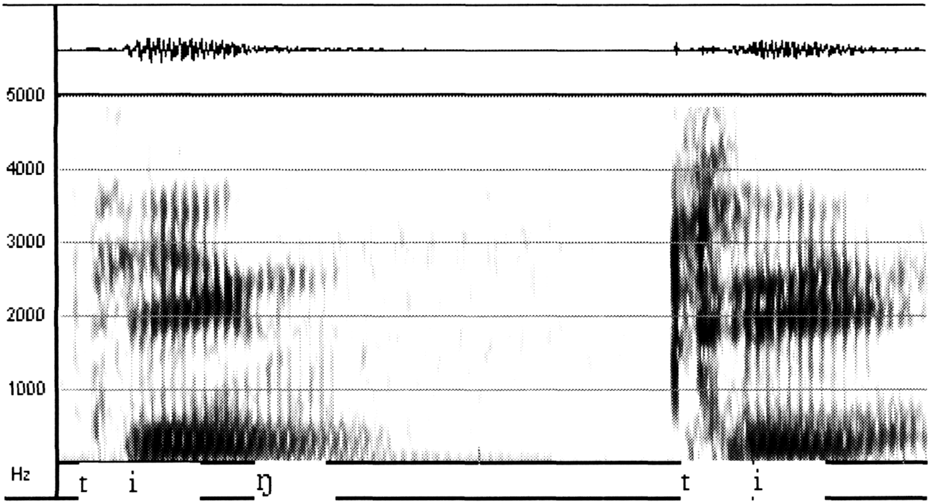

Figure 9.Speaker 4 [tiŋ ˧] 'heart' vs. [t̪i ˥˩] 'skin'

The variations in vowel formant structure for 'heart' are evident for each speaker. In Figure 7, the spectrographic reading of the vowel for the word 'heart' for Speaker 1 displays a weaker first formant (F1) structure than the vowel for the word 'skin' does. For Speaker 3 in Figure 8, the formant structure of the vowel in 'heart' is stronger, but weakens towards the end of the word with the presence of an alveolar nasal segment in coda position. This nasal is lamino-dental, and shows some structure in the second and third formants (F2 and F3). This can be contrasted with Speaker 4's production of 'heart' in Figure 9, which contains a plain vowel plus a velar nasal segment in coda position. The structure of the upper formants associated with the coda consonant in 'heart' appear merged for this speaker, which is characteristic of the velar nasal. In contrast to Speaker 1, the vowels for Speakers 3 and 4 for the word ‘heart’ are plain, and show comparatively stronger F1 values. These differences illustrate the differences in the way that the nasal feature is realized across different speakers.

Other words show the same kind of variation across speakers, and a sub-set of these, words (in the left-hand columns), contrasted with plain-vowel counterparts (in the right-hand columns) is listed in phonetic transcription for the same three speakers in Table 6.

speaker #	nasal	gloss	plain	gloss
1	[kʰĩ˧˩]		[kʰi˧]	
3	[kʰiŋ˧˩]	‘snow’	[kʰi˧]	‘3rd sg. pronoun’
4	[kʰĩ˧˩]		[kʰi˧]	
1	[kjẽ˧]		[kje˥]	
3	[kjẽ˧]	‘field’	[kje˥]	‘pretty’
4	[kje˧]		[kje˥]	
1	[tʰẽ˧]		[tʰe˧˩]	
3	[tʰe˧]	‘empty’	[tʰe˧˩]	‘pin’
4	[tʰẽ˧]		[tʰe˧˩]	

Table 6. Cross-speaker variation in production of nasal features[14]

Vowel Length

Another area of phonology in Manange that is subject to some debate is the questionable status of phonemic vowel length. Hoshi (1986) includes in her grammatical description what she calls “geminate vowels” (her transcription: aa, ii, oo, uu, ee), at the same time not-

14. The vowel for **1kjen** ‘field’ for Speaker 4 is only marginally nasalized in pronunciation. The same is true for **1tʰen** ‘empty’ for Speaker 3. The patterns suggest that nasalization is better preserved forms with final ***ŋ** than with final ***n** (Noonan personal communication)

ing "some ambiguity in the length of vowels".[15] A very small percentage of Hoshi's (1984) glossary (less than 10%) is actually comprised of lexical stems with long vowels, and those that she does list are all CV in syllable structure (including in disyllabics, where the geminate vowel is always an open syllable). They are found in all tones. In addition, this description includes no minimal pairs by which the lexically contrastive function of vowel length can be firmly established.

