ANALYSIS OF TONE IN THE LANGUAGE OF VANIMO PAPUA NEW GUINEA

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ABSTRACT Mean fundamental frequency data and duration measurements are presented for the three putative tonemes of the Dúmò dialect of Vanimo, a Papuan tone language of north-western Papua New Guinea. The evidential argument for the separation of three tonemes is presented from the acoustic data.

INTRODUCTION

The languages of New Guinea (including Irian Jaya on the Indonesian side of the border) have received relatively little attention from researchers, and whilst the existence of tonal phenomena has been noted for many of them, description is often poor and acoustic treatment is almost totally lacking; indeed, only one other language in New Guinea has received acoustic treatment in print, Kairi (Newman and Petterson 1989), an unrelated language on the south coast of PNG, which appears to have a completely different tonal system.

The Vanimo language has been previously described in detail (Ross 1980), and the three tones noted with the remark that two of them are very similar to each other. The three tones are described by Ross, with reference to his informants preferences, in terms of the features [HIGH] and [LONG]:

	Tone 1	Tone 2	Tone 3
	[+ HIGH] [- LONG]	[- HIGH] [- LONG]	[- HIGH] [+ LONG]
Examples:	lì 'garden'	l i 'sea'	lí 'dance'
	nì 'paddle'	ni 'we (exclusive)'	ní 'fish'

The shape of the [+ HIGH] tone is described by Ross as beginning "at a relatively high pitch, and typically falls sharply, but informants do not find this pitch movement significant". The [- HIGH] tone "begins at mid pitch, and may fall or rise according to the exigencies of intonation". For the [+ LONG] tone, Ross writes that it is "felt by the native speaker to be 'pulled', but the distinction is often barely perceptible to the writer".

The aim of this experiment is to quantify the description of the tonal system of this dialect of Vanimo, and to investigate the degree of contrast that exists between the three falling tones of this language, especially the [- HIGH] tones. this will bear on the question of how distinct tones need to be from one another, in terms of F_0 and duration in order to function as linguistic units in a language. Only the citation forms of the tones are studied here; the reported sandhi forms ([+ HIGH] → [- HIGH] / [+ HIGH] or [+ LONG]), or other tones in combination, are not investigated in this article.

PROCEDURE

Using the data on the Dúmò dialect collected and supplied by Ross, we selected suitable tokens of isolated monosyllables from the tapes of the two female speakers made available. The corpus of data selected was chosen to control for the effects of intrinsic F_0, and the perturbatory effects of initial consonants on F_0. The corpus consisted of isolated monosyllabic words of the form CV, where C was a sonorant (or, rarely, a voiced plosive), and V was either an open [a] or a close [i], [u] vowel, mixing the numbers of high and low vowels as equally as possible throughout the corpus. Some of the tokens had nasalised vowels, but this was seen to have no effect on the F_0 or duration of the tone. Due to the nature of the recordings available to us, the corpuses from the two speakers were not identical, but they have been controlled for maximum comparability. Eight tokens per tone per speaker were measured.

The corpus consisted of the following words:

Tone 1: bì *clothing*, dìng *bird*, dìng *canoe*, dù *word*, làng *southeast monsoon*, lì *garden*, nà *kaukauranus*, nì *paddle*, và *dead*, yì *blood*.

Tone 2: da *pig*, di *ashes*, du *white*, hlu *egg*, li *sea*, mi *you*, mlung *heart*, na *voice*, ni *we (pl. ex.)*, pli *mountain*, plu *rain*, yi *sago*.

Tone 3: bí *house*, dá *water*, hvá *he flies*, lí *dance*, mláng *mouth*, mláng *night*, ná *person*, ní *fish*, vá *person*, yí *red*.

In the list above, -ng indicates the presence of nasalisation, not a final velar nasal except when occurring with the vowel /u/, when -ung often collapses to a syllabic velar nasal; thus /húng/ 'I drink' is often pronounced [hŋ]; such allophonic forms were avoided in the compilation of the corpus. The phoneme /h/ in the data is voiced, and /y/ has the allophones [j ʑ ʒ ʤ ʥ]. The phoneme /v/ represents a [w] or [β]. The list, especially for tone 2, appears to be strongly skewed in favour of the high vowels, but in fact we had several tokens available for many of the words in each tone set; the proportion of high:low vowels measured was 2:1 for all of the tones.

