Language in India www.languageinindia.com ISSN 1930-2940 Vol. 15:5 May 2015

Acoustic Characteristics of Clear and Conversational Speech in Malayalam Speaking Children with Mental Retardation with Age Matched Norms

Faseeha. M. & Satish. K.

Abstract

Acoustic phonetic features that characterize clear to conversational speech transformation may vary across languages and different context i.e., acoustic properties and advantages of clear speech vary with languages. To understand the advantages of clear speech, it is important to know the acoustic properties of clear and conversational speech. Present study aimed at studying and comparing acoustic parameters of clear and conversational speech in Malayalam in mentally retarded children and age matched norms. A group of 10 verbal mentally Retarded children and 10 typically developed children on age range 4 to 7 years selected randomly. 50 simple written sentences and 5 pictures were selected. Each sentences contained 5 to 6 words. The sentences were prepared based on familiar words in Malayalam. Target vowels taken were |a|, |i| &|u| in initial, medial and final positions. Vowels in the common words were taken for measuring the acoustic parameters as well as comparing between clear and conversational speech. Specific acoustic analysis of vowels |a|, |i|, |u| in different positions in different acoustic parameters like F1, F2, F3, SNR, HNR, JITTER, SHIMMER and MEAN PITCH were observed. Results show that there is variation in acoustic parameters of vowels in both speaking styles within group as well as across group (between clear and conversational as well as between normals and MR). This information may be important in improving speech processing strategies in hearing aids, speech synthesis evaluation of effects of style of articulation and variability in speech production

and on speech reception and evaluating the effects of articulation of speech signal on intelligibility.

Keywords: Acoustic parameters, Mental Retardation, Typically Developing, PRAAT.

Introduction

Speech is the expression of ideas and thoughts by means of articulate vocal sounds, or the faculty of thus expressing ideas and thoughts. Humans express thoughts, feelings, and ideas orally to one another through a series of complex movements that alter and mold the basic tone created by voice into specific, decodable sounds. Speech is produced by precisely coordinated muscle actions in the head, neck, chest, and abdomen.

Voice (or vocalization) is the sound produced by humans and other vertebrates using the lungs and the vocal folds in the larynx, or voice box. Voice is not always produced as speech, however. Infants babble and coo; animals bark, moo, whinny, growl, and meow; and adult humans laugh, sing, and cry. Voice is generated by airflow from the lungs as the vocal folds are brought close together. When air is pushed past the vocal folds with sufficient pressure, the vocal folds vibrate. If the vocal folds in the larynx did not vibrate normally, speech could only be produced as a whisper. Our voice is as unique as our fingerprint. It helps define our personality, mood, and health.

Clear speech, is a manner of speaking that talkers adopt when they are told that their communication partner has a hearing loss or speaks a different native language, is often more intelligible than everyday conversational speech (Helfer, 1998; Picheny, Durlach, & Braida, 1985; Smiljanic & Bradlow, 2005).clear speech is defined to be the style of speech which results from people attempting, with the help of feedback on their intelligibility, to make their speech more intelligible. The size of the clear speech intelligibility benefit varies among talkers (Ferguson, 2004). Clear speech is defined to be the style of speech which results from people

attempting, with the help of feedback on their intelligibility, to make their speech more intelligible. The term conversational speech will be used to denote speech which is spoken in a style similar to a speaking style used in a natural everyday situation

Conversational speech is that people speak easily and freely without paying much attention to their enunciation. The term conversational speech will be used to denote speech which is spoken in a style similar to a speaking style used in a natural everyday situation. However, under various conditions, people tend to speak with more care in an attempt to make their speech "clearer". This term is denoted as "clear speech". One condition in which this might occur is when people cannot hear well, such as when talking in a noisy subway or when speaking to someone who has impaired hearing.

Down's Syndrome (DS) is the most frequent chromosomal disorder. Commonly, individuals with DS have difficulties with speech and show an unusual quality in the voice. Their phenotypic characteristics include general hypotonia and maxillary hypoplasia with relative macroglossia, and these contribute to particular acoustic alterations.

Down's Syndrome is also a congenital genetic syndrome which is associated with unusual voice features. It is 'harsh' (Berry & Eisenson, 1956), 'rough' (Leder & Lerman, 1985) 'strangled' (McWilliams, Lavorato & Bluestone, 1973) and 'strained' (D'Antonio, Muntz ,Province & Marsh, 1988). Pitch findings have been variable. D'Antonio (1988) finds excessive high or low habitual pitch level and range as well as reduced or excessive loudness. Alterations in laryngeal valving (McDonald &Baker, 1951) incomplete glottal closure (D'Antonio., 1988) and excessive pharyngeal and laryngeal tension (Berry & Eisenson, 1956) are proposed factors in these vocal differences.

Acoustic comparisons of conversational and clear speech in English have shown that clear speech modifications typically involve enhancement of the overall acoustic salience of the

speech signal by means of a decreased speaking rate, longer and more frequent pauses, an expanded pitch range, greater sound pressure levels, more salient stop releases, greater obstruent intensity, increased energy in the 1000–3000 Hz range of long-term spectra, and increased modulation depth of low frequency modulations of the intensity envelope In addition, the vowel space is expanded in clear speech when compared to conversational speech. It remains to be determined precisely which acoustic differences are actually responsible for the improved intelligibility of clear speech. It may even be that the acoustic differences that benefit one listener group, such as listeners with normal hearing listening in noise, may differ from those that benefit other groups, such as listeners with hearing loss (Ferguson & Kewley-Port, 2002).

Studies have found that both listeners with hearing loss and listeners with normal hearing listening in noise benefit from clear speech (Payton, Uchanski, & Braida, 1994; Uchanski, Choi, Braida, & Durlach, 1996). Clear speech is produced with higher voice intensity, a higher and more variable voice fundamental frequency, a slower speaking rate, longer phoneme durations, greater consonant power, and a larger vowel space than conversational speech (Bradlow, Kraus, & Hayes, 2003; Ferguson & Kewley-Port, 2002, 2007; Picheny, Durlach & Braida, 1986; Smiljanic & Bradlow, 2005)

Tjaden and Lam (2013) investigated how clear speech instructions influence sentence intelligibility. The results indicated different patterns of clear speech benefit for male and female speakers. Clear speech instructions affected the magnitude of the intelligibility benefit

Kumar (2006) measured the acoustical differences between clear and conversational speech in Kannada at global level and local level and concluded that clear speech in Kannada is characterized by longer vowel durations and length of sentences.

Prabhu (2007) compared the vowel duration and Fo, steady state F1-F2 vowel space matrices and amount of dynamic formant movement for individual vowel tokens for different

vowels, in clear and conversational speaking style. Results indicated that vowel duration and vowel space are expanded in clear speech compared to conversational speech. There is a remarkable stability in acoustic phonetic features that characterize the conversational to clear speech transformation across different languages.

Ranjini, Sonitha and Kumar (2008) compared the acoustic properties of clear speech to those of ordinary conversational speech, compared intelligibility of two ways of speaking and determined which acoustic properties are responsible for intelligibility. They measured differences at global level (rate, F0, HNR, LTAS) and local level (spectral amplitude, consonant spectra and vowel duration). Results showed that clear speech had more energy than ordinary conversational speech. The difference was more evident in high frequency range. In the high frequency region above 3 kHz the difference two spectrums was between 15 to 20 dB. There was no significant difference between means of pitch range, harmonic to noise ratio jitter shimmer between two ways of speaking. And spectral amplitude was more for consonants in clear speech when compared to conversational speech. They concluded that speaking clearly doesn't mean speaking slowly, there was no difference between clear and conversational ways of speaking in global measures and clear speech has higher spectral amplitude of release burst, friction noise and longer vowel duration.

Need for the Study

A substantial body of research work exists on acoustic characteristics of clear and conversational speech in Kannada. Acoustic phonetic features that characterize clear to conversational speech transformation may vary across languages and across different context i.e., acoustic properties and advantages of clear speech vary with languages. To understand the advantages of clear speech, it is important to know the acoustic properties of clear and conversational speech.

With the exception for few researches, most studies have focused on English clear and conversational speech and two studies are reported in Kannada. Knowing the acoustic properties of clear speech will help in identifying the acoustic cues that can enhance speech intelligibility. This information may be important in improving speech processing strategies in hearing aids, speech synthesis evaluation of effects of style of articulation and variability in speech production and on speech reception and evaluating the effects of articulation of speech signal on intelligibility.

Studies were neither reported in Down's syndrome population in Indian as well as Western accent, nor in Malayalam language in both normals and disordered population.
Hence the present study aimed at studying and comparing acoustic parameters of clear and conversational speech in Malayalam in mentally retarded children and age matched norms.

Aim of the Study

To measure and compare the acoustic parameters in clear and conversational speech in Malayalam speaking children with mental retardation with age matched norms.

Objectives

- To measure and compare the acoustic parameters of clear and conversational speech in Malayalam children with mental retardation
- To measure and compare the acoustic parameters of clear and conversational speech in Malayalam typically developing children
- To compare both speaking styles in mentally retarded children and with age matched norms
- Measure the acoustic parameters of |a|, |i|& |u| in different positions of clear speech
- Measure the acoustic parameters of |a|, |i| &|u| in different positions of conversational speech
- Compare between normals and Mentally Retarded subject

Methods and Materials

Subjects

A group of 10 verbal mentally retarded children and 10 typically developing children of age range 4 to 7 years selected randomly

Stimuli

50 simple written sentences and 5 pictures were selected. Each sentences contained 5 to 6 words. The sentences were prepared based on familiar words in Malayalam. Target vowels taken were |a|, |i|& |u| in initial, final and median positions. Vowels in the common words were taken for measuring the acoustic parameters as well as comparing between clear and conversational speech. Three examples were taken for all the vowels in all positions.

