International Journal of Multidisciplinary Research and Modern Education (IJMRME)
ISSN (Online): 2454 - 6119
(www.rdmodernresearch.org) Volume I, Issue I, 2015

VARIATION OF PITCH AND FORMANTS IN DIFFERENT AGE GROUP

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Abstract:
This paper addresses effects of age on certain acoustic properties of speech. Each human being goes through the process of ageing. Our voices and speech patterns changes from early childhood to old age. We examined there is difference in vowel acoustics between older and younger adults, possibly related to age-related changes in vocal tract morphology. In fact, younger children show higher phone duration and larger spectral and temporal variability than older children and adults. Analysis of vowel transition and the amount of spectral difference between vowels are clearly age-dependent. Younger children, in fact, show shorter transition duration and larger spectral difference in vowel. The purpose of this study was to examine the differences in variability of several measures of the speech produced by the adult female and child. The speech of female (child aged between 5-15 years, younger aged between 20-45 years, older aged between 50-85 years) was evaluated for identification of differences for age group across measure of fundamental and formant frequencies. A strong correlation between age and accuracy was found. In our study we have proved fundamental frequency decreases according to our age. Results show that older adults had overall lower frequency formants, and qualitatively different shaped vowel spaces, than the younger adults. Female has high pitch for younger age group and low pitch for old age group.

Keywords: Acoustics, Formants, Vowel Space, Spectrograph & Child Speech

1. Introduction:

It is well known that acoustic and linguistic characteristics of children's speech are widely different from those of adult speech. Furthermore, characteristics of children's speech vary rapidly as a function of age due to the anatomical and physiological changes occurring during a child's growth and because children become more skilled in co-articulation with age.

Much has been done in the past in analyzing the acoustic differences between children's and adult speech, with a particular focus on vocal tract length and its influences on pitch and formant frequency values, understanding the developmental changes in children's speech can help devise strategies for dealing with the acoustic mismatch between different age group. The acoustic characteristics of the glottal excitation signals have been shown to be gender dependent and are believed to change with age. A better understanding of these age and gender dependencies will help improve voice source estimation and analysis for a variety of speech processing.

In this paper, our main concern is with the effect of increasing age during the life span of an adult speaker on formant frequencies. Our interest in this association between formants and age is not only to advance our understanding of how increasing age in a childhood influences speech production, but also to assess the extent to which age-related formant changes may obscure phonetic differences between two groups of different aged speakers in the context of investigations. The decrease of formants has been attributed to a lengthening of the vocal tract, caused by a lowering of the larynx, and by a growth of the facial Skelton.

Still, not all studies of age-related changes in speech have taken differences between the sexes into account. For example, there are conflicting findings regarding

the specific effects of sex and aging on fundamental frequency, vowel formant frequencies in speech production. We discuss each of these properties in turn.

1.1 Formant Frequencies:

Formants correspond to resonant frequencies or pitch overtones of the vocal tract with the greatest amplitude, and differ depending on the configuration of the vocal tract for articulating different types of voiced sounds, most notably vowels. The specific formants F1, F2, and F3 are typically evaluated for comparison of different vowels: F1, the lowest formant, is inversely related to vowel height (or how close the tongue is to the roof of the mouth); the difference between F1 and F2 correlates roughly with tongue advancement (or how far forward in the mouth the highest point of the tongue is); and both F2 and F3 vary with the degree of lip rounding.

As with other acoustic measures of speech, there have been numerous studies that have reported on age-related changes to formants, particularly in the production of vowels. A common finding is that vowel centralization occurs with very old speakers and this is associated with a general lowering of vowel formants with age. In some cases, these changes have been identified as occurring only on particular vowels. There is some disagreement; however, regarding age related changes for men versus women. We observed age differences in vowel formant frequency characteristics for men but not women, such that men altered the dimensions of the vowel space with age, while older women preserved the vowel space with age, however, who found consistent lowering of formant frequencies for both sexes.

1.2 Fundamental Frequency:

Fundamental frequency (F0) has the perceptual correlate of voice pitch. The fundamental frequency of a periodic signal is the inverse of the period length. The period as, in turn, the smallest repeating unit of a signal. Fundamental frequency decreases according to age. Females have short vocal chords so it vibrates with high frequency to produce high pitched voice.

2. Methodology:

We are taking the subjects which are 10 speakers so 25 target words from 10 subjects resulted in 250 tokens. The corpus consisting of 25 words, which are 5 for [i], 5 for [e], 5 for [a], 5 for [o], and 5 for [u]. Female aged between 30-80 years and children aged between 5-15 years. Vowels /a/, /i/, /e/, /o/, /u/ are pronounced in isolation in a natural way by different female speakers. Target words are bead, bit, bet, bat, but, bird, pot, ball, put, boot, father. The recording level was set separately for each individual and was kept constant throughout the recording. The microphone was held within 30 cm from their mouth. The children who felt confident with their reading, read the list, where as those who could not read, were asked to repeat each word after their parent. Each subject was recorded twice and the best recording was chosen for analysis. Recording speech was analyzed with the help of PRAAT software and all the necessary measurements were taken from the spectrograms.

3. Results:

3.1 Vowel Formants:

The means and standard deviations for F1, F2, and F3 across the five vowels are shown in Table 1 for each participant group (YW- Younger women, OW- Older women).

