

A Preliminary Study of the Rhythmic Characteristics of Arrernte

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Abstract

The aim of this paper is to provide an initial description of the rhythm classification in Arrernte. Due to the contentious nature of Arrernte syllable structure, it is not possible to use conventional metric methods to determine the rhythm classification. However, a recent study by Grabe and Low (2002) has introduced a measure which ignores syllable structure in rhythmic classification. In the present study, a raw Pairwise Variability Index (rPVI) and a normalised Pairwise Variability Index (nPVI) were determined for two speakers. Broadly speaking, a higher nPVI suggests a “stress-timed language” and a lower rPVI suggests a “syllable-timed language”. The results show that Arrernte is more similar to a syllable-timed language (mean rPVI=45.95, mean nPVI=49.1) than a stress-timed language, confirming initial auditory analyses.

1. Introduction

Arrernte is a language spoken in central Australia, in and around Alice Springs. Today there are approximately 1500-2000 native speakers. Despite the use of English and other regional languages, Arrernte is used in everyday contexts. Arrernte belongs to the Arandic language family, which includes Kaytetye, Anmatyerr and Alyawarr. The aim of this paper is to discuss the rhythm classification of Arrernte in regards to future work on Arrernte prosody, in particular Arrernte intonation, and eventually a study of the articulatory prosody.

1.1. Previous Work: Arrernte

Previous studies of Arrernte include a concise grammar by Wilkins (1989) and topics in Central and Eastern Arrernte by Henderson (1998). In regards to phonetics and phonology, Breen (2001) provides a basic analysis of Arrernte phonetics and phonology and, Breen and Pensalfini (1999) provide a basis for a VC-based syllable structure. Using phonological data from Arrernte, Breen et al. challenge phonological theory of syllable hierarchy, whereby CV- based syllable structure occur in Arrernte but there is also evidence for an underlying VC- based structure.

In a recent paper, Tabain, Breen and Butcher (2004) carry on from this notion that the underlying syllable may be VC-based. This study compares F2 and F3 measures of the consonant and locus equation data from Arrernte, a possible VC-syllable based language; English, a typical CV-based language; and Yanyuwa and Yindjibarndi, two Australian Aboriginal languages. Tabain et al. note that although the data indicates that English has a definite underlying CV-based syllable, there is not enough evidence either way to determine whether the syllable in Arrernte is VC- or CV-based.

1.2. Previous Work: Prosody in Aboriginal Languages

Very little research has been conducted on the intonation and general prosody of Arrernte and Australian Aboriginal languages in general. Berry (1998) uses Optimality Theory to describe alignment and adjacency in Warlpiri and adapts this method to Arrernte, with the basis that Arrernte has a CV-based syllable. Pentland (2004) provides an analysis of stress and prosody in Warlpiri. Bishop (2002) provides a detailed autosegmental-metrical analysis of intonation in Binij Gun-Wok, using the BGW-ToBI transcription system developed by Bishop and Janet Fletcher. Fletcher and Evans (2002) also provide an analysis intonational of Dalabon and the Kundedjnjenghmi dialect of Bininj Gun-wok.

1.3. Previous Work: Acoustic Correlates of Rhythm Classes

Dauer (1983) noted that syllable structure and vowel reduction are the most prominent phonetic and phonological differences found between stress-timed and syllable-timed languages. Stress-timed languages are thought to have a greater syllable type inventory and have vowel reduction, where unstressed vowels are shorter in duration than stressed vowels.

Ramus, Nespor and Mehler (1999) use a method whereby vocalic and intervocalic measurements were used to give the proportion of vocalic intervals within a sentence divided by the total duration of the sentence; the standard deviation of the duration of vocalic intervals within each sentence; and the standard deviation of the duration of intervocalic intervals within each sentence. However, this study is used in comparison with the syllable types and syllable weighting found in the languages.

Grabe and Low (2002), on the other hand, took vocalic and intervocalic duration measurements of 18 languages. A Pairwise Variability Index is used to compare the rhythm

classes of a language. This study is similar to the Ramus et al. (1999) study, however it only provides measurements for one speaker of each language. The raw Pairwise Variability Index (rPVI) gives a ratio of the sum of the absolute difference of successive pairs of intervocalic measurements divided by the total number of intervocalic measurements in the utterance minus one. The formula for the rPVI is given in (1).

$$rPVI = \left[\sum_{k=1}^{m-1} |d_k - d_{k+1}| / (m-1) \right] \quad (1)$$

A normalised Pairwise Variability Index is used on the vocalic measurements. The nPVI formula is given in (2). In addition to the calculation found in (1), the normalised equation takes the result and divides the difference by the mean duration of the pair. This is then divided by the total number of measurements in the utterance minus one and is also multiplied by 100 as the normalisation produces fractional values. A normalised formula is used for the vocalic measurement to account for greater variation due to vowel quality.

$$nPVI = 100 \times \left[\sum_{k=1}^{m-1} \frac{|d_k - d_{k+1}|}{(d_k + d_{k+1})/2} / (m-1) \right] \quad (2)$$

where m = the number of intervals, d = duration of the k^{th} interval.

