

CHANGES IN SPEAKING FUNDAMENTAL FREQUENCY AS A FUNCTION OF AGE

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In daily life, man communicates through speech. An evaluation of the fundamental frequency in phonation, may not represent the true fundamental frequency, used by an individual in speech. Hence, it becomes important to evaluate the speaking fundamental frequency.

The speaking fundamental frequency is estimated subjectively by matching or it is determined objectively with a pitch meter or Digipitch. For more precise measurement, fundamental frequency histograms are obtained with the aid of a computer.

Many investigations have studied the speaking fundamental frequency as a function of age and in various pathological conditions.

Michel, Hollien and Moore (1965) studied the speaking fundamental frequency characteristics of 15, 16 and 17 years old girls, in order to determine the age at which adult female speaking fundamental frequencies are established. Their results indicated that female attain adult speaking fundamental frequencies by fifteen years of age. It seems necessary, there-

fore, to study speaking fundamental frequency in girls of fourteen years of age and younger, in order to determine when adult frequencies are first evidenced (Michel, Hollien and Moore, 1965).

Kushal Raj (1983) studied the speaking fundamental frequency as a function of age, in children between 4 to 12 years. He reported that the fundamental frequency, both in case of males and females, decreases with age, males showing a sudden decrease around eleven years of age. No significant difference in fundamental frequency was found until the age of eleven years between males and females. The fundamental frequencies of the vowels [a/], [i/], [u/], [e/], and [o/] occurring in speech indicated that the fundamental frequency of vowel [a/] was the lowest in both males and females [u/] was the highest for males and [i/] the highest for females.

The age dependent variations of mean fundamental frequency reported by Botime and Hecker (1970) indicate that the mean speaking fundamental frequency decreases with age upto the end of adolescence. A marked lowering takes place during

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adolescence in men. In advanced age, mean fundamental frequency becomes higher in men but slightly lowered in women.

Hudson and Holbrook (1981) investigated the mean model fundamental frequency, in reading, in two hundred young black adults whose age ranged from 18 to 29 years, and found it to be 100.15 Hz in males and 193.10 Hz in females. Compared to a similar white population studied by Fitch and Holbrook (1970) and found that the black population had lower mean model frequencies.

The mean speaking fundamental frequency of males age range from 20 to 89 years, indicated that progressive lowering of speaking fundamental frequency from age 20 to 40, with a rise in the level from age 60 through the eighties (Hollien and Shipp, 1972).

Many hearing impaired speakers are unable to control their speaking fundamental frequency. Meckfessel (1964) and Thornton (1964) reported speaking fundamental frequency data for 7- and 8- year old hearing impaired speakers that were higher than values for normal hearing speakers. Ermovick (1965) and Gruenewald (1966) reported values that were equal to or lower than values for normal hearing speakers.

Murry (1978) studying the speaking fundamental frequency characteristics of four groups of subjects, namely vocal cord paralysis benign mass lesion, cancer of larynx and normals. He noted that the parameters of mean speaking fundamental frequency failed to separate the normals from the three groups of pathologic subjects.

At present, mean speaking fundamental frequency is measured as a clinical test value (Hirano, 1981).

Rashmi's (1985) study on acoustic analysis of speech in children show that, there is little change in speaking fundamental frequency as a function of age in males upto 14 years, at which age a sudden decrease in the speaking fundamental frequency was observed and very little change in speaking fundamental frequency was observed in females with increase of age.

The present study is considering the measurement of fundamental frequency as it would be helpful in assessing the earlier findings and also to find out relationship between fundamental frequency and other parameters that are considered in the present study as all the parameters are measured on the same population.

Methodology:

Subjects: Adults, both males and females age ranging from 16 to 65 years were randomly selected for the study. The criteria for the selection of the subjects is the absence of any speech and/or hearing, and/or respiratory problems with no observable deformities of the nasal, oral or pharyngeal cavities.

One hundred adults were selected, such that, ten males and ten females were included in each of five groups with 10 years interval.

Test Material: Three Kannada sentences were selected for the analysis of their speech.

1. idu pa: pu (This is baby)
(
2. idu ko:ti (This is monkey)
(
3. idu kempu banna
((This is red colour)

These three sentences were chosen, as they have been used in earlier studies of acoustic analysis of speech in children (Kushal raj, 1983, Rashmi, 1985). Further it consists of three vowels required for analysis.

Data Collection:

The data was collected in the following manner:

Speech samples of subjects were recorded. The subjects were instructed as follows:

"Now I will say three sentences. Repeat each sentence three times." The sentences "idu pa: pu", "idu ko:ti" and "idu kempu banna" were spoken by the investigator and the repetition of these sentences by the subjects was recorded.

The recording was made using a philips tape recorder with built in microphone and coney cassettes.

Analysis:

1. Measurement of mean speaking fundamental frequency:
The following instruments were used for the measurement of mean speaking fundamental frequency.

