



FREQUENCY CHARACTERISTICS OF BENGALI AND TAMIL VOWELS IN VARYING SPEAKING RATE

Dr.Kala Samayan¹, Elanthendral C², Dr.Anamika Hui³

¹Dr. Kala Samayan, Associate Professor, Department of Audiology & Speech Language Pathology, SRM MCH & RC, SRMIST, SRM University, Kattankulathur, Chennai-603 203. Tamil Nadu, India

²Elanthendral C, Assistant Professor, Department of Audiology & Speech Language Pathology, SRM MCH & RC, SRMIST, SRM University, Kattankulathur, Chennai-603 203. Tamil Nadu, India

³Dr Anamika Hui, Audiologist and Speech language Pathologist, HCDLC, Navi, Mumbai, India

Article DOI: <https://doi.org/10.36713/epra8112>

DOI No: 10.36713/epra8112

ABSTRACT

Speech has its unique importance as the primary means by which language is expressed in all human cultures. It is a fluid phenomenon, characterized by rapid changes in articulation and its acoustic product. Vowels can differ in acoustic analysis in various aspects because the speech code varies with language, dialect, age and sex and specific physiological constraints of the speaker. Keeping in view that rate brings changes in speech and vowels being more acoustically approachable, it is assumed that there would be changes in vowel acoustics with change in rate of speech. The present study is aimed at understanding the influence of rate of speech on formant frequency of vowel acoustics in two different languages - Bengali (Indo-Aryan) and Tamil (Dravidian). The subjects for the study were grouped based on languages - Group I consisted of 10 males with native language as Bengali, Group II consisted of 10 males with native language as Tamil in the age range of 18 to 28 years. The results shows that the formant frequency of three similar vowels of /a/, /i/ and /u/ in both languages and non-similar/different vowel of /ɔ/ in Bengali and /A/ in Tamil indicates significant difference in varying speaking rate. The differences in vowel acoustics in varying speaking rate in Tamil and Bengali showed higher duration to read the passage in normal than fast rate.

KEYWORDS: Formant frequency, vowel acoustics, Tamil and Bengali

INTRODUCTION

Speech has its unique importance as the primary means by which language is expressed in all human cultures. It is a fluid phenomenon, characterized by rapid changes in articulation and its acoustic product. The dynamics of speech poses a great challenge to its analysis, and one solution has been to make measurements at selected time points thought to represent targets, goals, or steady states. This approach has been taken with vowel formant measurements, which have a long history in the study of speech production, especially because formant descriptions are suited to articulatory interpretations of acoustic data and are therefore fundamental to discovery of features in articulatory-acoustic conversion. (Kent, 2018)

Speech is movement made audible and explained that the movements of the speech organs – structures such as the tongue, lips, jaw, velum and vocal folds result in sound patterns that are perceived by the listener. These movements are used to produce consonants and vowels. Vowels are the sounds produced with laryngeal vibration under relatively open vocal tract that is shaped to produce particular patterns of resonances so that the entire vocal tract functions as a filter or frequency selective transmission system. The vowels are also the simplest sounds to analyze and describe acoustically.

Vowel sound exhibits spectral energy maxima in frequency ranges that correspond to the resonances of the vocal tract during speech production. These spectral energy maxima are known as formants. A formant is a



local maximum in the vocal tract transfer function. Vowels often have been characterized with first three formant frequencies.

Tsao, Weismer and Iqbal (2006) studied the effect of intertalker speech rate variation on acoustic vowel space. They found that within talkers, faster speaking rates result in the compression of the vowel space relative to that measured for slower rates. As a result when the habitual speaking rate was differed significantly, there was no difference observed in the average size of the vowel space for slow vs fast talkers. No relationship across talkers between vowel duration and formant frequencies was found as well. The intertalker variability of the vowel spaces was found to be greater for slow talkers than the fast talkers for both males and females (Dietrich, 2019). Keeping in view that rate brings changes in speech and vowels being more acoustically approachable, it is assumed that there would be changes in vowel acoustics with change in rate of speech. The present study is aimed at understanding the influence of rate of speech on vowels acoustics in two different languages - Bengali (Indo-Aryan) and Tamil (Dravidian). The present study included only males because the high frequency voices especially more than 400 Hz (women and children) usually suffer estimation inaccuracy, the spectral lines become so wide that a reconstruction of the spectral envelop from the available harmonic amplitudes fails to show the second formant. This failure does not mean that the formant is not present, it is just not detected. So, to avoid this inaccuracy, male data has been used in this study.

