Register in Mah Meri: A preliminary phonetic analysis

Mary Stevens, Nicole Kruspe & John Hajek

School of Languages
University of Melbourne, Australia
{mes; nkruspe; j.hajek}@unimelb.edu.au

Abstract

This paper presents the results of a first phonetic investigation of register in Mah Meri, a Southern Aslian language spoken in Peninsular Malaysia, and part of the larger Austroasiatic family spread throughout South and Southeast Asia. Voice register, a complex of laryngeal and supralaryngeal properties, is a common areal feature amongst members of the Austroasiatic family (particularly the Mon-Khmer group) but has never previously been reported to occur in an Aslian language. We consider general spectral appearance, duration and f0 in order to see how well they correlate with perceived differences in register.

1. Introduction

Mah Meri, also known as Besisi, is a little known Southern Aslian language spoken in the Malay Peninsula, see [1]. Aslian languages belong to the Mon-Khmer division of the larger Austroasiatic family spoken throughout mainland Southeast Asia and in eastern India. Until recently Aslian languages have not been particularly well described, but see [1, 2]. It has generally been considered true that Aslian languages do not show prosodic properties known to occur in other Mon-Khmer languages, like voice register. While from a typological perspective voice register is rare, many Mon-Khmer languages spoken in Thailand and Indochina are reported to have so called register as part of their phonological systems.

Voice register, or simply register, is best described as a complex of different laryngeal and supralaryngeal phenomena such as voice quality, vowel quality and length, and pitch [4]. Any one or more of these properties may dominate over the others in any specific register and this hierarchy varies from language to language. Register systems most commonly involve a minimal two-way contrast between a clear (or modal) voice quality, and a voice quality such as breathy or creaky. As many as four registers are known to occur in a single language [4]. Not surprisingly, the existence of register significantly complicates the structure of a language's vowel system.

Aslian languages are not generally thought to show any register-like behaviour, however some revision of this position is needed, as our research shows evidence of a two-way register system in Mah Meri.

2. Background

Mah Meri is spoken by an estimated 2100 speakers in a small pocket on the southwest coast of the Malay Peninsula. It has a complex phonological system with nine basic vowel qualities and a contrastive two-way register system. All nine vowels exhibit register 1 and register 2 variants.

In Table 1, register 2 vowels are represented by the IPA symbol [̤] below the vowel, which we use it to distinguish register 2, and not necessarily to indicate breathy voice.

	Front	Central	Back -round	Back +round
High	i i̤		ɯ ɯ̤	u ṳ
Mid-high	e e̤			o o̤
Mid-low	ɛ ɛ̤	ə ə̤		ɔ ɔ̤
Low		a a̤		

Table 1. Vowel phoneme chart showing registers 1 and 2.

2.1. Register 1

Register 1 vowels have a phonemic oral versus nasal distinction in all vowels. The vowels may occur in non-final syllables, and precede the full inventory of coda consonants. There are also associated consonantal allophonic effects, e.g. in coda position following register 1 oral vowels, voiceless plosives have a simultaneous glottal closure, and are unreleased, e.g. /bəkut/ [bəˈku͡ʔt̚] 'to be blunt'.

2.2. Register 2

Unlike register 1 vowels, register 2 vowels lack an oral versus nasal distinction, and never occur in the environment of a nasal onset or coda. Register 2 vowels are restricted to the final syllable, for which the only possible coda is a voiceless plosive. The plosives are unchecked in word-final position, e.g. /wa̤k/ [wa̤k] 'person' (classifier).

3. Methods

3.1. The data

The data were drawn from a set of recordings of pairs of tokens produced in isolation by a male speaker aged 33 years.

Of the nine pairs of register 1 and 2 vowels in Mah Meri, we examine eight pairs. Two tokens were recorded in isolation for each word listed below, giving 32 tokens in total. For technical reasons, the ninth pair was excluded.

V quality	register 1	gloss	register 2	gloss
a	luwat	'mangrove worm'	luwạt	'front'
e	ket	'little'	ʔiʔẹt	'no, not'
ɛ	jɛc	'be bored'	sɛ̣c	'endpoint'
u	bəkut	'be blunt'	dụk	'house'
o	jok	'to uproot'	cọk	'rattan'
ə	ɯəc	'Munia sp. Bird'	ɯə̣c	'to throb'
ɔ	sɔp	'to dress'	k^{h}ɔ̣p	'to get'
ɯ	bɯt	'to stop running'	təkụ̣t	'to press'

Table 2. Lexical items examined in the present study, for each vowel quality and register type.

