

SPEECH RHYTHM IN KANNADA SPEAKING CHILDREN: 4-5 YEARS

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ABSTRACT

Rhythm is a systematic temporal and accentual patterning of sound. The Pairwise Variability Index (PVI) is a quantitative measure of acoustic correlates of speech rhythm which calculates patterning of successive vocalic and intervocalic intervals showing how one linguistic unit differs from its neighbour. The present study investigated the type of speech rhythm in thirty (15 boys and 15 girls) typically developing 4-5 year old Kannada speaking children. Each child was instructed to describe simple pictures/cartoons to elicit a five-minute speech sample, which was recorded and stored onto the computer memory. PRAAT 5.1.14 software was used to analyze and measure the vocalic (V) and intervocalic (IV) durations of speech samples. The result indicated higher intervocalic PVI compared to vocalic PVI in typically developing, Kannada speaking, 4-5 year old children. Results also reveal different type of speech rhythm pattern in younger and older age groups of children and adults speaking Kannada.

Key words: speech rhythm, vocalic, intervocalic, raw Pairwise Variability Index, normalized Pairwise Variability Index.

INTRODUCTION

Rhythm is the systematic patterning of timing, accent and grouping in sequences of events. The study of speech rhythm has become a key challenge in speech technology since most of automatic speech processing systems have to cope with the variability of speech rate and rhythm and their consequences both on the segmental units and suprasegmental organization of speech. Rhythm enhances fluency by shortening the unstressed syllables. The speaker with the information on rhythm can deliver fast rate of speech. Also listeners enter into the speech rhythm and the speaker. Also it is important to know rhythm type in normal individuals in order to assess rhythm in clinical population. Languages differ in characteristic rhythm (Pike, 1945; Abercrombie, 1967) though no consensus has emerged on how the undoubted differences in rhythmic structures should be captured (Cutler, 1991). The Rhythm Class Hypothesis states that each language belongs to one of the prototypical rhythm classes stress-timed, syllable-timed or mora-timed.

Several measures have been used to classify speech rhythm in languages. These include standard deviation and syllable duration (Abercrombie, 1967), inter-stress interval (Roach, 1982), % vocalic duration, Δ vocalic, Δ consonantal (Ramas, Nesper & Mechler, 1999). Of these % vocalic and Δ consonantal could classify rhythm types in some languages. Low (1998) introduced Pairwise Variability Index (PVI) which measured the durational difference between successive vocalic intervals and successive intervocalic intervals. PVI could classify rhythm of languages which were traditionally classified as syllable timed, stress timed and mora-timed (Low, Grabe, & Nolan, 2000). High vocalic and intervocalic PVI's implied stress timed rhythm, low vocalic and intervocalic PVI's implied mora timed and low vocalic and high intervocalic PVI's implied syllable timed rhythm. In the Indian context Savithri, Jayaram, Kedarnath, & Goswami (2006) reported Kannada to be a mora-timed language based on PVI measures in adults. Further Savithri, Johnsirani, & Ruchi (2008) reported unclassified rhythm in Kannada speaking children with and without hearing impairment. Knowledge about development of speech rhythm helps in assessment of speech rhythm in clinical population. In this context, a project was undertaken to investigate development of speech rhythm in

typically developing Kannada speaking children. The present paper is a part of the project and reports on the rhythm in 4-5year old Kannada speaking children.

METHOD

Subjects: Thirty Kannada speaking, typically developing children in the age range 4-5 years (15 boys and 15 girls) participated in the study. They were screened for oral mechanism and function, speech, language, and hearing.

Test Material: Pictures (Indu, 1990) depicting simple stories were shown to elicit a five-minute speech sample of each child

Procedure: Each child was tested individually and was instructed to see the pictures carefully and describe them. Prompting was used at times when the child did not respond. Speech samples were audio-recorded using Olympus digital voice recorder at a sampling frequency of 16 kHz.

Acoustic Analysis: Speech samples were transferred onto the computer memory. PRAAT 5.1.14 (Boersma & Weinek, 2009) was used to measure Vocalic (V) and Intervocalic (IV) durations. Pauses were eliminated in order to get an appropriate measure of the vocalic and intervocalic intervals. The duration difference between successive vocalic intervals/ intervocalic intervals was calculated and averaged to get the normalized Pairwise Variability Index. Pairwise Variability Index developed by Grabe & Low (2002) was used as a measure of rhythm.

