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Investigating Changes in the Rhythm of Maori over Time

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Abstract

Present-day Maori elders comment that the *mita* (which includes rhythm) of the Maori language, has changed over time. This paper presents the first results in a study of the change of Maori rhythm. PVI analyses did not capture this change. Perceptual experiments, using extracts of speech low-pass filtered to 400 Hz, demonstrated that Maori and English speech could be distinguished. Listeners who spoke Maori were more accurate than those who spoke only English. The English and Maori speech of groups of different speakers born at different times was perceived differently, indicating that the rhythm of Maori has indeed changed over time.

Index Terms: Rhythm, Perception, Maori, Sound Change

1. Introduction

This paper presents the first results in our study of the change of rhythm in Maori over time. Maori is the indigenous language of New Zealand, spoken there for some 800 years. The use of the Maori language declined through the mid-1900s and the language has been subject to revitalisation efforts over the last twenty or so years. Although English and Maori are the main official languages of New Zealand, currently the number of speakers who are very fluent in the Maori language is relatively low, as few as 4% of the Maori population of ca. 0.25 million, though as many as 20% have some level of fluency [1, p195].

The MAONZE (Maori and New Zealand English) research project is studying the mutual influence of both languages, focussing on pronunciation. The study involves analysis of both historical and present-day speakers, investigating the Maori and English of three groups of Maori speakers: MU (historical elders, born in the late 1800s and recorded by the Mobile Broadcasting Unit of the New Zealand Broadcasting Service in the 1940s), K (*kaumatua*, present-day elders, born in the 1920s and 30s and recorded between 2004 and 2006) and Y (present-day younger speakers, born in the 1970s and 80s and recorded between 2004 and 2006).

The Maori vowel system is usually analysed in terms of five short vowels, /i, e, a, o, u/. These may occur alone or in sequences. Within morphemes, and variably across morpheme and even word boundaries, sequences of like vowels are realised as a single phonemically long vowel, and many sequences of unlike vowels are realised as diphthongs, which include some sequences of $V_1V_1V_2$ (for details see [1, 2]). All Maori syllables are open, onsets are empty or consist of a single consonant and peaks are any of the monophthongs or diphthongs, leading to the syllable structure (C)V(V(V)). Maori rhythm is usually described as mora-timed [3], with a mora being defined as a short vowel plus any preceding consonant. Morae clearly play a grammatical role, but their role in stress and rhythm is somewhat less clear.

We have shown that Maori has undergone considerable vowel change over the last 100 years [4]. There has been a loss of both quantity and quality in all the Maori vowels: the distinction between the short and long vowels is being lost, with the exception of /a:/~/a/. In the same time period, New Zealand English (NZE) has undergone sound change in vowel quality [5], and we have shown these that same changes can be observed in the English of our Maori speakers [6]. We have also demonstrated that the vowel changes observed in Maori have been considerably influenced by English [4].

Maori is characterised by a distinctive rhythm. The rhythm of Maori is likely to have changed due to the decrease of vowel duration as a contrastive phonetic feature, the influence of English on Maori and the suggestion that Maori is mora-timed while English is stress-timed. Anecdotal evidence indicates that this is the case, with concern expressed amongst Maori elders that the *mita* (metre, rhythm) of the language has changed. While it is unclear precisely what the speakers are referring to when they use this word, contextual information suggests it may include prosodic features as well as stress and pitch. This paper presents the first attempt to define the nature of rhythm change in Maori, a non-prototypical language as far as rhythm is concerned, which has been interacting with a rhythmically prototypical language English.

2. Preliminary Analysis

Although Maori does not have consonant clusters, it does contain clusters of vowels within and across syllable boundaries. It was therefore considered that the Pairwise Variability Index (PVI) [7] would probably not classify Maori in a way that agreed with the perception of speakers familiar with the language. In order to test this, four preliminary analyses were carried out using the PVI.

2.1. Analysis 1

An extract of 2 minutes 30 seconds (737 syllables) was randomly chosen from one of the oldest group of speakers (born 1885) and analysed according to the PVI

methodology [8]. The normalised nPVI for vocalic intervals in this extract was 62.1 ms and the rPVI for intervocalic intervals was 37.0 ms. This placed Maori close to the stress-timed languages on Grabe and Low's graph [7: Figure 2]. Inspection of the extract showed that the intervocalic intervals (rPVI) showed very little variation, but the presence of vowel clusters created great variation in the adjacent vowel lengths (the nPVI).

2.2. Analysis 2

It was impossible to identify long vowels on phonetic grounds, but diphthongs could be phonetically identified because of their changing formant structure. In order to lessen the effects of the vowel clusters, it was decided to redo the analysis choosing sections of the original extract which contained relatively few long vowels, and to remove the diphthongs. Eight short extracts (32 seconds) were reanalyzed [8]. The nPVI was 44.6 ms and the rPVI was 36.6 ms. This placed Maori closer to the syllable-timed languages according to [7].