3.2. Auditory impressionistic description of register in Mah Meri

Previous listenings of Mah Meri recordings had allowed for a very general definition of the basic characteristics of register. For the purposes of this study, specific vowel pairs (see Table 2) were identified and subjected to repeated auditory evaluation before acoustic analysis was undertaken.

3.3. Acoustic analyses

The spectral appearance of vowels in each register was examined, with reference to spectral and waveform displays within Praat. The duration of each vowel was measured, following the usual procedures. The fundamental frequency was measured using the pitch trace function within Praat, which enabled values at 10ms intervals to be extracted. These were subsequently plotted within Excel for comparison across tokens. Preliminary statistical analyses were made where appropriate using ANOVA within Excel.

4. Results

4.1. Auditory perception

Previous auditory evaluation of the two registers allowed for the following impressionistic descriptions, in very general terms:

Register 1 Register 1 vowels are typically, though not always, characterised by a clear tense voice quality and a shorter duration than register 2 vowels, and lower pitch.

Register 2 Register 2 vowels are generally perceived to be laxer and longer than their register 1 counterparts. They often have a breathy articulation, which is most clearly audible in the lower vowels, but less so as vowel height increases. They also tend to have higher pitch.

With respect to the perceptual properties of the data set used in this study, the distinction between registers 1 and 2 in Mah Meri was sometimes difficult to determine and the effects often seemed labile – such that we could not always be certain or agree on what we perceived to be the most salient features of register in each vowel pair comparison.

4.2. Spectral appearance

Generally speaking, the register 2 vowels showed less clearly defined formants than their register 1 counterparts, and the second and higher formants were occasionally noticeably weaker than formant 1 (though not in the example shown in Figure 1). Notwithstanding the weaker formant energy, there was energy in the higher regions, but it was more evenly dispersed: there were often weak striations in the upper regions of the spectrum. The vowels of register 1, by comparison, showed more clearly defined formants, and formant 2 in particular did not appear to be noticeably weaker than formant 1.

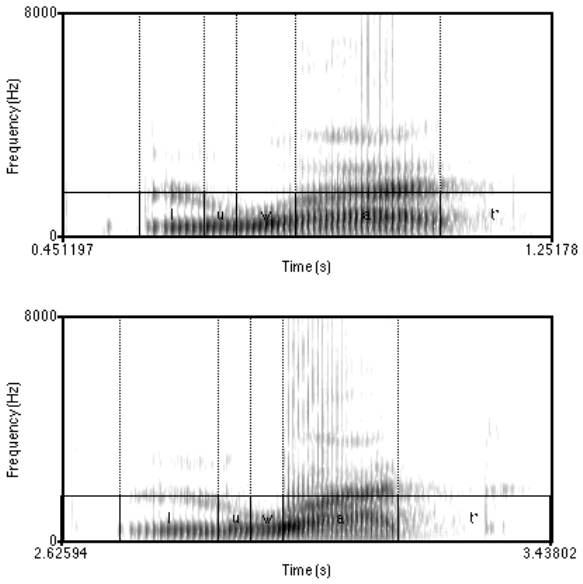

Figure 1. A spectrogram of /luwat/ *'mangrove worm' (top), showing the register 1 vowel* /a/*; and* /luwạt/ *'front', showing the register 2 vowel* /ạ/ *(below). Less clearly defined formants, and vertical striations, particularly in the first part, can be seen for the register 2 vowel.*

However, not all the register 2 tokens conformed to these patterns, and as such the spectral appearance of register 2 vowels did not consistently distinguish them from their register 1 counterparts.

4.3. Vowel duration

The average duration recorded for the plain register 1 vowels was 24ms. longer than for the register 2 vowels (see Table 3). The plain vowels also showed slightly greater (+13ms.) variation across tokens.

register	mean V (ms.)	st. dev.	no. tokens
1	254	69	16
2	230	56	16

Table 3. The average duration, standard deviation and number of tokens for the vowels analysed, according to register.

