A Study of the Fundamental Frequency of Voice and Natural Frequency of Vocal Tracts on an Indian Population of Different Age Ranges*

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The study was concerned with the frequency response of the vocal tract. This was undertaken on the assumption that the vocal tract is an acoustical system having a series of coupled resonance elements, with resonance peaks in the response frequencies. It is believed that the frequencies of the peaks of the resonances approximate the natural response frequencies of the system. The attempt at locating these peaks was undertaken in this study for males and females in different age ranges, between 7 to 16 years and 20 to 25 years.

The study was also concerned with finding the fundamental frequency for these groups. The fundamental frequency of the voice was considered as indicating pitch in the present study.

It was also attempted to see whether any relationship existed between natural frequency of vocal tract and fundamental frequency of voice.

In order to study these aspects the following hypotheses were advanced :

(1) There will be a difference in the resonance peaks (natural frequency) between males and females as well as between children and adults.

(2) There will be constant and consistent relationship between the fundamental frequency and the natural frequency of the vocal tract in each age group.

(3) This relationship varies from age to age and between sexes.

(4) There will be a reduction in the fundamental frequency with advancing age (in the age range to be studied).

In order to study these hypotheses the following experiments were undertaken. A tone of variable frequency, ranging from 100 to 5 KHz, having a constant intensity, generated by a beat frequency oscillator, was fed into the vocal tract, which was maintained in the vowel [a] position, by means of a probe speaker. The response of the vocal tract was picked up at the lips by a condenser microphone. The output was graphically represented on the calibrated paper of a level recorder. Definite intensity increases at the natural frequency of the vocal tract were observed at different frequencies for different individuals.

The fundamental frequency was measured directly from the Tachometer which was used in combination with a stroboscope and a SPL Meter.

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Hypothesis (1) was partly rejected and partly accepted. It is rejected in the lower age ranges and accepted in the upper age ranges. That is, differences in the natural frequency between children and adults is present but this difference is absent in the case of males and females.

Hypothesis (2) was also refuted.

Hypothesis (3), that the relationship varies from age to age and between sexes, was refuted. However, a difference in the relationship was seen between children and adults in the case of males only.

Hypothesis (4), that there will be a reduction in the fundamental frequency with advancing age in both sexes was supported.

Conclusions

(1) The natural frequency range of the vocal tract for different ages considered in the present study was found to lie between 700 Hz to 2 KHz.

(2) Natural frequency for the males does not show any significant change between any two successive age groups. Changes, if any, in the natural frequency are gradual.

(3) The natural frequency for females also show no significant shifts between any two successive ages. However, significant difference was seen between the ages of 10 years and 11 years, where the differences are significant at the 0·05 level.

(4) There is a difference in the natural frequency of the vocal tract between children and adults.

(5) No difference was observed in the natural frequency of vocal tract between the sexes.

(6) A lowering in the fundamental frequency with advancing age was observed in the case of both males and females.

(7) The relationship between natural frequency and fundamental frequency was not a stable phenomenon between ages and also within the age groups.

(8) Lowering of the fundamental frequency seems to be associated with changes not only in the vocal cords but also with changes in the resonators.

(9) Natural frequency is a valid measure. Gradual but definite changes in natural frequency were noted.

(10) Average speakers do not use their optimum pitch.

Recommendations

(1) A similar study to be carried out in a much larger and varied sample.

(2) Good speakers to be selected from various age groups and relationships to be found between natural and fundamental frequency.

(3) It is important to correlate maturational factors with frequency.

(4) Correlation between natural frequency, fundamental frequency and vocal tract size and shape should be studied.