My own work on Manange phonology has lead me to question the status of contrastive vowel length. No speaker has acknowledged lexical differences based on vowel length, nor do speakers themselves perceive noticeable differences in vowel durations. However, instrumental analyses of vowel duration has shown that there are words with longer recorded vowel duration measurements than others, depending on what appears to be differences in syllable structure and context of elicitation. Therefore, it is useful to compare the duration measurements of these words with those that are treated in Hoshi as geminate.

I suggest that while there is no strong phonetic evidence for contrastive vowel duration in Manange, vowel duration is sensitive to syllable or morpheme (or even word) boundaries (Maddieson 1985). In general, words with open syllables that are uttered in isolation have overwhelmingly longer vowel durations for both speakers than those words with a closed syllable structure or those words (verbs) with suffixes (in this case, the **-pʌ** nominalizer).

15. In Tamang, distinctive vowel length is found only in initial open syllables (Mazaudon 2003, 292). In Nar-Phu it is the result of morphological or phonological processes (Noonan 2003b, 337). In Chantyal distinctive vowel length is a marginal part of the system and is most likely the result of recent diachronic developments (Noonan 2003a, 315-16). In the Seke dialects different phonetic vowel lengths are marginally present, and it seems that long vowels now are located in the place of old final consonants. Honda notes that long vowels are "unstable and elusive", but their presence in morpho-phonological alternations highlights the preference in Seke for heavy syllables (2002, 200).

Syllable Type

In her grammar and glossary, Hoshi included as geminate only those words with open syllables (either CV or CV.CV). Given this constrained occurrence, one option is to look at the average vowel durations in a number of words from different syllable types to see whether vowels in open or closed syllables have longer durations. For this study, a syllable is considered "open" if it is a C(C)V nominal word only. All other words are considered "closed", meaning they are either monosyllabic nominal stems with coda consonants, or they are verb or verb-like adjective stems followed by the nominalizing suffix that has a /p/ in onset position (e.g. C(C)V(C)-pʌ words).

Table 7 shows the average vowel durations (in milliseconds, ms.) for 136 monosyllabic stems with both open and closed syllables, for Speakers 1 and 4.[16] These measurements are taken from words elicited in isolation, and a comparison of durations in different elicitation contexts is provided in later tables.

Syllable Type	Speaker 1	Speaker 4
Open (ms.) (n= 58)		
Mean	138	94
Std. Dev.	31	23
Closed (ms.) (n= 78)		
Mean	86	67
Std. Dev.	30	17

Table 7. Mean durations, open vs. closed syllables

16. Data from Speaker 2 are not included because of a tendency to produce very careful speech in the all elicitation settings for words of all syllable types, with consequently exaggerated vowel durations. Data from Speaker 3 are not included because of a number of gaps in the data set. However, data from these speakers are explicitly considered in Hildebrandt (2003), and the general findings for Speakers 1 and 4 in this study also apply to Speakers 2 and 3. Due to slight interspeaker variations in syllable structure for a couple of individual words between Speaker 1 and 4, and due also to one word missing from Speaker 4's dataset, there are a total of 55 open-syllable and 80 closed-syllable words included for him in this table.

Table 7 shows that the average values for Speaker 4 are shorter than for Speaker 1. This reflects the tendency for this Speaker to produce noticeably shortened articulations for most words. Table 7 also shows that for both speakers, open syllable words carry longer vowel duration than closed syllable words do. The results of an independent-samples t-test to query the significance of durational differences between open and closed syllables for both speakers resulted in a significance level of .000 for both speakers at a 95% confidence level. This suggests that the vowel durations across the two syllable types are significantly distinct to warrant a closer investigation of vowel length.

Table 8 shows average vowel durations (in ms.) for 26 (elicited in isolation) words that Hoshi labelled "geminate." The words include either CV monosyllabic nominals (e.g. Hoshi's transcription of **2kaa** 'blood') or the first (root) syllable of bi-morphemic verbs or verb-like adjectives (e.g. **1kraa** 'weep'). These are words that were also included in a database for my field research. This table also contains average durations for 118 words from the database that were not labelled as geminate by Hoshi.