SYMBOLIC NOTATIONS USED IN THE STUDY

- Formant frequency is symbolized as f_i , where f is the center frequency of the formant and i is the formant number.
- For example, ff_1 is the first formant frequency. The formant frequency for a particular vowel is expressed as $f_i / x /$ where f_i is the formant frequency for formant i and x is a phonetic symbol.
- For example, the first-formant frequency of vowel /i/ is expressed as $f_1 / i /$.
- Bengali normal rate of speech is indicated with the acronym BNR and Bengali fast rate of speech is indicated with the acronym BFR.
- Tamil normal rate of speech is indicated with the acronym TNR and Bengali fast rate of speech is indicated with the acronym TFR

AIM OF THE STUDY

To understand the acoustical differences with respect to formant frequency in two different languages, Tamil and Bengali in varying speaking rates.

OBJECTIVES OF THE STUDY

- 1) To compare vowel formant frequency (mf_1 , mf_2) in normal and fast rate in Tamil
- 2) To compare vowel formant frequency (mf_1 , mf_2) in normal and fast rate in Bengali
- 3) To document differences in vowel acoustics in varying speaking rate in Tamil and Bengali
- 4) To document differences in non-similar vowel acoustics in varying speaking rate in Tamil and Bengali
- 5) To compare of mean rate of speech in varying speaking rate in Bengali and Tamil

METHODOLOGY

Subjects

The subjects for the study were grouped based on languages - Group I consisted of 10 males with native language as Bengali, Group II consisted of 10 males with native language as Tamil. Subjects of both groups satisfied the following criteria. 1) All subjects were in age range of 18-28years. 2) No history of any speech, language and hearing disorders. 3) All participants were graduate student volunteers from West Bengal and Tamil Nadu.

Materials

All-phoneme passages in Bengali and Tamil were developed with 225 syllables and 372 syllables in each respectively. These passages served as reading material for the study.

Instrumentation

Tape SONY R 30 Digital Recorder and PRAAT software version 4.3.



Procedure

The subjects of Group I had to read Bengali passage and subjects of Group II had to read Tamil passages. Three recordings of reading from each subject under two conditions were collected. In condition one (Normal rate), the subjects were instructed to read the passage at their normal rate of speech. In condition two (Fast rate), the subjects were instructed to read the passage at twice their normal rate of speech. All the recordings were done in a quiet room. The samples were recorded into Tape SONY R 30 Digital Recorder. The samples were transcribed by Bengali and Tamil speaking speech-language pathologists to get the rate of speech.

Acoustic Analysis

The audio-recordings were digitized into the PC using the recording facility of PRAAT program. The samples were digitized at 22050 Hz sampling frequency and stored as wave files. Using the edit and spectrograph module of PRAAT, the following parameters were extracted for the inter-consonantal vowels with similar context /a/, /i/, /u/ and /ɔ/ in Bengali and /a/, /i/, /u/ and /ʌ/ in Tamil. /a/, /i/ and /u/ were selected as a common vowel to both the languages. /ɔ/ in Bengali and /ʌ/ in Tamil were selected as unique vowels in the language. The parameters assessed in both the languages for all the above mentioned vowels were Mean F1, Mean F2, transition duration, extent of transition to the following consonants and speed of transition.

Rate of Speech Analysis

The audio-recordings were digitized and analyzed from EDIT program of PRAAT to calculate the total number of syllables and time taken for reading the passages for three trials of both normal rate and fast rate. Rate of speech difference is documented with time taken for reading 225 syllables in Bengali and 372 syllables in Tamil respectively.

RESULTS

The present study aimed at comparing the mean formant frequencies of vowels in two different languages in varying speaking rate.