F_0 and duration were measured from narrow-band expanded scale spectrograms. F_0 was sampled at a rate sufficient to resolve details of the slope of the tone, namely at 20% intervals of the vocalic duration of each utterance as well as the onset and offset, which was determined by eye and reference to equivalent wide-band spectrograms of the same utterances. Mean values for the F_0 along the time course of the different tonemes were then calculated for each speaker, and are displayed in figures 1 and 2. Duration results are presented in figure 1 and figure 3.

RESULTS

The mean values for F_0 and duration are shown together in table 1; the tonal contours plotted as a percentage of the total duration, along with the relevant standard deviations, are shown in figure 2, and figure 3 shows the duration for each tone with standard deviations also shown. It is immediately apparent that the primary distinction is between tone 1 and the other two tones; this toneme shows a much higher onset and peak value for F_0 than the other two tones, and in isolation falls sharply to its minimum value at offset. The other two tonemes have very similar contours, differing significantly in their contour towards offset, where tone 3 rises whilst tone 2 continues to fall (figures 1 & 2).

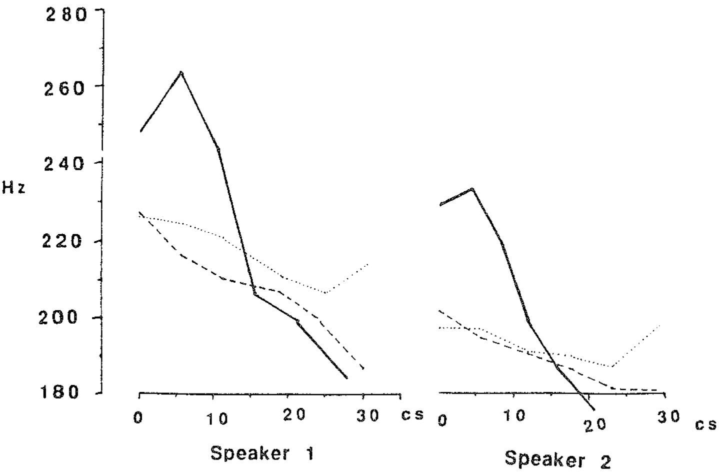
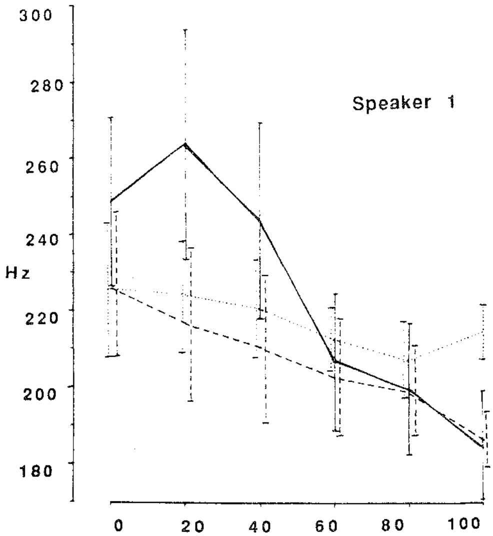


Figure 1: Mean Fundamental frequency shapes for the three tones



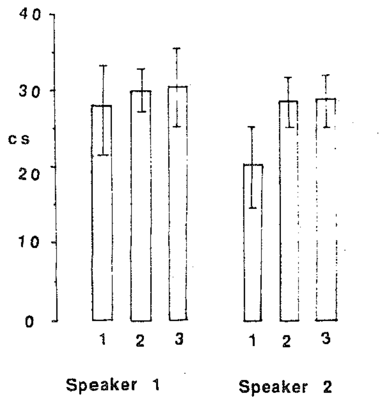


Figure 3: Mean duration in centisecond

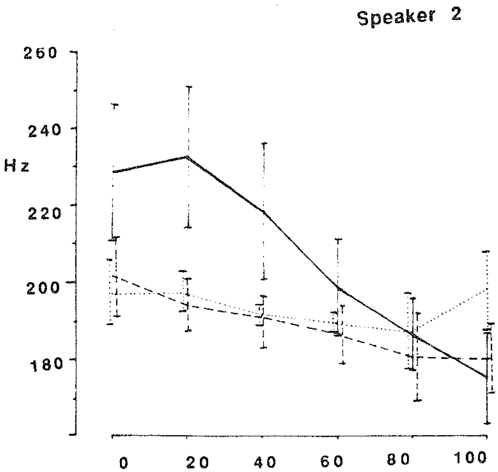


Figure 2: Fundamental frequency plotted against normalised duration

Speaker 1	0 %	20 %	40 %	60 %	80 %	100 %	Duration
Tone 1 x s	248.5 21.8	264.0 30.6	243.7 25.9	206.8 17.8	199.4 16.9	184.9 14.5	27.9 5.1
Tone 2 x s	226.8 18.5	216.8 20.1	210.0 19.3	203.1 15.5	199.2 11.3	186.8 7.1	30.0 2.6
Tone 3 x s	225.4 17.4	224.1 14.7	220.5 12.6	212.1 8.0	207.3 9.8	214.1 6.5	30.6 5.3