1. Tape recorder (Philips F 6112 stereo cassette deck)
2. Pitch analyzer PM 100
3. Speaker (Sois 2211, Ampli speaker)

Signal was fed from tape recorder to pitch analyzer PM 100 through line jack. Output from tape recorder was also fed to the speaker which provided an auditory feed back of signal being fed, to the investigator. The instruments were calibrated before and while

carrying out analysis. The display duration was set to the one second so that each stimulus sentence could be displayed more clearly and enlarged. The stimulus sentences "idu pa: pu", "idu ko:ti" and "idu kempu banna" were fed to the pitch analyzer. The mean speaking fundamental frequency for each sentence was directly read on the digital display at the end of the screen. The mean frequency used for speaking by each subject was obtained.

Results and Discussion:

The mean and standard deviation of speaking fundamental frequency in each age group have been calculated, for both males and females. The significance of difference between the age groups and between males and females have also been determined using t-test.

Speaking fundamental frequency:

The speaking fundamental frequency for all the 3 test

sentences were found by the method described in chapter-III. The mean and standard deviation for both males and females are presented in table.

Males: The inspection of the Table 1 shows that for the stimulus sentences speaking fundamental frequency increased gradually with age in males. Also the age group 16-25 years had the lowest speaking fundamental frequency (mean S.F.F. of 139.7 Hz) and the age group 56-65 years showed the highest speaking fundamental frequency (Mean S.F.F. of 149.76 Hz) for males.

There was no significant increase in S.F.F. when two consecutive age groups are compared. For example, there is no significant difference in speaking fundamental frequency when the age group 16-25 years and the age group 26-35 years were compared where as when the age group 16-25 years and the age group 36-45 years

		16-25	26-35	36-45	46-55	56-65
Males	Mean	139.7	142.38	147.1	147.6	149.76
	S.D.	7.2	12.66	16.14	16.14	14.22
Females	Mean	224.5	230.04	243.36	258.3	234.73
	S.D.	8.19	14.4	24.2	11.3	21.9

Table 1: Speaking Fundamental Frequency

Mean and Standard Deviation of speaking fundamental frequency (in Hz) in males and females.

were compared there was a significant increase in S.F.F.

The mean S.F.F. has changed from 139.7 Hz at the age group 16-25 to 149.76 Hz in 56-65 age group.

These findings are similar to the findings of Bohme and Hecker (1970). They found that in advanced age, the mean S.F.F. becomes higher in men. Hollien and Shipp (1972) also reported that from 69 years to 80 years S.F.F. increases in males.

Research has shown that changes in level and pitch range accompany growth and the age process. The results obtained by Fairbanks (1942), Fairbanks Wiley and Lassman (1949), Maysak (1959) suggest vocal pitch lowers at the rate roughly corresponding to laryngeal growth and at middle age the pitch level begins to rise slightly with increase in age ossification and calcification of laryngeal cartilages begin to take place. At the age of 65 years entire laryngeal frame except arytenoid cartilage will be ossified.

Females: The examination of the Table shows that in females the S.F.F. increased with the age upto the age of 55 years. From the age 55 year onwards the S.F.F. decreased significantly. The figure also shows that the highest S.F.F.

is shown by the age group 56-65 years (mean, S.F.F. of 258.3 Hz) and the lowest S.F.F. is shown by the age group 16-25 years (mean S.F.F. of 224.5 Hz).

Inspection of figure also shows that the age groups 36-45 years (S.D. 24.2) and 56-65 years (SD of 21.9) are more variable groups than other age groups. There is no significant difference between two consecutive age groups, but when compared to next group, there is significant difference between two age groups. This shows the S.F.F. changed gradually with increase in age in case of females.

Similar findings are reported by Bohme and Hecker (1970). Their findings showed that in advanced age the mean speaking fundamental frequency decreased. Kelly (1977) and Stoicheff (1978) also reported similar findings. Hence the hypothesis stating there is no significant difference in S.F.F. as a function of age in females is partly rejected and partly accepted.

Sex difference: There is a significant difference between males and females with respect to S.F.F. The figure shows that males use lower S.F.F. when compared to females from 16-65 years. There is a maximum difference of 110.7 Hz at 46-55 years age group and

a minimum difference of 84.8 Hz at 16-25 age group between males and females. These results are in line with the well known fact about the difference in fundamental frequency of vibration of vocal cords in case of males and females. This difference in frequency of vibration are attributed to the differences in the vocal systems in males and females.

The results on speaking fundamental frequency can be summarized as:

1. There is a gradual increase in S.F.F. with increase in age in males. The changes in S.F.F. are more at old ages i.e. above 55 years.

2. There is a gradual increase in S.F.F, with increase in age till 55 years in females. From 56 years, the S.F.F. lowers in case of females.

3. There is significant difference between males and females as far as S.F.F. in concern. use lower S.F.F'. than females throughout the age range studied.

The S.F.F. has varied from 139 Hz to 149.76 Hz from 16-25 years of age to 56-65 years of age in case of males and females in case of females and 224.5 Hz to 234.73 Hz from 16-25 years of age to 56-65 years of age. Further on the average a difference of 129.7 Hz is seen between males and females, in terms of S.F.F.

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