The PVI was calculated using the following formulae:

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

Where, m is the number of intervals and d_k is the duration of the k^{th} interval. Microsoft office excel program was used to calculate PVI's.

Statistical Analysis: Statistical analysis was carried out using commercially available SPSS (version 16) software.

RESULTS

Results of MANOVA indicated no significant difference between genders on intervocalic intervals [F (1, 28) = 1.39; $p > 0.05$] and intervocalic intervals [F (1, 28) = 2.02, $p > 0.05$]. Girls had higher PVIs compared to boys. However, as the SD's were very high there was no significant difference between genders. Intervocalic interval was higher than vocalic interval in boys. However, vocalic interval was higher than intervocalic in girls. Also, SD was higher in girls compared to boys.

Results of paired t-test indicated no significant difference [t (29) = 0.53, $p > 0.05$] between PVIs in both genders. Figure 1 shows PVIs in both genders. Figures 2 and 3 show the PVIs of individual subjects.

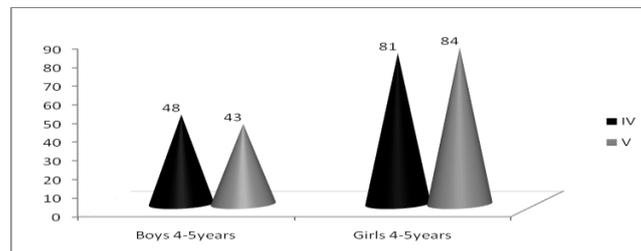


Figure 1: Intervocalic and vocalic values of 4-5 year old boys and girls.

¹ Kannada is one of the major Dravidian languages of India, spoken predominantly in the state of Karnataka. Native speakers are called Kannadigas, number roughly 50 million, one of the 30 most spoken languages in the world. It is one of the scheduled languages of India and the official & administrative language of the state of Karnataka. Kannada (n.d) *In Wikipedia Online. Retrieved from <http://www.wikipedia.com>*

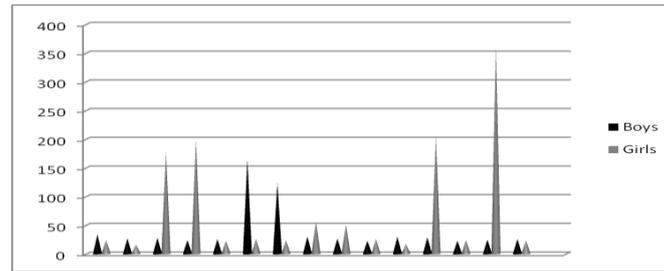


Figure 2: Vocalic PVI in 15 boys and 15 girls.

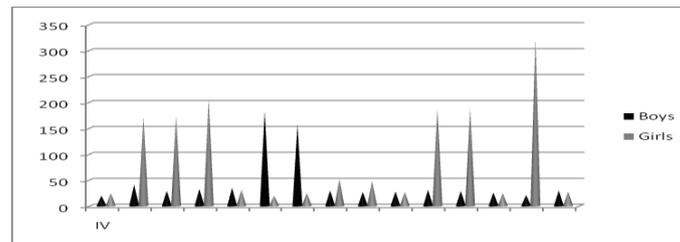


Figure 3: Intervocalic PVI in 15 boys and 15 girls.