Objective 1: To compare vowel formant frequency (*mf1*, *mf2*) in normal and fast rate in Tamil

Table 1.1. Comparison of vowel mean first formant frequency (mf1) of /a/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /a/ Tamil normal rate	10	683.8620	84.97163	25.450	.000
Mean first formant frequency /a/ Tamil fast rate	10	1180.1870	1740.56682	2.144	.061

The above table indicates that there is a significant difference between first formant frequency of /a/ in Tamil normal and fast rate

Table 1.2 Comparison of vowel formant frequency (mf2) of /a/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /a/ Tamil normal rate	10	1864.4320	246.16291	23.951	.000
Mean second formant frequency /a/ Tamil fast rate	10	1887.4250	250.41870	23.834	.000

The above table indicates that there is a significant difference between second formant frequency of /a/ in Tamil normal and fast rate



Table 1.3 Comparison of vowel formant frequency (mf1) of /i/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /i/ Tamil normal rate	10	567.2090	91.70438	19.559	.000
Mean first formant frequency /i/ Tamil fast rate	10	546.5750	57.18234	30.226	.000

The above table indicates that there is a significant difference between first formant frequency of /i/ in Tamil normal and fast rate

Table 1.4 Comparison of vowel formant frequency (mf2) of /i/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /i/ Tamil normal rate	10	2048.4250	105.80053	61.225	.000
Mean second formant frequency /i/ Tamil fast rate	10	2057.9500	131.98264	49.308	.000

The above table indicates that there is a significant difference between second formant frequency of /i/ in Tamil normal and fast rate

Table 1.5 Comparison of vowel formant frequency (mf1) of /u/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /u/ Tamil normal rate	10	596.8590	107.17629	25.450	.000
Mean first formant frequency /u/ Tamil fast rate	10	614.6500	154.68065	2.144	.061

The above table indicates that there is a significant difference between first formant frequency of /u/ in Tamil normal and fast rate

Table 1.6 Comparison of vowel formant frequency (mf2) of /u/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /u/ Tamil normal rate	10	2031.5110	74.35716	86.397	.000
Mean second formant frequency /u/ Tamil fast rate	10	2025.7090	114.64773	55.874	.000

The above table indicates that there is a significant difference between second formant frequency of /u/ in Tamil normal and fast rate

Objective 2:

To compare vowel formant frequency (mf1, mf2) in normal and fast rate in Bengali

Table 2.1 Comparison of vowel formant frequency (mf1) of /a/ in normal and fast rate in Bengali

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /a/ Bengali normal rate	10	626.6340	40.66656	48.728	.000
Mean first formant frequency /a/ Bengali fast rate	10	415.1300	22.42514	58.540	.000

The above table indicates that there is a significant difference between first formant frequency of /a/ in Bengali normal and fast rate



Table 2.2 Comparison of vowel formant frequency (mf2) of /a/ in normal and fast rate in Bengali
One-Sample Statistics

	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /a/ Bengali normal rate	10	1575.2700	247.74999	20.107	.000
Mean second formant frequency /a/ Bengali fast rate	10	1571.1400	176.57736	28.137	.000

The above table indicates that there is a significant difference between second formant frequency of /a/ in Bengali normal and fast rate

Table 2.3 Comparison of vowel formant frequency (mf1) of /i/ in normal and fast rate in Bengali
One-Sample Statistics

	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /i/ Bengali normal rate	10	406.0300	28.92362	44.392	.000
Mean first formant frequency /i/ Bengali fast rate	10	415.1300	22.42514	58.540	.000

The above table indicates that there is a significant difference between first formant frequency of /i/ in Bengali normal and fast rate

Table 2.4 Comparison of vowel formant frequency (mf2) of /i/ in normal and fast rate in Bengali
One-Sample Statistics

	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /i/ Bengali normal rate	10	1651.0100	312.49287	16.707	.000
Mean second formant frequency /i/ Bengali fast rate	10	1563.2680	294.03000	16.813	.000

The above table indicates that there is a significant difference between second formant frequency of /i/ in Bengali normal and fast rate