Grabe and Low (2002) tested the Pairwise Variability Indices on languages which had pre-determined rhythm classes based on syllable structure and including those which are unclassified for rhythm. These languages included: Dutch, German, British English, Japanese, French, Spanish, Thai, Tamil, Malay, Singapore English, Welsh, Greek, Estonian, Rumanian, Catalan, Polish, Luxembourgish and Mandarin. The method was found to accurately categorize those languages within the study.

2. Procedure

The method used in this study has been adapted from the Grabe and Low (2002) study. The Grabe and Low study was testing the accuracy of the method, whereas this paper is identifying the rhythm class of the language.

The corpus is taken from two recordings supplied by Gavan Breen. They are both narratives in the form of traditional stories. They are spoken by a male elder and a female elder.

Using EMU labeller, intervocalic and vocalic intervals were were labelled from passages from the narratives of two speakers, a female and a male. Vocalic intervals included vowel clusters and semi-vowels, whereas intervocalic intervals included consonant clusters. Duration measurements were extracted in R and placed through nPVI and rPVI functions in Microsoft Excel.

3. Results

The rPVI and nPVI values are given in Table 1 with the total number of measurements for intervocalic intervals and vocalic intervals respectively.

	Speaker 1	Speaker 2	Mean
rPVI	52.3 (m=289)	39.6 (m=307)	45.95
nPVI	47 (m=310)	51.2 (m=321)	49.1

Table 1: rPVI and nPVI values

As noted above, the results are based upon approximately 300 intervocalic and vocalic duration measurements for each speaker. Speaker 1 has a higher rPVI than the nPVI and the results for Speaker 2 indicate the opposite. When mapped against the results in the Grabe and Low (2002) study in Fig. 1., the closest languages to the Arrernte results are Rumanian which Grabe and Low class as a “mixed or unclassified language” and French which is a “syllable-timed” language.

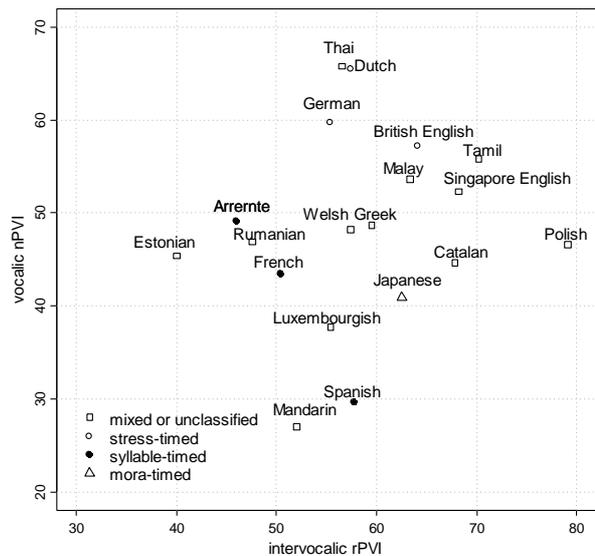


Figure 1: PVI profiles for the mean Arrernte data and the eighteen languages in Grabe and Low's (2002) study

4. Discussion

The final results indicate that Arrernte is not a stress-timed language but more like a syllable-timed language, confirming impressions from an auditory analysis. Therefore, it is hypothesized that when analysing the intonation of Arrernte, pitch accents will not necessarily align with any metrical stress.

There are concerns regarding the method. Asu and Nolan (2005) question the Grabe and Low (2002) method because the analysis only describes one speaker per language. Asu and Nolan, expand on the Grabe and Low study by providing an analysis of five speakers of Estonian. In regards to the Estonian data, Asu and Nolan find that using the Pairwise Variability Index is adequate but that measuring variation in syllables and stress feet is more appropriate. In addition to this concern, the main problem encountered with the Arrernte results is that when a smaller number of intervocalic and vocalic intervals were analysed ($m \leq 100$), the results were likened to that of German, a stress-timed language. It may be due to the fact that the data were not tightly controlled that although the speech is relatively natural, it is necessary to

measure larger sets of data in order to be confident of the results. This also indicates that a larger corpus may be necessary when there are fewer speakers. A larger cross-section of speakers will also improve the reliability of the results.

5. Summary

This paper has provided an initial description of Arrernte rhythm class. An experimental method, based on the Grabe and Low (2002) Pairwise Variability Index suggests that Arrernte is a syllable-timed language. The reliability of the results may be improved with more comparable data across a larger cross-section of speakers.

Further study will include an analysis of other narratives as they become available. The current study leads on to the labeling of pitch events and in the longer-term, a preliminary analysis of Arrernte intonation.

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