Instruments

Sony Xperia L Smart Voice Recorder Version 1.7

Procedures

For clear speech: Written sentences were given and the subjects were asked to read. Responses were recorded.

For conversational speech, Pictures containing those written sentences were shown in the laptop and questions were asked to elicit the target sentences.

A quiet sound treated room was selected for recording purpose. The subjects were seated comfortably on the chair at a distance of 1 feet from the laptop placed on the table. Each client's speech was recorded individually using a standard laptop computer with inbuilt microphone with the help of the PRAAT voice recording and analysis software 5.1 version.

Results

Acoustic differences between clear and conversational speech has been discussed under: Mean pitch, SNR, Jitter, Shimmer, Formant 1,Formant 2 and Formant 3.

PARAMETER		T VALUE	P VALUE
FORMANT1	Medial N		.001
	MR	4.173	Highly Significant
	FINAL N		.000
	MR	5.721	Highly Significant
MEAN PITCH	INITIALN		.002
	MR	3.624	Highly Significant
	MEDIALN		.034
	MR	2.298	Significant
	FINAL N	3.328	.004
	MR		Highly Significant

Table 1: Showing Formant 1 value of |a| in medial and final position of normals and MR in clear speech and Mean pitch values of |a| in initial, medial and final positions of normals and MR in clear speech

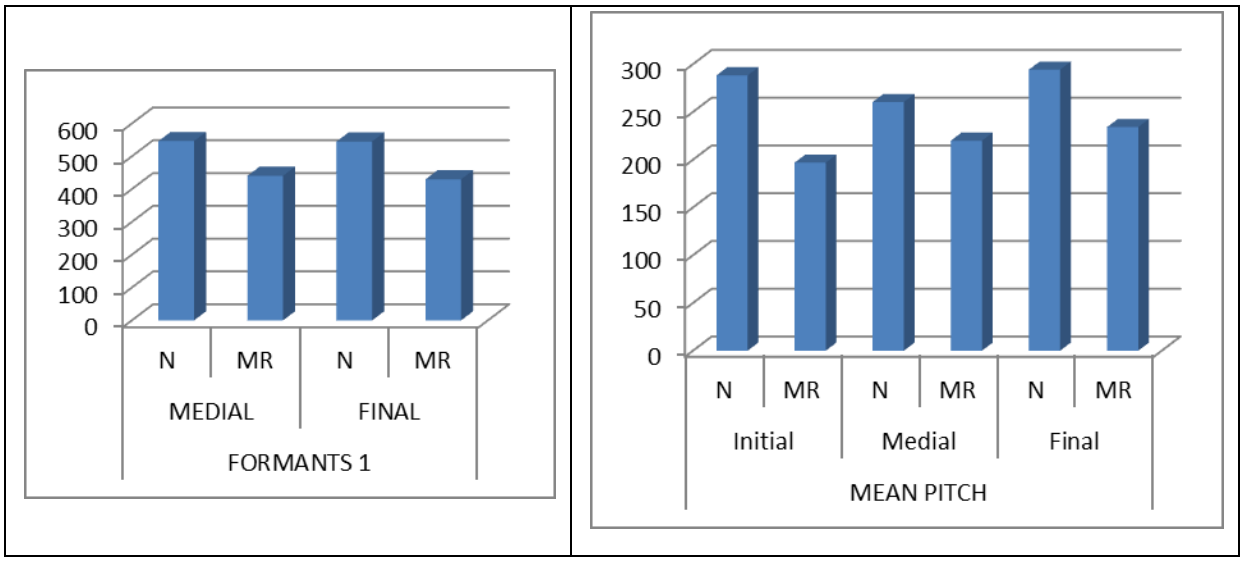


Figure 1 (a):Showing **Formant 1 of |a|** in medial and final position of N and MR in **clear speech**	Figure 1 (b): Showing **Mean pitch of |a|** in initial, medial and final position of N and MR in **clear speech**

From the above table 1 and figure 1(a),(b),Highly significant values at P = .001 &P =.000 was noted for Formant 1 of |a| in medial and final position in N and MR in clear speech, Highly significant values at P = .002 &P =.004 was noted for Mean pitch of |a| initial and final position of N and MR and significant value at P = .034 was noted in Mean pitch of |a| in medial position of N and MR in clear speech.

PARAMETER		T VALUE	P VALUE
FORMANT 1	MEDIAL N	5.445	.000
	MR		Highly Significant
	FINAL N	2.414	.027
	MR		Significant
FORMANTS 2	MEDIAL N	-2.432	.026
	MR		Significant
	FINAL N	-2.587	.019
	MR		Significant
MEAN PITCH	INITIAL N	2.798	.012
	MR		Significant
	MEDIAL N	3.466	.003
	MR		Highly Significant
	FINAL N	2.419	.026

	MR		Significant

Table 2: Showing Formant 1 of |a| in medial and final position, Formant 2 of |a| in medial and final position and Mean Pitch values of |a| in initial, medial and final positions of N and MR in conversational speech.

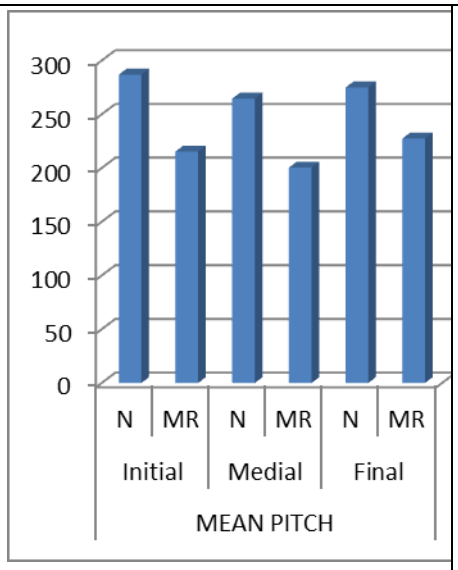


Figure 2 (a):Showing **mean pitch of |a|** in initial, final and medial position of N and MR in **conversational speech**

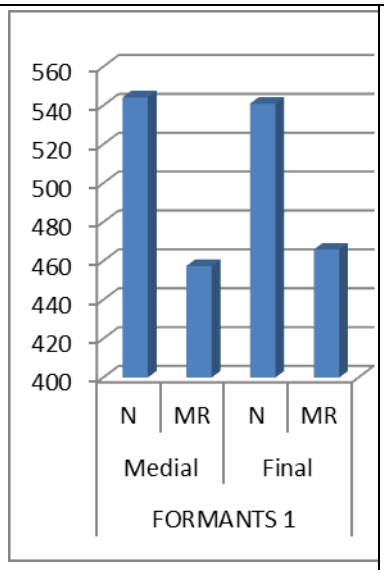


Figure2(b):Showing **Formant 1 of |a|** in final and medial position in N and MR **in conversational speech**

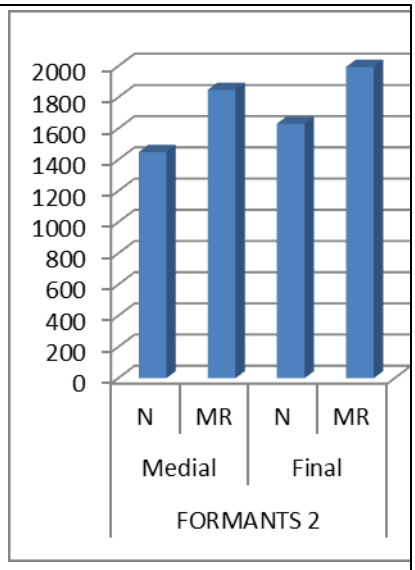


Figure 2(c):Showing **Formant 2 of |a|** in final and medial position in N and MR in **conversational speech**

From the above table 2 and figure 2 (a),(b) and (c),Highly significant value at P = .003 was noted for mean pitch of |a| in medial position, significant value at P = .012 and P= .026 was noted in initial and final position of normal and MR in conversational speech, Highly significant value at P = .000 was noted for formant 1 of |a| in medial position, significant value at P= .027 was noted in final position of normal and MR in conversational speech and significant value at

P= .026 and P= .019 was noted in formant 2 of medial and final position of normal and MR in conversational speech

PARAMETERS		ANOVA F	P VALUE
MEAN PITCH	MR INITIAL	4.988	.019 Significant
	MEDIAL		
	FINAL		

Table 3: Showing mean pitch of MR in initial, medial and final position of |a| in conversational speech

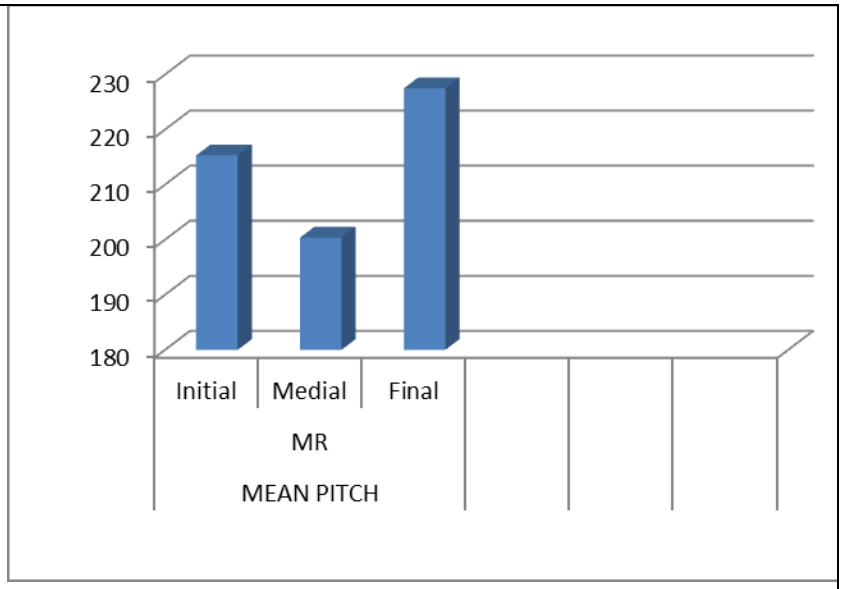


Figure 3 (a): Showing **Mean pitch of |a|** in initial, medial and final position of MR in conversational speech

From the above table 3 and figure 3(a); significant value at P = .019 was noted in mean pitch of |a| in initial, medial and final position of MR of conversational speech.