Table 2.5 Comparison of vowel formant frequency (mf1) of /u/ in normal and fast rate in Bengali
One-Sample Statistics

	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /u/ Bengali normal rate	10	454.2670	81.12285	17.708	.000
Mean first formant frequency /u/ Bengali fast rate	10	470.3230	90.26332	16.477	.000

The above table indicates that there is a significant difference between first formant frequency of /u/ in Bengali normal and fast rate

Table 2.6 Comparison of vowel formant frequency (mf2) of /u/ in normal and fast rate in Bengali
One-Sample Statistics

	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /u/ Bengali fast rate	10	1240.9500	146.35507	23.424	.000
Mean second formant frequency /u/ Bengali normal rate	10	2025.7090	114.64773	86.397	.000

The above table indicates that there is a significant difference between second formant frequency of /u/ in Bengali normal and fast rate



Objective 3: To document differences in vowel acoustics in varying speaking rate in Tamil and Bengali
Table 3.1 Comparison of vowel formant frequency (mf1) of /a/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /a/ Bengali normal rate	10	626.6340	40.66656	48.728	.000
Mean first formant frequency /a/ Tamil normal rate	10	683.8620	84.97163	25.450	.000

The above table indicates that there is a significant difference between first formant frequency of /a/ in Bengali and Tamil normal rate

Table 3.2 Comparison of vowel formant frequency (mf2) of /a/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /a/ bengali normal rate	10	1575.2700	247.74999	20.107	.000
Mean second formant frequency /a/ tamil normal rate	10	1864.4320	246.16291	23.951	.000

The above table indicates that there is a significant difference between second formant frequency of /a/ in Bengali and Tamil normal rate

Table 3.3 Comparison of vowel formant frequency (mf1) of /i/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /i/ bengali normal rate	10	406.0300	28.92362	44.392	.000
Mean first formant frequency /i/ tamil normal rate	10	567.2090	91.70438	19.559	.000

The above table indicates that there is a significant difference between first formant frequency of /i/ in Bengali and Tamil normal rate

Table 3.4 Comparison of vowel formant frequency (mf2) of /i/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /i/ bengali normal rate	10	1651.0100	312.49287	16.707	.000
Mean second formant frequency /i/ tamil normal rate	10	2048.4250	105.80053	61.225	.000

The above table indicates that there is a significant difference between second formant frequency of /i/ in Bengali and Tamil normal rate

Table 3.5 Comparison of vowel formant frequency (mf1) of /u/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /u/ bengali normal rate	10	454.2670	81.12285	17.708	.000
Mean first formant frequency /u/ tamil normal rate	10	596.8590	107.17629	17.611	.000

The above table indicates that there is a significant difference between first formant frequency of /u/ in Bengali and Tamil normal rate



Table 3.6 Comparison of vowel formant frequency (mf2) of /u/ in normal rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean second formant frequency /u/ bengali normal rate	10	1328.7900	179.38839	23.424	.000
Mean second formant frequency /u/ tamil normal rate	10	2031.5110	74.35716	86.397	.000

The above table indicates that there is a significant difference between second formant frequency of /u/ in Bengali and Tamil normal rate

Table 3.7 Comparison of vowel formant frequency (mf1) of /a/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /a/ bengali fast rate	10	584.3120	46.34369	39.871	.000
Mean first formant frequency /a/ tamil fast rate	10	1180.1870	1740.56682	2.144	.061

The above table indicates that there is a significant difference between first formant frequency of /a/ in Bengali and Tamil fast rate

Table 3.8 Comparison of vowel formant frequency (mf2) of /a/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean second formant frequency /a/ bengali fast rate	10	1571.1400	176.57736	28.137	.000
Mean second formant frequency /a/ tamil fast rate	10	1887.4250	250.41870	23.834	.000

The above table indicates that there is a significant difference between second formant frequency of /a/ in Bengali and Tamil fast rate

Table 3.9 Comparison of vowel formant frequency (mf1) of /i/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /i/ bengali fast rate	10	415.1300	22.42514	58.540	.000
Mean first formant frequency /i/ tamil fast rate	10	546.5750	57.18234	30.226	.000

