

A phonetic study of the Haka performed by the All Blacks

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ABSTRACT

Following a preliminary study in which it was demonstrated that there exists a strong relationship between voice and gestures in the performing of the *Haka* by the All Blacks, an acoustic analysis of the speech signal produced by a chorus of twenty-two male voices was undertaken with particular attention to its durational characteristics. From the measurements of speech spectrograms, it was found that each verse of the *Ka mate* may be divided into four (or five) rhythmic groups of approximate equal duration (750 ms). Likewise, stress intervals were found to be largely isochronous (about 750-800 ms), and most of the time three 'heavy' syllables were perceived as stressed in each verse. At the suprasegmental level, it may be said that the main prosodic feature of the *Haka* is a verbal rhythm (of a trochaic pattern) characterized by an alternate balance of long and short syllables with a left-headed metrical foot. At the segmental level, the production of the [a]-vowel associated with the voiceless stop consonants [p] and [k] is largely favoured in 'scanned' words uttered in a staccato mode.

1 INTRODUCTION

In oral communication, most individuals resort to two types of features to express their opinion and/or convey their emotions. These may be paralinguistic (non vocal) features such as bodily posture, gestures, facial expression and gaze or linguistic (vocal) features such as words, voice quality, loudness, pitch variations, speech tempo, rhythm, etc...

In speech research and especially in prosody, there has been a growing interest during the last decade for the study of emotional speech, and more particularly for the extraction of the acoustic and perceptual cues of emotions. It must be however acknowledged that the study of 'elicited' emotions in laboratory conditions suffers from a lack of naturalness, and that such studies have often led to controversial results. In our search for solid

acoustic cues of speech produced in more 'natural situations', therefore, a unique opportunity of studying 'genuine' emotions expressed at their fullest was offered by the utterance of the '*Haka*', the mythical ritual performed prior to rugby matches by the representatives of New Zealand, the famous All Blacks (ABs).

Basically, *Haka* is the generic name for a maori dance. Although there are several types of *Haka* [5], the one called '*Ka mate*' is the most well-known, as the matches of the ABs benefit from a worldwide TV coverage. Essentially, it is a message of challenge and defiance in which voice and gestures are timed to show the fierce determination of the team. Materially, this pressure is expressed through gestural behaviour, i.e. bodily posture, arm movements, *kakapa* (vibrating of the hands), facial expressions, *pūkana* (dilating of the eyes), *whētero* (protruding of the tongue), *pōtētē* (closing of the eyes), but mainly through the voice, whose auditory effect was originally meant to spread a feeling of terror among the enemies in the times of tribal wars.

In a previous study [3], it has been observed from video films that there exists a close relationship between the gestural and the vocal components, as the clapping of the hand on the legs or on the opposite arm, is synchronized with the production of the plosives [k] and [p] occurring in initial position. In the present paper, attention has been focused on the segmental and suprasegmental features of the speech continuum made up of a chorus of twenty-two male voices. Several questions were asked :

- from a phonetic point of view, which segmental units are favoured and what are their acoustic characteristics ?
- from a prosodic point of view, is there a rhythmic structure specific to the *Haka* ?
- finally, what is the complex alchemy of segmental and suprasegmental features which makes a semantically non-violent message sound like a true war-cry?

2 PROCEDURE

As the speech signal is mixed with acoustic interferences due to the clamours of the crowd and also noises of all kinds, the main difficulty consisted in finding a speech signal which would be suitable for both a perceptual and an acoustic analysis. Therefore, several matches of the ABs were recorded on video cassettes and an evaluation of the auditory quality of the signal was made. One recording was selected on the basis of a good S/N ratio, due to the (relative) silence of the audience, and also to an adequate positioning of the microphones close to the mouth of the *Haka* leader and other team-mates. The speech signal was then copied from the sound-track of the video film to an audio tape for further use.

Firstly, a perceptual experiment was conducted. Ten of our colleagues with a solid experience in prosody took part in the test individually. From a wide phonetic transcription made by the present author, they were asked to mark stressed syllables, rhythmic groups and vowel lengthening. As they had no prior experience with the maori language, they were allowed to listen to the tape as much as they felt necessary.

Secondly, the acoustic analysis was carried out with two software. The editing software *Phonedit* was used to digitize, segment and label the sound wave. Wide band spectrograms (0-4.0 Khz) were made especially for the measurement of the duration of verses, rhythmical groups, syllables, pauses etc.... The examination of the spectral characteristics of the speech sounds was carried out through FFT analysis with a 32 ms Hamming window at 512 pts. Lastly, the *Praat* software was used for the visualization of the intonation patterns and the measurement of fundamental frequency (F0) and intensity (A0) variations.

3 RESULTS

3.1 PROSODIC FEATURES

In the maori literature, a musical terminology is often used to refer to the *Haka*, e.g. a chant, an incantation, occasionally a song or '*a composition played by many instruments, in which hands, feet, legs, body, voice all play their part...*' [1]. As reference is explicitly made to musical expression and instruments, it appears that the vocal message accompanying the dance is uttered with a certain amount of musicality. In these conditions, it appears that the *Haka* does sound like 'stylized melodious speech' which should be distinguished from '*koorero*' (plain speech), '*karakia*' (ritual

threnody) and '*waiata*', which are found in the maori language [4]. Thus, the main question we may ask in the framework of this acoustic study would be: from the analysis of the sound wave, what are the relevant cues which may account for this subjective impression of musicality ?