PARAMETERS		ANOVA F	P VALUE
	MR INITIAL		.038
HNR	MEDIAL	4.037	Significant
	FINAL		
	MR INITIAL		.019
JITTER	MEDIAL	4.944	Significant
	FINAL		
	N INITIAL		.038
MEAN PITCH	MEDIAL	3.934	Significant
	FINAL		
	MR INITIAL		.010
	MEDIAL	5.946	Significant
	FINAL		

Table 4:Showing HNR of |a| in initial, medial and final position of MR, Jitter of |a| in initial, medial and final position of MR and Mean pitch of |a| in initial, medial and final position of Normals and MR in clear speech.

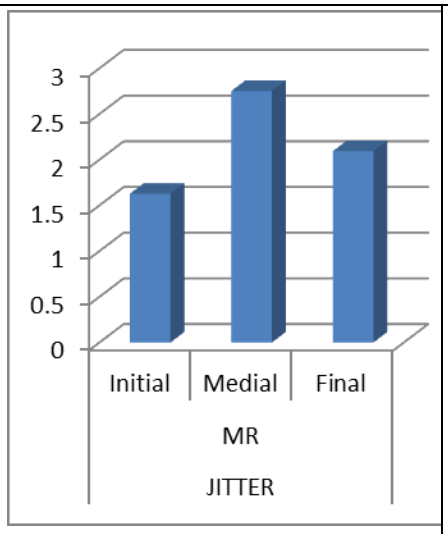


Figure 4 (a): showing **jitter of |a|** in initial, medial and final position of MR in **clear speech**

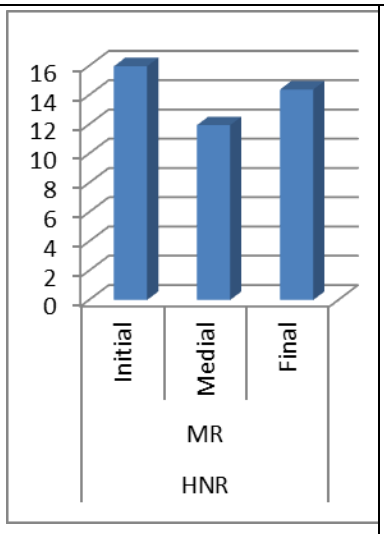


Figure 4 (b): showing **HNR of |a|** in initial, medial and

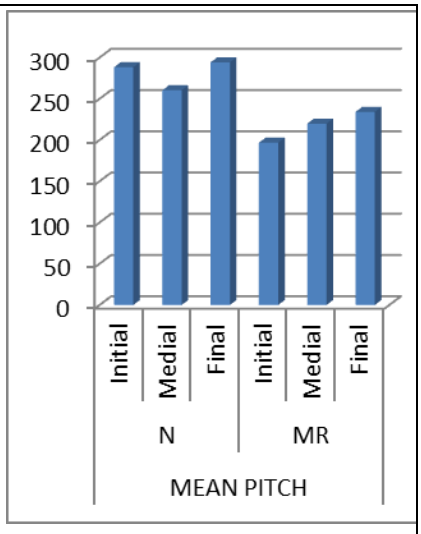


Figure 4 (c): showing **mean pitch of |a|** in initial, medial

	final position of MR in **clear speech**	and final position of Normals MR in **clear speech**

From Table 4 and figure 4 (a), (b) and (d) Significant value at P =.019 was noted in Jitter of |a| in all the positions of and MR in clear speech, significant value at P = .038 was noted in HNR of |a| in all the positions of MR in clear speech and significant value at P = .038 and P =.010 was noted in mean pitch of |a| in all the positions of normals and MR in clear speech.

PARAMETER		T VALUE	P VALUE
	INITIAL N	-4.462	.000Highly Significant
FORMANT 3	MR		
	FINAL N	-3.103	.006Highly Significant
	MR		
FORMANT 1	INITIAL N	3.066	.007Highly Significant
	MR		
	MEDIAL N	3.557	.002Highly Significant
	MR		
MEAN PITCH	INITIAL N	2.786	.012 Significant
	MR		
	MEDIAL N	2.509	.022Significant
	MR		
	FINAL N	3.363	.OO3Highly Significant
	MR		

Table 5:Showing Formant 1 |i| in initial and medial positions of N and MR in clear speech, Formant 3 in initial and final positions of N and MR in clear speech, and Mean Pitch values of |i| in initial, medial and final positions of N and MR in clear speech.

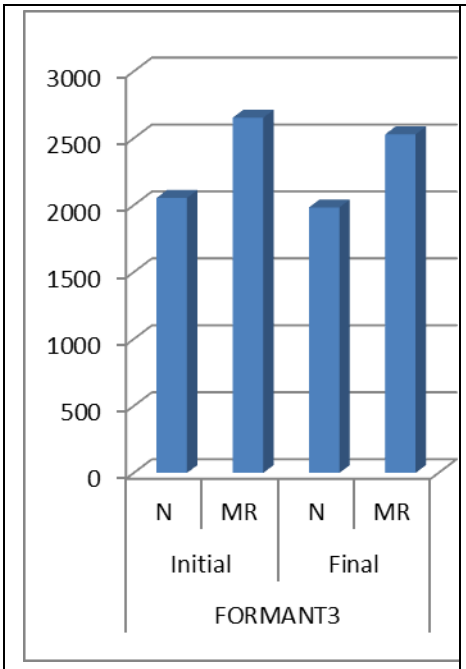


Figure 5 (a): Showing **Formant 3 of |i|** in initial and final position of N and MR of **clear speech.**

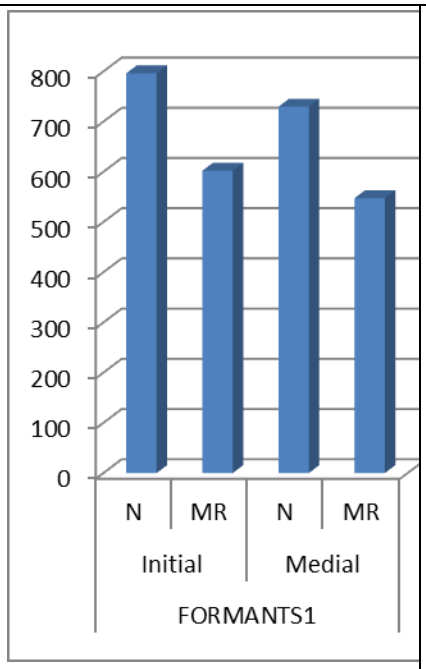


Figure 5 (b): Showing **Formant 3 of |i|** in initial and medial position of N and MR of **clear speech.**

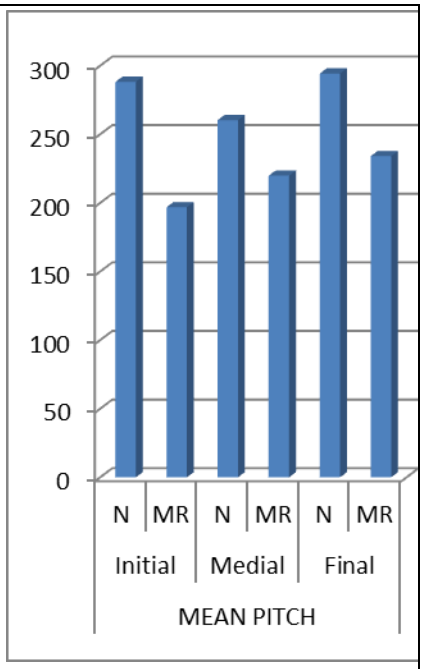


Figure 5 (c): Showing **Mean Pitch of |i|**
In initial and medial position of N and
MR **clear speech**

From the above table 5 and figure 5 (a), (b)and (c),Highly significant value at P = .000 and P= -006 was noted in Formant3 of |i| in final and medial position of normal and MR, Highly significant value at P = .007 and P= .002 was noted in Formant 1of |i| in initial and medial position of normal and MR and Highly significant value at P = .003 was noted in Mean pitch of |i| in final position of normal and MR. Significant value at P = .022 was noted in Mean pitch of |i| in initial and medial position of normal and MR of clear speech.

PARAMETER			T VALUE	P VALUE
FORMANT 3	INITIAL	N	-2.361	.005
		MR		Highly Significant
	MEDIAL	N	-1.599	.030
		MR		Significant
FORMANTS 1	INITIAL	N	2.917	.009
		MR		Highly Significant
	MEDIAL	N	3.959	.001
		MR		Highly Significant
MEAN PITCH	INITIAL	N	2.751	.013
	MR			Significant
	MEDIAL N		3.510	.003 Highly Significant
	MR			
	FINAL N/MR		2.215	.04 Significant

Table 6: showing Formant 1 of |i| in initial and medial positions of N and MR. Formant 3 of |i| in initial and medial positions of N and MR and Mean Pitch values of |i| in initial, medial and final positions of N and MR in conversational speech.