The above table indicates that there is a significant difference between first formant frequency of /i/ in Bengali and Tamil fast rate

Table 3.10 Comparison of vowel formant frequency (mf2) of /i/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /i/ bengali fast rate	10	1563.2680	294.03000	16.813	.000
Mean second formant frequency /i/ tamil fast rate	10	2057.9500	131.98264	49.308	.000

The above table indicates that there is a significant difference between second formant frequency of /i/ in Bengali and Tamil normal rate



Table 3.11 Comparison of vowel formant frequency (mf1) of /u/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean first formant frequency /u/ bengali fast rate	10	470.3230	90.26332	16.477	.000
Mean first formant frequency /u/ tamil fast rate	10	614.6500	154.68065	12.566	.000

The above table indicates that there is a significant difference between first formant frequency of /u/ in Bengali and Tamil fast rate

Table 3.12 Comparison of vowel formant frequency (mf2) of /u/ in fast rate in Bengali and Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	t	Sig. (2-tailed)
Mean second formant frequency /u/ bengali fast rate	10	1240.9500	146.35507	26.813	.000
Mean second formant frequency /u/ tamil fast rate	10	2025.7090	114.64773	55.874	.000

The above table indicates that there is a significant difference between second formant frequency of /u/ in Bengali and Tamil fast rate

Objective 4

To document differences in non-similar vowel acoustics in varying speaking rate in Bengali and Tamil

Table 4.1 Comparison of different vowel formant frequency (mf1) of /ɔ/ in normal and fast rate in Bengali

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean first formant frequency different bengali normal rate	10	581.9200	27.52041	66.866	.000
Mean first formant frequency different bengali fast rate	10	582.0330	41.37235	44.487	.000

The above table indicates that there is a significant difference between first formant frequency of non-similar vowel /ɔ/ in Bengali normal and fast rate

Table 4.2 Comparison of different vowel formant frequency (mf2) of /ɔ/ in normal and fast rate in Bengali

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean second formant frequency different bengali normal rate	10	1252.0400	145.27507	27.254	.000
Mean second formant frequency different bengali fast rate	10	1270.5700	100.44637	40.000	.000

The above table indicates that there is a significant difference between second formant frequency of non-similar vowel /ɔ/ in Bengali normal and fast rate

Table 4.3 Comparison of different vowel formant frequency (mf1) of /Λ/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean first formant frequency different Tamil normal rate	10	612.2880	94.36566	20.518	.000
Mean first formant frequency different Tamil fast rate	10	619.6100	58.98875	33.216	.000

The above table indicates that there is a significant difference between first formant frequency of non-similar vowel /Λ/ in Tamil normal and fast rate.

Table 4.4 Comparison of different vowel formant frequency (mf2) of /Λ/ in normal and fast rate in Tamil

One-Sample Statistics					
	N	Mean	Std. Deviation	T	Sig. (2-tailed)
Mean second formant frequency different Tamil normal rate	10	2466.7940	1913.96663	4.076	.003
Mean second formant frequency different Tamil fast rate	10	1877.0730	276.23307	21.488	.000

The above table indicates that there is a significant difference between second formant frequency of non-similar vowel /Λ/ in Tamil normal and fast rate.

Objective 5

To compare of mean rate of speech in varying speaking rate in Bengali and Tamil

Table 5.1 Comparison of mean rate of speech in varying speaking rate in Bengali and Tamil

Participants	BNR	BFR	TNR	TFR
1	7.41	4.47	7.57	4.44
2	7.52	4.21	5.58	4.39
3	7.05	4.38	5.65	3.75
4	7.86	5.27	6.7	4.96
5	7.51	4.13	7.51	5.44
6	7.58	4.56	7.86	5.9
7	8.33	5.24	9.62	6.33
8	7.82	5.13	9.79	5.75
9	7.33	4.42	8.02	5.94
10	8.42	5.08	7.35	4.5
Mean Rate of Speech	7.683	4.689	7.565	5.14