3.1.1. The regularity of the verses

From a durational point of view, the *Haka* is composed of six verses separated by short pauses (100-150ms) for an overall duration of about 18 seconds. Five verses are 2.8-3.0 sec. long, except for verse 5 which is slightly shorter (2.5 sec.). Each verse is a separate sentence in itself, and is composed of simple words. Some content words are loaded with a semantic weight which fit the contextual situation and are uttered several times, e.g. *mate* (death), *ora* (life), *whiti* (to shine), *ra* (sun), *upane* (one step up) etc... The recurrence of these words, embedded in verses of a constant duration, helps to give the chant an impression of regularity in the time domain.

3.1.2. The rhythmical groups

Once again, an analogy with music is patent. As a musical score is divided into measures of strict equal duration, each verse of the *Haka* may be divided into four or five (perceived) rhythmic groups of approximate equal duration (about 750-780 ms). This finding is best exemplified on the spectrogram shown in Figure 1, where one notices the presence of five evenly spaced clusters of vertical streaks (numbered 0,1,2 etc...) which look like bursts at the release of strongly articulated stop consonants. These streaks (spread on a time span of approximately 150ms) result from the non-synchronized contact of the palms' hands on the front part of the legs. Thus, the sequence [ʰakinoneʰoki] which is uttered at the end of the opening harangue, can be considered as a KEY moment in the *Haka* because from this time onwards, the basic rhythm initiated by the leader, will be preserved throughout the whole chant. Moreover, it has been observed from video films, that the claps of the hands off and on the legs are synchronized with the lifting and stamping of the players' foot, as most singers or musicians do when they beat time. These up and down movements of the foot (referred to as the ARSIS and THESIS according to the ancient Greek terminology), correspond in music to a measure and in poetry to a metrical foot ; in the present study, the physical rhythm (including both hands and feet) and the verbal rhythm are closely related which tends to explain why the speech continuum is divided into rhythmic groups composed of either long monosyllabic or short plurisyllabic units.

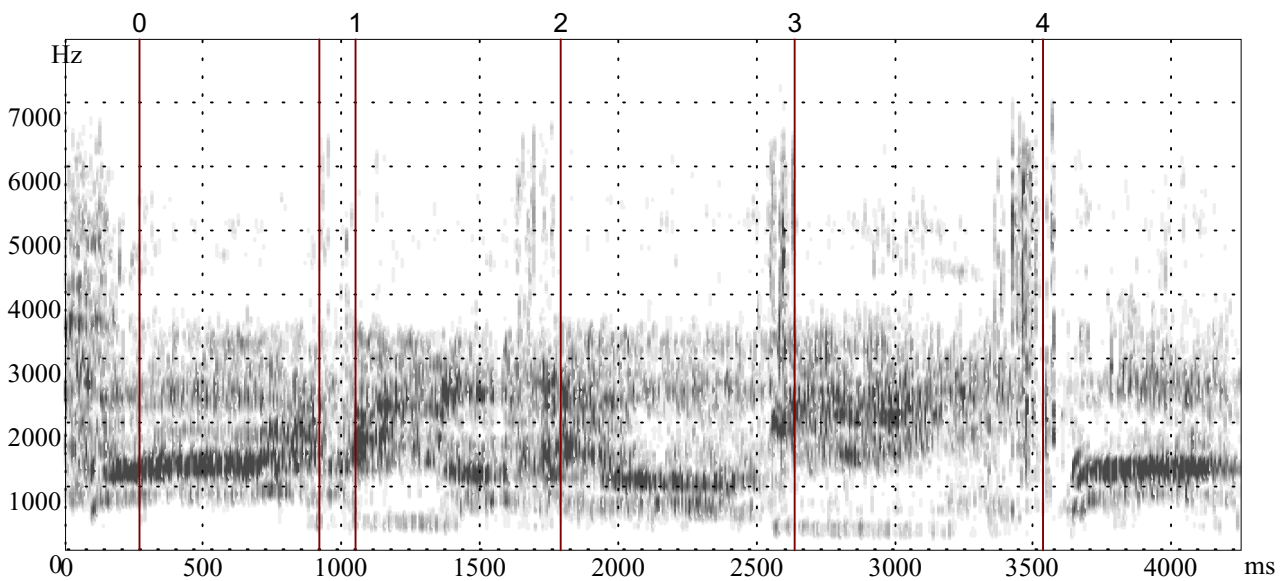


Figure 1: Speech spectrogram illustrating the segmentation of the sequence [ʰakinoneʰoki] (produced by a chorus of twenty-two male voices) into four rhythmical groups of approximate equal duration.