Type	Speaker 1	Speaker 4
"Geminate" (ms.) (n=26)		
Mean	120	87
Std. Dev.	42	77
Non-Geminate (ms.) (n=72)[a]		
Mean	113	82
Std. Dev.	43	24

a. Due to a gap in the data, there are 95 words analyzed for Speaker 4 in this table

Table 8. "Geminate" & non-geminate CV monosyllabics

Table 8 shows that for both Speaker 1 and 4 words with geminate vowels are slightly longer than those without. An independent-samples t-test performed to check the significance of the durational differences between the two word-types provided a significance level of .498 for Speaker 1 and a level of .375 for Speaker 4, suggesting that there is no significant durational difference between those words labelled as having geminate vowels and those not labelled as geminate by Hoshi. Rather, the greater difference in duration may be attributed to syllable boundary types, with open syllables or those words uttered in isolation having consistently longer phonetic duration, and closed syllables or words uttered in a frame context having shorter durations. This phenomenon has been explored in other literature, most notably Maddieson (1985). I now pursue this possibility in Manange by looking in more detail at durational differences as they may occur in different syllable structures and elicitation contexts.

Elicitation Context Type

In addition to the syllable type of the word, the context of elicitation also has an apparent effect on overall vowel durations. The words for this study were recorded in both isolation and frame-medial (clause-medial) contexts, and it was found that words uttered in isolation, regardless of syllable type, had noticeably longer vowel duration for both speakers. Table 9 shows durational differences compared between closed and open syllable types in both isolation and frame-medial contexts for Speakers 1 and 4 (female and male, respectively). The standard deviations are in parentheses.

Speaker 1	Isolation (n = 136)	Frame-Medial (n = 136)
Open Syllables	138 (31)	117 (29)
Closed Syllables	86 (30)	90 (39)

Speaker 4	Isolation (n = 135)	Frame-Medial (n = 135)
Open Syllables	94 (23)	76 (24)
Closed Syllables	67 (17)	59 (17)

Table 9.Duration differences in syllable types and contexts, speakers 1 & 4

For Speaker 1 words in isolation are longer on average than are those in a frame-medial context, for both open and closed syllables. An independent-samples t-test performed to query the significance of these differences shows significant values of .008 for open syllables across context types and .012 for closed syllables, at a 98% confidence level.[17] In addition, words with open syllables are longer in duration than are words with closed syllables, in both elicitation contexts. An independent-samples t-test shows this difference also to be significant, with a value of .000 in isolation context for both syllable types and a value of .009 in frame-medial for both syllable types, at a confidence level of 95%.

Table 9 also shows that for Speaker 4 vowel durations are longer in open syllables and words elicited in isolation. An independent-samples t-test shows that these differences are significant for both syllable types in both contexts, with values of .000 for both isolation and frame-medial contexts, at a 95% confidence level. These differences are also significant for both context types, across syllable types, with values of .000 for open syllables and .002 for closed syllables, respectively.

In summary, I suggest that while vowel length is not phonemic in Manange, it is especially sensitive to boundary phenomena, and there is a tendency for vowels in an open or non-bounded context to undergo phonetic lengthening.

17. Where a value under .050 represents a significant difference between durations.

3 SUPRASEGMENTAL SYSTEM

Tone

Manange has a system of four tones aligning primarily along a parameter of contrastive vowel pitch. Figure 10 shows lines that connect the starting, midpoint and ending fundamental frequency (F0) measurements for a tonal near-minimal set for Speaker 1. The words in this minimal set all begin with nasal segments, and were all recorded in a frame-medial context.