**BNR-Bengali Normal Rate; BFR-Bengali Fast Rate; TNR- Tamil Normal Rate; TFR-Tamil Fast Rate*

The rate of speech values of BNR/BFR and TNR/TFR are fed as follows: Participant 1 who is a native Bengali speaker had taken 7.41 minutes/225 syllables in Bengali normal rate of speech and 4.21 minutes/225 syllables in Bengali fast rate of speech. In the same way, Participant 1 who is a native Tamil speaker had taken 7.57 minutes/372 syllables in Tamil normal rate of speech and 4.44 minutes/372 syllables in Tamil fast rate of speech. Thus, the above table indicates that the mean rate of speech in Bengali and Tamil showed higher duration to read the passage in normal than fast rate.



DISCUSSION

Vowels can differ in acoustic analysis in various aspects because the speech code varies with language, dialect, age, sex and specific physiological constraints of the speaker (Fant, 2004). In the current study, we attempted to understand the acoustical differences in two different languages, Tamil and Bengali which belongs to two different language family, Dravidian and Indo-Aryan respectively. We introduced reading passages in the mentioned languages for understanding the differences in first and second formant frequencies of vowels extracted from the reading samples.

The results showed that there is a significant difference between first and second formant frequency of similar vowels /a/, /i/, /u/ in Bengali and Tamil in varying speaking rate. We also compared non-similar vowels in these two languages finding that there is significant difference between first and second formant frequency of non-similar vowels /ɔ/ in Bengali and vowel /ʌ/ Tamil in varying speaking rate. By documenting the differences in formant frequencies in varying speaking rate we are able to understand that rate makes an important difference in formant frequencies which is again also the influenced by the language spoken.

Thus, in this study it is proved that there would be changes in vowel acoustics with changes in rate of speech and it is clinically important to investigate the language specific rate of speech in individuals when we are assessing conversational discourse or reading sample for acoustical analysis. Further research in larger population might be needed for extensive information on the same.

It is known that the intertalker variability of the vowel spaces was found to be greater for slow talkers than the fast talkers for both males and females (Dietrich, 2019). We sought to understand if this holds good with different languages and different speaking rate in this study and found that the mean rate of speech in Bengali and Tamil was higher in duration when the passage was in normal rate than fast rate.

CONCLUSION

Vowel formant frequencies are among the most frequently reported acoustic measures of speech and are used in a variety of applications including automatic speech recognition, studies of speech production and speech perception in various populations of speakers, and clinical assessments in a range of speech, voice, and language disorders. In the present study that aimed at representing the influence of rate of speech on vowels acoustics in two different languages - Bengali (Indo-Aryan) and Tamil (Dravidian) by comparing the mean formant frequencies (mf1 and mf2) of vowels of /a/, /i/ and /u/ in two different languages Tamil and Bengali in normal and fast speaking rate, we found that there is a significant difference in one sample t - test. Results also indicated that there is a significant difference between formant frequencies of non-similar vowel /ɔ/ in Bengali normal and fast rate and /ʌ/ in Tamil normal and fast rate. Results of differences in vowel acoustics in varying speaking rate in Tamil and Bengali that the mean rate of speech in Bengali and Tamil showed higher duration to read the passage in normal than fast rate.

REFERENCES

1. Kent, R. D., & Vorperian, H. K. (2018). Static measurements of vowel formant frequencies and bandwidths: A review. *Journal of communication disorders*, 74, 74-97.
2. Perrier, P. (2005). Control and representations in speech production. *ZAS Papers in Linguistics*, 40, 109-132.
3. Tsao, Y. C., Weismer, G., & Iqbal, K. (2006). The effect of intertalker speech rate variation on acoustic vowel space. *The Journal of the Acoustical Society of America*, 119(2), 1074-1082.
4. Fant, G. (2004). *Speech acoustics and phonetics: Selected writings* (Vol. 24). Springer Science & Business Media.
5. Mefferd, A. S., & Dietrich, M. S. (2019). Tongue-and jaw-specific articulatory underpinnings of reduced and enhanced acoustic vowel contrast in talkers with Parkinson's disease. *Journal of Speech, Language, and Hearing Research*, 62(7), 2118-2132.