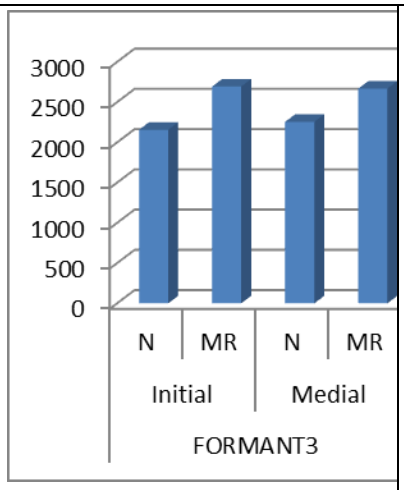
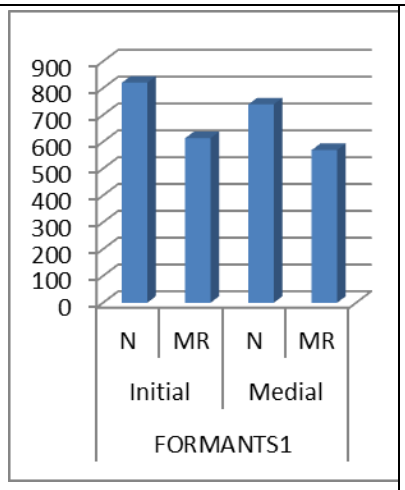
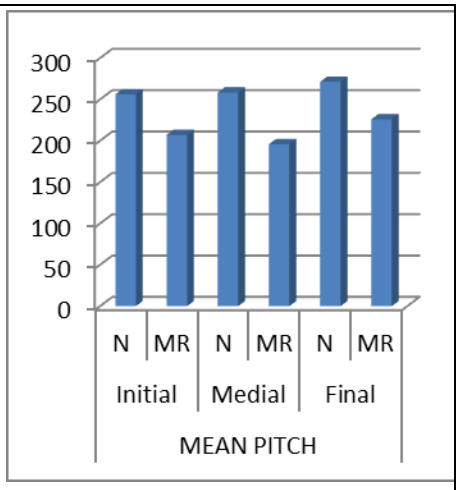
		

Figure 6 (a) : Showing **Formant 3 of |a|**in initial and medial position in N and MR in **conversational speech**	Figure6(b): Showing **Formant 1 of |a|** in initial and medial position in N and MR in **conversational speech**	Figure 6 (c): Showing **mean pitch of |a|** in initial, final and medial position in N and MR in **conversational speech**.

From the above table 6 and figure 6(a),(b) &(c); Highly significant value at P =.005 was noted in Formant 3 of |a| in initial position and significant value at P =.030 was noted in medial position in conversational speech of N and MR, Highly significant value at P =.009 and P = .001 was noted in Formant 1 of |a| in initial and medial position in conversational speech of N and MR, Highly significant value at P =.003 was noted in mean pitch of |a| in medial position and significant value at P =.013 and P =.040 was noted in initial and final position in conversational speech of N and MR of conversational speech.

PARAMETERS		ANOVA F	P VALUE
FORMANTS 1	N INITIAL	6.517	.007 Highly Significant
	MEDIAL.FINAL		
MEAN PITCH	MR INITIAL	5.723	.012 Significant
	MEDIIAL.FINAL		

Table 7:Showing mean pitch of MR and Formant 1 of normal in initial, medial and final position of |i| in conversational speech.

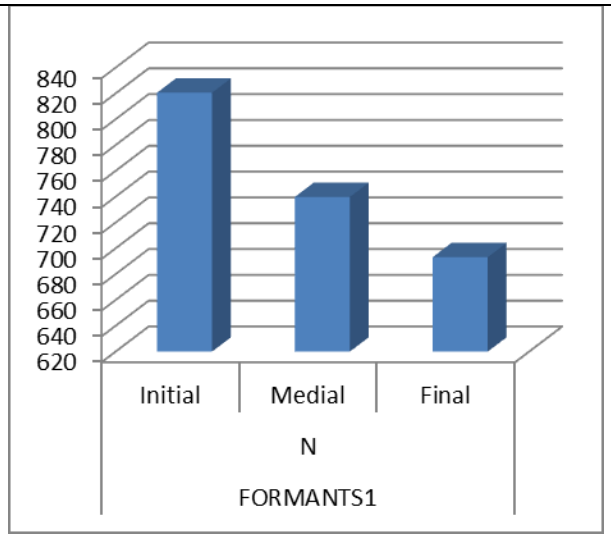


Figure 7 (a): Showing **formant 1 of |i|** in initial, medial and final position of Normals in **conversational speech**

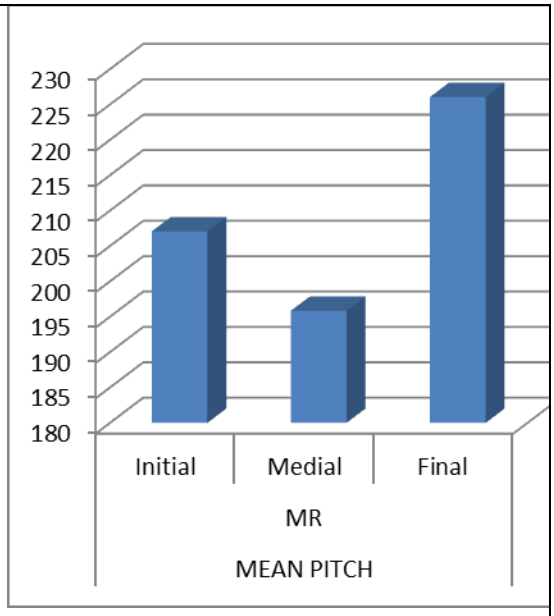


Figure 7 (b): Showing **mean pitch of |i|** in initial, medial and final position of MR in **conversational speech**

From the above table 7 and figure 7 (a) and (b), highly significant value at P= .007 was noted in Formant 1 of vowel |i| of normals in all the positions in conversational speech and significant value at P = .012 was noted in mean pitch of vowel |i| of MR in all the positions in conversational speech.

PARAMETERS		ANOVA F	P value
	N INITIAL	6.089	.010 Significant
FORMANT 3	MEDIAL		
	FINAL		
FORMANT 1	N INITIAL	6.198	.009 Highly Significant
	MEDIAL		

	FINAL		
	MR INITIAL	3.820	.044 Significant
	MEDIAL		
	FINAL		
FORMANT 2	MR INITIAL	5.148	.017 Significant
	MEDIAL		
	FINAL		
HNR	N INITIAL	4.04	.036 Significant
	MEDIAL.FINAL		
JITTER	N INITIAL	6.098	.010 Significant
	MEDIAL,FINAL		
MEAN PITCH	N INITIAL	13.397	.000Highly Significant
	MEDIAL.FINAL		
	N INITIAL	5.639	.013signific
SHIMMER	MEDIAL.FINAL		

Table8: showing HNR, Formant 3,jitter, mean pitch and shimmer of |i| in initial, medial and final position of Normals, formant 1of |i| in initial, medial and final position of Normals and MR and formant 2 of |i| in initial, medial and final position of MR of clear speech

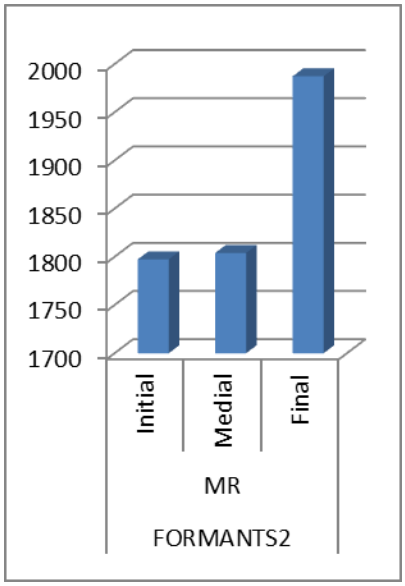


Figure 8 (b):Showing ;**Formant 2 of |i|** in initial, medial and final position of MR in **clear speech**

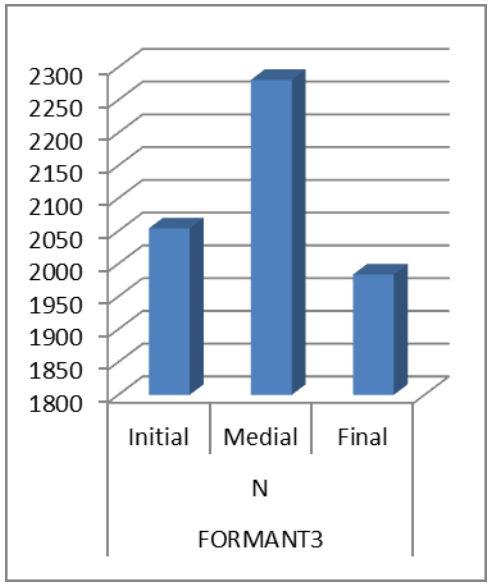
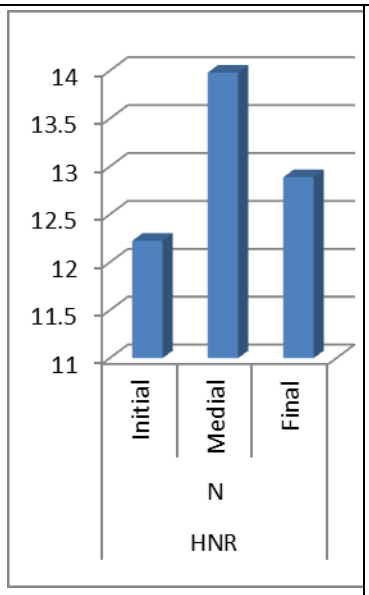
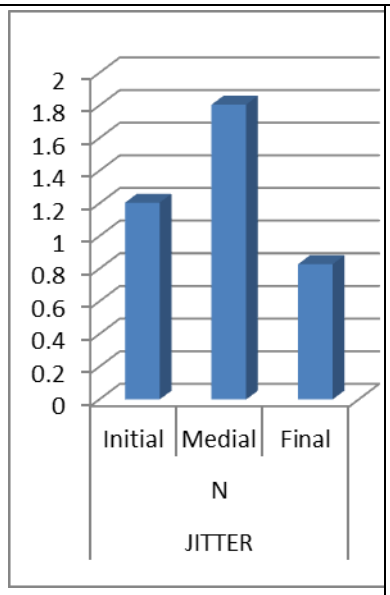


