==========
Language in India www.languageinindia.com **ISSN 1930-2940 Vol. 19:3 March 2019**
India's Higher Education Authority UGC Approved List of Journals Serial Number 49042
==========

Acoustic Characteristics of Diphthongs of Kannada Language in 8-12 years Typically Developing Children

Dr. Shilpashri, H.N.
Ph.D. (Speech-Language Pathology)
Lecturer
shilpashrihn@gmail.com

Tanushree V
B.Sc. Internship Student

Pooja B Gowda
B.Sc, Internship Student

S. Saraswathi
B.E. (Electronics), M.Sc. (Tech)
Lecturer

JSS Institute of Speech and Hearing
M. G. Road, Mysore 570004, Karnataka, India

==========

Abstract

Diphthong is a single sound produced when two vowels are paired together in a sequence. The present study aimed to analyse the various acoustic characteristics of Kannada diphthongs /ɑɪ/ and /ɑʊ/ in word initial, medial and final position. 30 native Kannada speaking children (15 male; 15 female) in the age range of 8-12 years participated in this study. Participants were instructed to repeat back Kannada words for diphthongs /ɑɪ/ and /ɑʊ/ (in word initial, medial and final position) after the examiner. Speech samples were recorded and subjected to acoustic analysis using Praat software to extract Acoustic parameters; onglide duration / offglide duration / total duration (/ɑɪ/ & /ɑʊ/)/ formant transition trajectories (F1 & F2)/ formant transition duration. Understanding the acoustic characteristics of Kannada diphthong and gender differences is the subject of discussion of this paper.

Keywords: Kannada diphthong /ɑɪ/ and /ɑʊ/, acoustic measures, typically developing children 8-12 years.

Introduction

Kent and Read (1992) diphthong is a combination of two vowels which has three critical points where their formants present some meaningful information. These critical points are: – On

glide – Transition phase – Off glide. Where onglide is the starting portion of the diphthong & offglide is the final /ending portion of the diphthong. In between the two, were the duration taken to release of the first speech sound and move towards the more-or-less steady state of second speech sound is the formant transition duration. Diphthongs are dynamic sounds in which the articulatory shape (and hence formant pattern) slowly changes during the sound production. The first two formants provide fundamental cues for the perception of the monophthong vowels; however, the second formant is considered one of the most fundamental acoustic cues for the perception of diphthongs (Jha, 1985; Aiza, Sana, & Aymen, 2004).

Sound wave is interpreted with the help of spectrogram. A spectrogram converts a two-dimensional waveform (amp v/s time) into a three-dimensional pattern (amp v/s frequency v/s time). Frequency indicates the occurrence of the total number of complete cycles per second (cps). Intensity of sound signal is identified through measuring the height of the highest period or peak from the central line, (i.e. only the positive side). Formants are the resonance peaks of the vocal tract during speech production.

Kannada language is one of the major Dravidian languages of India. The script was derived from Brahmi script. The language uses forty-nine phonemic letters, divided into three groups: Swaragalu (vowels, thirteen letters). The vowels are further classified into short vowels, long vowels and diphthongs (/ɑɪ/ and /ɑʊ/); Yogavaahakagalu (two letters); and Vyanjanagalu (thirty-four letters). Each written symbol in the Kannada script corresponds with one syllable. (http://en.wikipedia.org/wiki/Kannada_alphabet).

Need

Each speech sound has its own characteristics which can be described in terms of physiological, psychological and acoustic correlates. Data on acoustic measures of Kannada diphthongs /ɑɪ/ and /ɑʊ/ for children before pubertal age is limited. Hence, the present study was taken to determine the various acoustic characteristics of Kannada diphthongs /ɑɪ/ and /ɑʊ/ (onglide duration / offglide duration / total duration (/ɑɪ/ and /ɑʊ/) / formant transition trajectories – F1 & F2 / formant transition duration) in word initial, medial and final position.

Aim

1. The aim of this study is to quantify the acoustic characteristics of Kannada diphthongs /ɑɪ/ and /ɑʊ/ (initial / medial / final word position) as spoken by Kannada speaking children in the age range of 8-12 years.
2. To identify gender difference if any.