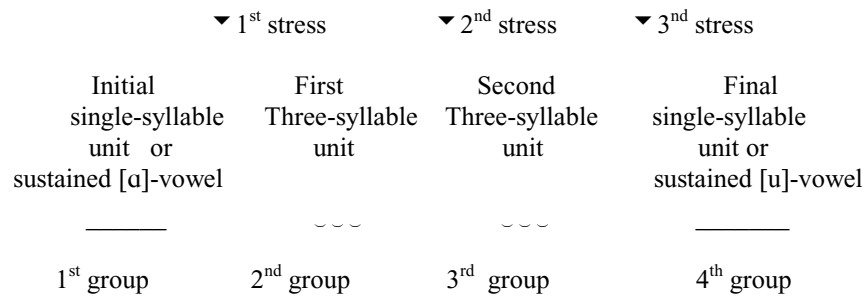


Figure 2 : Metrical analysis of a verse of the *Haka* as a function of rhythmical groups, syllabic structure and stress location.

3.1.3. The syllabic structure

Likewise, the number of syllables within the rhythmical groups is important in the prosodic structure of the *Haka*.

As illustrated on figure 2 , a typical verse may be broken up into several constituent parts.

- a long initial [a] vowel (average duration 465 ms) at the beginning of five verses out of six or the preposition *nā* at the beginning of verse 4.
- two successive units made up of three short

syllables (average duration 200-250ms), e.g. the focus-marking particle *ka* + the word *mate* (verse 1), the demonstrative adjective *tenei* + *te* (definite article), the word *tangata* (verse 3), the preposition *i:* (past tense) + *tiki* (verb) *mai whaka* [mawaka](verse 4), *Ka upane* pronounced [kupane] (verse 5) etc...

- a long final one-syllable unit, e.g. [k ɔ:] resulting either from the contraction of two adjacent vowels into a single one *ka ora* > [k ɔ:] (verses 1 and 2) or

from the elision of the [r]-sound, *te ra* pronounced [tea] (verses 4 and 6). In verse 3, the long [u]-vowel is perceived as two segments of briefer duration because of a sharp pitch fall from 400 to 330 Hz produced halfway through the vocalic segment. As in the previous section, the relation between music and speech is obvious just as a musical phrase mostly terminates in a lengthening of the last note, each verse of the *Haka* ends with a sustained vowel [ɔ], [a] or [u] whose average durations are mostly superior to 700 ms.

3.1.4. Perceived stress and stress intervals

The results of the perceptual test were generally consistent among listeners who were unfamiliar with the maori language. In our opinion, this consistency may be explained as follows.

Firstly, the subjects were sensitive to the audible claps of the hands (similar to the rhythmic beats of a metronome) which happened to be synchronized with the production of various syllables like [k a], [k ɔ:] (verses 1 and 2) or [pa] and [ku] (verses 5 and 6).

Moreover, as the first syllable is generally stressed in maori [2], it is not surprising that the initial syllables of *'tenei, 'tangata* (verse 3), or of other groups preceded by the focus-marking particule *Ka*, e.g. (*'ka mate*), would be perceived as stressed whatever the level of linguistic experience of the listeners.

Secondly, as stress intervals measured from the onset of the first stressed vowel to the onset of the next one were largely isochronous (750-800ms), the listeners were rapidly conditioned to expect three 'heavy' syllables to be produced at regular intervals, respectively at 0.500ms, 1.250ms and 2.000ms along the time axis for verses of a constant duration of 2.800-3.000ms, even in the absence of any audible claps, e.g. verses 3 and 4. Moreover, as the *Haka* is shouted in a high-pitched voice for males (average F0 frequency 350-375 Hz), the scale of F0 variations is rather limited which explains the presence of 'intonational plateaux' with no major differences in pitch between stressed and unstressed vowels.

4 CONCLUSION

From the results of this analysis of the vocal component, it may be stated that the *Haka* '*...a message born of the soul, spoken by the mouth, expressed by the body*' [5] can be considered representative of emotional speech.

At the suprasegmental level, it was demonstrated that its main prosodic feature is a verbal rhythm which is synchronized with a gestural one expressed through hand clapping and foot stamping. Thus, this verbal rhythm (of a trochaic

pattern) is characterized by an alternate balance of long and short syllables with a left-headed metrical foot. Although durational measurements showed that both rhythmic groups and stress intervals were largely isochronous, rhythm was essentially perceived as a function of the proeminence of 'heavy' syllables produced with the plosives [p,t,k] occurring mostly in the initial *fortis* position and followed by an open vowel. Moreover, the emotional touch is further enhanced by the recurrence of 'scanned' words or groups of words uttered in a staccato mode.

At the segmental level, a distributional analysis has shown that the open vowel [a] (55%) and the voiceless consonants mentioned above (65%) were largely privileged. As the *Haka* is generally considered as a war-cry meant to be shouted in a loud voice, this might explain why such speech sounds like glottalized [a] whose specific intensity is highest among vowels, or [k] whose burst is strongest among consonants, and which is viewed as a hard consonant favoring aggressiveness [4], were produced preferably as their intrinsic mode of articulation was particularly suitable for the emotional and contextual situation.

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