Figure 8 (c):Showing **Formant 3 of |i|** in initial, medial and final position of normals in **clear speech**





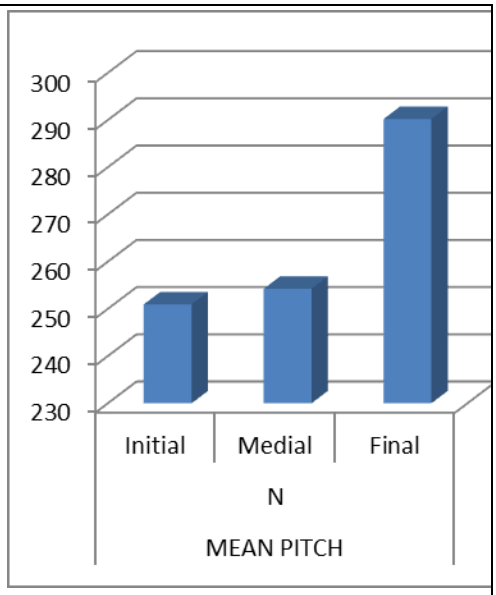


Figure 8 (d): Showing **HNR of |i|** in initial, medial and final position of normals in **clear speech**	Figure 8 (e): Showing **Jitter of |i|** in initial, medial and final position of normals in **clear speech**	Figure 8 (f): Showing **Mean Pitch of |i|** in initial, medial and final position of normals in **clear speech**

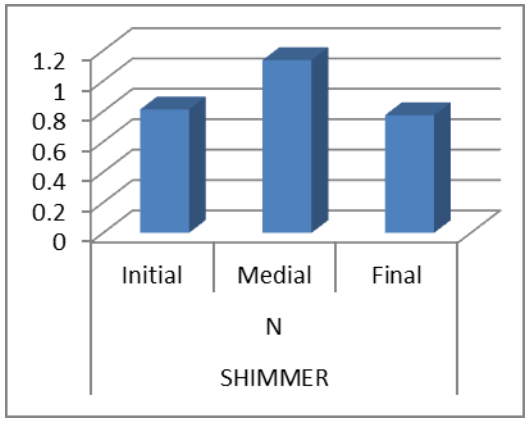


Figure 8 (g): Showing **Shimmer of |i|** in initial, medial and final position of normals in **clear speech**.

From Table 8 and figure 8 (a),(b),(c),(d),(e), (f)and (g); Highly significant value at P =.009 was noted in formant 1 of |i| in all the positions of normals in clear speech and significant value at P =.044 was noted in all the positions of MR, Significant value at P =.017 was noted in formant 2 of |i| in all the positions of MR in clear speech. Significant value at P =.010 was noted in formant3 of |i| in all the positions of normals in clear speech, Significant value at P =.036 was noted in HNR of |i| in all the positions of normals in clear speech, Significant value at P =.010 was noted in Jitter of |i| in all the positions of normals in clear speech and Highly significant value at P =.000 was noted in mean pitch of |i| in all the positions of normals in clear speech. And significant value at P =.013 was noted in shimmer of |i| in all the positions of normals in clear speech.

PARAMETER			T VALUE	P VLUE
JITTER	FINAL	N CLEAR	-2.717	.014 Significant
		CONVERSATION		
SNR	FINAL	N CLEAR	-2.533	.021 Significant
		CONVERSATION		

Table 9: Showing Jitter and Shimmer of |i| in the final position of clear and conversational speech in normals

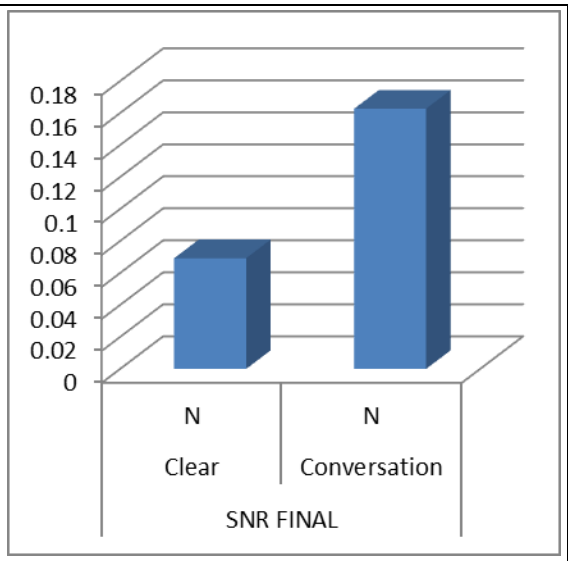


Figure 9(a):Showing **SNR of |i|** in final position of clear and conversational speech of Normals

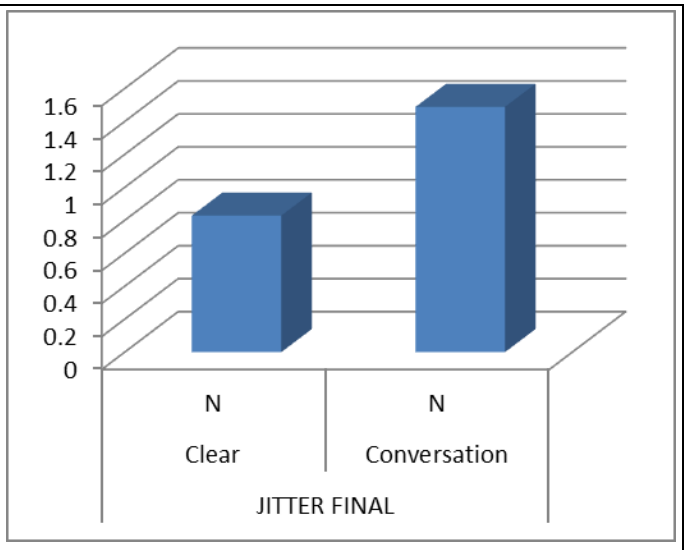


Figure 9(b):Showing **Jitter of |i|** in final position of clear and conversational speech of Normals

From the above table 9 and figure 9 (a) and (b) significant value at P=.021 was noted in SNR of |i| in final position of clear and conversational speech in normals and significant value at P=.014 was noted in Jitter of |i| in final position of clear and conversational speech in normals.

PARAMETER		T VALUE	P VALUE
FORMANTS 3	FINAL N	-2.382	.028Significant
	MR		
FORMANTS 1	INITIAL N	2.523	.021Significant
	MR		
	MEDIAL N	5.783	.000Highly Significant
	MR		
	FINAL N	3.234	.005Highly Significant
	MR		
MEAN PITCH	INITIAL N	2.302	.033Significant
	MR		
	MEDIAL N	3.224	.005Highly Significant

Table10: Showing Formant 3 of |u in final position of N and MR in clear speech. Formant 1 of |u| in initial, medial and final positions of N and MR in clear speech and Mean Pitch values of |u| in initial and medial positions of N and MR in clear speech.

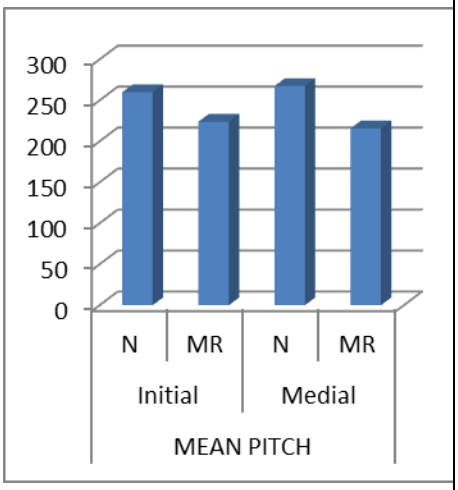
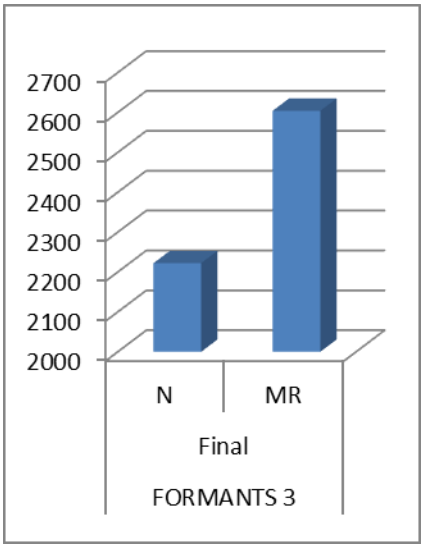
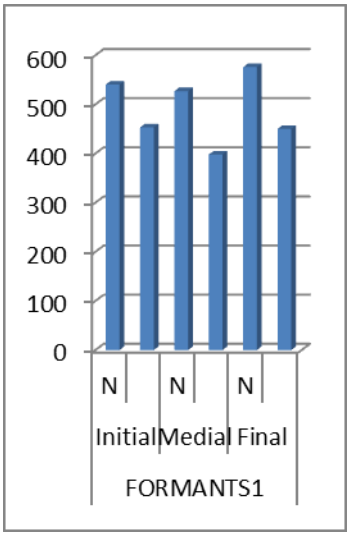
		

Figure 10 (a):showing **Mean Pitch of |u|** in initial and medial position of N and MR in **clear speech**	Figure10(b): showing **Formant 3of |u|** in final position of N and MR in **clear speech**	Figure 10(c): showing **Formant 1of |u|** in initial, medial and final position of N and MR in **clear speech**

From the above table 10 and figure 10 (a),(b)and (c)Highly significant value of P = .005 was noted in mean pitch of |u| in medial position ,Significant value at P= .033 in initial position of N and MR, significant value of P = .028 was noted in formant 3 of |u| in final position of N and MR and highly significant value of P = .000 and P =.005 was noted in Formant 1 of |u| in medial and final position , Significant value at P= .021 in initial position of N and MR.