This pattern, though not statistically significant ($p = 0.297$), contrasts with the auditory impression that the register 2 vowels were typically longer. Moreover, when the duration of individual vowel pairs was inspected, this general pattern was not consistently upheld. While the register 1 variant was substantially longer than its register 2 counterpart in four cases (see Table 4), for mid-front /e/, central /ə/ and mid-low back /ɔ/ the average duration difference between the two registers was minimal.

V type	Register 1	Register 2	Reg.1- Reg.2
ɯ	344.5	253	+91.5
o	207.5	130	+77.5
a	242.5	172	+70.5
ɛ	332.5	279.5	+53
ɔ	284	280.5	+3.5
ə	196.5	200	-3.5
e	266	284.5	-18.5
u	156	242	-86

Table 4. Average duration (ms) for the vowels of registers 1 and 2, listed in descending order according to the duration difference between register 1minus register 2.

We note that high back /u/, with a much longer register 2 variant, appears to be somewhat of an exception.

4.4. Fundamental frequency

The pitch of register 1 and 2 vowels was compared, in terms of absolute values and contour shape, by plotting the f0 contour for each token, according to vowel type.

We note that within each register the tokens analysed for each vowel type showed almost identical f0 contours (allowing them to be averaged in Tables 3 & 5).

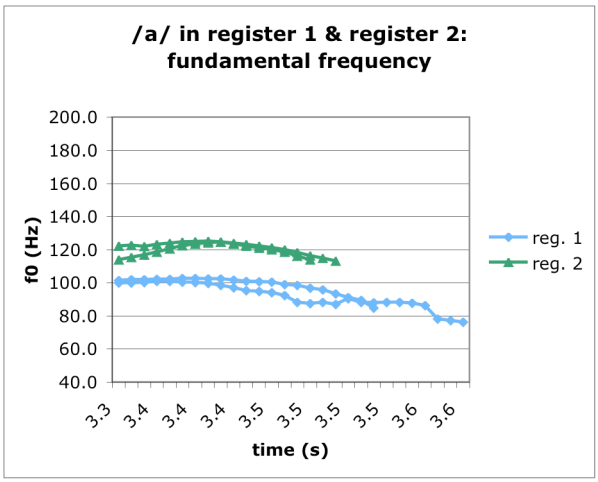

Figure 2. Fundamental frequency traces for four /a/ *tokens; two in register 1* /luwat/ *'mangrove worm' and two in register 2* /luwạt/ *'front'. Register 2 is seen to be higher than register 1. The register 1 vowel was also 70.5ms. longer (cf. Table 4.).*

Figure 2 shows the pitch contour for the low vowel /a/ in register 1 /luwat/ 'mangrove worm', and in register 2 /luwạt/ 'front', where the pitch of the register 2 variant was higher than that recorded for its register 1 counterpart.

Comparing the F0 values at the onset, midpoint and offset across register 1 and register 2 vowel pairs, we see that this pattern was upheld across vowel type:

	register	onset	mid	offset
a	1	100.7	96.7	80.5
	2	118.1	123.3	113.4
ə	1	126.9	144.2	126.6
	2	144.2	164.5	150.5
o	1	126.6	145.5	123.1
	2	154.8	152.9	146.5
ɔ	1	106	110	91.6
	2	112.3	116.8	98.7
e	1	120	122.6	111
	2	106.2	128.6	114.1
u	1	127.9	154.9	119.1
	2	144.1	171.3	151.4
ɯ	1	136.2	151.7	118.6
	2	153.5	141.3	111.5

Table 5. F0 values (in Hz) for the onset, midpoint and offset of vowels according to quality and register (mean values for the 2 repetitions of each token). Shaded cells indicate pairs where the mean pitch value for register 2 was higher than for register 1.

As for the low central vowel /a/, central /ə/ and mid-high back /o/, higher f0 values (~20-33Hz) were recorded across the

duration of the vowel in register 2. The difference in favour of register 2 was slightly less in the case of high back /u/.