Speaker 2	0 %	20 %	40 %	60 %	80 %	100 %	Duration
Tone 1 x s	228.5 17.9	232.6 18.3	218.3 17.8	198.3 12.2	186.8 8.9	175.3 11.8	20.1 5.4
Tone 2 x s	201.6 9.6	194.5 6.6	190.1 6.8	186.8 7.5	181.0 11.5	180.5 9.4	28.8 3.3
Tone 3 x s	197.4 7.7	197.4 5.6	191.7 2.7	189.7 3.1	187.1 9.9	198.3 10.1	28.9 3.4

Table 1: Mean F_0 and duration values
(F_0 measured in Hz, Duration in centiseconds)

For both speakers there is no significant difference in duration distinguishing tone 2 and tone 3 corresponding to the putative [± LONG] feature, the tone characterised as [+ LONG] (tone 3) by the speakers being, in the case of Speaker 1, 0.6 centiseconds longer, in the case of Speaker 2 only 0.1 centiseconds longer than the [- LONG] tone (tone 2). Both these differences are easily eclipsed by the standard deviations recorded for each (figure 3). Tone 3 is, however, readily distinguished by the rise occurring in the last 20% of its duration, showing a marked rise that is reflected in the F_0 traces for both speakers. Figure 2 shows that the mean offset point for tone 3 is more than one standard deviation away from the mean offset point for tone 2 in both the speakers. With speaker 2 there is a significant difference in the mean duration measured between tone 1 and tones 2 & 3, but whilst speaker 1 shows a shorter average duration for her tone 1, it is not markedly shorter.

It is notable that the difference between the two non-high tones, tone 2 and tone 3, is not perceptible to the writer, nor to another acoustic phonetician (Dr. Phil Rose) who has listened to them, both seeming to have the same steady fall in pitch. Obviously the ideal solution would be to conduct a perception test with speakers of Vanimo being asked to identify the tones of a series of tokens presented to them, in order to test the perceptual reality of the slight rise at the end of tone 3; the unavailability of speakers of Vanimo at the time of this experiment, however, has made that impossible.

CONCLUSION

In the absence of a conflicting perceptual experiment, it seems that from the data examined the Vanimo language distinguishes two of its three tonemes on the basis of the F_0 contour only in the final 20% of the tones; that this phenomenon is observed to be significant in the tones from both speakers shows that this is not just a chance result. Explanations for this real but slight difference could be:

the speakers are deliberately producing the difference, but we (non-native apeakers) are not yet cued in to this small difference;

the speakers are not deliberately making the difference. That is, there is a regular but phonemically non-significant difference between certain pairs of words; the speakers may not be consistently aware of this difference;

The difference between tone 2 and tone 3 may emerge only in sandhi form, thus not being made explicit in citation forms;

there may be another factor involved in the acoustic difference between the two tones, perhaps amplitude or vowel quality (not noticed by the writer).

The putative F_0 distinction between tone 2 and tone 3 is neutralised in this data over most of the domain of the tone, only a small (10Hz) difference at the end of the syllable being sufficient to differentiate the two tones. Tone 1 is clearly distinguished from both of these lower tones, and is not problematic.

HISTORICAL-TYPOLOGICAL NOTE

Another interesting result arising from this experiment, and close checking of Ross (1980) is the fact that native-speaker judgements of tonal categories were often at variance with the acoustic picture obtained, or data cited elsewhere in the corpus. Whilst the difference between a [+ HIGH] tone and [- HIGH] was non-problematic, native speakers regularly confused [+ LONG] with [+ HIGH] when distinguishing it from the [- LONG] tone, or the [- LONG] tone with the [+ LONG] tone when distinguishing it from the [+ HIGH] tone:

Actual toneme	Native speaker identification	when differentiating from
´ (3)	` (1)	- (2)
- (2)	´ (3)	` (1)