Method

Participants: 30 typically developing children (15 male and 15 female) in the age range of 8-12 years were selected for this study. Participants were Kannada speakers and had the Mysore dialect of

Kannada. Participants were screened for normal Speech and Language skills, Cognitive skills, Motor development and Hearing ability.

Material:
Six word lists were prepared using two diphthongs /ɑɪ/ and /ɑʊ/ in word initial, medial & final position.

/ɑɪ/		/ɑʊ/	
Kannada word (IPA)	**English meaning**	**Kannada word (IPA)**	**English meaning**
/**ai**vatu/	fifty	/**au**tana /	banquet
/a:r**ai**ke/	Nourishment	/ar**au**shi /	Morning
/balag**ai**/	Right hand	/lakn**au** /	Lucknow (Name of the place)

Procedure: An informed written consent was obtained from the parents of children before the data collection. Recordings were done in a less background noise room. Participants were made to sit relaxed and comfortably on a chair, were instructed to repeat back the words after the examiner. The instructions were repeated whenever required. Speech recording was done using Praat software using good quality microphone with a microphone distance of 15cm from the participants. Participants were given token of rewards for taking part in this study.

Analysis: The diphthong portion was marked in the spectrograms of the word utterances. A set of acoustic properties for each diphthong phoneme of Kannada were measured, they are:

1. Durational measure for on-glide [first vocalic element] and off-glide [second vocalic element] in word initial-medial-final position.
2. Total Duration of diphthong /ɑɪ/ and /ɑʊ/ in word initial-medial-final position.
3. Formant transition trajectories F1, F2 (starting at the on-glide section and ending at the off-glide section) in word initial-medial-final position.
4. Formant transition duration (F2) was taken from the release of the first speech sound and move towards the more-or-less steady state of second speech sound.

Statistical analysis: Independent samples T test was used using SPSS 17.0 for analysis of acoustic measures for diphthongs.

Results and Discussion

Diphthongs are unlike vowels in that they cannot be adequately characterised by a single vocal tract shape or a single formant pattern. A diphthong is a vowel of changing resonator. There is slow movement of the articulator from one vowel to another. This study attempts to understand the acoustic characteristics of diphthongs /ɑɪ/ and /ɑʊ/ in 8-12 years old typically developing Kannada speaking children. Each diphthong was analysed for different acoustical parameters; onglide

duration, offglide duration, total duration (/ɑɪ/ and /ɑʊ/), formant transition duration and Formant transition trajectories (F1 & F2) in word initial-medial-final position. Mean and standard deviation for male and female participants are presented in table 1.

Table 1: Mean and SD for acoustic parameters of Kannada diphthongs /ɑɪ/ and /ɑʊ/ in word initial, medial & final position.

Parameters Duration (msec) Formant (Hz)	**Position of diphthong**	**MALE**		**FEMALE**		**Significant (0.05)**
		Mean	**SD**	Mean	**SD**	
Onglide duration - /ɑ/	Initial	63	5.96	78	15.95	**S**
	Medial	63	5.96	73	13.50	**S**
	Final	45	7.89	57	5.64	**S**
Offglide duration - /ɪ/	Initial	77	24.08	115	13.27	**S**
	Medial	77	24.08	107	19.31	**S**
	Final	73	23.59	70	7.72	**NS**
/ɑɪ/ Duration	Initial	194	32.38	231	24.16	**S**
	Medial	163	28.10	192	36.62	**S**
	Final	112	15.60	160	56.58	**S**
/ɑɪ/ (F1) First formant	Initial	593	37.91	680	83.09	**S**
	Medial	622	89.82	581	65.48	**NS**
	Final	526	110.84	535	44.46	**NS**
/ɑɪ/ (F2) Second formant	Initial	2009	114.40	1725	204.22	**S**
	Medial	2123	157.73	1643	207.38	**S**
	Final	2325	203.66	1535	310.58	**S**
/ɑɪ/ Formant transition duration	Initial	44	7.24	52	11.66	**S**
	Medial	48	9.82	54	14.39	**NS**
	Final	41	5.53	46	17.99	**NS**
Onglide duration - /ɑ/	Initial	68	10.47	85	17.68	**S**
	Medial	64	13.43	80	12.51	**S**
	Final	78	15.23	74	26.66	**NS**
Offglide duration - /ʊ/	Initial	83	20.65	106	16.48	**S**
	Medial	103	28.33	90	13.79	**NS**
	Final	76	4.83	93	25.67	**S**
/ɑʊ/ Duration	Initial	193	22.05	222	26.46	**S**
	Medial	188	32.29	185	25.85	**NS**
	Final	184	35.74	177	52.54	**NS**