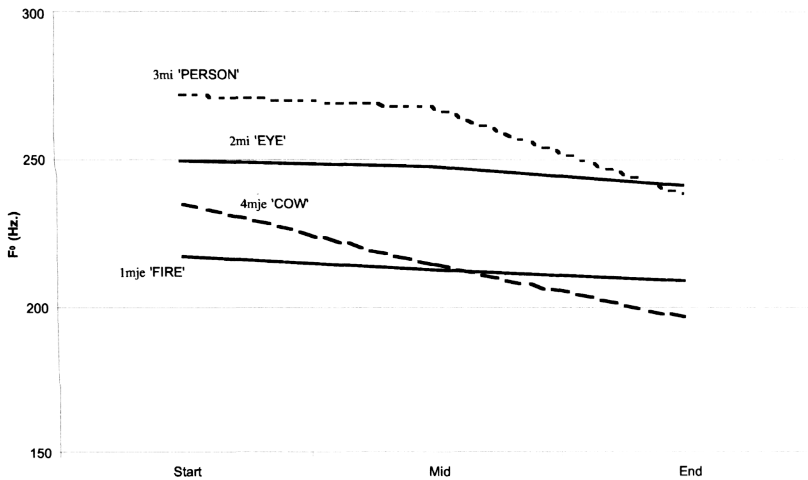

Figure 10.Near-minimal set, nasal-initial words, speaker 1

The words in Figure 10 are all monosyllabic nominal roots. Figure 9 illustrates the two types of tone melodies in Manange: words in tones /1/ and /2/ have relatively level tones (low and high, respectively), and those in tones /3/ and /4/ have contour pitches (very high falling and mid-high falling, respectively). Words with initial sonorant consonants (fricatives and approximants are included here along with the nasals) are found in all four tones, and display the same pitch properties as do words with initial obstruent consonants.

Figure 11 shows lines that connect the starting, midpoint and ending F0 measurements for a tonal minimal set containing words that begin with obstruents (the retroflex plosive).

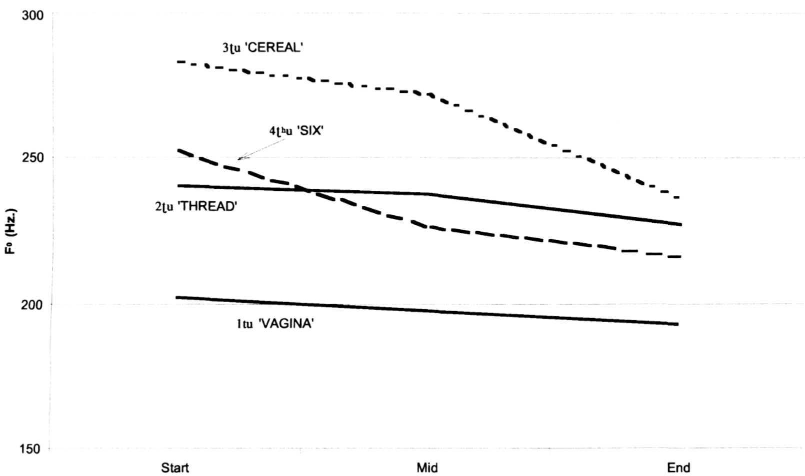

Figure 11. Minimal set, obstruent-initials, speaker 1

The pitch properties of the words in each of the tones are similar to those seen with the nasal-initial words in Figure 10. However, the IPA transcriptions of the words in Figure 10 show that when the onset consonant is an obstruent, tones /3/ and /4/ show a split; tone /3/ obstruent-initial words are unaspirated, and tone /4/ obstruent initial words are aspirated. This aspiration split is not present in tones /1/ and /2/, where words with aspirated and unaspirated obstruents both may occur.

As mentioned, obstruents in Manange are phonemically unvoiced, and there is no systematic phonetic voicing process that corresponds to tone type in Manange, unlike as is the case with some other TGTM languages. In addition, the voice onset time for aspirated initials across tones and also for unaspirated initials is nearly identical (i.e. similar among aspirated obstruents in tones /1/, /2/ & /4/, and also among unaspirated obstruents in tones /1/, /2/ & /3/).

With sonorant-initial words like those in Figure 11, there is no aspiration distinction in the two contour tones (/3/ and /4/). There are also no differences in degree of onset voicing with sonorant-initials, nor are there any differences in vowel phonation across the four tones. In other words, while tones /3/ and /4/ are distinct from the other two tones in terms of their aspiration contrasts with obstruent-initial words, this distinction is not relevant for sonorant-initial words. Thus, fundamental frequency is the primary correlate of the tone system, with aspiration distinctions having secondary significance; it applies in only two tones and then only for words with obstruent initials.

The domain of tone

The domain of the tone bearing unit in Manange is the phonological word. This includes the mono or polysyllabic root or stem morpheme and all phonologically bound derivational and inflectional affixes and clitics. Figure 12 shows the starting, mid-point and ending F0 values for a near-minimal set of disyllabic nominal roots from each of the four tones.