	'i'			**'e'**			**'a'**		
	F1	**F2**	**F3**	**F1**	**F2**	**F3**	**F1**	**F2**	**F3**
YW	**538**	**2835**	**3620**	**727**	**2595**	**3590**	**874**	**1840**	**3190**
OW	**431**	**2540**	**3090**	**700**	**2227**	**3105**	**860**	**1720**	**2750**

	'o'			'u'		
	F1	F2	F3	F1	F2	F3
YW	765	1498	3208	595	1209	3204
OW	608	1275	2735	501	1020	2830

We have shown the formant frequency of younger and older women for the Vowels [i], [e], [a], [u], [o]. It is observed that formant frequency in case of adult females is intermediate and child formants are the highest. In case of vowel [a] formant for female values maintain the same pattern seem more scattered. Generally, child formants are higher as compared to the adult female. Formants changes with different vocal tract configurations corresponding to different resonant cavities and thus different phonemes. Generally, the frequency of the formants decreases as the vocal tract length increases.

3.2 Fundamental Frequency:

The graphs are presented comparatively for the three classes of speakers (child, younger and older); in fig 1-3 for each vowel separately.

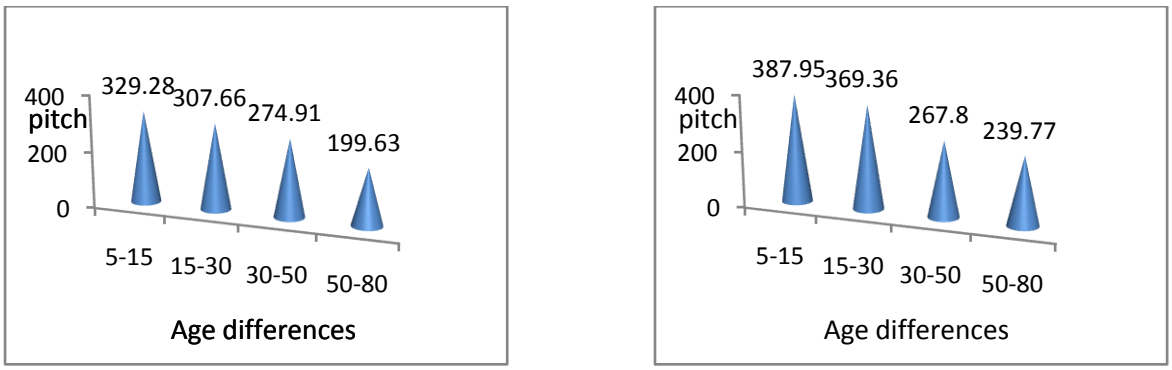

Figure 1: Shows the effect of Age Difference on pitch for the Vowel "i"& "u"

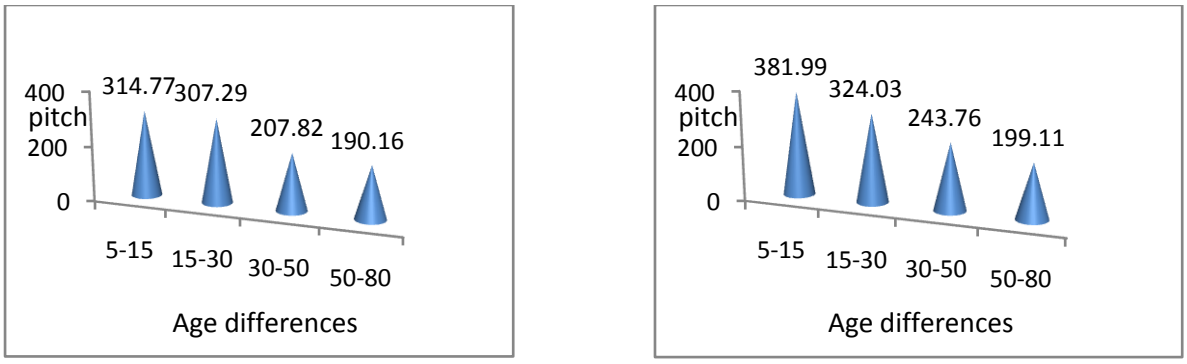

Figure 2: Shows the effect of Age Difference on pitch for the Vowel "a"& "e"

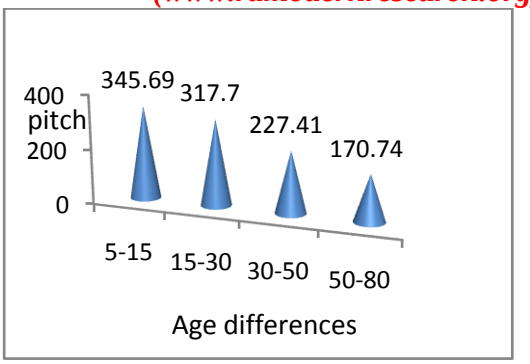

Figure 3: Shows the effect of Age Difference on pitch for the Vowel "o"

We have shown pitch in female at different age group and observed that child age have higher pitch than younger female and old age. Fundamental frequency decreases according to age. Females have short vocal chords so it vibrates with high frequency to produce high pitched voice.

4. Discussion:

The acoustic characteristics of the glottal excitation signals have been shown to be gender dependent and are believed to change with age. These changes may be caused by an edematous change of vocal fold in aged females. In both child and aged females amplitude perturbation becomes large. Our voices and speech patterns changes from early childhood to old age. Changes in the respiratory system effect speech breathing as well were voice. We analyzed the first three formants of vowels produced by child, younger and older of same gender, as well as the relationship between these values. Child formants are found to be higher than adults', so that the child vowel space is placed more 'downwards and to the left' in comparison with the adult vowel spaces. In case of vowel [a] formant for female values maintain the same pattern but child formant values seem more scattered. The older speakers produced significantly greater and larger numbers of inflections than the younger persons. The older women exhibit significantly higher minimum and significantly lower maximum intensity than the younger women. The voice of aged female is characterized by a decrease in fundamental frequency.

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