2.3. Analysis 3

In order to provide a further test of the effects of vowel clusters, a new passage was created that contained very few long vowels. This passage was read by a young L1 speaker of Maori (born 1983) and was comparable to the passage in Analysis 1, being 2 minutes 30 seconds long and containing 242 syllables [8]. The nPVI was 39.0 ms and the rPVI was 45.9 ms, placing Maori even closer to the syllable-timed languages [7].

2.4. Analysis 4

In order to investigate whether the vowel changes identified by Harlow et al. [4] showed up in the rhythm, PVI analyses were carried out on another extract from the speaker in Analysis 1 (MU1) and on extracts from five further speakers, two from each of the older groups and one from a young speaker. These extracts were three to four minutes in length, and were analysed without removing diphthongs (in the same way as the original analysis under 1) above). Vowel PVI values (nPVI) for each speaker are shown in Table 1. Because English has affected Maori over time, an increase in PVI could have been expected. Table 1 shows that there is no significant increase in the nPVI, indicating that the analysed changes in vowel duration do not result in changes to the PVI.

Table 1. PVI values from speakers whose birthdates span 100 years

	Historical Elders			Present-day Elders		Present-day Young
Speaker	MU1	MU2	MU3	K1	K2	Y1
nPVI	59.2	59.8	60.8	59.8	57.5	57.4

2.5. Discussion

Using a traditional PVI analysis on extracts from Maori aligns it with stress-timed languages, producing results that are counter-intuitive to those who are familiar with both Maori and New Zealand English. These results are even more counter-intuitive in that a PVI analysis classifies Maori accented New Zealand English as considerably more syllable-timed than other varieties of English [9] and there is some evidence that general New Zealand English can itself be classified as relatively syllable-timed [10]. In addition, documented changes in vowel duration over time do not lead to changes in nPVI. These results together emphasise that PVI alone is not an adequate tool for analysing rhythm in Maori.

Arvaniti [11] argues against metrics such as PVI on the grounds that they equate rhythm with timing, meaning that the relationship between metrics and the definition on which they rest is circular. One reason they are inadequate is that they narrow the focus of the analysis to the measure of absolute and relative duration, which is unquestionably relevant, but is also only a small part of a much bigger canvas. The purely phonetic approach to rhythm measurement ought to be moved aside in favour of one that is more in line with phonological and psychological models of rhythm [11].

Dauer [12, 13] took a view of linguistic rhythm as stress, or prominence, as defined by a set of eight parametric criteria, ranging from duration, through syllable structure and segmental quality, to pitch, intonation and tone. Arvaniti [11] advocates a conception of rhythm that rests on grouping and patterns of prominence, but highlights the need for a more liberal view than Dauer's, and for the investigation of a wide range of languages.

It is true that prominence may be produced and perceived cross-linguistically according to different criteria. In addition to duration, parameters such as temporal spacing [12], pitch and intonation [15], or spectral tilt [16] are only a few of the possibilities. Native perception of linguistic rhythm produces varied results when speakers of different languages are exposed to the same stimuli [14], meaning that native parametric settings ought to be taken into account.

Ultimately, as Arvaniti [11] argues, this means that perception, particularly that of native speakers, is key, as is a more multi-faceted point of view. In light of this discussion, a perception experiment using low-pass filtered speech was designed in order to assess whether New Zealand listeners could differentiate Maori and English as spoken by the three groups of MAONZE speakers. This experiment was designed as a first step towards investigating the perceived changes over time in *mita*.

3. Experiment: Perception Test

Passages of approximately fifteen seconds were randomly chosen from the Maori and English interviews of five speakers in each of the three groups (MU, K, Y). In addition, short interviews were conducted in Japanese with two Japanese speakers and 15 seconds were extracted from these, giving a total of 32 extracts. The two Japanese extracts were chosen because Japanese is acknowledged as a mora-timed language [eg. 7]. The extracts were low-pass filtered in Praat (http://www.fon.hum.uva.nl/praat/) to 400 Hz with 50 Hz smoothing, in order to remove segmental information, while retaining information provided by pitch, intensity and timing. They were concatenated in a random order, with each extract preceded by non-filtered numbers. The resulting WAVE PCM file was presented via loudspeakers to university students in the course of their normal lectures. The listeners were asked to identify each

extract as either Maori or English, and were told that all speakers were Maori males. There were 70 participants, 31 Maori and 39 Pakeha (non-Maori New Zealanders). The Maori students were 3rd year students of Maori language. They were all L2 speakers of Maori who were very familiar with spoken Maori and had good exposure to the language. The Pakeha students were all native NZE speakers. Most participants were aged 18-30 (mean 24.1 sd 8.7). There were 60 females and 10 males. Because of the uneven distribution of age and gender, and because the major focus of this study was on the perceptions of New Zealand listeners, no attempt was made to use the categories of age and gender in the analyses.

4. Results

4.1. Overall results

Overall, 68% of the tokens were correctly identified in terms of language. These results are significant. Clearly the task was not trivial and the listeners did not demonstrate simple categorical perception of the two languages. When the results are broken up according to listener group (Maori vs Pakeha) and according to language spoken (Maori or English) and speaker group (MU, K or Y), perception remains above chance for each of the categories.