Additionally, mid-low back /ɔ/ and mid-high front /e/ also showed higher f0 values, although the effect was much slighter, and was not particularly perceptually salient in the auditory analysis. We note that at the onset of /e/, the pitch was higher for register 1 than register 2. We might attribute this exceptional value to segmental context: a glottal stop preceded the register 2 token in /ʔiʔɐ̤t/ 'no, not' which may have lowered the pitch at the onset of the vowel. In other cases where the prevocalic consonant varied across pairs, possible differing perturbation effects on the value of f0 at onset were not sufficient to lower register 2 values below those of register 1. The remaining vowel, high back unrounded /ɯ/ showed the opposite pattern to the other vowels, at least after the onset of the vowel, whereby the f0 values for the register 2 vowel were instead lower than for their register 1 counterparts from mid-point. This difference in pattern occurs too late in the vowel for it to be ascribed to specific perturbation effects triggered by different onset consonants.

5. Discussion

It is well-known that that the definition of register in any language considered to have it is particularly problematic since it is not one well-defined property, such as tone in a tonal language, but a complex grouping of different laryngeal and supralaryngeal properties that can easily vary and overlap in production, e.g. [4, 6]. Previous auditory analysis had allowed for the properties of each register in Mah Meri to be determined, at least impressionistically, but, like others, e.g. [4, 6], we also found that identifying the salient properties of each register in a specific item was often difficult.

On this point, we note the results of perceptual identification tests conducted by two phoneticians of register in Suai (Mon-Khmer, Thailand) [4]. They considered pitch (low v. high) and phonation (modal v. breathy). There were substantial differences between raters across both registers for pitch (although high pitch was more generally identified on register 1 (74.2~98%) and low on register 2 (56.6~91.9%)). While modal voice was regularly identified as such in register 1 (98~98.5%), expected breathy voice on register 2 was much less frequently identified (48.5~66.7%).

It was hoped that acoustic analysis of our data, focussing on three specific criteria, would resolve some of the uncertainty for Mah Meri and allow for a better and more reliable (acoustic) specification of register differences at least for this language.

With respect to the spectral appearance of vowels in Mah Meri, formants were more clearly defined for the register 1 (modal) vowels, whereas register 2 vowels often showed greater and more widely dispersed energy at the level of the higher formants. However, not all tokens conformed to this pattern, undermining the reliability of this criterion.

As for vowel duration and register, statistical analysis did not find any significant difference in either direction, although previous impressionistic evaluation suggested greater duration was more characteristic of register 2. Differences between individual vowel pairs were very inconsistent: in some cases register 1 vowels were substantially longer, in others there was no major difference, whilst only in one case was register 2 clearly longer (see Table 4). Further investigation is needed to determine why register 2 vowels were perceived as longer much more consistently than acoustic results would suggest.

Our preliminary results suggest that pitch appears to be the most reliable indicator of register. Register 2 had higher f0 values throughout the vowel with few exceptions. However, differences were variable, with only slight differences often noted. As a result, it is not clear that f0 on its own would be sufficient or reliable enough for register identification.

A comparison with other acoustic studies of register [4, 6]) in Mon-Khmer languages confirms the complex nature of register, where, of the parameters considered here, no single parameter functions consistently in the same manner across languages. Vowel duration is not a reliable predictor of register differences in any of the languages considered. Although register 2 vowels in Chanthaburi Khmer appear to be longer on average (+26.3ms, two speakers), no statistically significant effect was found [6]. A similar absence of effect was found for Suai [4]. Pitch as measured by f0 was higher in register 2 (breathy) in Chanthaburi Khmer. However, the difference was relatively small and not significant (+4.45Hz, two speakers). In Suai, on the other hand, f0 differences were significant, with higher pitch on register 1 (modal) than in Mah Meri. However, in Suai the difference only occurred in the first half of the vowel, and was most noticeable at onset, with similar f0 values achieved by vowel midpoint.

6. Conclusion

While much remains to be investigated and understood, results presented here are useful in helping to understand: (a) the nature of register in Mah Meri; and (b) how the phenomenon in this language might compare with that in more distantly related languages as part of a wider Mon-Khmer areal phenomenon. Although preliminary, our results are consistent with those of earlier studies that find register to be a complex and variable phenomenon across and within these languages and whose identification, especially perceptual, relies not on a single acoustic factor, but on the interaction between many different ones.

7. References

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