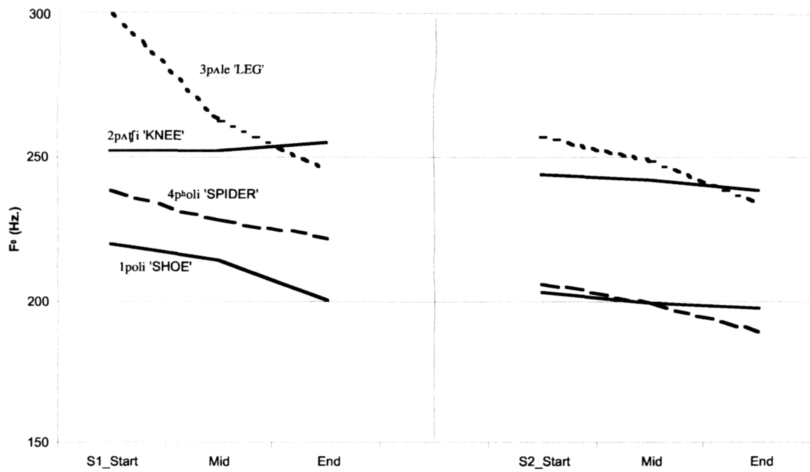

Figure 12.Near-minimal set, disyllabic roots, speaker 1

It is difficult to locate an exact minimal pair of disyllabic roots, as most roots in Manange are monosyllabic, and most polysyllabic words are morphologically complex. However, we can see that for disyllabic roots that are analyzed by speakers as morphologically simple, the tone pattern is the same as with monosyllabic roots. This is shown in Figure 12. The distinctive F0 displaying the same (expanded) trajectory spreads across both syllables of a disyllabic root, as with the single rhyme of a monosyllabic word.

One apparent difference between disyllabic and monosyllabic roots is that in disyllabics the aspiration distinction between tones /3/ and /4/ seems to not exceptionlessly apply. In other words, there are a few disyllabic words in tone /4/ that begin with unaspirated obstruents, and a couple of words in tone /3/ that begin with aspirated obstruents. These are listed in Example 2.

(2)	**/3/**		**/4/**	
	3tʰiŋi	'sun'	4koʈe	'button'
	3tʃʰupi	'duck'	4toŋe	'bear'
			4kikjɑ	'pocket'

The mechanism by which these words have come to be members of the particular tones or have these particular onset phonations is not currently understood. However, speakers recognize these words in these tones, and the words display the characteristic pitch properties of the two contour tones /3/ and /4/.

This single, level or falling, trajectory of each of the four tones also spreads in the same manner across morphologically complex phonological words. Figure 12 shows lines connecting the starting, mid-point and ending F0 values for a near-minimal set of verbs, all with the nominalizing suffix –pʌ, from each of the tones. In addition a number of other inflectional and derivational functions, this suffix is used when speakers utter the citation form of verbs, with a meaning equivalent of 'to X' in English.

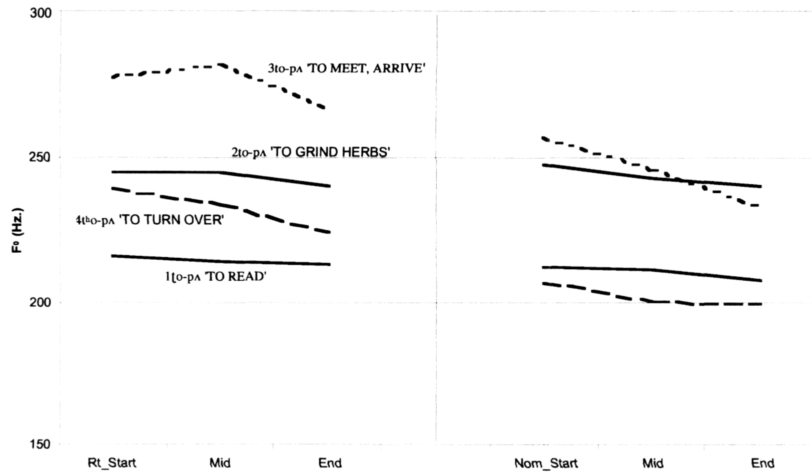

Figure 13. Near-minimal set, verb stems + nominalizer suffix, speaker 1

As with disyllabic roots, the F0 values carry or spread across the root and suffix syllables, illustrated in Figure 13. This suggests that phonologically bound grammatical morphemes are inherently toneless. The distinctive pitch of the root spreads rightward, to the end of the word.