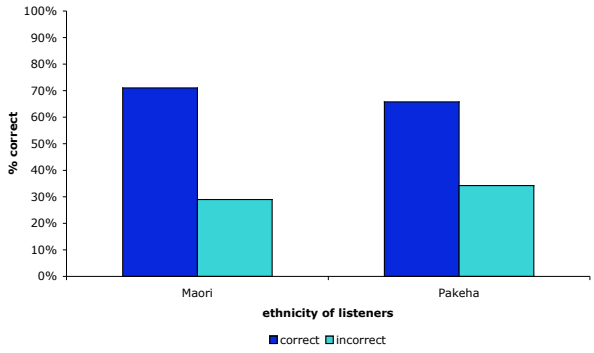

Figure1: *Overall accuracy by listener group*

4.2. Results according to listener groups

For this analysis, Maori and Pakeha listeners were considered separately. All the Maori listeners were familiar with the Maori language, whereas the Pakeha listeners were not. We therefore consider that these results reflect ability with the Maori language rather than ethnicity per se. Overall, Maori listeners were significantly more accurate in correctly identifying the languages than were Pakeha listeners (chi-squared = 7.10, df = 1, p = 0.0077). Maori listeners obtained 71% correct responses and Pakeha listeners 66% correct (see Figure 1). Responses to the Japanese speakers were regarded as correct if they were not identified as English.

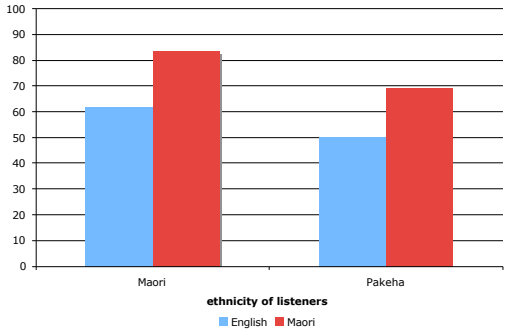

Figure 2: *Accuracy of results for MU speakers*

4.3.Results according to listener groups, speaker groups and language

The results were broken down so that the responses of the Maori and Pakeha listeners were considered separately for each of the three speaker groups (MU, K, Y) in each of the two languages. The results are shown in Table 2. The Maori listeners were significantly more accurate than the Pakeha listeners in correctly identifying the language spoken by the (historical) MU speakers, whether these speakers were speaking Maori or English (see Figure 2). Although all other results are above chance, there is no significant difference between the listener groups for the K or the Y speakers for either language.

Table 2: Percentage correct identification according to listener group, speaker group and speaker language

	Listeners		Statistics		
Speaker group	Maori	Pakeha	Chi-squared	df	p
MU-M	83%	70%	8.70	1	0.0032*
K-M	70%	68%	0.71	1	0.1370
Y-M	69%	69%	0.01	1	0.9171
MU-E	61%	50%	4.33	1	0.0374*
K-E	78%	72%	1.79	1	0.1809
Y-E	75%	71%	0.65	1	0.4211

* statistically significant, $p < .05$
-M = speaking Maori, -E = speaking English

When the historical MU speakers were speaking English, almost half the listeners, both Maori and Pakeha, identified them as speaking Maori (see Figure 2). In contrast, the Maori listeners identified two of the Y speakers as speaking English, when they were, in fact, speaking Maori. The language spoken by the K speakers was correctly identified by the majority of both groups of listeners. Both the Japanese speakers were identified as speaking Maori most of the time by all listeners.

5. Conclusions

Present-day elders, *kaumatua*, comment on changes in the *mita* of the Maori language. Analysis using PVI did not reveal changes over time in Maori, indicating that this method of analysis is not able to capture the changes noted

by native speakers. When connected speech is low-pass filtered to 400 Hz, segmental information, which would clearly identify which language is being spoken, is removed. However information on pitch, intensity and timing is retained. Groups of Maori and Pakeha listeners were able to distinguish between Maori and English when they listened to low-pass filtered extracts from speakers of the two languages. The language spoken by present-day elders (the K group) was correctly identified by the majority of both groups of listeners. However, a majority of both listener groups identified the historical MU speakers as speaking Maori, even when they were speaking English, suggesting that the distinctive rhythm of Maori was being carried into their English speech. Conversely, many of the Maori listeners heard two of the Y speakers as speaking English when they were actually speaking Maori, similarly suggesting that they were carrying a more English rhythm into their Maori speech.

The Maori listeners were all fluent second language speakers of the language, and would have had a reasonable level of exposure to Maori speakers, older as well as younger. They performed more accurately than the Pakeha listeners in identifying the language spoken. Older Maori listeners who would have had even more exposure to the language, and could have heard speakers similar to the historical MU speakers in their childhood, could be expected to perform even better than younger Maori in this perception task. The Pakeha listeners had not learnt the Maori language but would have had exposure to it by virtue of living in New Zealand. Following Arvaniti [11] we would suggest that non-New Zealanders would not perform as well as the Pakeha listeners on the experimental task. Using native New Zealand listeners we have thus demonstrated that Maori and English are perceptibly different when segmental information is removed and confirmed the perception of the *kaumatua* that the rhythm of Maori has changed over time. We hope that further investigation will enable us to quantify these changes.

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