This confusion might indicate that the difference between tone 2 and tone 3 is being lost in the language. This would accord well with the areal tendency of the Sko languages to place less functional load on tone the further east they are; in the Krisa family (east of Vanimo), Warapu appears to be at most marginally tonal, and makes extensive use of polysyllabic words, and according to Laycock "Krisa and Rawo may have only two tones each". In the Vanimo family the Sko language has a three-tone system, with a clear difference between a high falling tone, a low level-falling and a low rising tone, which corresponds etymologically to tone 3 in Vanimo. It might be that the tonal features of the language are being progressively lost, with the eastern languages being first affected. This is curious given that the eastern languages also seem to have collapsed many segmental features as well -Vanimo, for instance, has no velar series in its consonant inventory, has lost the high front rounded /ü/ vowel, and both the /f/ and /r/ phonemes, and does not allow syllable final sonorants, as is the case in Sko; furthest east, Warapu has further reduced the vowel inventory to five (/a e i o u/).

In any case, the cofusion evidenced by the speakers in identifying tone 2 and tone 3 suggests that the loss of tonal contrasts in Vanimo is imminent, following the pattern set by its eastern cousins.

ACKNOWLEDGMENTS

Thanks are due to Dr. Malcolm Ross, ANU, who kindly made his tapes of the Vanimo language available to us, enabling this study to be carried out.

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DYIRBAL INTONATION

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ABSTRACT - Declarative intonation phrases in Dyirbal are analysed using Pierrehumbert's model in order to ascertain the constructs required to account for the Fo contours. Results thus far obtained are presented .

INTRODUCTION

Intonation in Australian Aboriginal languages has, to date, received scant attention. This paper, which presents a quantified analysis of Dyirbal declarative intonation phrases, goes some way towards redressing the imbalance.

Dyirbal is a language of the Innisfail area of North Queensland, a grammar of which was published in 1972 by R.M.W. Dixon. The five texts used for this analysis were recorded by Dixon in the 1960s. These consist of three narratives and two conversations of natural speech by five speakers (one female and four male). Spectrographically derived measurements have been obtained from 240 intonation phrases extracted from the five texts. 94 of these intonation phrases have been used for this analysis.

METHOD

The model being applied to the data was developed by J. Pierrehumbert to give a phonological and phonetic description of English intonation (Pierrehumbert, 1987). This model posits just two tones, a high and a low, and an intonation phrase that is made up of one or more pitch accents followed by a phrase accent and a boundary tone. The pitch accent can either be a single tone, as in figure 1, or a pair of tones as in figure 5. The starred tone represents the centre of the accent and the secondary tone (marked -) denotes the 'leading' or 'trailing' tone. The bitonal form of the pitch accent is responsible for describing the local behaviour of the Fo around the stressed syllable. Pierrehumbert refers to the pitch accents as Fo targets which are crucial points in the contour that can be lined up with crucial points in the text. The overall shape of the intonation phrase is determined indirectly by the rules for implementing the pitch accents; i.e. the phrase contour is only a "... by-product of the application of the local tonal implementation rules" (Pierrehumbert, 1987:78).

The shape of the Fo contour following the pitch accents is determined by the phrase accent and the boundary tone. The phrase accent (H- or L-) controls the Fo from its position following the final pitch accent to the onset of the phrase-final boundary tone. The boundary tone (H% or L%) occurs right at the phrase boundary regardless of the behaviour of the Fo immediately preceding or following it. It can, in some cases, also occur phrase initially.

Pierrehumbert appears to rely totally on Fo contours for her analysis without taking into account the auditory impression (i.e pitch). In this analysis, however, I have utilised auditory observations to ascertain the speaker's intended targets for the tones in conjunction with the spectrographic measurements for the Fo contours. As well, Pierrehumbert makes no attempt to define the pragmatic, semantic and syntactic determiners on intonation and that is the approach I have taken here.

RESULTS AND DISCUSSION

The results show clearly that there is an unmarked contour which occurs in 23% of declarative intonation phrases. In this contour, illustrated in figure 1, the Fo rises to a peak from an initial low boundary tone, declines steadily until the point where it begins to rise for the second pitch accent before declining again to a low final boundary tone. The rules for deriving this contour are predominantly phonological and phonetic; however the marked declarative intonation phrases, which adopt many different contours, are largely determined by pragmatic and other non-phonological rules. The following is a discussion of each component of the intonation contours and an attempt to construct rules which will derive these contours.