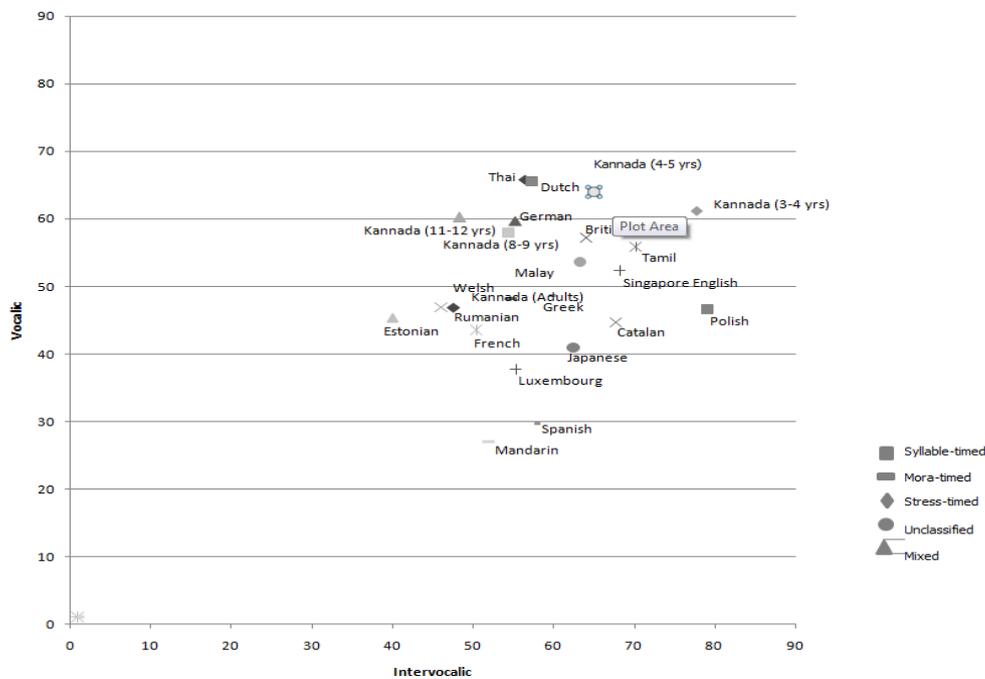


Figure 4: Intervocalic and vocalic values of 3-4, 4-5, 8-9, 11-12 year old children and Adults speaking Kannada.

DISCUSSION

The results of the study revealed two points of interest. First of all, there was no significant difference between genders on PVIs. Inspection of PVIs among gender reveals that boys had lower PVIs compared to girls (as low as by 37). However, the PVIs varied highly in both genders resulting in high standard deviation which was greater than the mean. The high SD indicates inconsistencies in some subjects. The lower PVIs in boys may be attributed to lack of word-final/ phrase final lengthening of vowels and probably omission of consonants. Second, comparing the average PVIs with those of 3-4-year old Kannada speaking children indicated that the intervocalic PVI was lower and vocalic PVI was higher in 4-5-year old children. Results of Savithri et al. (2011) in 8-9, 11-12, and adults speaking Kannada revealed higher vocalic PVI compared to intervocalic PVI. While girls in the age range of 4-5years exhibited this trend, intervocalic PVI was higher than vocalic PVI in boys. Considering the average PVI's in 4-5year old children, the rhythm can be classified as mora-timed. Figure 4 shows the

PVI's of 4-5-year old children as compared to PVI's in other groups of subjects speaking Kannada. A developmental pattern was observed in that the rhythm changed from syllable-timed to mora-timed. Comparing the results of the present study with those of world's languages indicated that the rhythm in 4-5-year old Kannada speaking children was closer to British English. British English has been classified to have stress-timed rhythm. According to rhythm class hypothesis a language with high PVIs can be classified to have stress-timed rhythm. However, high and low are comparative terms and hence there can be no strict categorical distinction. Languages can be more or less stress-timed or syllable-timed. The present study has focussed on temporal measurements. Future studies using PVIs of F0, amplitude and other measures are warranted. These measures may be helpful in classifying the rhythm types in languages.

CONCLUSIONS

The present study investigated speech rhythm in 4-5-year old boys and girls speaking Kannada using pair-wise variability index of durations. Results indicated no significant difference between genders, high SD and no significant difference between PVIs, and the rhythm was classified as mora-timed.

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Acknowledgements: The authors thank the Department of Science and Technology, Ministry of Science and Technology, Government of India, for providing grants towards the project. They also thank Director, AIISH, Mysore, for permitting us to carry out the study and Ms. M. S. Vasanthalakshmi, Lecturer in Biostatistics, Department of Speech-Language Pathology, for the help in statistical analysis. Our sincere thanks to all the participants of the study.