PARAMETERS		T VALUE	P VALUE
FORMANTS 3	MEDIAL N	-2.555	.020Significant
	MR		
	FINAL; N	-3.737	.002Highly Significant
	MR		
FORMANTS1	INITIAL N	2.697	.015Significant
	MR		
	FINAL N	2.359	.030Significant
	MR		
FORMANTS 2	INITIAL N	-2.747	.013Significant
	MR		
	MEDIAL N	3.613	.002Highly Significant
	MR		
MEAN PITCH	INITIAL N	2.881	.010Significant
	MR		
	MEDIAL N	2.928	.009Highly Significant
	MR		

Table 11: showing Formant 1 of |u| in initial and final positions of N and MR in conversational speech, Formant 3 of medial and final position of N and MR, Formant 2 of initial and medial and Mean Pitch values of |u| in initial and medial positions of N and MR in conversational speech.

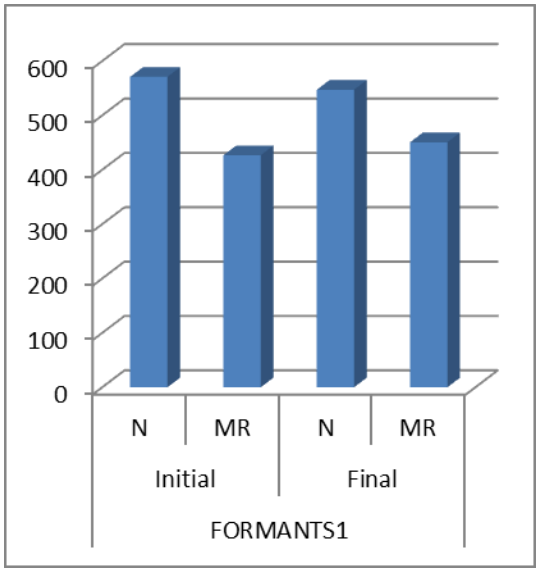


Figure 11 (a):Showing **Formant 1 of |u|** in initial and final position of N and MR in conversational speech.

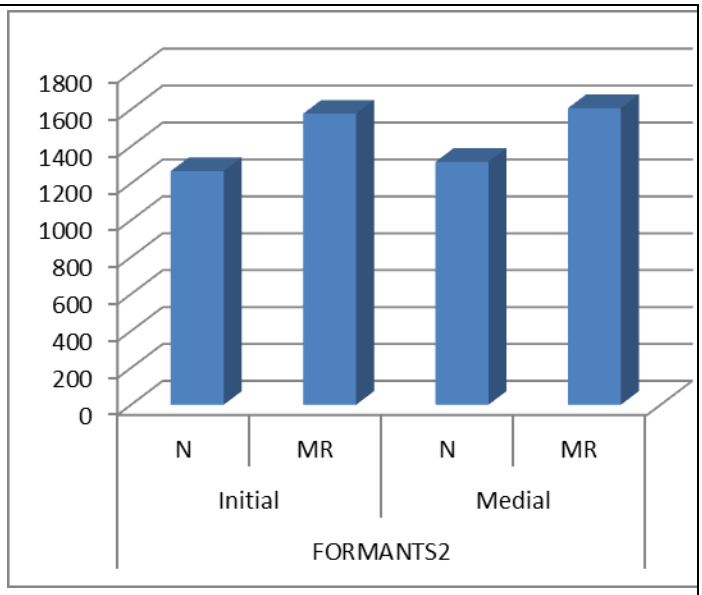


Figure 11 (b): Showing **Formant 2 of |u|** in initial and medial position of N and MR in conversational speech.

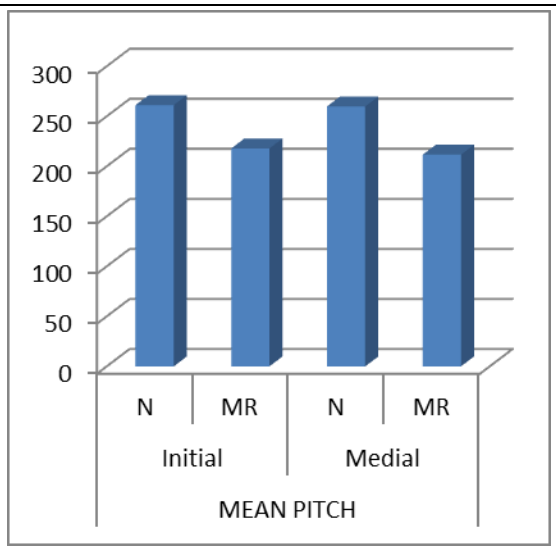


Figure 11(c): showing **mean pitch of |i|** in initial and medial position of N and MR in conversational speech.

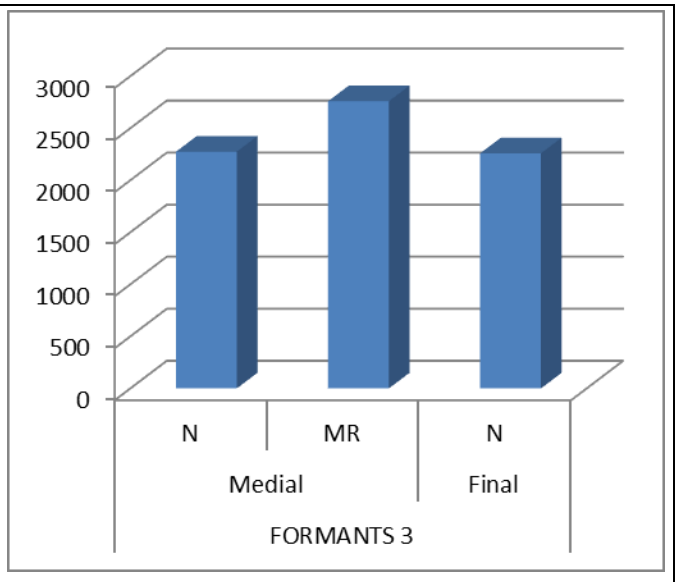


Figure 11 (d): showing **Formant 3 of |i|** in final and medial position of N and MR in conversational speech.

From the table 11 and figure 11 (a), (b), (c)and (d) significant value at P = .015 and P =.030 was noted in formant 1 of |u| n initial and final position of N and MR in conversational speech. Highly significant value at P = .002 was noted in formant 2 of |u| in medial position, Significant value at P = .013 was noted in initial position of N and MR in conversational speech. Highly significant value at P = .009 was noted in mean pitch of |i| in medial position, Significant value at P = .010 was noted in initial position of N and MR in conversational speech. Highly significant value at P = .002 was noted in formant 3 of |i| in final position, significant value at P = .020 was noted in medial position of N and MR in conversational speech.

PARAMETERS		ANOVA F	P VLUE
HNR	N INITIAL	15.019	.000 Highly Significant
	MEDIAL		
	FINAL		
	MR INITIAL	5.742	.012 Significant
	MEDIAL		
	FINAL		
JITTER	N INITIAL	4.822	.021 Significant
	MEDIAL		
	FINAL		
	MR INITIAL	5.567	.013 Significant
	MEDIAL		
	FINAL		
MEAN PITCH	N INITIAL	7.055	.005 Highly Significant
	MEDIAL,		
	FINAL		
SHIMMER	N INITIAL	4.382	.028 Significant
	MEDIAL		
	FINAL		
	MR INITIAL	4.190	.032 Significant
	MEDIAL.FINAL		

SNR	N INITIAL		.009
	MEDIAL.FINAL	6.118	Highly Significant
	MR INITIAL		.027
	MEDIAL.FINAL	4.464	Significant

Table 12: Showing HNR, Jitter, shimmer of |u| in initial ,medial and final position of Normals and MR in conversational speech , SNR and mean pitch of |u| in initial, medial and final position of Normals in conversational speech

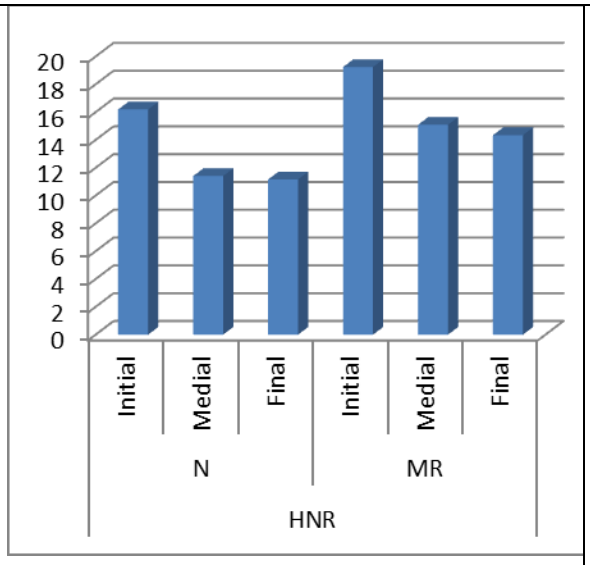


Figure 12 (a); Showing **HNR of |u|** in initial, medial and final position of Normals and MR in **conversational speech**