The same rightward spreading of pitch suggests that for the purpose of tone at least, compounds in Manange are comprised of a single phonological word, even when the distinct semantics of each element are transparent. My investigation has not yet included a comprehensive analysis of pitch properties of all compound types in Manange, but Figure 14 illustrates the starting, mid-point and ending F0 values for both syllables of three compound words from tones /1/, /2/ and /4/. A morphological analysis of the compound elements is provided in Table 10.

Compound	Element 1	Element 2	Gloss
1tʃʰuku	1tʃʰi 'lard'	2kju 'water'	'cooking oil'
3nɑhuŋ	3nɑ 'jungle'	2huŋ 'copse'	'forest'
4mʷiʃʌ	4mʷi 'silver'	1ʃʌ 'flesh' ??	'money'

Table 10. Compound components

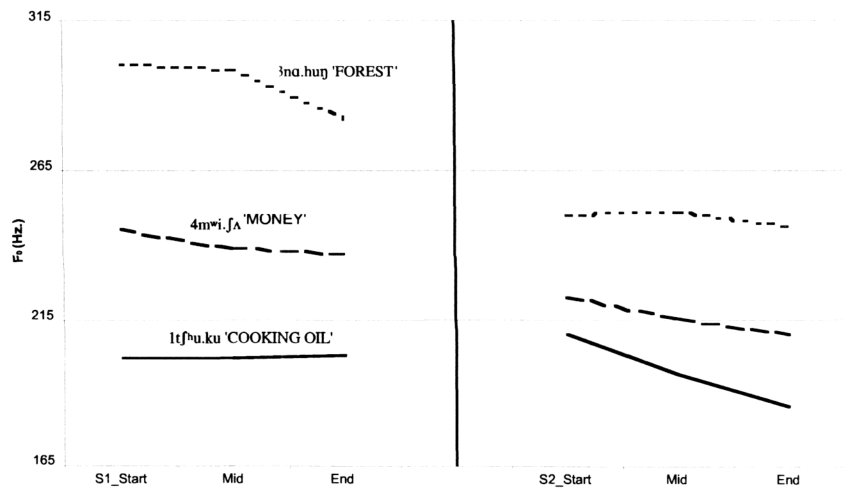

Figure 14. F0 values for three compounds, speaker 1

In noun-noun compounds, it is the distinctive pitch of the first element that spreads rightwards, including both elements in the overall trajectory. The tone /1/ compound for 'cooking oil' has a somewhat more steeply falling trajectory on the second syllable. It is unknown at this time what this may be attributed to, as the pitch trajectory is more level for the same word analyzed from the other three speakers.

There are some instances of somewhat idiosyncratic pitch properties with certain compounds and some disyllabic nominal roots. In particular, certain disyllabic roots from the "high tones" (/2/ and /3/) display a rather dramatic pitch-reset on the vowel of second syllable. In addition, certain so-called compounds like **1mikju** 'tear drop' (2mi 'eye' + **2kju** 'water') appear to have 2 distinct pitches on each element (a rising and a level pitch), suggesting that they are perhaps concatenations or juxtapositions of two phonological words, rather than a single phonological unit. A comprehensive analysis of this phenomenon is beyond the scope of this paper, however. Table 11 summarizes the phonetic properties of the four tones.

Tone	Onset constraints	Pitch across word	Phonetic transcription
/1/	none	low, level	˨
/2/	none	mid-high, level	˦
/3/	[- asp.] if stop/affricate	very high, sharp fall	˥˧
/4/	[+ asp.] if stop/affricate	mid-high or mid-low falling	˧˩

Table 11.Manange tones

4 SUMMARY

This phonetic analysis has described several segmental and suprasegmental features of Manange. The alveolar tap phoneme alternates with a voiced fricative allophone in word-initial position. Four of the six vowels occupy a generally centralized space of the vocal tract, with some acoustic overlap between the close- and open-mid vowels. This is especially true for the male speaker. Nasalized vowels are perhaps marginally phonemic in the language, but for some speakers the contrastive difference is realized as more of a vowel-plus-nasal-segment rhyme sequence than as a feature of the vowel. Vowel length is not phonemically contrastive in Manange, but vowel duration is extremely sensitive to syllable, morpheme and word boundaries. Finally, the tone system aligns primarily along vowel pitch distinctions and secondarily along obstruent aspiration. The tone bearing unit in Manange is the phonological word.

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