/ɑʊ/(F1) First formant	Initial	628	53.01	624	47.31	**NS**
	Medial	586	33.07	624	76.00	**NS**
	Final	676	41.17	626	122.14	**NS**
/ɑʊ/ (F2) Second formant	Initial	1382	195.19	1364	165.48	**NS**
	Medial	1416	82.93	1525	78.41	**S**
	Final	1349	174.37	1442	210.15	**NS**
/ɑʊ/ Formant transition duration	Initial	47	4.51	56	15.03	**S**
	Medial	53	8.82	52	16.28	**NS**
	Final	44	3.87	55	16.08	**S**

S: significant; NS – Not significant

The present study showed significant difference at 0.05 level of significant between male and female participants for parameters; **diphthong /ɑɪ/**- onglide duration **/ɑ/** (initial medial and final position); offglide duration **/ɪ/** (initial and medial position); **/ɑɪ/** duration (initial, medial and final position); formant trajectories (F1) for **/ɑɪ/** (initial position); formant trajectories (F2) for **/ɑɪ/** (initial, medial and final position); formant transition duration (initial position). **Diphthong /ɑʊ/** - onglide duration **/ɑ/** (initial and medial position); offglide duration **/ʊ/** (initial and final position); **/ɑʊ/** duration (initial, position); formant trajectories (F2) (medial position); formant transition duration (initial and final position).

This article highlights the acoustic correlates of Kannada speech sound concentrated to diphthongs /ɑɪ/ and /ɑʊ/. **For male participants temporally**, total duration for /ɑɪ/ and /ɑʊ/ was more in word initial position; onglide and offglide duration for /ɑɪ/ was more in word initial and medial position; onglide duration for /ɑʊ/ was more in word final position; offglide duration for /ɑʊ/ was more in word medial position. Formant transition duration for /ɑɪ/ and /ɑʊ/ was more in word medial position. **Spectrally**, diphthong are characterized by high formant trajectories F2 for /ɑɪ/ compared to /ɑʊ/ ; formant trajectories F1 was similar for /ɑɪ/ and /ɑʊ/.

For female participants temporally, total duration for /ɑɪ/ and /ɑʊ/ was more in word initial position; onglide and offglide duration for /ɑɪ/ and /ɑʊ/ was more in word initial position. Formant transition duration for /ɑɪ/ was more in word medial position and /ɑʊ/ more in word initial position. **Spectrally**, formant trajectories F1, F2 was similar for /ɑɪ/ and /ɑʊ/.

Conclusion

The diphthongs are considered to be a combination of two vowels, so pronounced as to form a single syllable. The results of the present study indicate that the acoustic values of diphthong depends on type of speech sound (i.e. /ɑɪ/ and /ɑʊ/) and also the position of speech sound in word level (initial, medial, and final). Gender differences were also noted for few parameters. The acoustical data for diphthong presented in this study provide useful information for a better

understanding of the various acoustic properties (spectral and temporal) of the Kannada diphthong /ɑɪ/ and /ɑʊ/.

==========

References

Aiza, S., Sana, A., & Aymen, A. (2004). Diphthongs in Urdu Language and Analysis of their Acoustic Properties. Center for Research in Urdu Language Processing (CRULP), pp. 9-15.

Jha, S. K. (1985). Acoustic analysis of the Maithili diphthongs. Journal of Phonetics, Vol. 13, pp. 107-115.

Kent, R. D., & Read, C (1992). The acoustic analysis of speech. San Diego: Singular Publishing Group.

http://en.wikipedia.org/wiki/Kannada_alphabet

==========

Acknowledgements

We thank the cooperation of our participants and their family members during this study.

==========