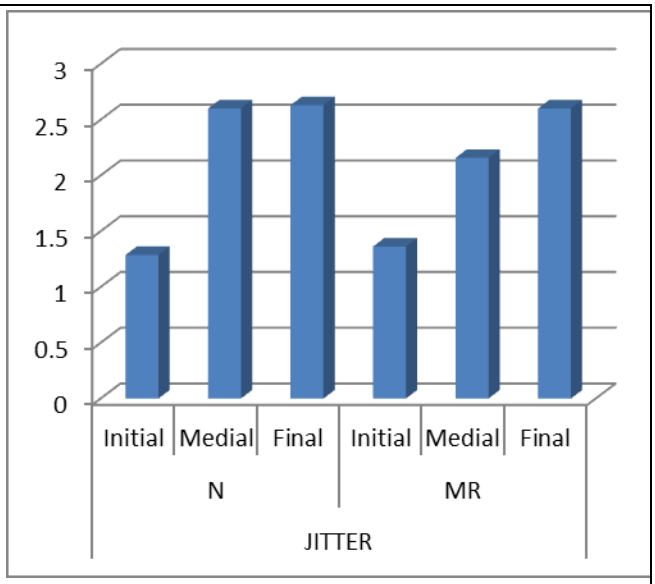


Figure 12 (b); Showing **Jitter of |u|** in initial, medial and final position of Normals and MR in **conversational speech**

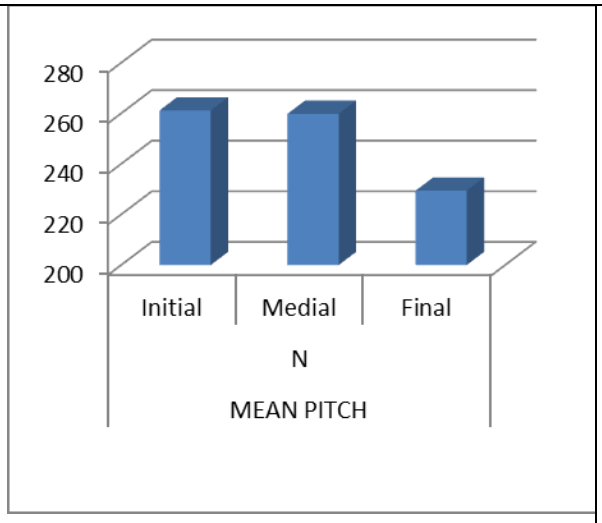


Figure 12 (c): Showing **mean pitch of |u|** in initial,medial and final position of Normals in **conversational speech**

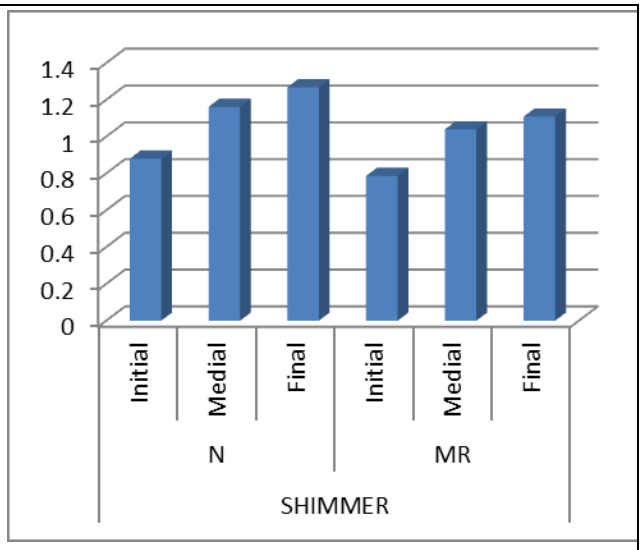


Figure 12(d): Showing **Shimmer of |u|** in initial,medial and final position of Normals and MR in **conversational speech**

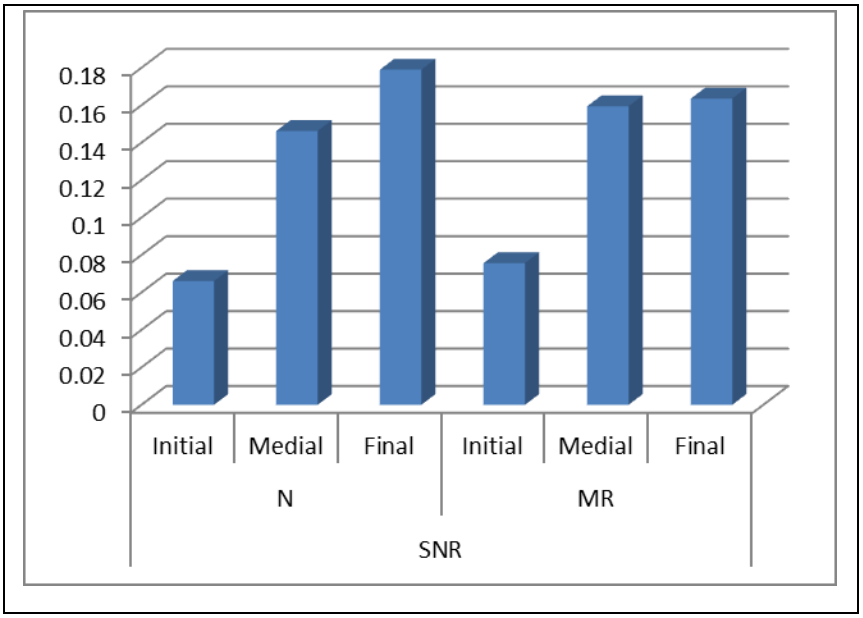


Figure 12 (e):Showing **SNR of |u|** in initial, medial and final position of Normals and MR in **conversational speech.**

From the above table 12 and figure 12 (a),(b),(c),(d)&(e); Highly significant value at P = .00 was noted in HNR of |u| in all positions of normals and significant value at P = .012 was noted in all the positions of MR in conversational speech. Significant value at P = .021 and P =.013 was noted in Jitter of |u| in all the positions of normals and MR in conversational speech. Highly significant value at P = .005 was noted in mean pitch of |u| in all the positions of normals in conversational speech, Significant value at P = .028 and P =.032 was noted in shimmer of |u| in all the positions of normals and MR in conversational speech. Highly Significant value at P = .009 was noted in SNR of |u| in all the positions of normals and significant value at P = .027 was noted in all the positions of MR in conversational speech.

PARAMETER		ANOVA	P VALUE
	N INITIAL		.007
FORMANT 1	MEDIAL	6.517	Highly significant
	FINAL		
	MR INITIAL		.012
MEAN PITCH	MEDIAL	5.723	Significant
	FINAL		

Table 13: Showing Formant 1 of |u| in initial, medial and final position of normals in clear speech and Mean pitch of |u| in initial, medial and final position of MR in clear speech

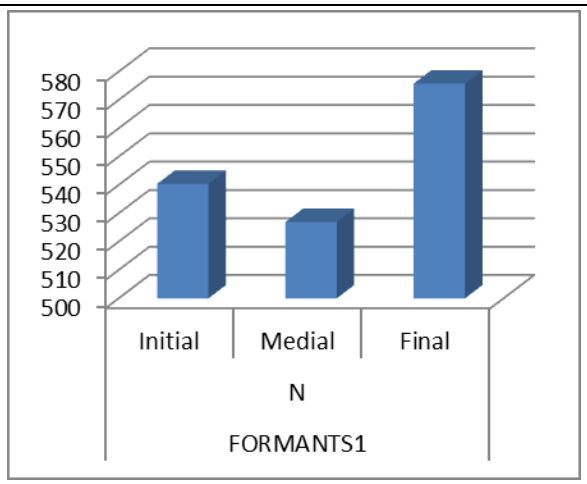


Figure 13 (a): Showing **Formant 1 of |u|** in initial, medial and final position of normals in **clear speech**

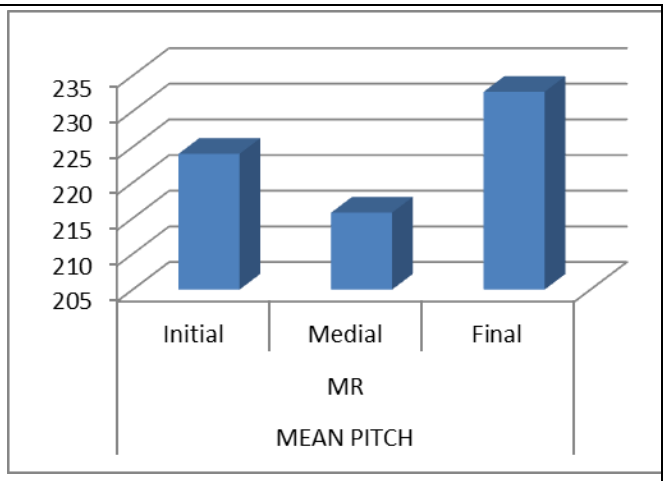


Figure 13(b): Showing **Mean pitch of |u|** in initial, medial and final position of MR in **clear speech**

From Table 13 and figure 13(a) and (b) Highly significant value at P =.007 was noted in formant 1 of |u| in all the positions of normals in clear speech and significant value at P =.012 was noted in Mean pitch of |u| in all the positions of MR in clear speech.

PARAMETER			T VALUE	P VALUE
FORMANT 2	MEDIAL	MR CLEAR	-2.818	.011 Significant
		MR CONVERSATION		

Table 14:showing Formant 2 of |u| in the medial position of clear and conversational speech in MR

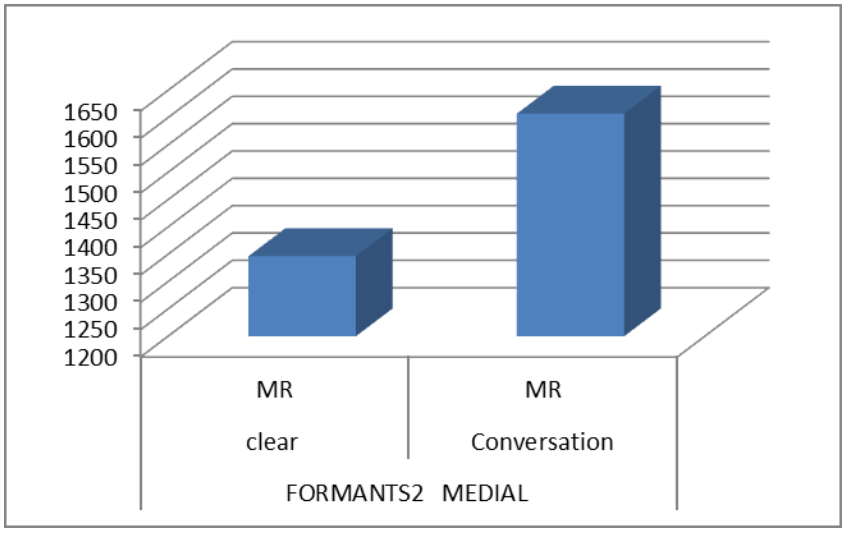


Figure 14(a): Showing **Formant 2 of |u|** in medial position of clear and conversational speech of MR

From the above table 14 and figure 14.significant value at P=.011 was noted in formant 2 of |u| in Medial position of clear and conversational speech in MR

Discussion

The study aimed at measuring and comparing the acoustic parameters of clear and conversational speech of Malayalam speaking children with mental retardation with age matched norms.

From the above results, it is clearly evident that highly significant differences were noted in Formant 1, Formant 2, Formant 3 and Mean pitch values. Significant differences were noted in HNR, Jitter and Shimmer values and no significant difference were noted in HNR value.

Significant difference were noted in jitter ,SNR and F2 values of |a| and |u| in clear and conversational speech of normals and MR. No significant differences were noted in any other

parameter during the comparison of clear and conversational speech. No differences were noted for the vowel |a| in any of the parameters.

Highly significant difference were noted in F1,F2,F3,and Mean pitch of |a|, |i| and |u| of normals and MR in clear speech, significant difference were noted in jitter, HNR and shimmer values and no significant difference were noted in SNR values of clear speech.

Highly significant difference were noted in F1,F2,F3,and Mean pitch of |a|, |i| and |u| of normals and MR in conversational speech and significant difference were noted in all the other parameters including HNR, SNR, jitter and shimmer in conversational speech.

Among normal population, Highly significant difference were noted in F1,F2,F3,and Mean pitch and in MR population, significant difference were noted in F1, F2, F3, HNR, SNR and mean.

Summary and Conclusion

It is by now well-established that "clear speech," a manner of speaking that talkers adopt when they are told that their communication partner has a hearing loss or speaks a different native language, is often more intelligible than everyday conversational speech.

The above study gives an overview about how acoustic parameter of vowels differs in normals and MR in different speaking styles (clear and conversational).

A group of 10 verbal intellectually disabled children and 10 typically developed children on age range 4 to 7 years selected randomly. 50 simple written sentences and 5 pictures were selected. Each sentences contained 5 to 6 words. The sentences were prepared based on familiar words in Malayalam. Target vowels taken were |a|, |i| &|u| in initial final and median positions. Vowels in the common words were taken for measuring the acoustic parameters as well as comparing between clear and conversational speech. Three examples were taken for all the

vowels in all positions. Specific acoustic analysis of vowels |a|, |i|, |u| in different positions in Malayalam language was carried out.

It is clear from the above study that there is variation in acoustic parameters of vowels in both speaking styles within group as well as across group(between clear and conversational as well as between normals and MR).

When comparing the difference between clear and conversational speech, significant variation in acoustic parameters like F1, F2, F3, SNR, HNR, JITTER, SHIMMER and MEAN PITCH was observed for MR population than normal population. Among normal population, difference was observed for almost all the parameters but highly significant for F1, HNR, MEAN PITCH and SNR. Among MR population, difference was observed for almost all the parameters, no highly significant difference was found in any of the parameters.

From the above results, significant differences were seen within group as well as across group in different parameters. Differences were commonly evident in F1, F3 and MEAN PITCH while comparing different positions across vowels and within vowels. While comparing vowels in clear and conversation speech of both normals and MR, variation were found only in SNR, JITTER and F2.

Implications

Vocal training programs can be framed to improve speech intelligibility**.**

Limitations

Study was done only on 10 subjects and individual variations may vary the findings. Perceptual comparison of clear and conversational speech was not done.

Spectral analysis was not carried out, only Acoustic analysis and formant analysis was done

Subjects were selected randomly irrespective to gender; comparison was not done between males and females.

==========

=

References

Berry, M. D., & Eisenson, J. (1956). *Speech disorders: Principles and practices of therapy.* New York: Appleton Century Crofts.

D 'Antonio, L. L., Muntz, H. R., Province, M. A., & Marsh, J. L. (1988). Laryngeal / voice findings in patients with velopharyngeal dysfunction. *Laryngoscope*, 1988 Apr ;98 (4):432-8

Ferguson, S. H., & Kewley-Port, D. (2007). Talker Differences in Clear and Conversational Speech: Acoustic Characteristics of Vowels.*Journal of Speech, Language, and Hearing Research* October 2007, Vol.50, 1241-1255. Doi: 10.1044/1092-4388(2007/087)

Ferguson, S. H., & Kewley-Port, D. (2008). Subjective ratings of sentences in clear versus conversational speech.*The Journal of the Acoustical Society of America* (Impact Factor: 1.65). 11/2008; 124(4):2457. DOI: 10.1121/1.4782643

Ferguson, S. H. (2004). Talker differences in clear and conversational speech: vowel intelligibility for normal hearing listeners. *Journal of Acoustic Society of America*; 116:2365–2373. Doi: 10.1121/1.1788730.

Ferguson, S. H., & Kewley-Port, D. (2008). Vowel intelligibility in clear and conversational speech for normal-hearing and hearing-impaired listeners.*Journal of Acoustic Society of America.* 2002 Jul;112(1):259-71.

Ferguson, S. H., & Quene, H. (2014). Acoustic correlates of vowel intelligibility in clear and conversational speech for young normal-hearing and elderlyhearing-impaired listeners. *Journal of Acoustic Society of America.*2014.june;135(6):3570-84,doi:10.1121/1.4874596..

Helfer, K. S. (1998). Auditory and auditory-visual recognition of clear and conversational speech by older adults.*Journal of the American Academy of Audiology*, 9, 234-242.

Kumar, P. (2006). Comparing Acoustic Parameters of Clear and Conversational Speech in Kannada.Unpublished Master Dissertation, Mangalore University Mangalore, India

MacDonald, E. T., & Koepp-Baker, H. (1951). Cleft palate speech: an integration of research and clinical observation. *Journal of Speech and Hearing Disorders*, 16, 9-19.

McWilliams, B. J., Lavarto, A. S., & Bluestone, C.D. (1973).Vocal cord abnormalities in children with velopharyngeal valving problems.*Laryngoscopy*,83, 1745-1753

Picheny, M. A., Durlach, N. I., & Braida, L. D. (1986). Speaking Clearly for the Hard of Hearing IIAcoustic Characteristics of Clear and Conversational Speech.*Journal of Speech, Language and Hearing Research*, December 1986, Vol. 29, 434-446. doi:10.1044/jshr.2904.434

Picheny, M. A., Durlach, N. I., & Braida, L.D. (1989). Speaking Clearly for the Hard of Hearing IIAn Attempt to Determine the Contribution of Speaking Rate to Differences in Intelligibility between Clear and Conversational Speech. *Journal of Speech, Language, and Hearing Research*, September 1989, Vol. 32, 600-603. doi:10.1044/jshr.3203.600

Picheny, M. A., Durlach, N. I., & Braida, L.D. (1985). Speaking Clearly for the Hard of Hearing I Intelligibility Differences between Clear and Conversational Speech. *Journal of Speech, Language and Hearing Research*, March 1985, Vol. 28, 96-103. doi:10.1044/jshr.2801.96

Prabhu, S. (2007). Acoustic characteristics of Vowels in clear and conversational speaking style in Kannada. Unpublished Master dissertation, Mangalore University Mangalore, India

Payton, K. L., Uchanski, R. M., & Braida, L.D. (1994). Intelligibility of conversational and clear speech in noise and reverberation for listeners with normal and impaired hearing.*Journal of the Acoustical Society of America*, 95, 1581-1592.

Picheny, M. A., Durlach, N.I., & Braida, L. D. (1986).Speaking clearly for the hard of hearing II: Acoustic characteristics of clear and conversational speech.*Journal of Speech and Hearing Research*, 29, 434–446.

Ranjini., Sonitha., Kumar, P. (2007). Comparing Acoustic Properties of Clear and Conversational Speech in Indian Accented English. Poster presented at 40th ISHA conference. Mangalore, Karnataka

Smiljanic, R., & Bradlow, A, R. (2009). Speaking and Hearing Clearly: Talker and Listener Factors in Speaking Style Changes. *LanguageLinguist Compass*. 2009 January 1; 3(1): 236–264. doi:10.1111/j.1749-818X.2008.00112.x.

Smiljanic, R., & Bradlow, A, R. (2008). Temporal organization of English clear and conversational speech. *Acoustic Society of America*.2008 Nov; 124(5): 3171–3182.doi: 10.1121/1.2990712

Smiljanic, R., & Bradlow, A. R. (2005). Production and perception of clear speech in Croatian and English. *Journal of Acoustic Society of America*. 2005; 118:1677–1688.Doi: 10.1121/1.2000788

Uchanski, R. M., Choi, S. S., Braida, L. D., Reed, C. M., & Durlach, N. I. (1996). Speaking clearly for the hard of hearing IV: further studies of the role of speaking rate. *Journal of Speech, Language, and Hearing Research*. 1996;39:494–509

==========

Faseeha, M.
Second Year Post Graduate Student
Dr. M.V. Shetty College of Speech and Hearing
Maladi Court, Kavoor
Mangalore - 575015
Karnataka, India

fasi.faseeha123@gmail.com

Satish Kumaraswamy
Principal
Dr. M.V. Shetty College of Speech and Hearing
Maladi Court, Kavoor
Mangalore - 575015
Karnataka, India
sat8378@yahoo.com